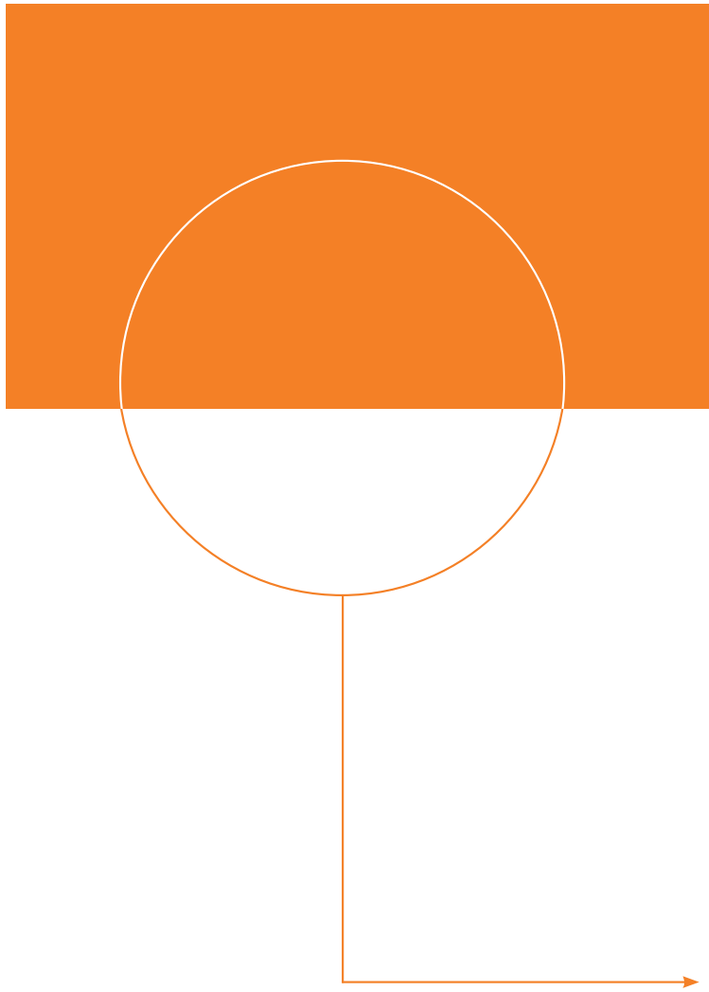

Master's thesis

2020

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Collaborative Partnering: Understanding how client, main contractor and subcontractor relationships vary between transactional and collaborative processes

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Summary

The purpose of this thesis was to explore and understand how client, main contractor and subcontractor relationships vary between transactional and collaborative processes.

The research questions that were investigated are as follows:

1. What is the Norwegian Public Roads Administration experience with design and build and design bid build contracts?
2. What is the extent of collaboration within the design- bid-build and design and build project delivery methods?
3. What is the effect of collaboration between the client, main contractor and subcontractors?

Using qualitative analysis, the design of the study was broken into three main parts, the first being a literature review, two case studies consisting of surveys and follow-up interviews and lastly a document study. In order to gage how the relationships between all three parties vary, two public road projects were explored with different project delivery methods. The first case utilised design and build contract whilst the second utilised a design-bid-build contracting strategy.

The findings from this thesis identified that although collaboration was still occurring in the traditional design-bid-build (DBB) project delivery method it was starting late in the project cycle rather than at inception. Although design and build (DB) by nature is a more collaborative project delivery method compared to design-bid-build project delivery and may be a step in the right direction in regards to collaboration, it is not still not the optimal method.

Therefore, it was found that much promising work is being undertaken currently by the NPRA in regard to projects utilising Integrated Project Delivery methods such as Public-Private Partnerships (PPP). Where organisations and teams are being utilised from all around Europe that they should continue in this direction. Not only are IPD and PPP approaches more rewarding in terms of innovation and collaboration but also would help prepare the NPRA for the future as design-build contracts would only tide them over for some time.It was identified that there was a need for the NPRA to become well acquainted with Integrated project delivery methods. Projects procured through IPD contracts and PPP require a greater degree of collaboration and can have numerous benefits such as innovation.

In order to get the full benefits of collaboration the NPRA needs to introduce the concept of collaboration early in the project cycle and continue it to the end. By reducing the distance between the client, main contractor and subcontractor and thus reducing the uncertainty between each party that true collaboration can occur and give way for those benefits that transpire from working together. Only by acquiring more information as early on as possible can one reduce the level of uncertainty associated with projects and thus collaboration should be utilised as a viable tool to gather information. These hurdles can be met head on and thus prevent them into manifesting into large public issues.The NPRA should continue to utilise DBB contracts and begin to form a clear line between projects where standard repetitive projects deemed simple and straightforward are automatically processed as DBB. The move

from comfort to something unknown is never an easy step to navigate, however the NPRA have proved that with some confidence and the recognition that change is required in a bid to keep with changing times that having an agile mentality is key. Ultimately, design-build projects have some useful aspects and some negatives and thus my recommendation is to continue on the road that they have begun on. However, the NPRA must keep in mind that they must keep evolving and strive for more collaboration so that they may continue to make advances in engineering as well as to pioneer the public roads sector for Northern Europe and beyond.

Foreword

This master thesis was written as the final semester individual project as part of the course TBA4190 to achieve the Master of Science in Project Management. This thesis has been written with the Department of Civil and Environmental Engineering at the Norwegian University of Science and Technology (NTNU) in collaboration with the Norwegian Public Roads Administration (NPRA). The scope of the assignment is 30 credits and marks the end of a two-year master's study for Project Management at NTNU in Trondheim.

The interest in the subject chosen came about from meetings with the academic supervisor Ole Jonny Klakegg where it had emerged that collaboration would be an interesting topic to look into. In collaboration with supervisor Ole Jonny Klakegg, it was decided to write a project and a master's thesis on collaborative partnering between clients and main contractors as well as their respective subcontractors. Consequently, shedding light on how such relations vary between transactional and collaborative approaches and aiming to build a complete picture rather than a partial snapshot.

I would firstly like to say thank you to my academic supervisor, Professor Ole Jonny Klakegg, for his invaluable knowledge and input in writing this thesis. I would also like to thank Professor Luitzen de Boer for his guidance and recommendations in relation to the public sector.

I would like to thank the Norwegian Public Roads Administration especially Jan Egil and Nyland Bård for assisting me in finding two comparable cases for the basis of the study, and for all of their valuable input throughout the thesis. I would also like to thank the two main contractors and subcontractors for their open and honest answers: Skanska and Bertelsen & Garpestad AS as well as the two subcontractors Hæhre and Consto.

I would like to thank my uncle, Hanif Ismail for all his patience and guidance throughout this process.

I would also like to thank Nick Lander and Peter Duncan from Rogers Clarke Lander Ltd for taking that somewhat risky chance on me as a 20-year-old trainee engineer, for whom without none of this would have been possible. I would also like to extend my warmest thank you to my Grandmother - Razia for always believing in me and my Partner – Mats who has been my rock. Finally, I would also like to thank my family and friends Farah, Milly, Alisa, Ryan and Yamini for their love and support.

Trondheim, July 2020

Aynie Ismail

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Abbreviations

CM	Construction Management
CM@R	Construction Management at Risk
CMMP	Construction Management Multi-Prime
DB	Design - Build
DBB	Design - Bid - Build
DBFO	Design - Build - Finance - Operate
DBOM	Design - Build - Operate - Maintain
GMP	Guaranteed Maximum Price
IPD	Integrated Project Delivery
MC	Main Contractor
NPRA	Norwegian Public Roads Administration
OPS	Offentlig-Privat Samarbeid
PPP	Public-Private Partnership
SC	Subcontractor

Chapter 1

1 Introduction

The background behind the choice of topic was four-fold, primarily due to my personal interest based around the topic of collaboration. Collaboration is often seen as a crucial process but is often engulfed by a bubble of complexity and uncertainty and thus commonly can be seen as 'harder said than done'. Also, I found that understanding the main contractor and subcontractor relationships would be key to exploring such dynamics further as well as aiding to build a true reality of the process opposed to a fragmented documentation which can often be heavily biased and offer a sole perspective. Moreover, I felt that the concept of collaborative partnering within the public sector is one that is relatively new and has an immense growing potential.

1.1 Background

In Norway, most public infrastructure projects are undertaken with a design-bid-build contract form. Inherently, this practice is highly visible within the Norwegian Public Roads Administration. However, over recent years there has been widespread acknowledgement across the industry that perhaps the traditional method may in fact have some severe pitfalls in regards to time adherence, large demand of numerous resources and lastly contributing to a more probable chance of conflict especially between the project owner and contractor. Consequently, such aforementioned factors coupled with the ever-increasing magnitude and complexity of today's projects has resulted in project owners to not only reflect on downfalls but also focus on gaining an improved ability to foresee such problems in projects in the future. Thus, in light of this there has been a somewhat shift in the approach to which contracts should readily be deployed whereby public owners are turning instead to the usage of design and build contracts.

Design and build contracts offer a higher degree of flexibility as a project delivery method compared to design-bid-build contracts. If implemented correctly, is this degree of manoeuvrability that can widely contribute to advantages and benefits. However, it goes without saying that there are of course some drawbacks.

Ultimately, the advantages associated through the utilisation of design and build contracts predominantly lies in the reduction of associated costs and lead times. Furthermore, through the utilisation of design and build contracts it has come to light that such contracts can aid in relieving resources especially for the project owner and thus harness the contractor's competence. Correspondingly, the drawbacks that are commonly associated with design and build contracts are in relation to quality whereby the contractor may exploit a specification that is open to interpretation and thus choose the most economically viable route.

1.2 Research Questions

The purpose of the thesis is to explore how client, main contractor and subcontractor relationships vary between transactional and collaborative approaches. Therefore, the first research question is about the Norwegian Public Roads Administrations experience with

design-build and design-bid-build contracts. The extent of collaboration within these two project delivery methods is then examined. This leads onto, the last research question which concerns the effect of collaboration between the client, main contractor and subcontractor with the Norwegian public roads sector today. Table 1 depicts the research questions for this thesis.

No.	Research Questions
1	What is the Norwegian Public Roads Administration experience with design and build and design bid build contracts?
2	What is the extent of collaboration within the design- bid-build and design and build project delivery methods?
3	What is the effect of collaboration between the client, main contractor and subcontractors?

Table 1:Research Questions

1.2.1 Frameworks

The master's thesis is written for the Department of Civil and Environmental Engineering within the study specialization project management at NTNU in Trondheim. The master's thesis counts 30 credits and is completed in the spring semester 2020.

1.2.2 Deposition

The division of chapters has a logical order as illustrated below in Table 1:

Chapter	Description
Chapter 1 - Introduction	This section not only sets the tone and outline for the basis of the thesis but provides relevant and useful background for the reader. The introductory chapter also recognizes the relevant knowledge gap and thus in turn leads to fascinating research questions.
Chapter 2 - Methodology	The methodology provides the reader with a glance into the authors line of thought. Illustrating the way in which work has been conducted shedding light on what exactly it consists of and lastly what information is to be collated. Documents how the work has been conducted and gives a detailed description of the methodical approach. There is also an assessment of methods to highlight weaknesses and strengths of use.
Chapter 3 – Literature Review	The literature review supports the theoretical framework, what dynamics between what actors were to be looked at according to the research area studied.
Chapter 4 – Theoretical Framework	Review relevant theory and concepts that are necessary to answer the research questions of the thesis and Presentation of Case Studies.
Chapter 5 – Results	Explains the study's findings. The results are documented, and their accuracy and reliability are assessed.
Chapter 6 – Discussion	The discussion section analyses and evaluates the findings. Works as the foundation for the conclusion chapter.
Chapter 7 – Conclusion	Clarify the impact the results have on the topic and research questions. The conclusion responds to the thesis research questions. Describe how the work can be continued in the future studies and which areas of interest should be focused on.

Table 2:Deposition

Chapter 2

2 Method

The intention of this chapter is to provide an overview of the research methods that have been used within the research and the reasons for this. Additionally, strengths, weaknesses and possible sources of error whilst selecting methods is also included. Thus, it can be deduced that buy reading this chapter, the reader should be able to understand how the research was carried out and what impact the choices may have had on the study.

The chapter presents the nature of scientific research as well as highlighting the chosen path that is to be implored for this master's thesis. Consequently, it is deemed imperative that a methodological and concise approach must be utilised in order to collect both credible and interesting information.

2.1 Research Method

In order to be able to verify claims and extract knowledge, the procedure used is described below. Different approaches have different suitability and are selected based on the problem and possession of knowledge (Ringdal, 2018). The research method must inform how to obtain or test knowledge (Dalland, 2017).

2.2 Quantitative Versus Qualitative Methods

Dalland (2017) portrays that a quantitative method measures social reality using instruments and methods that generate numerical information. Whilst, a qualitative method attempts to gather information about reality through the analysis of words and thus making the information considerably more complex to quantify or measure. Consequently, many researchers and literature tend to find a distinction between quantitative and qualitative methods. The distinction is illustrated below in figure 2 which has been adapted by Klakegg (2010) based upon Bryman (2007).

Klakegg (2010) proposes that such methodological stances on research leave one with lens like sight. The lens is positioned as a vessel to describe how a researcher's methods may become tinged depending on the lens chosen, irrespective an air of tunnel vision is introduced irrespective of which lens is chosen. For instance, Klakegg (2010) proposes that although on one side of the coin in relation to quantitative methods the lens may be 'dominated by deductive, positivistic and objectivist positions'. Contrastingly, for qualitative assessments the lens may instead be 'dominated by inductive, relativistic and constructivist positions' (Klakegg, 2010). Ultimately, it is sum of such choices that lay the fundamentals of the chosen research strategy. In figure 1 below, one can see the methodological positions as part of a research strategy according to (Klakegg, 2010).

Therefore, one can argue based upon the very nature and conceptuality surrounding the term 'research' that there is no 'superiority'. Rather, in fact it is a matter of 'suitability' which

governs the choice of research methodology dependent on a multitude of factors for example; nature research question, the researcher's vision and the hypothesis that are being tested.

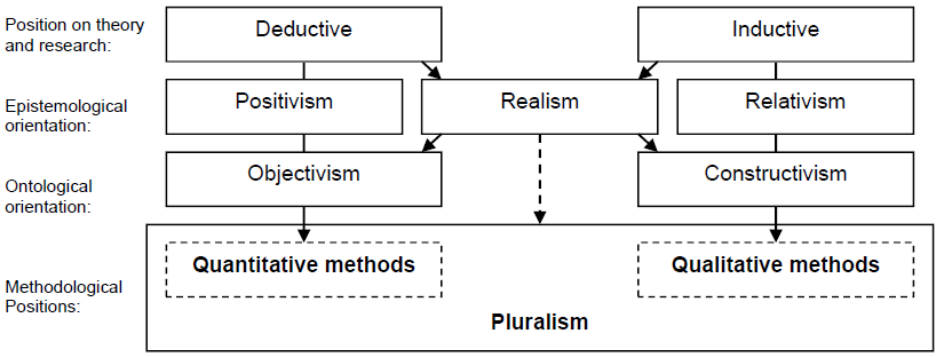


Figure 1:Methodological positions as part of research strategy (Klakegg, 2010)

2.3 Choice of Method: Qualitative Method

A qualitative approach was chosen as being best suited to the exploratory nature of the study and to address the research question (Egon et al., 1982). In order to maximise credibility, dependability and confirmability of the findings, multiple qualitative methods were utilised. Thus, the qualitative methods employed in this this study included document review, survey questions, interviews, case analysis and cross case to afford a more thorough and multi-faceted examination of the issues than could be gained from any single method.

A qualitative approach can generate information that provides a deeper and more detailed a comprehensive understanding of a phenomenon. It is the qualitative approach that offers the best methods for exploring human behaviour. According to Fidel (1993), it is deemed exploratory and the most suited for investigating complex phenomena when very little is known about them. Fidel (1993) also depicts that most information retrieval (IR) studies that use qualitative methods focus on users and investigated human behaviour in relation to information seeking and retrieval. Thus, in order to study focal phenomena, intensive surveys can be utilised on a limited number of interviewees where all variation and diversity surrounding the singularity can be studied in detail.

Consequently, one of the utmost common ways of collecting qualitative data is through interviewing several subjects that have some expertise or experience in the related field of research. According to Jacobsen (2015), the qualitative method is suitable for clarification of an unresolved matter and as such is best used to gain a more detailed description of the topic. Hence, due to the widespread acknowledgement within the industry that collaboration and partnering are increasingly becoming ever more vital coupled the prevailing sense of unfamiliarity and a lack of know how to implement or facilitate such relationships. It seemed fitting that a qualitative method was devised in order to delve further and really investigate if there was in fact a place for collaborative partnering between main contractors and their subcontractors within the public construction sector.

The purpose of the thesis is to provide a broader understanding of collaborative partnering and how the level of collaboration varies in the public construction sector between design-bid-build

(traditional) and design-build (collaborative) project delivery methods. The qualitative method makes it possible to gather knowledge and experiences whilst, the literature study, document study, surveys and follow up semi-structured interviews were utilised for data collection.

Research Question	1. What is the Norwegian Public Roads Administration experience with design and build and design bid build contracts?	2. What is the extent of collaboration within the design- bid-build and design and build project delivery methods?	3. What is the effect of collaboration between the client, main contractor and subcontractors?
Method Used	Case studies, discussions, surveys and follow up interviews and documentary analysis		

Table 3: Research questions and method used

2.3.1 Qualitative techniques utilised

Qualitative triangulation can be used to deepen the researchers' understanding of the issues and maximize their confidence in the findings of qualitative studies (Denzin, 1978). Through combining a multiple methods and data sources in qualitative research, one can develop a comprehensive understanding of the phenomena (Patton, 1999). The mixed-method or triangulation has been viewed as a qualitative research strategy to test validity through the convergence of information from different sources. Therefore, by triangulating within qualitative research the researcher gains in breadth and depth of understanding and corroboration, while still offsetting the weaknesses that may be inherent to using solely one method.

Additionally, due to the nature of the research and the fact that a series of relationships are to be studied which are entirely subjective numerous vantage points would be beneficial in reducing the level of subjectivisms and aim to level perspectives. It will also be useful when trying to ascertain different perspectives and analyse the research question from different angles as well as further offering clarification on unexpected findings and shedding light on possible contradictions. Furthermore, it will also be extremely beneficial to build a whole picture where the document study will illustrate the theory of what should happen in practice, whereas the case and interviews will acknowledge what actually has happened on projects utilising different project delivery methods.

2.3.2 Types of Qualitative Triangulation

As discussed above, triangulation can operate within research strategies such as the qualitative method. Denzin (1978) and Patton (1999) identified four types of triangulation, the table below illustrates the four types and what they consist of:

Type of Triangulation in a Qualitative Methods			
Method triangulation	Investigator triangulation	Theory triangulation	Data source triangulation
Methodological triangulation involves the use of multiple qualitative and/or quantitative methods to study the program. If the conclusions from each of the methods are the same, then validity is established	Investigator triangulation involves using several different 'interpreters 'in the analysis process. This is ultimately where different researchers conduct a separate analysis of the data and their different interpretations are reconciled or compared.	Theory triangulation involves the use of multiple perspectives/disciplines to interpret a single set of data. It is where a variety of different theories are utilised to interpret data such as discourse, narrative and context analysis and these different ways of dissecting the data are then compared.	Data source triangulation involves using different sources of information in order to increase the validity of a study.

Table 4: Types of Triangulation in Qualitative Research Modified Denzin (1978) and Patton (1999)

Denzin (1978) argues that in order to achieve an approach to 'naturalistic inquiry' that will examine the research problem from multiple perspectives including 'multiple observers, theories, methods, and data sources, with the intent of overcoming the 'intrinsic bias that comes from single method, single observer, single theory studies'. Denzin (1978) states that 'multiple methods should be used in every investigation, since no method is ever free of rival causal factors (and thus leads to completely sound causal propositions), can ever completely satisfy the demands of interaction theory, or can ever completely reveal all the relevant features of empirical reality necessary for testing or developing a theory'.

Therefore, for the following masters study a data sourced triangulation method will be utilised where a number of sources of information are to be used in order to increase the validity of the study. The sources will consist of, a literature study, document study and a case study which will consist of surveys and follow up interviews see figure X (below) for an illustration of which sources will be utilised within the qualitative method.

Additionally, this will provide the reader with a greater viewpoint as the combination of numerous data sources will allow for the researcher to draw wider comparisons and understand the dynamics of the culture in a more realistic manner.

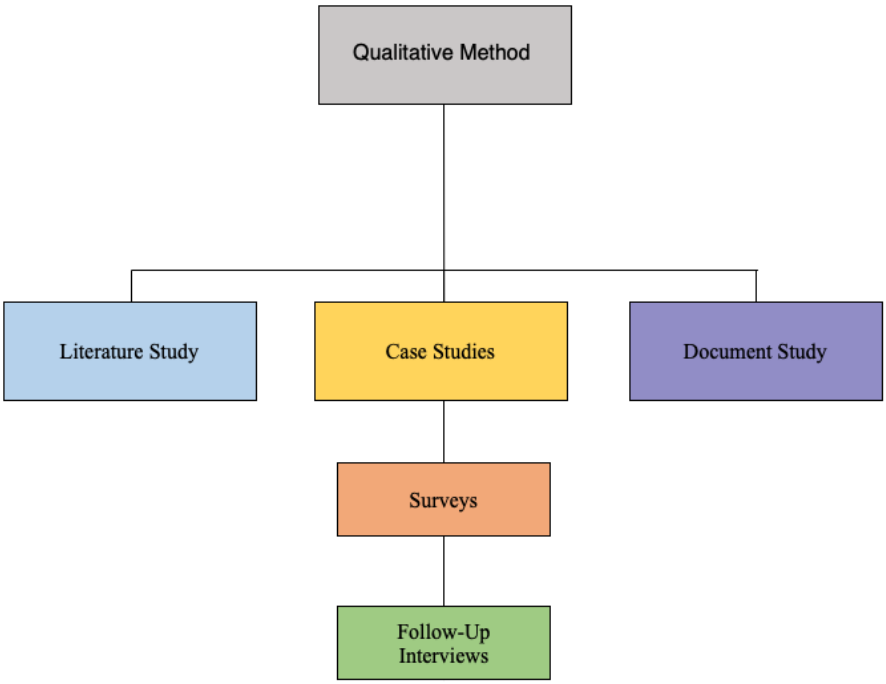


Figure 2: Overview of Qualitative Methods utilised in this thesis

2.3.3 Strengths and Weakness of Data Source Triangulation

Advantages	Disadvantages and Limitations
1. A greater confidence in the validity of the data. 2. Provides a deeper and more comprehensive understanding of the of the issue at hand. 3. Provides innovative perspectives on the study topic (Thurmond, 2001: 254 in Guion et al. 2013) 4. Provides strengths that counterbalance the weaknesses of solely utilizing one data source such as interviews.	1. Can be very time-consuming to a) find different data sources b) to analyse numerous data sources 2. The research design can become very complex. 3. It may be unclear how to resolve discrepancies that arise in the interpretation of the findings.

Table 5: Strengths and Weaknesses of Data Source Triangulation Adapted (Mathison, 1988)

2.4 Validity and Reliability in Qualitative research

The concept of validity is described by a wide range of terms in numerous qualitative studies and this concept is not a single or fixed concept. Creswell & Miller (2000) suggest that the validity is affected by the researcher's perception of validity in the study and his/her choice of paradigm assumption.

Validity relates to how accurate a method measures what it is intended to measure and to the degree in which a method can be verified. Whereas, reliability relates to how consistently a method measures a phenomenon. Figure 2 illustrates a comparison of reliability and validity.

Thus, if research has a high validity it can be deduced that a measurement is valid. However, if a method is not reliable, it most likely is not valid. Validity and reliability are concepts that are utilised to evaluate the quality of the research and they indicate how well a method, technique or test ultimately measures something. Therefore, validity relates to the consistency of a measure whereas, validity relates to the accuracy of a measure.

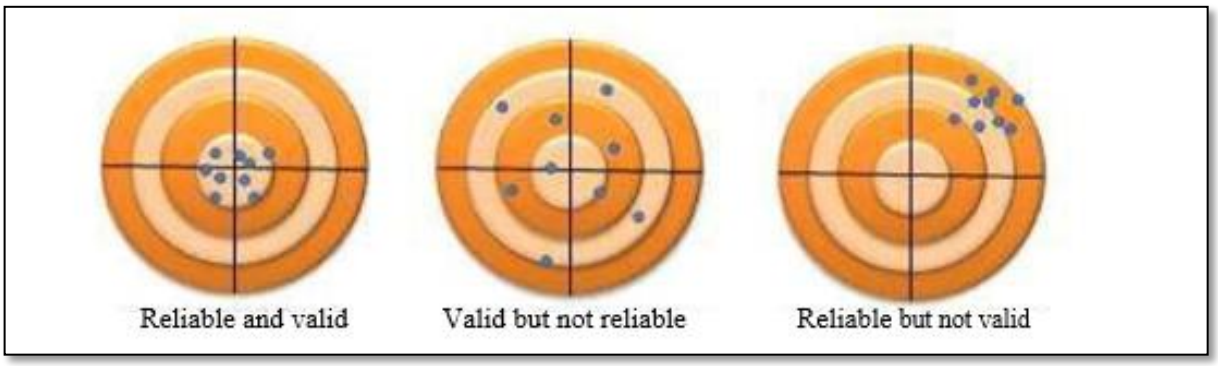


Figure 3: Comparison of reliability and validity (ER Services, 2012)

When testing cause-and effect relationships the validity can be split into two different types; internal and external validity. Internal validity refers to the extent in which relates to the degree of confidence that the phenomenon being testing is trustworthy and uninfluenced by other factors or variables. Whereas, external validity indicates the extent to which result from a study can be transferred to other situations. Similarly, reliability can also be divided into two different types; internal and external reliability. Internal reliability is the extent to which a measure is consistent within itself. Whereas, external reliability is the extent to which a measure is consistent when assessed over time or across different individuals.

Blumberg et al. (2014) define two questions for the literature: “Is the literature relevant for the study?” and "Does the literature contribute anything to the arguments or information?". If the answer to these questions is "yes", the literature is worth reading. Dalland (2017) describe two requirements that must be set for data: Reliability and relevance. These apply for literature collection, document collection, surveys and follow up interviews. Therefore, the questions that are posed to interviewees must be relevant and shed light on the problem.

By reliability is meant freedom from inaccuracy, and relevant data must be collected in a reliable way. In surveys and interviews, communication is a possible source of error. The informant may misunderstand the question and the researcher may misunderstand the answer as well as content being altered by transcribing or proofreading. All of which can contribute to a lower reliability. Reliability is important for the research to be verifiable, that that is, the same results occur if the study is repeated (Samset, 2015).

This report has been carried out for the Department of civil and environmental engineering at NTNU. The purpose behind the thesis is interest in the topic. The researcher has no connection to any of the informants prior to the interviews.

2.5 Literature Study

2.5.1 Choice of Method

Several methodologies have been developed to illustrate literature documentation and how researchers choose to fragment them into more useful bite-sized chunks of information can vary immensely across the board. However, the general ideology remains the same the requirement to analyse such studies into finer detail and to unravel some of the cornerstones within them. The information taken from such sources can then be transformed and aid in the research of new, innovative concepts where one is free to explore areas where little to no study has previously been conducted.

However, the following method was not one that followed 'a traditional method' but more so a tool to simplify analysis and thus apply in a somewhat logical framework that would naturally evolve. To go about this, the first thing required was to set a clear criterion that was strictly adhered to and which would eventually form the backbone of the paper as well as preventing this paper from spiralling into an academic abyss. It was imperative for this area of research that a vast array of findings would need to be utilised to expand on perhaps previous articles with a strong tendency for secondary bias see table 3 for exclusion criteria.

2.1 Approach

The literature search was based upon the research questions. The study is based on in-depth reading of relevant literature findings from the literature search. The literature study was performed in adherence to M. Blumberg et al. (2014) guidelines:

- Defining what to achieve and to focus on this within the search
- The use of encyclopaedias, dictionaries, manuals, and textbooks to identify keywords, people or events relevant to what is to be studied or researched
- Utilising these keywords, people, or events to search indexes, bibliographies and online to identify specific secondary sources
- Find and review specific secondary sources that are relevant
- Evaluate the value of each source and its content

Ultimately, the largest challenge when conducting a literature study is the ability to differentiate between relevant and irrelevant literature. This can be incredibly difficult, as one piece of literature relevance is largely indicative of the research style, research questions and of course internal bias of the author. Thus, in order to combat some of these, utilizing M. Blumberg et al. (2014) guidelines may be a first port of call and thus assist one to ascertain the relevance of the information attained. The literature study conducted was in accordance to such guidelines, in order to prepare a knowledge base on the subject and the problem of the thesis.

Ultimately the sources were assessed based upon the 5 main criteria when sourcing and evaluating literature:

1. Suitability and intended audience

An assessment of the purpose of the source, for example was the main reason to provide information etc and to whom the intended audience was for example scholars and academic researchers with specialised knowledge

2. Authority and credibility

An assessment of the author based upon them either being an individual or organisation. The authors qualifications, knowledge, recognition, educational background and current affiliation to academic institutions are also assessed.

3. Accuracy and reliability

An assessment of whether or not the information provided is in detailed, comprehensive and well researched. Additionally, has the author disclosed the validity and reliability of the data.

4. Currency and timeliness

An assessment of whether or not the publication was up to date and number of citations as well as considering what elements require current information and what does not where historical data can be used.

5. Objectivity or bias

An assessment of whether information is presented in an unbiased or biased way for example, is the source factual or opinion based.

2.1.1 Documentation of Process Findings for Literature Study

To narrow down the approach, a table was created to illustrate how the process was executed; this was especially useful when going back after days of reading different articles in between as it behaved as an interface and metricised the elements of articles that were of particular interest and importance hence allowing an ongoing process of comparability and different points to advance.

Review of Eligibility for Literature Study

Criteria [Phase 1]:

The following eligibility criteria were established not only to document the process adhered to but also to set some basic guidelines to what would be included and excluded from the offset. This was predominantly used as a point of departure and was primarily funnelled down and filtered as knowledge on the subject increased.

The below Inclusion Criteria	Exclusion Criteria
- Available in English - The most current version of the document - Peer-Reviewed Journals - Credible source; accredited scientific journal books and research databases.	- Unavailable in English - The document is a draft or unfinished version - Merely provided resources from external groups - Non-credible sources - Uncited or referenced documents

Table 6:Review of Eligibility Criteria (Inclusion and Exclusion)

Review of Number of Articles [Phase 2]:

The second refinement (above) it was especially useful in aiding one to home in which literature was most relevant to one's area of study and thus attain articles that are relevant and specific as well as this the model helped to stay within the realms of the problem statement and allow to build on both similar and contradicting arguments equally. Correspondingly, the next phase was in essence much more of streamlining effort where the below criterion was set:

Current Situation	History	Selection Methods	Questions for Further Research
Information Needed to understand the topic or focus of the literature review.	Chronological progression of the field, the literature, or an idea that is necessary to understand the literature review, if the body of the literature review is not already a chronology.	The criteria you used to select (and perhaps exclude) sources in your literature review. For instance, you might explain that your review includes only peer-reviewed articles and journals.	What questions about the field has the review sparked? How will you further your research as a result of the review?

Table 7:Streamlining and narrowing down articles found

Arksey and O'Malley (2005) lines out a scoping review which implements the framework to be utilised. The framework covers 5 steps which are illustrates in table 5 below. The framework consists of 5 stages:

1. Identify the research question
2. Identify relevant studies
3. Study selection
4. Chart Data
5. Collate and summarise results

Review of Methodical guidelines for scoping review [Phase 3]:

1. Guidelines	2. Sources	3. Collected Data	4. Results
• Sources: electronic databases, selected journals, and specific recommendations; • Timespan: last thirty years (1987–2017); • Sources must be peer-reviewed• Access to full-text;	• Oria • Scopus • Web of Science • Science Direct • Elsevier Engineering Village	• Title, author(s), year of publication, study location • Delivery Method examined • Keywords used • Aim and purpose of study • Methodology • Results	• Tables listing findings both general and detailed. • Figures and charts offering comparisons or perspectives.

Table 8:Methodical guidelines for scoping review

Review of articles and ordering into the matrix via themes [Phase 4]

Note: The numbers shown in brackets were the number of articles to be shortlisted and further investigated for relevance on the research area.

Search Number:	Additions to the search string (represented using a Scopus search format)	Number of Hits			
		ORIA	Web of Science	Scopus	Science Direct
1	TITLE-ABS-KEY (Project delivery (system OR model OR method) AND All Fields (Collaborative OR Integrated)	265 (7)	158 (8)	1727 (15)	2074 (16)
2	TITLE-ABS-KEY Project procurement (system OR model OR method) AND All fields (Construction) AND TITLE-ABS-KEY (Collaborative OR Integrated) And Peer-reviewed	70 (13)	42 (7)	4699 (40)	537 (18)
3	TITLE-ABS-KEY (Integrated OR Collaborative) Project Delivery AND All fields (Construction	286 (46)	53 (7)	5437 (28)	379 (16)
4	TITLE-ABS-KEY Project Partnering AND TITLE-ABS-KEY (construction) AND Peer reviewed	672 (54)	459 (2)	1836 (47)	2130 (10)
5	TITLE (Collaborative OR Cooperative OR Relational OR Integrated) Project ((system OR model OR method OR Arrangement) AND TITLE-ABS-KEY (construction)AND Peer reviewed	831 (17)	869 (26)	1189 (15)	8689 (27)
6	TITLE-ABS-KEY Project alliancing AND TITLE-ABS-KEY (construction) AND Peer reviewed.	409 (16)	10 (2)	126 (17)	402 (11)
Total Number of documents to be further investigated before review		153	52	162	98
Total number of documents used for literature review		7	6	17	21
		53			

Table 9:Overview of search history and filtration system devised

The above table was then analysed and summarised, where articles that had common themes or contradicting themes were assorted into a matrix structure. This was employed so that a conclusive argument from all sides would be put forward with the limited secondary bias being the goal. However, due to previous research remaining generalised, there were insufficient details available. Thus, the fine-combing process was somewhat hindered as articles fulfilling all filters were at times challenging to come across. On the other hand, having more specific filters ensured that the research conducted was targeting the problem statement and staying within the bounds of criterion. Therefore, the limitations also set, thus keeping the paper on track.

2.1.2 Relevance of Literature Study

Furthermore, the search for accurate documents specific to the question at hand, the filter feature was heavily utilised whereby articles were able to be matched based upon their titles and thus key words. The articles found to be most relevant were then shortlisted into a separate area whereby they were allocated by them into several different packs. Table 6 illustrates how many pieces of literature were found on which database through which key words but also depicts that these were first narrowed down to the number shown on the brackets based upon the eligibility criteria illustrated above before being further narrowed down to 53 literature pieces based upon the abstract readings. Once this had been completed, methodologies and summaries were skimmed from each article and a matrix was constructed illustrating main themes that ran through the paper, a conscious effort was made to document similar or contradicting articles this was useful in the next stage of elimination. The second stage of the refining process was to then pool together to assess the problem from different views and perspectives; this was categorical to increase the variety of literature.

2.1.3 Credibility and Objectivity of Literature Study

To firstly assess the credibility of the sources utilised have been deemed as credible, by using specified websites and books that are publishing scientific articles and thus eradicating potentially significant sources of error. Therefore, credible and quality-assured databases such as Oria, Web of science and Scopus. Furthermore, articles were assessed for credibility based upon the origins of the paper (according to EU or EEA law and protocol) and lastly the number of citations attached to the paper as well as the division that they may be under this is shown in table 5 above for each specific source.

Correspondingly, to continue to select a strategy for objectivity, it was imperative that if one should want to build a conclusive wider image of the relationship between main contractors and subcontractors each papers objectivity and specificity will change. However, in terms of the research being conducted as long as the objective is within the realms of collaborative Partnering and how it is utilised within the industry between main contractors and subcontractors.

2.1.4 Evaluation of Literature Study

The following criteria for the evaluation of literature were designed to gage a trio of situations; current affairs, previous experiences and potential enhancement techniques (if any) that have both been implemented and can be implemented for the future. Secondly, in order to reflect on such findings and essentially cross-reference such experiences. This scoping methodology was chosen as the strengths of this method as it provided a framework to create an overview of the current state as well as mapping what collaboration and transactional actually means within project delivery methods.

However, there were some evident draw backs early on the lack of standardisation across terms such as relational, collaborative, partnering, transactional and traditional project delivery methods. This meant that several combinations often had to be implored during the scoping review where key words were utilised alongside such terminology in order to streamline the search to some extent. Furthermore, some of the search phrases that were utilised gave an immense number of results and as such operators such as (IN, AND, OR, NOT) were deemed essential to narrow down the search. Correspondingly, once these had been narrowed down a second more in depth strategy was evolved using the process provided by. Blumberg et al. (2014) guidelines shown in section 2.5.1. Further to this, a further search was utilised for 'traditional project delivery' and 'collaborative project delivery methods' but this time including the terms design-bid-build and design build.

Lastly, the searches were first made in English this was a strength as much larger volumes of literature could be reviewed with numerous accreditations and citations. However. due to the lack of consistency in standardised language and difference in what words mean from the UK to Norway. It was decided that for more specific terms adhering to laws, rules, regulations that Norwegian documents would also be reviewed. Further to this and the discrepancy between what Norway and the EU defines as design -build and design bid build it was deemed necessary to utilise Norwegian documentation.

2.1.5 limitations for literature study

One possible source of error is that incorrect literature can be selected, i.e. insufficient source criticism. It may also be that relevant literature was not discovered due to errors keywords or that the search was done in the wrong search engine. Further to this, as copious amounts of literature was reviewed in Norwegian that misunderstandings may have occurred despite cross checking occurring at numerous points throughout the study. Therefore, for these reasons coupled with the limited amount of literature reviewed may have led to assumptions from the literature being utilised.

2.2 Case Studies

The subchapter provides a description of the master's thesis case and study of this case. The case study consists of surveys and follow up interviews (in place of a semi-structured interview) and a documentation study.

2.2.1 Rationale for finding case studies

As the research area is directly comparing how collaborative approaches vary between collaborative and transactional project delivery methods. It was therefore deemed imperative that in order to build a comprehensive picture that cases were evaluated early on. It was crucial that these cases would need to convey the variance of collaboration and transactional approaches between design-bid-build and design build contracts. It was identified early on that two case studies would be studied, with one focussing on a traditional design-bid-build contract and the latter focussing on a more collaborative approach utilising a design and build contract.

Initial contact was established through my thesis supervisor Prof. Ole Jonny Klakegg, who contacted at the NPRA affiliated with the Civil and Environmental Engineering Department at NTNU. The email consisted of the research area and a proposition of whether cases matching the research question could be utilised. The NPRA requested more information regarding the type of projects that would be suitable. The researcher sent a one-page document outlining the research purpose, screening process and what was to be compared in the two case studies was then sent across to the contacts. The key personnel identified were then contacted via zoom, where a discussion took place discussing the suitability of projects as case studies and after some discussion it was decided that the two case studies to be selected were, E6 Helgeland and E6 Kapskarmo- Svenningelv-Lien.

2.2.2 Approach adopted for case studies

In order to gain insight and thus understand how main contractor and subcontractor relationships vary between transactional and collaborative processes, two case studies were examined with a qualitative approach based on Yin's (2014) guidelines. According to Yin (2014), the six most common methods in case studies are:

1. Document study
2. Archive
3. Interviews
4. Observations
5. Participatory observations
6. Physical objects

For the purposed of the following research only four of Yin's (2014) four principles for data collection in case studies were utilised:

- Principle 1: Use several methods

The study should not be based on a method. For example, the thesis should not be based solely on interviews, but project documentation should also be examined. Using multiple sources in the case study gives the researcher the opportunity to explore a broader perspective.

- Principle 2: Prepare a case study database

This is not done in this work to a greater extent than storing documentation locally on the researcher's PC. The main purpose of this is to organize the documentation by making it easily available for yourself and for others for future work.

- Principle 3: Establish a chain of evidence

This principle is used to increase the reliability of the task and to make it easier for external observers to make the same conclusions as the researcher based on the same available information. The external observer should be able to follow the steps of the issues to the conclusion. The figure below illustrates how this can be achieved:

Case Study Reports → Case Study Database → Case Study Protocol → Case Study Questions

- Principle 4: Take care with electronic sources

The amount of information available can be overwhelming and one should therefore limit the search. It is also important to cross-check the information you find and not necessarily accept the first and best source. This principle is well covered by the guidelines which is followed in the thesis literature study.

2.2.3 Description of Cases

The following table presents the two cases examined in this master's thesis.

Project Name	Project Type	Client	Contract	Status
E6 Helgeland South	New Road Construction (57 km)	NPRA	Design - build	Construction almost complete. Due completion summer 2020
E6 Kapskarmo-Svenningelv-Lien	New Road Construction (22.2 km)	NPRA	Design - bid - build	Construction complete 2019.

Table 10:Presentation of two cases examined in this master's thesis

E6 Helgeland South

The E6 Helgeland is a very important and long-awaited project in the region. The sub-project extends over 132 kilometres, from the Nord-Trøndelag border to the south side of Korgfjellet. The previous road had been deemed poor in relation to NPRA standards; as the road was narrow with numerous bottlenecks. Ultimately, this resulted in an abundance of problems such as significantly reduced travel speeds and thus a building up of traffic but also causing immense problems for the food transport industry. Furthermore, issues such as road safety and neighbouring residents were also taken into consideration and it was governed that there was in fact a great need to improve and rebuild the stretch of road.

The development of E6 Helgeland south takes place through what the NPRA call a 'road development contract', this is more commonly known as a design and build contract. Hence, providing the contractor with responsibility both for the design and construction of the road, as well as operation and maintenance throughout the contract period (Norwegian Public Roads Administration, 2020).The contract has a duration of 15 years, which includes a construction time of four years. According to Statens Vegvesen 'With such a contract we ensure a continuous, linear and predictable development over the long stretch of road. The main

contractor awarded was Skanska and the spade went into the ground in May 2017. Skanska will both designs, build and improve a total of 58 kilometers of E6. The contract with Skanska is the largest in the E6 Helgeland project, with a value of NOK 2.88 billion (incl. VAT). The entire development has a cost framework of approx. 6.5 billion (Norwegian Public Roads Administration, 2020). Table 9 below, clarifies all three parties involved on the project E6 Helgeland South:

E6 Helgeland South		
Client	Main Contractor	Subcontractor
NPRA	Skanska	Hæhre

Table 11:E6 Helgeland South - Client, Main Contractor and Subcontractor

Table 12: E6 Helgeland South and its seven parcels ((Norwegian Public Roads Administration, 2020)

E6 Kapskarmo- Svenningelv-Lien

The sub-project consists of two development parcels: Kapskarmo – Svenningelv and Svenningelv – Lien. The former was opened on October 3, 2019. The main contractor selected was Bertelsen & Garpestad AS. Congruently, on the Svenningelv – Lien section, the basic conditions in the original road line proved to be so poor that NPRA decided to build on a new line. Therefore, an entirely new zoning plan was devised.

The project consisted of building a total of 22.2 kilometres of new road. As discussed above. The first segment was spread over 12.1 kilometres and the latter over 10.1 kilometres. Additionally, measures were taken on the local road network in Trofors. Where, the new European road was approximately 2.5 kilometres shorter than the previous road.

The sub-projects E6 Helgeland north and E6 Helgeland south are being built as known under so-called road development contracts. However, for this part of the project traditional contract forms have been utilised (Norwegian Public Roads Administration, 2020).

Trofors town

The E6 was moved out of Trofors and was laid on the west side of the railway. The bridges over the river were built in Svebakken in the south and Valryggen in the north. A new junction to national road 73 towards Hattfjelldal and Sweden was also established where the E6 crosses the river to the south (Norwegian Public Roads Administration, 2020).

This contract is carried out as an execution contract. Several of the bridges are planned to be completed and have been approved by the Road Directorate. Other design and foundation documents will be designed according to known standards and regulations. In terms of market, this parcel will be well suited for medium-sized contractors who are good at mass relocation work. Construction time approx. 2 years. Table 11, summaries all three parties involved on the project E6 Kapskarmo - Svenningelv-Lien.

E6 Kapskarmo- Svenningelv-Lien		
Client	Main Contractor	Subcontractor
NPRA	Bertelsen & Garpestad	Consto

Table 13:E6 Kapskarmo- Svenningelv-Lien - Client, Main contractor and Subcontractor

2.2.4 Evaluation of Case Studies

In order to evaluate a project, one must use professionals, key personnel at the NPRA and logic when considering the validity of the project within one's research. The project is reliable, and the project's credibility is justified and subject to Norwegians public procurement law. E6 Helgeland South is relevant as it is a project that is on the very near end of completion. Thus, the project participants memories are fresh in regards to the goings on of the project. Furthermore, despite being put on hold for months on end due to covid-19, the project is still scheduled for the same date. E6 Kapskarmo- Svenningelv-Lien also appears relevant and reliable in the sense that a design-bid-build project delivery method has been utilised.

Furthermore, E6 Kapskarmo- Svenningelv-Lien is part of the same work parcel as E6 Helgeland South and as such many of the factors remain the same between the two and as such make it more visible to observe the variance of collaboration between the two PDM's.

2.2.5 Limitations of Case Studies

As the master's thesis is limited by time and scope, initially it had been discussed that a singular project may in fact be better suited to the limitations mentioned above. However, due to the nature of the research question, need for a comparison and to offer a true reality of the differences between the two PDM's. It was decided that order to build a factual representation, that two cases should be compared and not a singular case. Furthermore, case studies provide copious information and documents that need to be reviewed which is a very tedious and time-consuming process.

2.3 Interviews

2.3.1 Choice of method for interviews

The interview is an important tool when working with people (Dalland, 2012). The interview allows one to ask questions to converse with respondents and collect elicit data regarding a specific subject. The interviewer is there to understand the situation and to an extent make oneself understood to facilitate and gain insight to the research purpose. Ultimately, in order to get answers, one must ask the right questions and as such the right questions must be designed.

The purpose of the qualitative interview is to obtain knowledge through descriptions of the situation in which the interviewee finds himself in. According to Blumberg et al. (2014), a qualitative interview can be categorized as either unstructured or semi-structured, which differs from the quantitative method structured survey. In an unstructured interview, the interviewee speaks freely. Whereas, aaccording to Tjora (2017) a semi-structured interview is also called an in-depth interview and therefore allows for an open and unrestricted interview survey based upon specific and predetermined topics. Therefore, the researcher has some questions prepared but there is still room for the interviewee to provide more information and voice their own individual opinions and comments.

2.3.2 Rationale for choosing the interviewees

It was therefore important that in order to build a comprehensive picture that the right interviewees were found early on. The key NPRA personnel identified from the case studies were the project managers and part of both cases being studied thus they held relevant experience and expertise in conducting both types of contracts. Therefore, they were deemed highly suitable and when asked to partake in interviews were more than happy to participate.

In regards, to interviewing the main contractors and subcontractors working on both cases the key personnel identified previously yet again were crucial to establishing contact with other parties. A series of emails were initiated where the research area was yet again explained but this time directed at the main contractors, subcontractors on each case study mentioned in

section 2.6.2.The interviewees were identified as key people working within both cases and all held project management positions in their respective organizations.

2.3.3 Implication of COVID-19 on Interview Process

The initial plan for this study was to utilize semi- structured interviews as a method where questions were designed in advance but only to be used as a guide or checklist. This would allow the interviewees to voice their opinions and speak freely on the matter. However due COVID-19, fast changes were required, and alternative solutions were necessary as face physical semi structured interviews were no longer an option. Correspondingly, it was suggested that alternatively a semi structured interview could be conducted but in a virtual setting utilising zoom, skype or Microsoft teams.

However, due to the nature of the study, and the fact that three separate perspectives were necessary to build a complete picture as well as the depth and detail that was required. This coupled with the fact that the key personnel identified from industry were hesitant to answering questions in a transcribed recorded virtual setting in English and without seeing the line of questioning beforehand. Therefore, solely interviewing in a virtual environment was deemed unsuitable. Therefore, the best of both methods was utilised where, initial surveys were first conducted and were then used as the interview guide for follow-up interviews.

2.3.4 Survey and Follow- up Interview Approach

As mentioned above, the approach utilised was a combination of initial surveys and follow-up interviews to both find the depth required for the study as well as allowing the interviewees to familiarise themselves with the topic, style and line of questioning beforehand.

The follow-up interviews only focussed on areas that had had been flagged as interesting from reviewing survey questions. Therefore, if an interviewee had mentioned or provided insight into something thought-provoking more questions would be asked to shed more light and be elaborated upon. Additionally, areas that were also flagged as unambiguous were also revisited as part of the follow- up interview. Furthermore, the questions were adjusted to the interviewees based on their role (client, main contractor and subcontractor) and therefore each interview guide also varies to some extent. However, the main essence of the questioning is similar but words such as main contractor/subcontractor/ client have been interchanged depending on which party is being interviewed.

The interviewees gave the researcher permission to use their role and company name but not their individual name. As personal experiences were being sought of collaboration in the public sector, and questions were to be asked in relation to live and ongoing projects it was decided to anonymise interviewees. Additionally, this was also to prevent this thesis from having any effect on the way things would have been conducted as if this topic had not been investigated and thus leaving the matter unchanged.

Furthermore, all local permissions were sought and applied for including permission from the Norwegian Centre for Research Data. NSD is the Data Protection Official for Research for all the Norwegian universities, university colleges and several hospitals and research institutes.

The Data Protection Official scheme implies that the requirement for obtaining licenses from the Data Inspectorate for a greater part of research projects are replaced by a notification requirement where NSD is the last instance for reviewing applications for licenses. As surveys and, follow up interviews were used this was necessary the NSD Reference number for this study is 392018.

2.3.5 Structure of Surveys

The survey structure was created to somewhat assimilate to Tjora's (2017) proposal for conducting an interview plan. However, it has been heavily adapted in order to suit a survey rather than an interview. The main reasoning for this, was to take the respondent on a journey rather than firing an array of in-depth questions from the very beginning. The thinking was that the survey should steer away from the conventional list of several questions but instead use sections to gain an insight into specifics. The tool that was utilised was Zoho survey, where an interactive survey can be created (ZOHO, 2020). The last section was utilised as a means of reflection for the entire survey but also a place where more in depth answers could be provided. This and the survey being utilised as the survey guide largely aided in bridging the gap from survey to follow-up interview.

- Section 1: Setting the Scene (5 min)

Ultimately, the first section in the survey was used to set the scene. However, it is important to note, that a series of ice breaker and networking phone and Zoom calls had taken place beforehand and as such this section became a formality. Therefore, this was a chance for each interviewee to put into writing something about them and what they do and how that would correlate to the thesis.

- Section 2: Experience (5 min)

Clarification on what experiences the interviewee has with the topic and what current projects have contributed or not and thus encourage the interviewee to open regarding what roles have been played in the projects. Section 2 fundamentally built upon section 1 as a way of forming trust and gaining a deeper relationship as it was crucial to be able to firstly attain facts and secondly gain a good open relationship in a virtual setting.

- Section 3: Focus (15 min)

Ultimately, direct questions are asked regarding the research questions and collaborative concepts regarding time, quality and safety. These questions are designed to quickly get into the relationship so that things can be understood. These are a basis for the follow up questions and almost act as an interest flagger for example something emphasized in this section will be revisited in the next section or yet again in the follow up interview. A bulk of information is obtained within this section.

- Section 4: Reflections (10 min)

Clarification of any ambiguities and an opportunity to revisit and thus add any missing information that may not have been directly asked. This is a chance for an open dialogue to occur and for more depth to be added. Consequently, it is through summating findings that

gaps for further questioning can be acknowledged and as such the course of the thesis can be adapted based on the experience and knowledge gained.
A total of 6 surveys were designed with 25 question in each, this was because two people from each party (client, main contractor and subcontractor) was deemed necessary as one person from each party would be too subjective. As this was compared across two projects, 12 people in total were surveyed and of those 6 were follow up interviewed via telephone, email and zoom. The reason for 25 questions was in a bid to simplify data and avoid bombarding interviewees, 5 questions per section according to 2.7.1 were utilised.

2.3.6 Structure of follow up interviews

Through utilising the survey as an interview guide for the follow up interviews a number of advantages were found. Firstly, in regards to a smoother interpretation as interviewees already had a very good idea regarding the research area and had the time between the survey and follow up interviews to remember more in-depth information.

Further to this, any interesting aspects that were flagged during surveys could be established and the section area could be revisited quickly during follow up interviews. The survey/interview guide that was utilised during the follow up interviews was simple and based largely upon the individual outcomes of each survey. The interview guide was structured around the research questions and the same structure was used during all the interviews and as such served for both clarification and reflection as well as encouragement to further elaborate on the core of the thesis.

The follow-up interviews were based on the answers they provided in their surveys to the questionnaire and the central topics surrounded their thoughts on how the design-build project increased collaboration and the clients. The interviews lasted between 30 minutes to an hour. Furthermore, for the follow up interviews and with the consent of the interview subjects, the zoom calls were recorded and transcribed. Lastly, summaries were written based on the transcribed material. This was sent to the participants for any comments and approval.

2.3.7 Validity and Reliability of Survey and follow-up interview questions

Validity and reliability are challenging when using a qualitative interviewer as if the study is repeated, there is no guarantee that the same data will be found. Dalland (2012) suggests that the validity of an interview can only be assessed based upon the quality of the data collected. Therefore, there are numerous factors that can impact the quality of a qualitative interview.

According to (Dalland, 2012), the more structure that an interview has, the higher the level of verifiability. As the survey questions were used as an interview guide, the researcher and interviewee had some level of structure during the follow up interviews. It is important to note that as both parties had the survey results in front of them whilst speaking it was easy for them to verity any misunderstandings. Additionally, through using the survey as an interview guide the researcher and interviewee could shift focus to specific sections that were of interest or unambiguous easily and transcribe specific areas very quickly. This meant that there was less

chance of data being manipulated and changed through the researchers own insight as comments being delivered during the follow up interviews were easily recorded immediately.

However, the main things to prioritize during follow up interviews is that the interview is conducted in an open way so that the interviewee is minimally affected by the researcher. Clarification of terms prior to the follow up interviews via the survey where terms and questions could be seen in Norwegian were also very beneficial in assuring an element of reliability as there was less of a chance of information being misinterpreted and assuring that both the interviewer and respondent were speaking on the same matter.

The final section of the survey was a reflective section which ensured that everything had been understood and when this was mirrored again in the follow up interviews not only did new discussion points come up but also provided a chance for misunderstandings to be identified and conveyed correctly.

2.3.8 Evaluation of Survey and follow-up interview questions

The qualitative approach is well suited when a phenomenon is to be investigated in depth (Dalland, 2012). As discussed above, the method of utilising a survey and follow up interviews was not a standard method and one that instead was formulated due to unforeseeable circumstances as the thesis methodology was developing. Therefore, the surveys initially formed a basic rapport with the select sample of key people from main contractors and subcontractors on both cases. The surveys coupled with the follow- up interviews create a mutual understanding of the research problem and as such a place where experiences based upon the two case studies can be shared.

As discussed previously, all key people involved in the surveys and interviews were identified by the NPRA and consisted of project managers and engineers that had directly been a part of both cases studied. Therefore in regards to the level of knowledge, experience and expertise all of the interviewees had a very good understanding surrounding the research area and case studies. Furthermore, all respondents were more than happy to participate in surveys and follow-up interviews and were very helpful in pointing out colleges and documentation that may also be able to provide information and contribute to data collected. This showed that there was an overall willingness to facilitate this research, which not only was benefitting the data obtained but was also assisting in finding new useful data.

The follow-up interviews allowed for open conversations to occur but as the surveys were being utilised as the interview guide it allowed for something to go back to in the case that the interview was trailing and as such provided structure. Consequently, this was viewed as a positive as it meant that interviews were able to elaborate and go into depth on specific topics but also allowed the researcher to cover ground very quickly by bringing focus back to sections that had been flagged during the surveys as either interesting or unambiguous. On the other hand, the follow up interviews also opened up the fact that interviewees had been able to think about their experiences in more detail off the basis of the survey and as a consequence may not have been answering questions at the follow up interview as they were asked.

Additionally, the way in which questions are asked can have an immense impact on the way in which the respondent answers for example using suggestive or bias language. The interviewer therefore must be aware to use neutral language that does not lead the respondents answer.

2.3.9 Limitations of Survey and follow-up interview questions

On limitation that was established early on, was that of language as a number of key personnel identified did not feel comfortable writing in English but were happy to speak with me in a combination of Norwegian and English. Therefore, the surveys were translated to Norwegian with English beneath. The reasoning for this, was that it was absolutely crucial to the clarification and levelling of terms so that misunderstandings were mitigated as much as possible from the very beginning.

As follow up interviews were conducted over the phone or zoom, it was not always possible to record all meetings and as such the information from the follow up interviews was not always available afterwards. Therefore, the researcher was required to make notes and transcribe immediately. However, as the meetings were transcribed after the interview, the meaning may change and if recordings are not available there is no way of knowing what was actually said and thus contributing to recall bias.

The general weakness associated to recording audio or video calls is that the respondent does not answer as freely as one would in a regular conversation and as such where an advantage lies of not recording. However, as an interviewee that has signed an NSD for data collection you are able to remain anonymous so it remains uncertain as to how much the respondent may have limited themselves by being recorded. The interviewees that had follow up interviews via phone or zoom were contacted again via email if anything recorded during the summary was unsure and were then asked to confirm findings from the follow -up interview.

Furthermore, the loss of face to face interviews was seen as a limitation. As although surveys and virtual follow up interviews were conducted it was still not the same as a traditional interview. It was not only difficult to create the same open environment but also proved to be technically more complicated. For example, when pinpointing specific documents and areas of interest during follow up interviews it was difficult to both record the interviewee and gain insights to other areas in other documentation.

2.4 Documentation Study

2.4.1 Choice of method for document study

Jacobsen (2015) recommends using documentation studies as a supplement to situations where there is insufficient knowledge or information. These documents should be objective rather than subjective and can be beneficial as preparatory research and a means to cross check the qualitative data produced in interviews.

A vast proportion of the documentation study was performed on documents that were in direct relation to the two case projects, E6 Helgeland South and E6 Kapskarmo- Svenningelv-Lien. The reasoning for which documents will be explained and evaluated in the following sections.

2.4.2 Approach to identifying key documents

The key personnel identified key documents that may be useful early on in the process when virtual informative meetings were taking place prior to surveying. The reasoning for why a supplementary document study was conducted was that reviewing project documentation ensures a level of stability as changes are not made to such documents (Yin, 2014).

The NPRA utilise an organisational portal where documents are archived, this is called the Norwegian Public Roads Administration's eRoom. Permission for access to review such documents was sought and granted via key personnel at the NPRA HR. The documentation that was available on the eRoom consisted of the contracts, contract strategies, procedures, standards, background information on case studies and minutes of meetings between clients, main contractors and/or subcontractors.

Initially, general documentation was first studied to gather a solid foundation on the way that contract strategies were in fact built as well as to gain familiarity with the way the NPRA do things. General documents such as backgrounds for both cases were also utilised again to corroborate what the NPRA key personnel had advised and to also ensure that nothing was missed. The second more focussed documentation study focussed on meeting minutes and communication documents between the parties involved on both projects. General documents helped to unravel key procedures that were in place at the NPRA whilst central documents are pivotal in providing specific details and insights into the internal processes within the cases. This documentation was key in providing insight to the dialogue and communication between the NPRA (client/owner) and the main contractor. The contracts also showed how the NPRA managed projects what requirements were in place for both cases

2.4.3 Evaluation: Document Study

The first document that was examined in the general documentation study was the NPRA's Construction Strategy. This was mentioned in the first kick off meeting and explains the fundamentals in the NPRA strategy. In total, there were over 50 documents that were investigated but were narrowed down to 30 based upon objectiveness and relevance.

All documents chosen had been designed or conducted by the NPRA, this is why the documents are considered valid and reliable. The documents and reports are objective in regards to the implementation of both project delivery methods and state the procedure at the NPRA for both contracting methods.

Reliability can be further enhanced by examining documentation from the main contractors and subcontractors that were utilised on each project.

2.4.4 Limitations

One main limitation of the documentation study was that a large proportion of the documentation drew upon conclusions from the NPRA. Although, there were some reports from collectives consisting of numerous actors ranging from academics to industrial engineers outside of the NPRA, the NPRA still were very much part and parcel of the reports. Thus, the

Norwegian Public Roads Administration is a relevant source, but one must be critical that the documentation can also carry with it a degree of bias and subjectivisms.

Furthermore, the documentation which covered direct communication between parties such as the NPRA, main contractor and/or subcontractor was recorded in meeting minutes, email correspondence and official dialogue. Therefore, there were many documents to review and piecing together a picture based upon several chunks of data from various sources made it difficult to evaluate as a whole.

The documents are a result of what has been done in the project and is not made with any other goal or meaning. The documentation often has requirements that make it specific and detailed, while at the same time embracing a longer time perspective. The problem with document studies is often the availability. It can be difficult to obtain documentation and some of the information may be withheld intentionally for the project to appear as desired.

3 Literature Study

3.1 Literature Study Introduction

The working of the following literature study is two-fold; the first study was conducted during the autumn semester of 2019 and the second in the spring of 2020. The literature review has therefore been a live document and as such has been progressively edited, built-on and refined. During the fall semester, the literature study acted as a preliminary study in order to gain an effective insight into knowledge transfer, partnering and current collaborative approaches. Conjoined with the purpose of creating a better understanding of the research purpose and analysing how the link between these topics and how this is perceived both in industry and in literature by researchers.

Similarly, the second revision not only built upon such theories in a more focussed manner but further provided an insightful foundation to current practices, previous experiences and potential enhancement techniques (if any) that have been currently been implemented and what those outcomes have consequently observed. However, as the second literature review was conducted during the document review process for the chosen case studies after contact had been established it was much easier to streamline points of interest. For example, the various roles in contracting for infrastructure projects and the reasoning for the majority of contracts at NPRA being conducted through execution contracts (design-bid-build contracts). Ultimately, not only did this aid in the discovery of necessary theoretical framework that is fundamental and crucial to partnering within the public construction sector but also supported that there was in fact some substance for the purpose of this study. The theoretical framework will be examined further in chapter 4.

Overall, the literature review provides an insight into how the relationship between the client, main contractor and subcontractor is different and with what factors but will begin to unravel the complications that occur when this relationship is altered by the conveyance or lack of and thus will explore the current literature from the perspective of each party. The review will also assist in structure for further study as well as identifying gaps in knowledge, current legislation and lastly, pinpoint thought-provoking research areas to delve further into.

3.2 Background Information

Description of the literature

In Europe, the idea or concept of ‘partnering’ mostly originated in the United-Kingdom in the early 1990s compared to the USA where it was first introduced in the middle of the 1980s. At this time in particular in the U.K., and an ever-increasing number of actors from the government, regulating bodies and various professionally accredited institutions (H.M. Government, 1995; Latham, 1994; NEDO, 1988; The Institute of Civil Engineers, 1996) and also from academia (Barlow & Jashapara, 1998; Bresnen & Marshall, 2000; Crane, Felder, Thompson, Thompson, & Sanders, 1997; Sai-On, Ng, Shek-Pui, & Suena, C.H, 2003; Thompson & Sanders, 1998) began to question the prevalence of challenging relationships between the numerous parties scrambled with the construction supply chain.

Current State of Affairs; Where is Partnering Today?

It is widely understood that the greatest prospective for saving costs is within the choice and usage of subcontractors, and thus as a result, the widespread prevalence of imbalanced practices has been cultivated (Barlow & Jashapara, 1998; Bresnen & Marshall, 2000). The general procurement of projects on a one-off basis was depicted to show little to no regard to future needs or even simple supply development, and this the overall fractured structure of the industry was somewhat criticised for fuelling individualism and creating little synergy between parties. Cain (2004) states that the potential savings that are to be obtained from supply chain integration and on unnecessary costs could be around 30%.

Therefore, Partnering was presented as more than just a boost to reduce costs and increase productivity, and it was also presented as an adequate opportunity to improve quality, reduce project times and hence lead to higher customer satisfaction which in turn leads to a much more stable environment (Bresnen & Marshall, 2000). Consequently, the adoption of Partnering and new collaborative relationships between clients, contractors, sub-contractors and suppliers was then seen as a way to overcome the industry's performance problems as well as innovative (Barlow & Jashapara, 1998).

The literature review of partnering in construction acts as an enabler where one can identify various interpretations as well as being able to pinpoint numerous definitions (Barlow & Jashapara, 1998; Nystrøm, 2005; Saad, Jones, & James, 2002). The most widely adopted definition of 'Partnering' is proposed by the Construction Industry Institute (1991) and in essence refers to a long-term commitment between two or more organisations whereby shared goals and shared understanding are the fundamentals of the relationship leading to trust to develop for the benefits of improving construction (Bygballe, Jahre, & Swärd, 2010; Hong, Chan, Chan, & Yeung, 2012).

3.3 Partnering

Adoption of Partnering within the Construction Industry

Naturally, the adoption of Partnering has become increasingly popular in terms of business relationships and how they are being formed within the construction industry. The implementation of such procedures was initially utilised within the industry due to the ever-growing uncertainty stemming from a lack of trust and honesty between clients, main contractors and subcontractors. Inevitably, this distrust manifested and lead to an array of issues ranging from procurement matters to more serious problems resulting in litigation not only was this having a resounding effect on the companies but more importantly leading to the immense customer satisfaction.

Trust in Partnering

According to Wong and Cheung (2004) 'developing trust amongst project partners is of fundamental importance'. Whilst, previous research within partnering has highlighted the importance of developing trust amongst the various construction parties to facilitate project success. This is especially visible within the construction industry where trust seems to rely

more on formal agreements, otherwise known as system-based trust than on interpersonal relationships (Wong & Cheung, 2004). Most literature reviewed generally discussed the term partnering within the context of two main categories; Project Partnering and Strategic Partnering (WCF, 1995). Whereby, project partnering is distinguished by being affiliated to a single project where at the end of the project, the partnership is terminated; thus, a further relationship may or may not commence on the next project. Correspondingly, strategic Partnering is a process which essentially takes place when numerous firms use partnering on a long-term basis to take on larger or many projects.

The effects of applying partnering principles: Main contractor – Subcontractor

The effect of applying partnering principles to improve the subcontractor selection process was studied by Kumaraswamy and Matthews (2000). Their study shows that general contractor subcontractor partnering approaches can be beneficial by improving time and cost control, reducing pricing levels by at least 10% whilst improving the relationships between all project participants. The general philosophy of partnering involves integrating all key participants and identifying a common sense of project purpose, commitment, teamwork, and problem-solving.

A commonly cited definition originates from the Construction Industry Institute (1991) who quotes it as "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 an understanding of each other's individual expectations and values"(Kumaraswamy & Matthews, 2000). Developing a strategic long-term partnership with a selected or a number of selected subcontractors can lead to cost and value advantages for the general contractor through knowledge sharing and integrating a consistent supply chain to create value and deliver high quality projects.

Effect of partnering on cost, time and quality control

Correspondingly, it was concluded by Kumaraswamy and Matthews (2000) that although the tender costs via a partnering approach were significantly greater than those found on competitively tendered projects that it was considerably easier to govern and control cost and time performance levels. Thus, eluding to achieving higher quality levels given the close cooperation and transparency exhibited between both parties which in turn facilitated prior anticipation and therefore mitigated or reduced potential problems.

Adversarial Relationships: studying main contractor and subcontractor relationships

As discussed above, such adversarial relationships amongst main contractors and subcontractors can often result in poor projects (Meng 2012) and thus, the management paradigm within the construction industry tends to be fragmented. The number of limited cooperative relationships on an industry-wide base have hampered effective project execution and impeded enhancement of participants' individual competitive abilities in the industry (Chen et al. 2012;(Construction Industry Review Committee, 2001) as most construction work

is conducted by subcontractors, the cooperation required between main contractors and subcontractors expressively and instead explicitly targets the "traditional iron triangle goals" ((Clough, Sears, Sears, Segner, & Rounds, 2015); Meng 2012; Wu and Tang 2015). These traditional iron triangle goals are; cost, quality, and schedule of construction projects. It is therefore deemed essential for main contractors to maintain and uphold honest relationships with subcontractors and overall improve project performance hence winning more bids for future projects (Chan, Chan, & Ho, 2003; Clough et al., 2015); Moore et al.

Catalyst for change: what has led to partnering approaches?

In recent years, withering relationships within the construction industry has ultimately led to further partnering approaches and fundamentally outlined the need for change. Predominantly, according to the largest contributing factors that can be attributed to the adoption of partnering approaches is due to Kumaraswamy and Matthews (2000) the overriding lack of trust, respect and honesty between professionals and more specifically main contractors and subcontractors. Consequently, it was these behaviours which led to issues in procurement surrounding problems with litigation and claims which negatively impacted the satisfaction levels amongst clients (Kumaraswamy & Matthews, 2000)

N.B: The catalyst for change is explored further in the interview guide and as such incorporates questions surrounding satisfaction levels from all three perspectives so irregularities and differences can easily be identified. Furthermore, questions are also asked in relation to whether or not NPRA have in fact adopted any long term-strategic partnering relationships with subcontractors.

Partnering approach to subcontractor selection: Literature example

Kumaraswamy and Matthews (2000) further depict an example of a partnering subcontractor selection method that involves the identification of the main jobs and work packages of the construction project e.g. foundation designs, steel members, external facade cladding. Once, such packages have been formed the senior project team members suggest names of subcontractors. These suggestions are made based on a combination of factors (bullet pointed below) however, it is frequently based upon previous performance and thus track record. Consequently, a meeting between respective subcontractors is set up.

Alternative criteria recommended to be assessed include:

- Ability to undertake the quantity of work
- Ability to produce the required standard of work
- Ability to undertake the work (without overstretching the subcontractors)
- Positive attitude (past experiences)
- Firm financial background
- Good in-house design service (where applicable)
- Good standards of management (site and head office)
- Main contractors desire (if any) to develop a long-term relationship with the subcontractors.

As a result of such a meeting, the number of subcontractors which are selected as potential should be narrowed down to around three to five subcontractors for each package. It is these subcontractors which are then invited to a subcontractor interview. The purpose of the interview is to assess the ability of the subcontractor in regards of design capability, background as well as assessing more personal and individual qualities such as ethical standing, attitude and enthusiasm towards the project. Additionally, the meeting is also serving as a good introduction to the project and a respectable place to discuss matters regarding the philosophy of partnering as well as passing over pricing details and any other relevant information focal to the project. Subsequently, the project manager and the team assess each subcontractor through a pro forma on key criteria. For instance, criteria such as price, technical ability, past experiences of similar work, quality control.

Following this, a second subcontractor interview should then take place based on a project briefing and tender clarification before selecting the appropriate subcontractor for each work package. An indicative price and budget rate should be agreed upon based on the clients' cost plan. Results from this method yielded that subcontractors on average reduced their pricing levels by 10% and increased quality levels provided by the close cooperation and transparency associated with earlier anticipation and minimization of potential (Kumaraswamy & Matthews, 2000).

Previous Research Conducted; Where may Partnering lead to in the future?

The general trend on research articles investigating or focusing on partnering as an aspect tended to concentrate on behaviour principles and the techniques required to successfully conduct a partnering project (Bresnen & Marshall, 2000). Concerning specific contractual issues, Partnering has often been presented as a form of relational contracting along with alliancing, public-private partnership and joint venture arrangements (Chan, Chan, & Yeung, 2009; Rahman & Kumaraswamy, 2004)

3.4 Closer insight into main contractor and subcontractor relationships in the industry

If we look into the main contractor and subcontractor relationship in isolation within the construction industry, we can see that the general behaviour of the construction industry has transgressed to a place where the overall lack of honesty and mutual respect between professionals specifically sub-contractor and main contraction relationships have a dire and negative effect on the procurement process. The traditional approach dictates that main contractors would be required to execute the vast majority of a project by utilising directly employed labour. However, there has been a shift in the industry where the number of sub-contractors has increased immensely. Thus almost 90% of the value of work that is undertaken on projects are currently being subcontracted according to Nobbs (1993). Jamieson *et al.* (1996) they state that despite a drop-in construction work available in the marketplace, there has been no significant change overall in the number of U.K. construction workers and that actually in many circumstances Main Contractors currently provide only the management and coordination aspects of a particular project. Ultimately, this sets the precedence that perhaps main contractors are now being called on as a type of 'professional service firms' consisting

of an array of Project Managers, Contract Managers, Design Engineers, Architects etc. whose central role is to assist in the planning aspects of the project rather than the physical constructing of the project.

Need for Standardisation in Collaborative Partnering

Furthermore, one particular area of research touches upon the idea that even though the concept of Partnering is practised on numerous fragmented projects that Partnering still required some essence of countrywide and national standardisation so that Partnering can be used efficiently across the industry in the way that it was intended (Kubal, 1994). The concept of standardising is further developed WCF (1995) where the impression that inventiveness within Partnering has been key to enabling secondary and tertiary generation partnering to evolve, where second-generation Partnering is supported by the 'seven pillars' of Partnering. These are strategy, membership, equity, integration, benchmarks, project processing and feedback. Similarly, one can conclude that from the third generation of Partnering will focus more on building virtual organisations along with associated supply chains to provide a service which is in all ways innovative, efficient and beneficial to all parties involved.

How can the main contractor and subcontractor relationships thrive; what can be done?

For main contractors and subcontractors to thrive, they should share aligned goals and thus develop an overall win-win strategy for maintaining a collaborative/partnering relationship with each other. Subcontracting can be a fruitful and equally beneficial business arrangement where hiring subcontractors can offer exciting new prospects whereby specialised services can be provided to clients and thus increasing overall business capacity. Ultimately, subcontractors have low start-up costs and can incur a relatively steady stream of work without having the requirement to acquire new clients and keep the flow of work continuous. However, it is imperative to note that as discussed above there are numerous short comes associated and that for the main contractor to subcontractor relationship to survive seamless communication is critical and that a clear narrative of communication is made early on to establish an utmost effectual relationship where all goals, objectives as well as limitations are so to speak laid on the table. To succeed, a clear understanding must be established where the terms and conditions of the arrangement and the finer details are utterly transparent hence not only guaranteeing a smooth, efficient method of work but resulting in a higher level of customer satisfaction. Subsequently, main contractors have realised that one of the highest potentials for cost-saving lies within the usage of sub-contractors.

The table below illustrates some of these added benefits or advantages of sub-contraction:

Advantages of Sub contraction	Disadvantages of Sub contraction
• The ability to hire a contractor or subcontractor when you need more flexibility with a specific task. • They are enabling permanent staff to concentrate on the core business. • Fast reaction time, projects can be started at short notice, this is not only economically beneficial but great for reputation etc. • Specification of the type and duration of the contract required for the specific contracted project • Flexible nature for different jobs hence jobs requiring specialist expertise or fast turnaround.	• Potential to cost your business more than the equivalent daily rate for employing someone. • No direct control over the quality of subcontractors' work • Lack of appreciation and may not possess the motivation and commitment

Table 14:Advantages and Disadvantages of Sub contraction

These costs primarily arise due to a lack of harmonisation between contracting parties where throughout history this relationship has been based on a transactional entity where both the main contractor and subcontractor are attempting to secure utmost value and the lowest possible cost. Despite this, it is widely acknowledged that one party does not have to lose for the other to win and that multiple studies conducted have found that mutual benefit, gain and cooperation can supersede a stereotypical triangulated costing strategy.

3.5 Summary of Literature

The current partnering literature has primarily concentrated on the relationship between the main contractor and the client with a negligible focus between the main contractor and subcontractor relationship. Additionally, a vast majority of the current partnering literature available today is limited in terms of the detail explored within the paper as the topic is broad due to the generic nature of the question at hand. Additionally, it seems to be evident from reading the literature that each relationship has been isolated and coupled with either a specific company/case study or limited to a country. As we are analysing human interactions, behaviours and thus relationships these can vary a great deal from place to place and therefore bringing in the added notion of bridging cultural aspects as well as the expected outcomes. Therefore, current research is lacking and requires significant further exploration.

Through the evaluation of the above literature, it has become evident that there are most definitely areas that need to be elaborated or researched into greater depth and thus begin to flatten such biases and cultural differences. Through, analysing such behaviours and offering comparisons to how matters are conducted, are we are then able to work together to contribute to a change in practice regarding being able to be more collaborative and understanding a better approach to managing our future business relationships.

3.6 Knowledge gaps identified through literature

It is important to note that although many may argue that fulfilling all the above criteria may be viewed as a somewhat precarious due to the subjectivisms of the human psyche that this paper will aid in providing a microcosm into the world of collaboration enabling one to draw comparisons and providing a point of reference whereby actors involved within the partnering agreement that have had a history and a potential future of interreacting, and that this leads to ways of relating to each other in the focal partnering project. Therefore, it is proposed that to quantify this subjective approach to partnering that we should start by beginning to understand why, how and with whom such partnering techniques are implemented. The following project fundamentally builds upon previous research conducted but intends to offer an alternative angle onto what has been implemented and how the relationships between client, main contractors and subcontractors can impact, limit or enhance collaborative partnering.

4 Theoretical Framework

The following chapter explores and presents the theory behind projects, the roles within them, and sheds light on the way in which a contract strategy is determined. Additionally, as this thesis relates to cases directly within the public sector domain some public procurement principles will also be outlined but will not be discussed in detail.

The framework chapter allows one to gage a quick and necessary overview of roles within the construction industry as well as an outline of current practices and project delivery methods utilised today. The reasoning for this, is to guide the reader through key knowledge that is required as a prerequisite to comprehend the knowledge gap that was utilised for the master's thesis.

4.1 Definition of a 'Project'

Across the industry, there are numerous definitions of a project resulting in variation in guidelines and parameters. Furthermore, the definition of project varies immensely based upon whether the sector the project falls under is public or private. Therefore, the definition is indicative of perceptions and can often be biased depending on the industry and specific views.

However, according to the PMI the following definition has been acknowledged based on suitability based upon the thesis:

`a project is a temporary endeavour undertaken to create a unique project service or result'

PMBOK Guide - Fourth edition (Project Management Institute, 2011)

Elbeltagi (2009a), defines a project by the following characteristics; a defined goal, a or numerous specific tasks to be performed, something with a defined beginning and end and where resources being consumed.

4.1.1 Successful Projects

According to Pinto and Slevin (1988), the concept of project success has remained ambiguously defined, both within project management literature and often in the psyche of project manages. Projects are often rated as successful because they have come in on or near budget and schedule and achieved an acceptable level of performance (Pinto & Slevin, 1988). Furthermore, Pinto and Slevin (1988) come to an acknowledgement that 'until project management can arrive at a generally agreed upon determinant of success, our attempts to accurately monitor and anticipate project outcomes will be severely restricted'.

4.1.2 The Construction Project

According to Elbeltagi (2009a) the goal of a construction project is to build something and that the main differentiating factor between the construction industry and other industries is that the projects are large, built on site and, built on site and generally tend to be unique. Projects begin with a goal which is established by the client/owner and are then achieved by the project team and therefore as the team begins to work together, the team learn more about the project than

when the goal was first established. This can often lead to a redefinition of the project goals. (Elbeltagi, 2009a).

4.2 Roles in a Project

4.2.1 The Client

The Code of Practice for Project Management (CIOB) defines a client as the 'entity or individual or organisation commissioning and funding the project, directly or indirectly'(The Chartered Institute of Building, 2014). The Norwegian ministry of labour inspection define a client by the following: 'any physical or legal person who is assigned to carry out construction or civil engineering work' (Arbeidstilsynet, 2020a). Furthermore, according to the Norwegian Public Roads Administrations manifesto, 'a client's function is a formal part rooted in standards and regulations and through these are assigned specific responsibilities and tasks (Statens Vegvesen, 2015).

Correspondingly, in construction projects will the client normally enter into contracts with both contractors and the designers individually or together (Laedre, 2012). This detail is dependent on the project delivery method that is procured and will be depicted in more detail in section 4.5. Public owners or clients are public bodies are governmental organisations that solely deal with public projects that are built for public use and not sold to others. Therefore, for the purposes of the following thesis, it will be assumed from this point on that the 'client' is a public client.

The Norwegian Public Roads Administration: Client Role

The Norwegian Public Roads Administration state that for the NPRA, the client function is also an internal organisational model which encompasses much more than the actual contract phase. Consequently, the agency's client function includes the entire responsibility for development, for design and construction as well as planning and execution of operation and maintenance of the entire road network as a functional infrastructure.

It is this responsibility that makes the NPRA a major and important player in society. Consequently, the NPRA is a formal client on national roads. The general goal of the client's function is to carry out development projects as well as carry out operations and maintenance in a way that is as profitable as possible for road users and the community, and which makes efficient use of the grants.

The NPRA have a sectoral responsibility to follow up national tasks for the entire road transport system. The NPRA serves society through our three roles:

1. As a contracting client
2. As an authoritative body
3. A s an expert agency

One key task for the NPRA is to safeguard and develop the road network, this is a collaborative process as development projects are part of a continuous process. Therefore, numerous

investment assessments are initiated as well as the management of existing road networks through operation, maintenance and traffic functionality. Ultimately, this form the basis of the NPRA's project development strategy. This is specified in the annual budgets and as such provides the NPRA with the ability to make realistic and affective plans for the forthcoming year. Ultimately, it is this integrated structure forms the basis for the overall efficiency in the development of the road network.

Norwegian Public Roads Administration: Regulations and Standards

As Aforementioned, the Norwegian Public Roads Administration is subject to the Public Procurement Act. Additionally, the NPRA also have designated internal rules, standards and guidelines for road development in Norway (Statens Vegvesen, 2020). Ultimately, such standards and guidelines consist of manuals, standards and process codes (Statens Vegvesen, 2015). Naturally, such internal standards and manuals are deemed mandatory and apply to all public road development and network projects. Such standards and manuals establish minimum requirements for procedures and technical solutions. Ultimately, requirements can be addressed directly with the Norwegian Public Roads Administration during construction. However, any deviations from the standards and law must be clarified with the county and the Road Directorate respectively.

4.2.2 The Designer

The designer or design professionals are architects, engineers or design consultants and the major role of the designer is to interpret and assist the client in developing a project scope, budget, schedule and construction documentation (Elbeltagi, 2009a). Ultimately, the designer's role can change depending on the project delivery method utilised. Consequently, if a Design-bid-build method is utilised for project delivery, the designer will become an advisor to the client. However, if a design-build method is procured the designer will answer directly to the main contractor. Furthermore, the designer's role may yet again vary even further in a Public-Private-Partnership or an Integrated Project Delivery contract whereby a more horizontal dynamic will evolve and as such the designer will be valued as an equal partner. This will be discussed, in more detail in sections 4.4.4

Note: See figure 3 and 5 for illustrations of how the designer's role changes between DBB and DB contracts.

4.2.3 The Main Contractor

The Norwegian ministry of labour inspection define the main contractor as 'a contractor or supplier who has taken on an assignment for an ordered and who has one or more subcontractors to carry out part of the assignment' (Arbeidstilsynet, 2020b). According to, (Elbeltagi, 2009a) 'the main contractor is responsible for delivering a complete project in accordance with the contracts documents and in most cases, the main contractor divides the work among many specialty contractors called subcontractors.'

Correspondingly, Regjeringen (2020) state that the main contractor is ultimately free to organise themselves in a way that they see fit, including the right to use subcontractors on the

parts of the contract that it is deemed appropriate. Furthermore, it is also detailed that the ‘use of subcontractors can strengthen competition in public procurement and facilitate more and better offers’ and that it is particularly important for giving SMEs access to contracts with the public sector.

Eikeland (1998) acknowledges that the contractors contribution goes beyond this and justifies that ‘the contractor's contribution to the project is not just managing and performing physical work at the construction site, but more so to assume a responsibility with the associated risk of the work following agreed specifications’. Therefore, the role of the contractor can be somewhat variable and ultimately even though the contractors primary reward may be of an economic nature that there is in fact more to it and as such cannot be deemed under a generic role. As ultimately, the changeability, range and various combinations of the main contractor role and the level of responsibility associated for the design and execution of the project.

4.2.4 The Subcontractor

The Norwegian ministry of labour inspection therefore define a subcontractor ‘as a contractor or supplier who performs part of the contract agreed between the main contractor and the customer’ (Arbeidstilsynet, 2020b). Similarly, the official Norwegian government documentation defines ‘a subcontractor is usually understood as a supplier who performs one or more parts of the contractual obligation between the main contractor and the client (Regjeringen, 2020).

The likelihood that a single main contractor will have all the necessary skills and expertise required to fulfil a project irrespective of the complexity is unlikely. Therefore, the main contractor will be looking for parties to offer this expertise and taking on new employees for projects with no guarantee of what expertise may be required on following projects makes little sense for a multitude of reasons. Thus, it has therefore become common practice in the industry that main contractors can seek and utilise subcontractors to conduct specific elements of the project.

4.3 Definition of a ‘Contract’

The classic 19th-century definition of a contract is 'a promise or set of promises which the law will enforce' (Pollock, 1950). Elbeltagi (2009a) builds upon and defines ‘a contract is defined as ‘an agreement made between two or more parties which is enforceable by law to provide something in return for something else from a second party’.

Ultimately, a contract is a legally binding agreement between two or more parties which in turn creates a mutual legal obligation upon all parties. Furthermore, the contract provides necessary framework and dictates the level of cooperation to occur between all parties involved. The contract will also state key terms and conditions that have been formally agreed upon. Additionally, the contract will stipulate that if the project should terminate what the procedure would be as well as defining specifications, responsibilities, durations, quality adherences as well as conflict resolution processes. All parties involved are expected to uphold their individual obligations to the project and this is expressed in a mutually agreed set of contractual

documentation. The contract is necessary is not only safeguarding the client but also any other party involved.

4.3.1 Selection of a Contract Strategy

The selection of a contract type or strategy to be used for a construction project is decided by the client. Firstly, this selection must meet the client's objectives and consider any constraints associated with the project. Fundamentally, the scope, nature and characteristics of the project will primarily affect the selection of the contract strategy (Elbeltagi, 2009b).

According to Lædre (2012), in standard construction works there will most often be a general basis of conditions that will be covered and as such it is common for standardised strategies to be instigated for routine works. Contrastingly, for more complex non-standardised projects such a strategy will not suffice and thus a specific strategy will be chosen that will accommodate the needs of the specific project. Overall, the contract strategy plays a pivotal and integral part of the main contractor's overall project strategy.

4.3.2 Contracting Strategy in the Norwegian Public Sector

The public sector in construction in Norway is subject to the Public Procurement Act. The public procurement act directly influences and has a significant effect on the client's contracting strategy by prompting the way in which the contracts are designed (Lædre, 2006).

The main objective of the Act is to contribute to value creation for society and to utilise available resources efficiently. The Norwegian Public Roads Administration is a Norwegian government agency responsible for the planning, execution and maintenance of the Norwegian road network (Sandvin, 2015). Traditionally, the Norwegian Public Roads Administration has used traditional (design-bid-build) contracts for most of the projects in its portfolio. Ultimately, their systems for procuring as well as specific requirements in contracts and the contracting strategy are based upon a traditional (DBB) contract. The Norwegian Public Roads Administration now wants to look at the possibilities of increasing its use and competence of turnkey (Design-Build) contracts (Sandvin, 2015).

Consequently, the NPRA's goal with the move into utilising more turnkey (Design-Build) contracts is a comprehensive, fast and cost-effective development of Norwegian main roads (Government, 2015).

4.3.3 Contracting Forms in Norway

The two primary forms for project processes is divided into two main sections; execution contract (design-bid-build) and turnkey (design-build) contracts.

The central difference between the two forms of contract lies in where the responsibility for the design is located. In a execution (DBB) contract, the client is responsible for all or most of the design. The client can carry out the design himself or enter into contracts with architects and consultants who design, describe and design the building. The contractor shall carry out the work described (DIBK, 2012). Correspondingly, for turnkey (DB) contracts the contractor

undertakes both to carry out the design and execution of what the contract covers. The right of liability may be collected by the turnkey contractor or it may be divided between the subcontractors for design and execution (DIBK, 2012).

Both of these processes will be elaborated on in more detail in Section 4.5.

4.3.4 Five Main Norwegian Standards for Contracting in Construction

1. Subcontracting (Delentreprise): The client engages architect and consultants himself and enters into independent contracts with several contractors. One of the contractors is often given responsibility as a managing site contractor (DIBK, 2012).

2. Main contract/execution contract (Hovedentrepriser/ utførelsesentreprise): The client engages the architect and consultants himself. A contractor has the essential part of the building, but the builder engages, for example. technical contractors themselves (DIBK, 2012).

3. General contract/execution contract (Generalentreprise/utførelsesentreprise): The client engages the architect and consultants himself, but only one contractor who in turn has a contract with all the other contractors (DIBK, 2012).

4. Interaction contractor (Samspillsentreprise/Partnering/Samarbeidsentreprise): The builder and contractor work together in an "open book" format. Where you share unforeseen costs, and contractors get a fixed premium on expenses (DIBK, 2012). The interaction contract is a form of cooperation that is characterized by early involvement of the parties and openness in the process (DIBK, 2012). Within interaction projects, the designated designers are in a contract with the client in the early phase. An interaction process will then occur when the designers and executives will develop the project together. This type of project is often carried out with an agreed distribution between the parties of under /exceeding a set target price (DIBK, 2012). The liability rights for the execution may follow the agreements with the client or be split up into respective subcontractors.

5. Public Private Partnering (Offentlig-privat samarbeid): is a collaboration between the public and private sector on a project, where the private sector takes a larger share of the responsibility related to the development and /or operation of the project (DIBK, 2012). This will be explored in more detail in section 4.4.5.

4.4 Selection Criteria and Procurement Elements

Selecting key personnel and thus organisations who play a fundamental and pivotal role within the project is a large step for the client and if the decision is taken lightly or incorrectly can ultimately result in the failure of the project. Therefore, the client has to select the main contractor carefully and as such a competitive building process has been the main way for main contractors to get work. This process is required by law for public projects both in Norway and the EU.

4.4.1 Prequalification Criteria

Generally, in more complex projects which are of a larger scale, there is often a need for a contractor or advisor to have a specialism in a specific field. The pre-qualification criteria is

where the client will set up the required and necessary qualifications so that the main contractors can be chosen in accordance to this (Wardani, Messner, & Horman, 2006). In the pre-qualification stage, the client is able to convey their specific needs and ultimately find the right people to conduct their project in accordance to the specifications that have already been set. Additionally, the pre-qualification stage allows the client to seek out more information regarding the contactors and consultants. The information could be in regards to a number of things but predominantly would be expertise in specific areas, past project experience and implementation and even financial stability (Jacobsen, 2015).

4.4.2 Award Criteria

The term award criteria refs to the selection process of the way in which a client can award a contract to the contractor. According to (Lædre, 2012), the client can award the contract to the contractor on the basis of several award criteria (most economically advantageous) or on a 'lowest price' basis as the only award criterion. Consequently, the figure below illustrates the two alternative ways in which the contract can be awarded.

These specific criteria must be based on the characteristics of the tender and that the relevant award criteria may be in addition to price, quality and technical value amongst many other things. Ultimately, the criteria which are deemed most appropriate will fundamentally depend on what the contracted work is set to include.

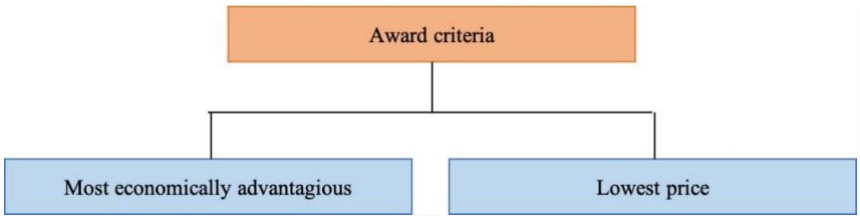


Figure 4:Award criteria for contracts (European Commission 2017)

4.4.3 Lowest price Versus Most Economically Advantageous

The client is able to contract suppliers based upon the lowest price. However, if this is the case then it is important that the client has good qualification requirements. These qualification requirement should relate to a multitude of different qualities such as organisation, capacity, qualification and skills(Lædre, 2009). Ultimately, this is crucial in aiding the client is being able to distinguish between offers and decide ultimately which contractors are right for the job. Therefore, for a control to be awarded to suppliers with the most economically advantageous tender, the criteria for determining the most economically advantageous tender must be determined in advance (Difi, 2016). In addition to cost and life cycle costs, criteria that are not purely economic in nature can also be used. This can act on quality, technical value, aesthetic and functional characteristics, environmental characteristics, operating costs, profitability and time for delivery or completion (Lædre, 2012). This criterion must be clearly depicted in accordance to the weighting each element carries which is usually illustrated by a means of a percentage.

4.4.4 Quality Versus Function Description

The description of what the client wants as the final product of the project can be in the form of job descriptions or quantity descriptions (Lædre, 2009). These quantity descriptions consist of specifications of quantities ranging from the amount of soil to be removed to the required amount of concrete for laying foundations. The client must therefore understand what is required and set adequate goals and conditions of the specific project. Often, this is a demanding process for the client and can be a time-consuming project. Thus, the main advantage is that it is a known procedure many of the contractors are familiar with, and collaboration thus becomes predictable (Lædre, 2009). Feature descriptions describe the product's prescribed function (Lædre, 2009). Subsequently, there are thus no restrictions on choice of design, alternative solutions and material selection along as the product meets the given requirements. Therefore, this can open up a scope for the contractor as their resources and expertise can be utilised. Additionally, this can also allow and give space for facilitating a holist approach and encouraging innovation. (Asp, 2015).

The figure was created in order to illustrate the procurement elements in terms of award criterium which has been explained above. This follows into different project delivery methods which are suited to those criteria. The project delivery methods will be covered in more detail in the following section.

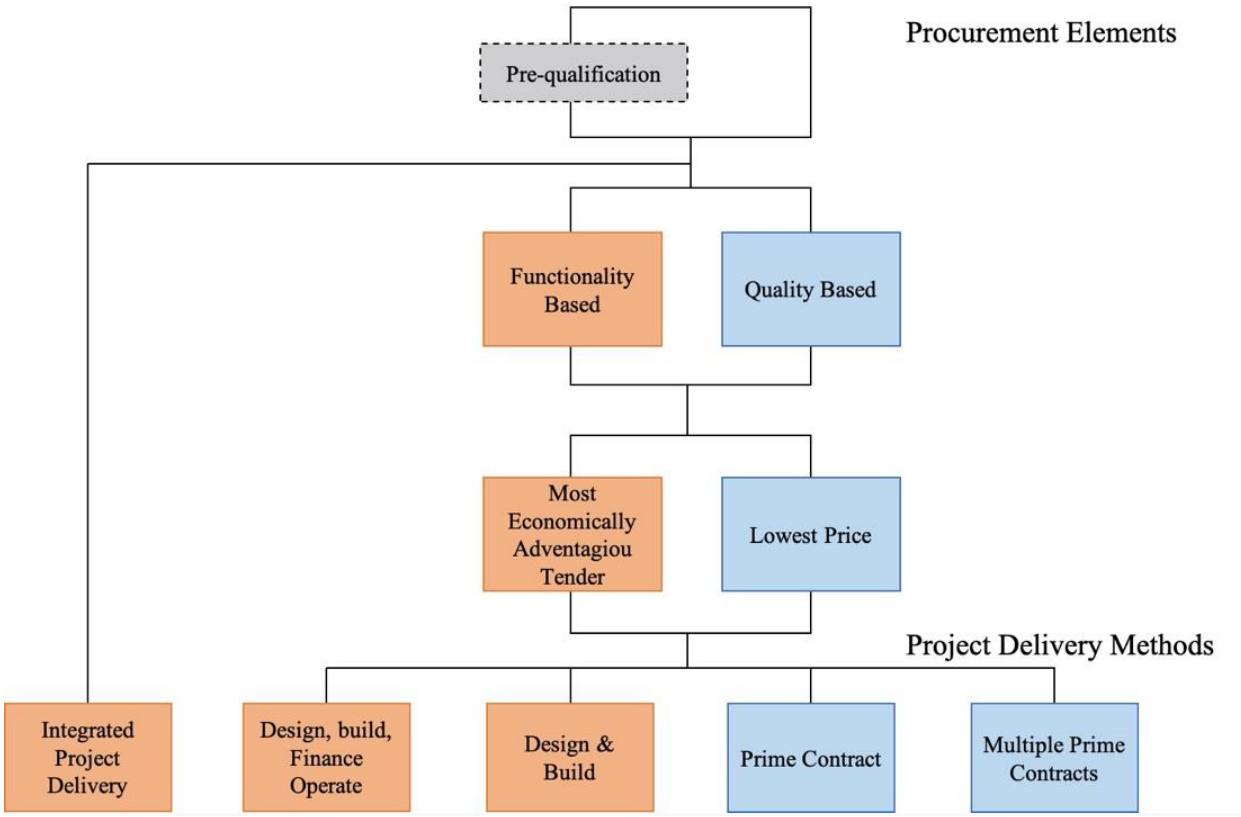


Figure 5:Project delivery methods based upon pre-qualification and award criteria

4.5 Project Delivery Methods

According to Lædre (2009), project delivery methods can be divided into two primary categories; design-bid-build (DBB) and design-build (DB) contracts where the differentiation is predominantly based upon the varying responsibility placed upon the client and contractor respectively (Lædre, 2006).

In relation to the following thesis in regards to the comparison of a traditional project delivery model with a more collaborative project delivery model, the two focal project delivery projects to be described, examined and compared will be design-bid-build and design-build contracts. However, the following section explores additional project delivery methods asides from the above to help to build an understanding of the scope and represent the entire story. Consequently, the design-bid-build and design-build sections will be in discussed in greater detail in order to provide a solid framework for the discussion in chapter 5.

In Design and Build contracts the contractor is responsible for both the design and the construction (Lædre, 2006). Whereas, if the responsibility for the design lies with the client, the contract form is DBB. In the same way, there are two principal contractual differences between DBB and DB for instance DBB utilises two separate contracts for design and construction whereas, DB utilises a single contract where both design and construction are combined. Moreover, DBB contracts are often also divided into several smaller contracts and yet again DB contracts vary on this as they can be divided into several or can often be utilised as a single contract.

In the following section, one will look into the various types of project delivery methods and form the basis for which delivery methods utilise collaboration from the offset. Ultimately, this section will provide the reader will knowledge on the strengths, weaknesses, advantages and disadvantages associated to each type of project delivery model. Furthermore, in doing so will set up the basis of discussion in chapter 5 for whether or not the level of collaboration on a project is pre-determined by the chosen method of project delivery. As well as shed light on whether certain project delivery methods are in fact better suited or geared towards collaboration or that all project delivery methods gain from collaborative approaches (see figure 4).

4.5.1 Design-Bid-Build (DBB)

This project delivery method is the 'traditional' means of delivering a construction project and creates a clear separation between the design and construction process. Most often, the only criteria for the selection of a main contractor in a design-bid-build (DBB) projects is the lowest construction price (Hale, Shrestha, Gibson Jr., & Migliaccio, 2009). In order to begin the DBB process an engineer or architect is hired by a client to create design documents consisting of drawings and technical specifications for a particular project. The Engineer or architect will then develop a project schedule and cost estimate. Once this has been completed, a request for bids or proposal is formulated and then released to main contractors (Hale et al., 2009). Figure 5 below illustrates the DBB process:

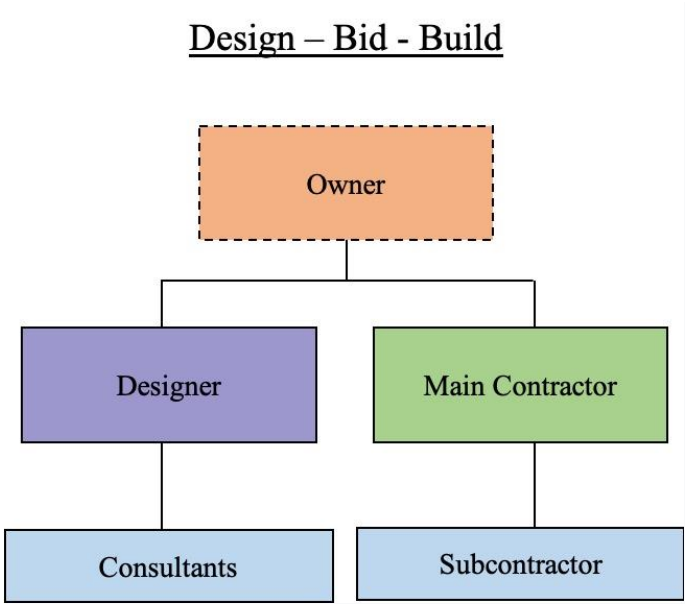


Figure 6:Design-bid-build Flow Chart from (Harwood n.d.)

Main contractors are then able to evaluate the project documents and thus provide a price for the work. Once a bid has been selected, the owner can then formulate and establish a contract with the winning main contractor and work can commence on the project thereafter. Ultimately, the DBB method as stated is the most traditional means of delivering a project and as a consequence has become the most typical and familiar contract to be utilised within the industry. The NPRA are no exception to this and a vast majority of their comfort, expertise and project delivery methods lie within DBB delivery methods.

In Norway, DBB contracts can be divided into three subcategories; general contractors, main contractors and divided contracts. With a general contractor, the client will have contracts with the design professionals and the general contractor. The general contractor is responsible for managing his subcontractors. In the case of a main contractor, the client will have contracts with the design professionals, the main contractor and side contractors. The main contractor has the biggest contract in the project, but the side contractors will be legally equal. In the use of divided contracts, the client will have contracts with the design professionals and with the contractors. The client will be responsible for all tasks that are not covered by the contracts with the contractors (Lædre, 2006).

Accordingly, DBB in theory has the ability to deliver projects in a low-cost manner and is considered that one of main advantages of the traditional method is the element of greater certainty as the design is finalised prior to contractors being appointed and as such there is clarity in regards to what is required and thus estimations of relative costs are much more likely to be accurate (Hale et al., 2009).

This method isolates the contractor from the overall design process and as a direct consequence opens potential doors for conflict between design documents and constructability of the projects and thus in turn increasing the overall project cost.

Further to this, it is widely acknowledged that selected a contractor based upon price alone can often result in a negative impact on the quality of a project (Lædre, 2006). Similarly, combining lowest cost with project profitability and quality control may easily result in overriding frictions giving way too much more sinister conflicts. In addition to the aforementioned the traditional method can often be a slower form of contracting as the contractor is only appointed once the design has been completed and as such an overlap cannot occur. Not only does this waste precious and valuable time but also means that the contractor is unable to improve the buildability of the design or contribute to the chosen solution as the project is being developed. This can lead to an immense number of changes being deemed necessary as the shortest overall programme is not the client's main priority and the project evolves and hence giving rise to additional costs. The main advantages and disadvantages with design-bid-build contracts have been summarised below:

Design-bid-build	
Advantages	Disadvantages
Competitive fairness and transparent process	Overall project duration may be longer than other procurement routes – sequential process
Design led – can ensure quality	No input into design and planning by the contractor
Price certainty before commencement	Strategy based on price competition – could lead to adversarial relations
Well known procedures	Dual point of responsibility design team for design and contractor for construction
Changes are reasonably easy to arrange and value	If the design is not complete at the time of tender, cost and time certainty are reduced

Table 15:Advantages and disadvantages with design-bid-build contracts (Hale et al. 2009)

4.5.2 Design- Build (DB)

Design and build is a term used to illustrate a procurement route in which the client will appoint a single contractor to design or complete the design and then to construct the works to deliver the project from start to finish (Hale et al., 2009). In Norway, the word 'totalentreprisen' is utilised this directly translates to a 'turkey contract' and in relation to the NPRA such words are interchangeable. Thus, from this point onwards design and build will be transposable with turnkey projects (DIBK, 2012).

Therefore, this method is opposed to the traditional method of DBB mentioned in the previous Section 4.3.3. Where clients appoint consultants to undertake the design and then a contractor is further appointed to construct the works. Thus, in DB only one team or company is deemed responsible for the design and construction of the project the pricing changes can be kept to a minimum. Further to this and in some cases where design and build contracts are utilised the design team can be novated to the contractor. Further to this, under some design and build

contracts the design team is novated (transferred from being employed by the client to the contractor) to the contractor. Not only can this impact the quality level but also maintain continuity between pretender and post tender design process whilst still leaving sole responsibility for designing and building the project with the contractor. However, it can also leave them without adequate advisors that are independent to help them to manage the design and then later the construction (Hale et al., 2009). Figure 6, illustrates the interconnectedness of a DB method:

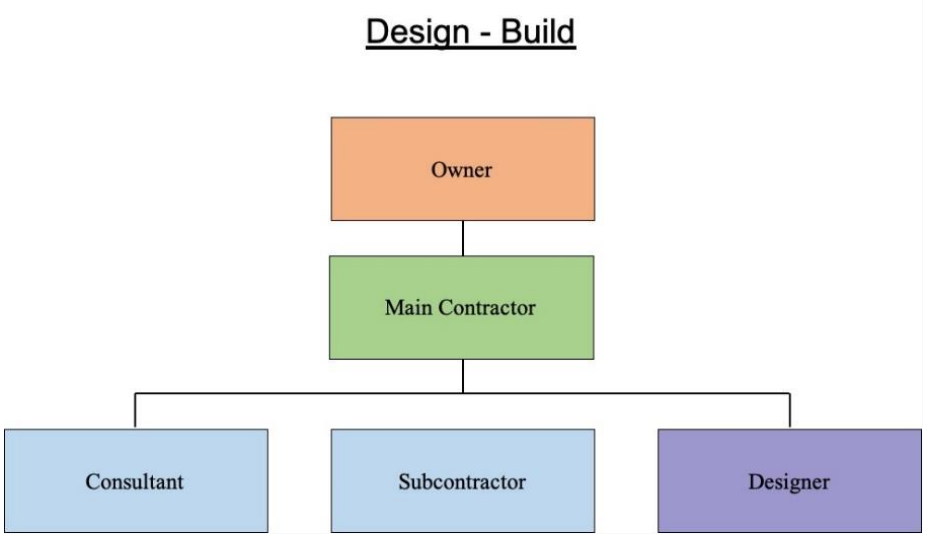


Figure 7:Design-bid-build Flow Chart adapted from (Harwood n.d.)

Ultimately, pricing changes are often isolated to those situations in where unknown obstacles are encountered or where the client requests necessary cost increases. Additionally, it is paramount that if DB entities comprise of a number of companies that the client identifies the working relationship between all parties in a bid to minimise potential conflicts from arising.

Utilising the design-build method is especially advantageous when schedule is a concern and time is of the essence as DB allows for the overlap of design and construction and thus reducing overall project delivery time. The DB method is one that allows for projects to be fragmented into smaller parts and delivered in a package approach. Additionally, the design-build method also removes aspects of the schedule that would classically be used up by the bidding and procurement processes. Correspondingly, in regards to costs, a design build contract provides a higher level of cost control for the contractor. This is due to the fact that the contractor is required to take on the responsibility for the design and construction of the project for a firm maximum price. This firm maximum price is established very early in the project development and as such the contractor carries immense financial risk (Hale et al., 2009).

As a result of there being single point of responsibility for the client to deal with once the contract has been awarded, numerous complexities can be simplified. For instance, the client is able to engage with the contractor and subsequent design teams early in the design process and thus achieve a more innovative, buildable or practical solution.

However, there are of course draw backs and disadvantages associated to the design and build procurement route. Firstly, the emphasis on quality may somewhat dwindle as the contractor may potentially exploit a specification that may be open to interpretation and hence choose the most favourable or cheapest option which in turn may compromise the level of quality on the project. Additionally, there is an additional risk that the client may have to pay considerably more based upon the fact that the contractor is required to take on an immense level of risk due to a lack of design clarification whilst in the tendering process. In terms of design flexibility, it is also important to consider that any request for changes will have cost and time implications.

The main advantages and disadvantages with design-build contracts have been summarised below:

Design-Build (DB)	
Advantages	Disadvantages
Single point of responsibility for design and construction	Client may find it hard to prepare a sufficiently comprehensive brief
Earlier commencement on site	Client has to commit to a concept design early
Early price certainty	Variations from the original brief can be difficult to arrange and expensive and the ease of fabrication may be prioritised above aesthetic quality
Benefit of contractor's experience harnessed during design	Harder to compare tenders and determine if they offer value for money

Table 16:Advantages and disadvantages with design-build contracts (Hale et al. 2009)

Construction Management (CM) is still a relatively new method, however, shows to be incredibly successful in projects that have a large undefined scope and are under pressure to finish within a limited time (Archtoolbox, 2020). Furthermore, CM procedures are often more applicable and complimentary to projects involving complex integration between disciplines or multiple phases of construction and thus where the oversight provided by a construction manager is incredibly beneficial.

Construction management can fall under two project delivery methods; CM multi-prime (CM MP) and CM at risk (CM@R). In a CMAR project, the owner selects a 'Construction Manager (CM)'. The Construction Manager is responsible for building the project, hence under the contract with the owner for the development and design phases, the CM assumes the risk for construction performance as the equivalent of a general contractor, holding and managing all trade subcontracts during the construction phase (Harty & Leiringer, 2017).

Furthermore, the CM provides input on items such as project budget, construction cost estimating and the overall schedule as well as providing review of design drawings to identify constructability issues and potential cost savings. The pricing of the construction is begun early

in the design process and is refined as the design progresses with a final guaranteed maximum price (GMP) provided to the owner prior to beginning of construction. The CM will in practice act as a main contractor and will be able to hire subcontractors (Harty & Leiringer, 2017).

Correspondingly, Harty and Leiringer (2017) describe another version of CM; agency construction management. Whereby, a CM agent will help the owner to manage and make critical decisions regarding a project. Thus, the CM agent will almost act a professional consultant and as such will not commit to delivering the project on time or on budget and will not enter into subcontracts with trade contractors. Therefore, the key difference between CM@R and agency CM is that the CM agent will only be in a contractual relationship with the client, and not with the design professionals or the contractor (Harty & Leiringer, 2017)..

4.5.3 Design-Build/Finance/Operate (DBFO/DBOM)

Design Design-Build/Finance/Operate (DBFO) or Design build operate maintain (DBOM) is a variation of the classic design and build method of procurement in which the main contractor is appointed to design and construct the works (Abdel Aziz, 2007). This method contrasts with the traditional procurement route where the client first appoints the consultant to design the project and then further appointed a contractor that will construct the project.

According to Abdel Aziz (2007), in DBOM the client selects a contractor responsible for design, construction, maintenance and operation for an agreed period. In DBFO the contractor is also responsible for the financing in some literature, this project delivery method is described as Public-Private-Partnership (PPP). Public-Private-Partnership will be elaborated on in the following section. Correspondingly, the operation and maintenance period can span up to 30 years during which the contractor is said to have the 'concession' and is responsible for the safe and smooth operation of the facility and may benefit from operational income. The facility itself however remains the property of the employer.

The main advantages and disadvantages with Design-Build/Finance/Operate contracts have been summarised below:

Design-Build/Finance/Operate (DBFO/DBOM)	
Advantages	Disadvantages
Knowledge of methods and materials to be used allows the DBOM contractor to develop a tailored maintenance plan that anticipates and addresses potential issues thereby reducing risk and costs.	Long term needs must be specified up front to enable correct specifications to be drawn up. Clients lose much control they usually have with traditional contracts.
The DBOM contractor can establish a long-term maintenance programme up-front, plus estimated costs.	Great care is needed to ensure correct standards are specified for design, construction and maintenance, especially if owners are not accustomed to the process.
It relieves the owner of the time and trouble spent on operational and maintenance issues	Much risk is placed on the contractor, but this is usually reflected in its price.

Retain control of design	Owner responsible for changes
Contractor involved early	Prices can turn out to be excessive in the long term (see PFI for more information)
Flexibility to price the project	Architect may not take input from CM during design

Table 17: Advantages and disadvantages with Design-Build/Finance/Operate contracts (Abdel Aziz 2007).

4.5.4 Public-Private-Partnership (PPP/OPS)

Public Private Partnership (PPP) also known as OPS in Norway (Offentlig Privat Samarbeid) is an implantation model which is based upon the collaboration of both public and private operators. The implementation itself is founded on what a public company orders as a service and describes the work to be done through functional requirements, as well as the desired standard and quality.

The private PPP company has the builder role, performs engineering and takes full responsibility for construction, financing, operation and maintenance for a defined period (FOA, 2020). A typical form of PPP contract is that the public client is responsible for the financing of the project, while the private actors are given the task of developing, designing, building, operating and maintaining a building or facility for a specific period, for example 25 years (DIBK, 2012).

Ultimately, the main advantage behind the utilisation of a PPP contract is that it allows for innovation as well as permitting both parties to focus on the total life cycle costs for the project. An insight into the different implementation models provides a better understanding of why turnkey and Public Private Partnerships are the most appropriate models for increased collaboration (Gokhale, 2011).

4.5.5 Integrated Project Delivery Contract

Integrated Project Delivery (IPD) contracts represent the more recent move to a more collaborative approach to delivering construction projects (Gokhale, 2011). It is a delivery method that sets out to optimise efficiency and is formed by a single, multi-party agreement. In turn it is based odd a shared risk and reward model where guaranteed costs and waivers of liability lie between project team members. The approach strongly encourages proactive as early as possible involvement (sometimes even at the conceptual stage) as well as collaboration in experience and knowledge between all parties consisting of owners, designers, contractors, and key stakeholders on a project and not just the client, consultant and contractor (Gokhale, 2011). The approach strongly encourages proactive as early as possible involvement (sometimes even at the conceptual stage) as well as collaboration in experience and knowledge between all parties consisting of owners, designers, contractors, and key stakeholders on a project and not just the client, consultant and contractor (Gokhale, 2011). Ultimately, this type of contract not only encourages more transparency but simply ensures it. Furthermore, the risk and thus reward are therefore shared by all parties who are part of the IPD contract. This not

only results in a larger pooling of resources, processes and expertise which would simply not be deemed achievable not attainable under a traditional contract.

The IPD approach not only alters the traditional method but also utilises new steps again catered more towards encouraging collaboration and cooperation to occur, the table below summaries the stages and provides a description of the happenings in each stage.

IPD Approach	
Stage	Description
Conceptualization	The pinnacle and most important phase for collaboration. All main project participants will meet to discuss and analyse potential issues and get to know one other's expertise.
Design	Evaluations made during the conceptualisation phase will be integrated with the main project goals and consideration to reduce waste and optimise costs.
Implementation	The implementation phase utilises technology where modelling software is engaged, and all information previously gathered is collated from the design phase. The projects performance and outcome will then be predicted.
Construction	If all the previous phases are conducted correctly, the construction process will run smoothly with minimal delays, waste and scheduling problems. This is where the collaboration that occurred at the beginning of the process comes to use as ultimately by working together and encountering problems and uncertainties early on fewer problems can be encounters at a later more costly stage in the project.

Table 18:IPD Approach Stages (Associated Builders Contractors 2018).

4.5.6 Design-build Versus Design-bid-build contracts

Design-build is a project delivery system where the owner contracts with a single entity, contractor, that is responsible for both the design and the construction (Wardani et al., 2006). Correspondingly, if we look at the design build project delivery method plans, and specifications are not included as per the contract. The contract is primarily built upon a description of the product functions as oppose to a complete and specified design for construction (Gransberg & Molenaar, 2004). If we compare to traditional project delivery methods such as design-bid-build one can see that this differs greatly as commonly for a traditional methods require the completion of design before the procuring process can begin (Molenaar, Songer, & Barash, 1999). Whereby, a performance specification describes the quality or result required. This demands the contractor to develop the details for the design. This includes coordination of subcontractors and progress planning (Lædre, 2009).

It is therefore imperative that the client seeks upmost clarity and creates rigid requirements, descriptions and ultimately sound frameworks for the project providing emphasis on what is expected from the project. As previously discussed, in a design and build contracts the

contractor has the responsibility for both the design and construction of the project and thus should seek to develop a comprehensive and holistic plan of the projected activities that constitute the entirety of the project. Furthermore, this contract form enables the contractor to develop the design and technical solutions simultaneously as the execution is ongoing and so no one party is waiting one activity to close before the next can begin which is the case in traditional design-bid-build contracts (Gordon, 1994). Correspondingly, a traditional design-bid-build contract consists of the owner/client developing the details for the design be it in house or by a separate consultant (Wardani et al., 2006).

Whereas, in a design- build setting the contractor is solely responsible for the construction with the condition that all requirements laid out by the client are adhered to. Ultimately, this provides a level of freedom in regard to technical solutions and execution as well as more trivial matters such as the material choice etc. Yet again, this is all on the condition that all requirements addressed in the contract are satisfied. Subsequently, the contractor takes on more responsibility and therefore with the increased level of freedom also comes and increased proportion of risk. The contractor is fundamentally liable if any mistakes are made within the design process which in turn increases the cost during execution. In the traditional design-bid-build delivery system, quality is established by a completed design for the construction upon which the contractors bid (Gransberg & Molenaar, 2004).

On the other hand, a design and build contract not only enables the client to have more control over specifications on the project but also provides more control over the technical solutions that are chosen in order to achieve what the client stipulates. It is therefore important to realise that design and build contracts are most definitely more catered towards specific projects and do not work so well for others as ultimately the level of control also comes with an increased level of risk for the client. The suitability of which project delivery method is most suitable for type of project is explored by Songer (1997). Songer (1997) ultimately explores which projects are best suited for design-build contracts via a series of interviews and surveys with various project owners. Songer (1997) concludes that the highest impact on project success is a well-defined scope and a shared understanding of the scope.

If one relates this to the level of collaboration that occurs on a project and the conclusion of Sogner's (1997) findings, one can deduce that collaboration is the key to success when aiming to achieve a well-defined and shared understanding of a project scope and thus in turn a project can have all the necessary ingredients to make a successful project. On the other hand, it also illustrates that should a project present a vague and lax project scope that one should recognise that design-build contracts may not be the first port of call.

In this chapter, I have covered the theoretical framework for concepts central to the development of this thesis. In the subsequent Chapter 5, I will present my results and discussions that will form the foundation to my findings in Chapter 6.

5 Results

This following chapter presents the results and form the basis of the discussion that will be explored in Chapter 6.

This chapter will present the findings made via the literature study and two case studies consisting of surveys follow up interviews and document studies. Predominantly, this section will focus on the findings made as a direct outcome from answers that have emerged from surveys and interviews during the survey and interviewing process. Furthermore, discoveries made upon reviewing policies from the NPRA and other documentation provide background and context respectively.

This chapter aims to provide a broader understanding of collaborative partnering and how the level of collaboration varies in the public construction sector between design-bid-build (traditional) and design and build (collaborative) project delivery methods.

Therefore, the chapter is structured according to perspectives. The first part explores the NPRA's perspective and explores this via a series of themes. However, for the main contractor and subcontractor perspectives the results are presented in the way in which they were collected with survey results covered first and additional interview results following. The justification for this was firstly due to the sheer volume of data collated due to four perspectives across two cases as well as the fact that different elements of the data collected was used to discover specific areas and as such cannot be generalised under a theme or research question.

The results of the literature study and case studies aim to clarify the implementation and experiences of collaboration.

5.1 The Norwegian Public Roads Administration - Client Perspective

The results are informed by the data gathered through direct conversations with the NPRA, these were via a series of phone calls and zoom meetings that were designed to build rapport and gain background only, but surprisingly resulted in conversations regarding the projects and important issues surrounding them.

In the following results section, I will report on the surveys and follow up interviews, as this was crucial for understanding the perspectives of the three main parties. Analysis of the documents provided by the NPRA via the eRoom were useful in corroborating all of the methods (case studies, surveys and interviews) and were helpful and interesting in regard to understanding behaviours and situations that prevailed during the projects.

5.1.1 Reducing Conflict

The main theme from NPRA personnel elicited from questionnaires and interviews was the desire to reduce the level of conflict between the client and the contractor. The NPRA felt that the best way of achieving this aim was through the utilization of design and build contracts.

When asked about conflicts during the interviews the reactions were very similar, with many stating that the use of design-bid-build (execution) contracts can often result in a struggle

evolving between the client and main contractor. In the respondent's views, these tensions often left an 'embittered sentiment' between parties, that can result in a severed relationship. Further to this, interviewees commented that aside from conflict being unpleasant that the main problem with conflict was the delay on projects that it caused which in turn increased associated costs. This will be discussed more in the next section.

Furthermore, the NPRA elaborated that a direct consequence of such a breakdown between parties, can mean that dialogue is reduced to claims and counterclaims rather than positive interactions

5.1.2 Time and Cost

A main focus of the NPRA's reason to adopt design and build contracts was due to achieving results in a more time adhering and cost-effective manner. NPRA interviewees repeatedly highlighted the numerous benefits associated with design and build contracts. The NPRA conveyed that although they were enjoying the new style of contracts, they were still learning the process to fully utilize the benefits.

NPRA Interviewees reported a significant advantage with achieving early project completion, something that they had rarely experienced previously. Therefore, the increased use of design and build contracts not only benefits the political goals of a quicker and more cost-effective approach but furthermore for many major road development projects allows the NPRA to achieve such goals through the simplification of such contract interphases whilst utilising the main contractor in a better way to suit the NPRA.

5.1.3 Increase collaboration for Optimum solutions

The key personnel from the NPRA, explained that for design and build contracts, that collaboration and communication had been stipulated in the NPRA's protocol and rules for how projects should be conducted. Therefore, prior to the start of construction, four weeks were set aside for interaction between the parties in succession.

The NPRA personnel mentioned that the purpose of the road development contract was to achieve economies of scale and coordination through a longer-term and comprehensive responsibility for many tasks. The NPRA were hopeful in that by giving a contractor more comprehensive tasks and responsibilities that as a consequence new and alternative solutions to the tasks would be found. The link between design, development, improvement and subsequent operation/maintenance should be an incentive for the contractor to find good quality and cost-effective solutions. Level of autonomy for the main contractor had increased significantly, shifting from dependency.

The NPRA, found by using DB project delivery methods brought numerous advantages, including continuity of collaboration between contractors and consultants who together were able to develop solutions together. All the contractors described this direct contact with consultants as advantageous as challenges were dealt with continuously and any redesigns could be taken directly without interference from the builder. Collaborative working led to 'solutions' that provided added value, were smart and efficient, and easy to operate. The

coming together of the builders, contractors, consultants and operators at an early stage, paves the way for a positive working relationship. By involving all parties in the early stages, solutions were optimised as all the actors wanted to develop a solution that meets their needs.

The NPRA explained that further interaction meetings were held between tender phase and execution phase. During the interaction period, the builder and contractor had start-up meetings to jointly commit to the project and gain a common understanding and overview over what to do. This is where critical processes such as the working environment were discussed, quality, HSE, risk assessments, challenges, goal progress, etc. The dialogue meetings ensured that communication was indeed occurring and on a regular basis. Ultimately, the dialogue meetings allowed skills to be collated at an early stage and as such work could be allocated more proactively and thus removing problems before they could be encountered through increasing the information available early doors and thus reducing uncertainty further down the line. Thus, according to the NPRA these were key drivers in building a solid foundation so that a more intelligent project could commence

5.1.4 Shift in Corporate Culture

Interview data provided an understanding of what happened in each case but also provided insight into how the attitudes and behaviours of actors impacted the projects and as such the way in which these parties view both design-bid-build and design-build contracts.

Interviewees reported that the adoption of design and build contracts introduced a new way of working and required a major cultural shift in ways of working. It was also stated on numerous occasions that no internal standards have been established for design and build projects and that this was unchartered territory for the NPRA. This heralded new procedures that required changes to established standards and policies. The interviewees from the Norwegian Public Roads Administration acknowledge that the Norwegian Public Roads Administration's degree of collaboration is limited based upon the fact that the NPRA has traditionally carried out its projects as design-bid-build or execution contracts and as such their manuals, standards and process codes have been built around this practice.

5.2 Surveys and Interview Results

This section will report on the survey results that were conducted to establish baseline data and to assist in developing the interview schedules. Research participants (main contractors and subcontractors) reported reluctance in answering interview questions in a formal interview setting without knowledge of the line of questioning. Hence, the survey was designed to not only inform them in more detail on the line of questioning but also to make each potential interviewee feel more at ease.

This section also includes findings from the interviews where they help to explain or elaborate on the survey findings. The surveys were split into 5 sections, beginning with introduction and background, assessing satisfaction, relationship dynamics, performance indicators and reflections.

The design of the interview schedules relied heavily on the responses from the surveys. Additionally, the survey provided a further benefit, as it allowed actors to re-familiarise themselves with what happened when and by whom prior to the interview so that information could be relayed concise and furthermore, it was important that the survey was conducted on an interactive medium so that all parties involved would be able to submit answers with full confidence. The reasoning for the survey interface chosen (ZOHO) was that the survey tool was highly interactive, answers were generated in a very visually appealing way and was very user friendly.

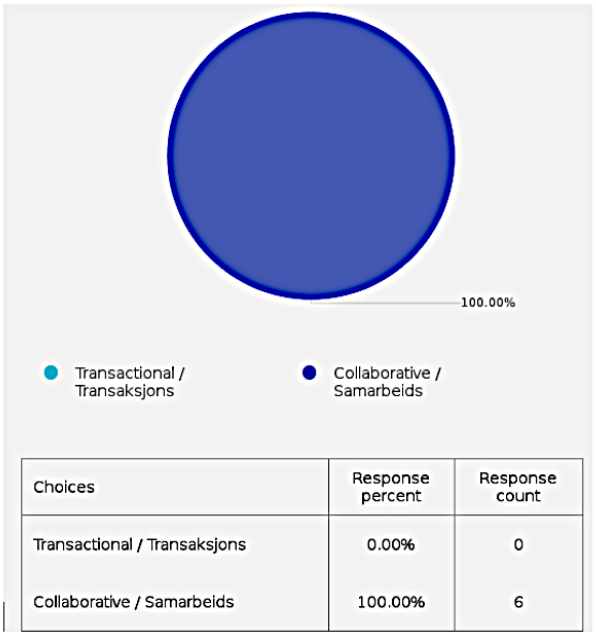
The surveys, interviews, phone conversations and documents that were provided were all conducted mainly in Norwegian. Thus, for uniformity, everything has been translated into English.

5.2.1 Background Information

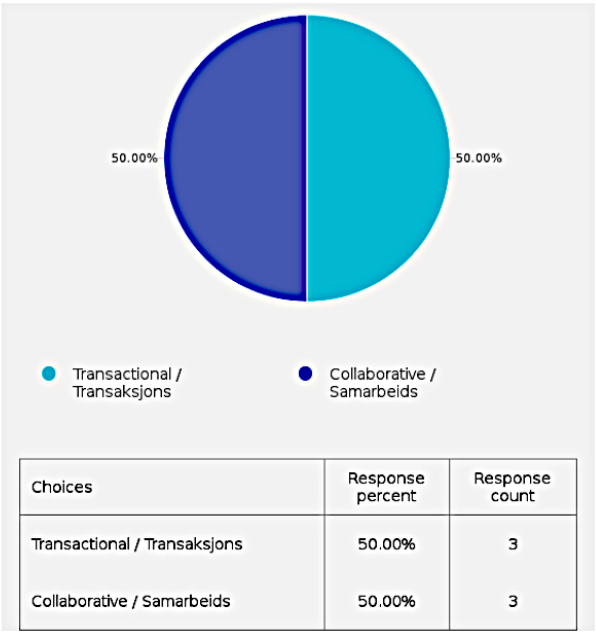
The background for all actors surveyed were key personnel on both projects and held titles under project manager, project engineer etc. The project directors, project managers, project engineers working directly on this project for each respective organisation were the main target group for this study. The reason key personnel were identified beforehand was to create a balance of who would be answering the questions as well as increasing the reliability of results by making sure the right people were fundamentally answering the right questions.

A key question in the first part of the survey, asked each main contractor and subcontractor whether they would classify the project in question in terms of working on a ‘transactional’ or ‘collaborative’ project. In regard to project E6 Helgeland South which utilised a design and build contracting strategy, the results were unanimous with all 6 respondents selecting ‘collaborative’. Correspondingly, in regard to E6 Kapskarmo–Svenningelv which utilised a design-bid-build contracting strategy, the results were very mixed with the client (NPRA) affirmatively considering the project to be ‘transactional’ whilst the main contractors considered the project to be ‘collaborative’ and the subcontractors considered the project to be split over whether the project was a transactional or collaborative project.

The figure bon the next page depicts these results below with E6 Helgeland South (left) and E6 Kapskarmo–Svenningelv (right).



Choices	Response percent	Response count
Transactional / Transaksjons	0.00%	0
Collaborative / Samarbeids	100.00%	6



Choices	Response percent	Response count
Transactional / Transaksjons	50.00%	3
Collaborative / Samarbeids	50.00%	3

Figure 8:Comparison of Survey Answers for 'Transactional' or 'Collaborative' Process for E6 Helgeland South (left) and E6 Kapskarmo–Svenningelv (right)

5.2.2 Assessing Satisfaction

This section explored the general levels of satisfaction between the main contractors and their subcontractor's.

The results (see table 17) from the survey between both projects were generally very satisfied to moderate satisfaction between main contractors and subcontractors. Specifically results assessing satisfaction were slightly higher for E6 Helgeland South (DB) with a vast majority of participants choosing ‘very satisfied’. Correspondingly, for project E6 Kapskarmo (DBB), the satisfaction levels varied between both main contractor and subcontractor with the main contractor being very satisfied and the latter opting for ‘somewhat satisfied’. Furthermore, when prompted during follow up in regards elaboration on satisfaction with communication both parties were more than happy to facilitate that they were somewhat satisfied and felt that although communication could have been improved that they were still content with how it had gone see figure 16 on the next page.

When revisiting this question with both parties (follow up interviews) it was emphatically conveyed that both parties were incredibly happy with the collaboration that occurred. Furthermore, when both parties for both projects were asked to comment on their satisfaction with communication, both subcontracting parties acknowledged that communication was moderately ok but could have been better. Interestingly the client and main contractors rated satisfaction with communication as very satisfied. all parties agreed and conveyed that the level of cooperation in the project was ‘a great deal’.

Table 17 on the following page, reports the results assessing satisfaction amongst all three parties.

*Note: Scale: 1- Very satisfied/ 2- Moderately satisfied/ 3- Neither sat or dissatisfied/ 4- Not satisfied/5- dissatisfied. Responses are for 2 people per party, therefore 50% means 1 person gave one answer whilst the other gave another.

Satisfaction						
	E6 Helgeland South			E6 Kapskarmo-Svenningelv-Lien		
	MC	SC	Client	MC	SC	Client
Level of satisfaction in the relationship between yourselves and the subcontractor?	1	1	1	1	1	3
How satisfied were you on the delivery of the project	1	1	1	1	1	3
How satisfied were you with communication on the project?	2	2	1	1	50% - 1 50% - 2	2
Satisfaction with the safety level/ risk management of subcontractors?	1	1	2	1	1	3
Satisfaction with subcontractors regarding enhanced financial capability?	2	N/A	N/A	1	N/A	N/A
Satisfaction with the main contractor's ability to capture project brief?	N/A	N/A	1	N/A	N/A	3

Table 19:Results Assessing Satisfaction

5.2.3 Dynamics of Main Contractor Subcontractor Relationship: Collaboration

When both parties for E6 Helgeland South were questioned in the survey regarding the adherence to time constraints on the project, the main contractor gave feedback that he had 'a good dialogue with the subcontractor and client, there was a good use of planning, talented managers and crew'. Again, this was supported by the subcontractor who responded that it was very 'good planning and good project management and control. The client was also asked the same question and offered a different perspective to time adherence.

The NPRA's interviewees reported 'we complete and opened the road 1 year before contractual completion, so this is about the level of freedom for the contractor and our capabilities to pay for work conducted and thus provide liquidity in the project' and that a 'good level of project management had been conducted by the client and main contractor'.

Similarly, for E6 Kapskarmo- Svenningelv, according to the survey results from the main contractor the subcontractor had demonstrated 'very good adherence' to time constraints and further when asked to elaborate as to what may have been the reasoning for this it was stated 'that 'they had a very good interaction and good cooperation with everyone involved and that

the subcontractor delivered within deadlines'. The subcontractors also stated that 'the project was completed according to plan and that they believed that it was because of the great focus from the main contractor when it came to deadlines throughout construction time'.

Additionally, comments from other interview participants from the subcontractor involved in this project made comments such as 'very good' regarding the main contractor and the way in which it was managed. The client was also asked the same question and stated that they felt a moderate amount of adherence to time management had been followed by the main contractor.

Correspondingly, the second factor of cost control from the survey was examined and whether or not the respective party implemented any actions to reduce project expenditures. In the survey the main contractors when asked regarding the subcontractors depicted that the subcontractors influenced 'a great deal' on the costs of the project. Whereas, on the other hand the subcontractor and the client felt the main contractor had contributed a moderate amount to reducing costs see table 17. All three parties involved stated in the survey that the respective parties were 'above average' regarding collaborating with other project participants such as contractors, suppliers etc.

Furthermore, during interviewing the subcontractor it came to light that the main contractor perceived the importance of payment and contract issues in maintaining the relationship as a moderate amount. This is interesting because the client in this case the NPRA are very aware of the impact of providing liquidity to the main contractor, however it seems that the subcontractor is not so convinced in regard to whether the main contractor values that the subcontractor also needs regular payments to maintain liquidity.

Correspondingly, the second factor of cost control was examined via interview and whether the respective party implemented any actions to reduce project expenditures. Interestingly the main contractors when asked regarding the subcontractor's performance in relation to reducing project expenditure or exercising cost control stated that a moderate amount was demonstrated. The subcontractors when asked regarding if the main contractor had taken any action to attempt to design cost reduction plans answered that they had also taken a great deal to a moderate stance on the matter.

The table 17, reports results regarding collaboration:

*Note: Scale: 1- A great deal 2- A lot/ 3- A moderate amount 4- A little/ 5- None at all. Responses are for 2 people per party, therefore 50% means 1 person gave one answer whilst the other gave another.

Collaboration						
	E6 Helgeland South			E6 Kapskarmo-Svenningelv-Lien		
	MC	SC	Client	MC	SC	Client
What was the level or degree of cooperation on the project?	2	2	50% - 1 50% - 2	2	1	3
What was the level of cost control demonstrated? For example, did subcontractors take action to save project expenditures or how they design cost-reduction plans?	2	3	3	3	3	3
What was the level of adherence to time constraints on the project?	1	3	50% - 1 50% - 2	2	50% - 2 50% - 3	3
Would you ever consider future work when deciding to establish a relationship with the main contractor/subcontractor?	3	2	N/A	2	2	N/A
How did the subcontractors manage to collaborate with other project participants, including the main contractor, other subcontractors, suppliers, etc.?	2	2	2	2	1	3
How would you rank main contractor/ subcontractor performance at the completion of the project?	2	2	50% - 2 50% - 3	2	1	3
How did main contractors perceive the importance of payment issues and contract issues in maintaining the relationship?	N/A	3	N/A	N/A	3	N/A

Table 20:Results Assessing Collaboration

5.2.4 Assessment Indicators of Main Contractor/Subcontractor Performance.

E6 Helgeland South

For the case E6, Helgeland South, the main contractor and subcontractor unanimously agreed from the surveys that both parties performed above average at the completion of the project and that overall 'they were very content'. Correspondingly, the client when ranking the main contractor performance gave mixed reviews with half of interviewees stating that they were above average with the latter stating average. Additionally, when asked how they would describe what it meant for their firm to perform well the main contractor responded 'a satisfied client and that we reach our goals in terms of safety and financial results'. Similarly, the subcontractor stated 'that means we make money and are satisfied with employees and ultimately build a good company culture whilst safeguarding good HSE practices and that the company becomes attractive to people and clients so that one has the opportunity to continue to get jobs and thus grow'. The answer provided by the subcontractor prompted interview questions regarding whether they consider future work opportunities when deciding to establish a relationship with a main contractor to which the response was 'a great deal'.

Correspondingly, when asked about how this compares to the way in which performance is measured at their firm the main contractor responded 'the project is a road development contract where it is calculated and projected with opportunities in its implementation phase' the subcontractor however commented that they 'measure financial key figures and key figures related to HSE and that projects are measured mostly on the same criteria as the rest of the company, only at a lower level'.

Subsequently, when the above was revisited in an interview, the main contractor stated that 'In hindsight a lot of learning occurred, amongst many other things and re-regulation work was new and educational for us. A lot of time and resources were consumed. In reflection, we would have considered this differently. As a result, we do not reach our goals'. Whereas, the subcontractor was very happy with its alignment stating, 'it aligns very well'. As this was such a thought-provoking element in the reviews, another question was angled in order to shed more light onto the matter and as such recommendations and suggestions were asked for in relation to what should be a top priority for good performance. The main contractor stated that 'they had no indication that the contract would involve so much change and had they known it from the start they would have organised themselves differently'.

E6 Kapskarmo–Svenningelv

For the case E6 Kapskarmo, when all three parties were asked in the survey how they would describe what it meant for their firm to perform well, the main contractor responded, 'that the company should be a preferred supplier, that the client should be particularly pleased with delivery and end product'. Similarly, the subcontractor instigated that 'performing well is very important for reputation and having good references to add ahead of future projects. The answer provided by the subcontractor prompted follow up questions regarding whether they consider future work opportunities when deciding to establish a relationship with a main

contractor to which the response that in fact consider future work opportunities to a great extent when deciding to establish a relationship with a main contractor.

Similarly, the main contractor was asked if the tendering price for the subcontracted project was the most competitive than those of other candidates to which the response was 'agree'. Unfortunately, the level of competitiveness was not discussed further. Correspondingly, when asked about how this compares to the way in which performance is measured at their firm the main contractor responded 'we measure according to whether we deliver on time and fulfil our commitments' with the subcontractor stating 'the performance will be measured against the results and feedback we receive from our clients'. Not only does this illustrate that performance is incredibly dependent on the company and the individual but also that one company values quantitative analysis in a more mechanical way whilst the other bases their performance on both results and qualitative feedback.

Subsequently, the main contractor stated in an interview regarding rating performance of the project that it had gone 'Very well - the project was delivered according to the agreement'. Whereas, the subcontractor was very happy with its alignment stating, 'we have received good feedback from the main contractor on both quality, quality and punctuality on the project'. When asked in relation to the effectiveness of such measures and what they considered that to be both stated that it was 'very effective' with the main contractor stating, 'they are very important measures and are part of the value chain'. The main contractor stated in the survey that 'they had no indication that the contract would involve so much change and had they known it from the start they would have organised themselves differently'.

The last question in regards to performance was angled in order to shed more light onto the matter and as such recommendations and suggestions were asked for in relation to what should be a top priority for good performance. The main contractor stated that 'Good and solid competence at all levels, large HSE/ YM / KS and a good focus and control on risk management'. The main contractor also said that the 'subcontractors were safe and good at planning with great executional skills utilising correct resources.' Consistently, the subcontractor also added the following 'In order to achieve good results, a company should ensure that they have a sufficient organization to be able to take the job. The next is to go through the project carefully, plan it well and allocate responsibilities within the organization. Make precise progress plans and keep these. Proper staffing and right cooperation partners.

5.2.5 Main Contractors and Subcontractor Perspective: Final thoughts and reflections

On E6 Helgeland South, each party was asked in order to summarise what the top priorities for their firm were when making decisions to select main contractors or subcontractors respectively. The main contractor mentioned trust, risk management, price and profitability and lastly capacity and competence whilst adding 'It is important to have a predictable supplier that can deliver at the right price, time and quality'. Correspondingly, the subcontractor chose very similarly - previous collaboration, risk management, price and profitability and lastly capacity and competence.

Moreover, when this question was revisited at a follow up interview a much more in depth answer was provided:

> *'It is important to choose a subcontractor who has a price that is right in that regard the price level that you have used yourself for the job, especially if you do not want to lose money. At the same time, experiences from previous collaborations weigh heavily because of this creates a security and predictability in the delivery. Then you might know that the subcontractor has a good capacity and competence to do the job. Risk management is also important so that risk is positioned out to the players who have the greatest opportunity to manage the risk in a good way. So, then you can then avoid bearing all the risk for the work that has been completed, for example, by a subcontractor'*

Additionally, parties were asked in interview if they had ever worked with project managers that they liked and what factors contributed to their evaluation. Both agreed that they had and said that 'leaders that can be trusted and will help when challenges arise' as well as 'close follow up, good dialogue, good feedback culture and freedom during responsibility so that you have the opportunity to develop yourself'.

On the other hand, the main contractor E6 Kapskarmo, mentioned capacity and competence whilst adding 'that is very important alongside a good dialogue and cooperation with subcontractors. Whilst the subcontractors opted for price and profitability, capacity/competence and previous collaboration and added when further questioned 'prior experience with any subcontractors is important before they are chosen. Of course, price also means a good deal and the company has the capacity and expertise to take on the responsibility'. Furthermore, both parties on E6 Kapskarmo were asked if they had ever worked with project managers that they liked and what factors contributed to their evaluation. Naturally, both agreed that they had and constituted 'Yes. learning and value creation' as well as 'Experience is very important for project managers from the same type of projects and the ability to cooperate effectively'.

5.3 Document Studies

The document studies were conducted in two main parts:

1) General document study

The general document study looked at NPRA standards, norms and examined protocol and procedures that were in place.

2) Case specific document study

The more case specific document study focused on the two case studies and consisted of meeting minutes and specific issues encountered on each project.

5.4 General Document Study: Assessing NPRA Protocol

The NPRA states that a start-up meeting and cooperation process must be conducted without altering the distribution of responsibility and risk in the contract in relation to the basis of competition. Additionally, subcontractors that are in the agreement must also participate in this cooperation meeting and the contractor must also be willing and expect to participate in separate collaborative meetings with other contractors in different areas to coordinate. This illustrates that although collaboration may not be occurring in terms of project optimisation that there is still a great degree of collaboration between parties it is the timing of collaboration on the project timeline that is the main differential.

The document study for this case was initially focused around background information, methods, standards and internal process codes. Ultimately due to the contract being transactional by nature due to its design-bid-build contract form meeting minutes from conception were somewhat limited.

However, after investigating the NPRA's protocol it came to light that the procedure encourages several collaboration and cooperation meetings and thus adequate meeting minutes could be located. Subsequently, the level of collaboration present on this project in the traditional sense of the word was minimal as collaborative approaches to the design were not applicable due to the nature of the contract where the main contractor is not part of the design process. However, in regard to collaboration after the design had been completed was most definitely present and in fact immense collaboration and cooperation occurred, this will be investigated below.

5.4.1 Start-up meeting and Cooperation process

Collaboration must be carried out before the contract work is started. The parties shall set aside sufficient time for this. Furthermore, the agenda for the interaction meeting must be clarified and agreed upon in the start-up meeting. This interaction shall include at the minimum:

1) People, roles, collaboration

- Networking: get to know everyone
- Collaboration as a basis for cooperation in the implementation phase
- Meeting structure
- Roles, responsibilities and authorizations
- Communication
- Clarify the need for further interaction for individual and special operations

2) Review of the contract

- Review of project-specific assumptions and conditions
- Review of key work operations in contract work
- The contractor presents his quality plan

3) Health, environment and safety (SHA and YM)

- Responsibility of the parties
- Control and follow-up
- How to avoid accidents and other adverse events? Know the parties help each other?

4) Dispute management

- Review of contract dispute settlement mechanisms - the provisions of the contract Chapter C2, item 12 Cooperation meetings
- How to handle disputes of an interpersonal nature
- Alert and response routines - handling that does not help disagreement escalates
- The aim is that only matters of principle must reach the judiciary

Subsequently, the NPRA state that in order to document the parties' agreement on good and useful procedures for use in the execution of the contract work, a written summary must also be prepared which is then to be signed by all parties present at the conclusion of this cooperation process. This not only cements the ideologies that have been put forward but also serves the purpose of imparting group-thinking and aids in creating a formal teamwork arrangement. Often when parties are asked to devise a written summary or strategy it becomes a group effort strengthening the sense of 'teamwork' and 'shared goals' and thus helping to build trust amongst parties. This forms the basis of all future construction meetings as this cooperation document must be recorded in the first construction meeting and revisited as a central theme and all construction meetings to come. Correspondingly, one very interesting element is that the document remains live and is updated once the work on the project has commenced and thus the document can be readily provided and accepted by additional subcontractors at a later date in the project. This yet again, aims to align all parties and brings everyone involved up to speed very quickly on the inner goings on of the project despite the timing of when a party joined the project. This is a crucial element, as this is the space that can commonly occur in large construction projects with numerous parties being involved at various points and as a consequence communication suffers and messages are not relayed which in turn can evolve into both costly and timely challenges. This is also extended to all hired and posted workers, where the cooperation document must be accepted as a prerequisite for their involvement in the execution of the contract work.

Furthermore, in this particular project two weeks were allocated for this collaboration to occur which is started from the point of signing the contract. The NPRA also offer flexibility in regards to this collaboration process for instance if all parties agree quickly the cooperation process can also end at an earlier date and hence the contract work can start. Similarly, the parties can also agree that the cooperation process will be extended if all parties do not agree. Evidently, this can both have a positive and negative impact on the project as often parties are not only working solely on a singular project and time is always of the essence. Thus, there may be a pressure within the meetings to finalise things quickly and agree in order to save time and reach an agreement quickly even if the right and most suitable conditions have not been agreed on. Once an agreement has been reached between the parties on the extension of

cooperation, the parties can then clarify whether this provides a basis for agreeing new partial deadlines and completion time.

5.4.2 Collaboration Meetings

Correspondingly, the NPRA stipulates that for contracts with a duration of more than 1 year, a cooperation meeting shall be held every 3 months for the first year. In addition, a cooperation meeting will also be held should any one party request it. The first meeting was held within one month of the cooperation process ending and contract work starting and where the central theme for such collaborative meetings was to review what has been set out in the cooperation document.

Additionally, these meetings serve as a place for where concerns related to collaboration and potential dispute can be acknowledged early on. It is at these meetings that potential sources of disputes and conflicts can be logged, discussed and mitigating measures to be possibly implemented. In a similar manner, if the dynamics between all parties works well without any particular concern attached to the collaborative relationships and potential disputes the frequency of such meetings can be reduced but only after the first year however the frequency is not permitted to fall under 2 meetings per year. Not only does this allow for some flexibility and thus preventing parties from wasting time if items need not be discussed but also provides a limit thus reducing internal pressures between parties to speedily agree and wrap up quickly and therefore encourages an open collaborative process.

During the collaborative meetings, representatives from both the client's, the chosen contractors and local project management must always be present. Moreover, subcontractors engaged at the time of cooperation meetings may attend the meeting or parts of the meeting if it is deemed appropriate. In the case that one party denies subcontractor participation in a collaboration meeting, it must be objectively justified as to the reasoning behind this.

To summarise, the collaborative meetings also include an internal evaluation process in order to make the process better and to find out what works and what does not. All parties involved are required to evaluate each other based upon a report. In regards to collaboration this may again act as a hindrance in the sense that parties are more likely to shy away from any potential opposition which may verge on a disagreement in order to avoid being evaluated incorrectly. It is important to note that in cultures where conflict, disputes or friction is regarded as troublesome rather than constructive. This can often result in a manifestation of problems and thus give rise to an entire multitude of issues. However, the overriding advantage and one that it not only provides an insight but more a reflection of what actually happened in regards to the interaction that occurred between parties. Through the writing of a report, parties must think carefully and reflect honestly. However, it must also be pointed out that rather often these written reports skim the surface where real evaluations are not made in fear of conflict or simply not having enough time to complete formalities.

5.5 Case Specific Document Study

5.5.1 Document Study for E6 Helgeland South

In order to conduct a valid document study and also to begin to unravel the level of collaboration occurring on E6 Helgeland South and E6 Kapskarmo–Svenningelv it was decided that as well as conducting case studies, interview/survey questions that documents collated by the NPRA would also add not only an interesting dimension but would aid in corroborating the true happenings of both projects. Ultimately, access to relevant documentation was provided in the Norwegian Public Roads Administration's internal system, eRoom (covering the time period of 2010-2020).

Documents Reviewed:

- General project documentation (e.g. background, project scope etc.)
- ELM New contract form E6 Helgeland
- Development package for E6 Helgeland
- Meeting minutes
- Internal client meetings
- Dialogue between client and main contractor
- Progress Meetings
- Collaborative Meetings

5.5.2 Description of the project Issues: E6 Helgeland

In regards to collaboration, steps 1-3 were to some extent pre-determined as a firm simply encouraging collaboration does not necessarily translate into collaboration actually occurring. Therefore documents 1-3 were very useful in terms of gaining an insight and for general understanding for why design-build (turnkey projects) were to be utilised. As well as providing details regarding project issues and the initial development package that was formulated and he way in which this progressed over time.

However, the most interesting documents to study to assess collaborative measures were the meeting minutes and description of the issues and challenges met. The following section will therefore solely focus on the meeting minutes and elements discovered upon review of the issues and challenges incurred on this project.

5.5.3 Meeting Minutes: E6 Helgeland South

The minutes from the meetings between the Norwegian Public Roads Administration and the contractor gave insight into the dialogue between the parties and how they worked together towards a common goal, as well as documenting the type and frequency of meetings. Although the meeting minutes were recorded due to the use of competitive dialogue on this project and not collaboration, they still serve the purpose of illustrating the level of collaboration. As ultimately, they aid in determining what was said by whom and provides a factual basis oppose to only covering individuals' perspectives on what was conveyed throughout meetings. The

minutes studies covered; client's internal meetings, meetings between main contractor and developer, progress meetings and collaborative meetings.

The interactions between the client and the main contractor seems to be very straight forward, professional and one that is heavily indicative of mutual respect. The minutes of the meeting showed a continuous dialogue in which the client was able to provide feedback and convey additional requirements and needs to the main contractor. Furthermore, knowledge was shared regarding fields of expertise and areas were identified which were weaker in terms of expertise. This not only assisted in being able to allocate the right jobs to the right people and prevent problems from occurring before they were encountered and thus slowing down the project delivery time but also categorically aligned the main contractor and client by making sure that all parties were indeed on the same page. Consequently, through the examination of the minutes it seems largely apparent that the meetings were used for clarifications between parties and thus assuring that all parties were moving forward in the right direction together. Clarifications varied from which manuals to apply to quality requirements which may not seem detrimental to achieving the project on schedule or elevating costs, but it was the principle of collaboration that ultimately served to prevent greater conflicts that would have otherwise stopped the project in its very tracks.

Furthermore, the progress meeting minutes depict that a great level of priority is placed upon the progress of the main contractor. If any problems are incurred, they are almost dealt with immediately as there is a regular check- in and as such challenges cannot be ignored or put to the bottom of the pile. Ultimately, this sits very well with the client as it offers a degree of control and a method of following up what is actually occurring within a design and build contract within each phase especially within the production phase.

Similarly, quality assurance meetings were also conducted with a high level of priority and open dialogues between all parties occurred regarding the use of relevant manuals to be utilised in order to achieve quality. Yet again, this not only made sure that everyone understood the importance of quality but made sure that if any party had a different idea on the level of quality being sought by the client that there were manuals readily available and that everything planned must adhere and be in accordance to these specific manuals.

Additionally, fundamentals to the project such as the documentation required by the main contractor to prepare for quality assurance were also discussed and as the main contractor is still relatively new to the workings of a design and build contract. This particular aspect seems to cement an element of trust within the relationship where a duty of care and collaboration can be clearly seen as a way to almost provide support where a win-win mentality is strongly advocated.

Lastly, and perhaps the most significant advancement within this project in relation to collaboration was recorded in the collaborative meetings. The design had been developed by a consultant and had been agreed upon however as a direct outcome of this meeting the design was changed despite the foundations having already been laid. Initially, the NPRA was initially unsure as to why changes should be made after the foundation had already been built however,

they were told that upon review of the consultants work that some significant optimisation opportunities could in fact be incorporated if some changes were made. Subsequently, this was one of the major benefits associated with this contract and more specifically design and build contracts. Thus, illustrating that through communication and collaboration that one can truly optimise design and utilise all avenues of expertise available to all parties.

5.5.4 Document Study for E6 Kapskarmo–Svenningelv

Documents Reviewed:

- General project documentation (e.g. background, project scope etc.)
- Konkurransegrunnlag Prosjekt: E6 Brattåsen-Lien Parsell: Kapskarmo – Brattåsen - Svenningelv Kapskarmo – Svenningelv
- Contract Documentation: E6 Kapskarmo–Svenningelv

5.5.5 Minutes of meetings: E6 Kapskarmo–Svenningelv

There was a total of 40 meeting minutes reviewed, these consisted of two collaboration meetings, seven special meetings, four other meetings and 27 construction meetings.

Ultimately, the first meeting under ‘collaboration meeting’ was a two-day meeting called by the client where protocol was discussed regarding collaborating, cooperation and teamwork. Correspondingly, the second collaboration meeting discussed: health safety and environment, environmental considerations, technical quality, client’s deliverables, progression, resource consumption, economy amendments and other cases.

One of the main points recorded in other cases of interest was that by the second collaborative meeting the cooperation/interaction document had not been received and thus it was recorded that the client requested this document. Correspondingly, other construction meetings underlined issues regarding misunderstandings regarding invoicing without the client’s agreement and thus increasing ‘accounting clutter’ and other matters concerning the clarification of the contract type where misunderstandings regarding unit price contracts and what they specifically include and do not include.

6 Discussion

This thesis set out to explore the main contractor subcontractor relationship, outlining current strategies employed and thus identify what is needed to conduct successful collaborative Partnering.

This chapter discusses the results and their significance for the thesis and its issues. In this discussion section, I will discuss the three research questions and to the extent of which they could be answered. The findings are also discussed, and their contributions and limitations are discussed. Moreover, this chapter will provide depth and substance for the subsequent chapter 7, where conclusions will be drawn regarding findings of this thesis.

The specific research questions were:

1. What is the Norwegian Public Roads Administration experience with design and build and design bid build contracts?
2. What is the extent of collaboration within the design- bid-build and design and build project delivery methods?
3. What is the effect of collaboration between the client, main contractor and subcontractors?

6.1 NPRA's experience with design and build and design-bid-build contracts

The first research question was about the NPRA's experience with design- build contracts and design-bid-build contracts. This was found to be straight forward and it was conveyed very early on through interviews that approximately 95% of the projects conducted by the NPRA were in fact procured via the traditional (design-bid-build) project delivery method. Findings indicate that the NPRA were newly starting to integrate more design-build contracts for a multitude of reasons such as fewer conflicts between client and main contractor and lowering time and cost. Additionally, the NPRA stated that this would also allow the NPRA to utilise the contractor in a better way and utilise the contractor's expertise in a better way.

As reported in 5.1.1 reducing conflict between client and contractor was a primary objective of the NPRA as conflict was found to be detrimental to successful delivery and had a significant impact on time schedule and subsequent costs. The fact that NPRA's experience so far with design and build (turnkey) contracts had so far been very positive is a strong indicator that they will promote its use in the future.

Furthermore, it is clear the NPRA recognised that in order to be truly innovative and be able to deliver complex projects they need to adopt a more collaborative approach. The NPRA, stated that by using DB project delivery methods that numerous advantages could be sought including continuity of collaboration between contractors and consultants who together were able to develop solutions together. All the contractors described this direct contact with consultants as advantageous as challenges were dealt with continuously and any redesigns could be taken directly without interference from the builder. Collaborative working led to 'solutions' that provided added value, were smart and efficient, and easy to operate. The coming together of

the builders, contractors, consultants and operators at an early stage, paves the way for a positive working relationship. By involving all parties in the early stages, solutions were optimised as all the actors wanted to develop a solution that meets their needs.

The NPRA were hopeful in that by giving a contractor more comprehensive tasks and responsibilities that as a consequence new and alternative solutions to the tasks would be found. The link between design, development, improvement and subsequent operation/maintenance should be an incentive for the contractor to find good quality and cost-effective solutions. Level of autonomy for the main contractor had increased significantly, shifting from dependency.

Through early contractor involvement, critical processes such as the working environment, quality, HSE, risk assessments, challenges and goal progress could be discussed. The collaboration ensured that communication was occurring on a regular basis and allowed skills to be collated at an early stage. Therefore, project uncertainty could be largely reduced by the gathering of more concise information from the very beginning. Thus, according to the NPRA these were key drivers in building a solid foundation so that a more intelligent project could commence.

6.2 The extent of collaboration within the design- bid-build and design and build project delivery methods

The second research question explored how the main contractors and subcontractors collaborated within design-bid-build and design-build project delivery methods. The findings indicate that on the whole design and build contracts were from the beginning more collaborative and collaboration was strongly encouraged. Whereas for design-bid-build projects this was somewhat more challenging and very much depended on the main contractor and subcontractor on the project.

In this design-bid-build case for example there was some collaboration, but this was not facilitated by the NPRA. For instance, at the first meeting with key personnel at the NPRA, all personnel knew which parties were working on the E6 Helgeland South Project (design build) and the names of the main contractors and subcontractors as well as names of people working on them. However, for the design-bid-build project, in this case E6 Kapskarmo that the NPRA were unsure as to who the subcontractors on the project were. This indicates a severe lack of communication and inhibits equal collaboration between the three main parties tasked with delivering the project, however this is a typical feature of design-bid-build contracts and where a majority of conflicts between the client and main contractor occur.

There is no doubt that there are limitations set out by the design-bid-build in regards to the level of collaboration that can evolve on projects with this project delivery method. The contractor is told what to do and therefore aims to fulfil that, there is no place to have an opportunity to influence or optimise the design process as the design is to be developed by a separate consultant and thus is not involved at that early stage of the project. The contractor must wait for the designer or consultant to complete the design and only then can the contractor begin their work. Ultimately, this means that buildability or the opinions of the contractor are not optimised and as such change orders may need to be placed costing more money and adding

additional time to the project schedule. However, in order to give the contractor some degree of opportunity the NPRA have incentivised any potential improvements that the contractor may come up with be it in cost savings, time or solely on the project itself. These incentives and the basis of such development work will be explained in more detail in the following section.

There is no doubt that design and build contracts are to some degree more collaborative and in essence present from the conceptualisation phase. However, when considering the level of collaboration in design-bid-build contracts it can also be deduced that although this traditional method may be associated with a transactional nature that there is still a high level of collaborative involvement amongst parties. It may not be from the conceptualisation phase but nonetheless it is still present and very much part and parcel of the project process. Consequently, it is evident that in both types of projects that collaboration is not only vital but more so pivotal. However, the main differentiating factor between the two delivery methods is the timing of which this collaboration in fact occurs.

6.3 The effect of collaboration between client, main contractor and subcontractor

The last research question regarding the effect of collaboration between client, main contractor and subcontractor was very interesting and all interviewees were on the whole very positive about collaboration and the need for it suggesting numerous advantages and positives that they themselves had experienced.

Overall, the satisfaction levels in E6 Helgeland South procured by a design-build contract were not only more uniform across the board but also were scored highly with satisfaction and performance. This was an unexpected finding especially for the E6 Helgeland Project. This project had received copious amounts of press attention regarding the 'envelope 2' case, where the envelope containing vital documentation for the Skanska (main contractor) bid was delivered to the wrong NPRA office and resulted in Hæhre winning the bid. This ultimately resulted in controversy and resulted in a court case. However, rather than end in a bitter feud resulted in a joint venture partnership where both parties despite the main contractor – subcontractor dynamic worked together in a more horizontal manner. The main contractor on E6 Helgeland (Skanska) elaborated further and said, 'they had a very good interaction and good cooperation with everyone involved'. Whereas for E6 Kapskarmo the satisfaction levels amongst parties was significantly lower and a lot less uniform with the subcontractors reporting the least satisfaction and performance of the other party. This was unsurprising as levels of communication were low from the outset of the project.

6.4 The limitations of the findings

The first limitation of the findings was due to the outbreak of COVID-19, which made gaining trust and openness in a short amount of time is especially difficult. It was an arduous task to build rapport in a virtual teamwork setting and to really gain a deep understanding through surveys and document reviews as a face to face scenario would have eliminated such limitations.

The size of the study as only two projects are compared utilizing two opposing project delivery methods (design-build and design bid build) little can be definitively put to each type of contract. More in depth interviews and cases should be looked at to obtain a comprehensive picture of the NPRA and their desire to utilize more design and build (turnkey) contracts in their projects. Furthermore, as a small number of research participants from five well known organisations were utilised, they could easily be identifiable and perhaps meant that despite the surveys and interview being anonymised that participants still held back. The sample chosen also carried sample selection bias, as the key personnel were identified through supervisor contact and not through a large search.

As human interactions and behaviours were being studied within specific project delivery methods and based on their nature of being either transactional or collaborative. It therefore provides us with valuable insights but does not tell us how this would prevail in all DBB or DB implemented by the NPRA in future projects.The case comparison provides a valuable snapshot in time of the NPRA's reasoning for the move to DB contracts and eventually aims to reflect upon why such methods may in fact be better geared towards a higher level of success, performance and satisfaction. Through the comparison of these two projects, an attempt has been made on forming a comprehensive and overall picture of the cases from the perspectives through interviewing representatives from all three parties; the client, main contractor and the subcontractor.

Another limitation was the reliance on secondary sources especially during the document study as these documents were collated by the NPRA over a long period of time and therefore may have carried a large bias.

The last limitation lies with the researcher as the researcher is a non-native speaker and is not completely fluent in Norwegian. Therefore, language limitations may have occurred through translations and terms may have been misinterpreted. Especially, terminology and definitions that differ immensely from EU and UK protocol. For example, Norway interchanges design and build with turnkey. In the UK these are two different project delivery methods.

6.5 Strengths of Findings

The outbreak of COVID -19 also had a strength, as a very flexible schedule could be adopted to suit the times of participants. Therefore, conversations and interviews could occur over the phone, zoom and email outside of regular working hours. It was also dynamic in the sense that they were remotely conducted as well as the number of conversations not being limited.

Correspondingly, in regard to the size of the study although only two case studies were selected, a high level of depth could be achieved. The case studies were in-depth and incorporate a wide range of data sources. Additionally, as direct contact has been established by the supervisor. The researcher gained access at a privileged position to internal data sources that are not publicly available which helped to gain deeper insights. Furthermore, difficulties would have been encountered in gaining access to such diverse key participants through direct contact if my supervisor did not make initial introductions.

Through comparing design-build and design-bid-build a baseline could be established for further work as IPD and PPP are still new project delivery methods for the NPRA. Although projects have started as PPP delivery methods, none have yet reached completion. Therefore, comparing DB and DBB helps us to gain an insight quickly to gage if collaboration is working or not and what results more collaborative approaches such as DB can achieve

Lastly, as mentioned in limitations above the researcher is a non- native speaker but was able to utilise both languages to explain, translate documents, and prevent misinterpretations.

7 Conclusion

The Master's thesis has examined the Norwegian Public Roads Administration experiences with design-build contracts and design-bid-build contracts through two case studies; E6 Helgeland South and E6 Kapskarmo –Svenningelv. The thesis has examined whether these two project delivery methods are in fact collaborative or transactional respectively. As well as whether the level of collaboration is limited by the NPRA's chosen project delivery method, or if in fact this lies outside of the realms of the type of project delivery method chosen. Thus, accommodating that collaboration can not only flourish but in today's day and age is something that is present and part and parcel despite the method of conduction.

In relation to the two case studies that were selected and in particular E6 Helgeland South. It is evident that although it has been an outstanding performance from all three parties involved achieving a completion date a year ahead of schedule (without taking in the time that has been lost due to COVID 19). It goes without saying that the mistakes that have been made in relation to the main contractors stating that 'had they have known what they know now' changes could have been avoided and therefore making it an altogether smoother process that a large amount has been learnt and conveyed by all parties.

Often, in construction once the project has been completed little focus is put on the way in which completion was achieved and the 'business as usual' mindset is assumed, and the next project is swiftly begun. However, at the core of this continuous process lies the keys to what aided the project in firstly achieving completion and secondly being successful. It is only through reflecting and pondering upon those challenging areas that true understanding, developing and furthering can occur.

It is important to note that although many may argue that fulfilling all the above criteria may be viewed as a somewhat precarious due to the subjectivisms of the human psyche that this paper has aided in providing a microcosm into the world of collaboration enabling one to draw comparisons and providing a point of reference whereby actors involved within the partnering agreement that have had a history and a potential future of interacting, and that this leads to ways of relating to each other in the focal partnering project. To quantify this subjective approach to Partnering and to begin to understand why, how and with whom such partnering techniques are implemented. It is therefore suggested that going forward that the implementations of tools that may be utilised to improve Main contractor and Subcontractor relationships should be examined and a way in which procedures can be somewhat standardised. For the implementation of new approaches to seem less of a daunting task and one that can be encouraged throughout the industry. Finally, it is imperative to remember that for true collaboration to exist that all parties must equally commit to the entirety of the ideals and rebuffs associated with collaboration.

Supposing we conceptualise collaboration on a scale from 1-5 and place design-bid-build on level 1 whilst placing integrated project delivery method at 5, we can see that design- build may be a step in the right direction in regards to collaboration but it is not the optimal. It can therefore be advised that as so much promising work is currently occurring for the NPRA in

regard to projects utilising integrated project delivery methods such as public-private partnerships (PPP). Where organisations and teams are being utilised from all around Europe that they should in fact continue in this very direction. Not only are they more rewarding and innovative but also would prepare the NPRA for the future as design-build contracts would only tide them over for some time.

However, there is a need for the NPRA to become well acquainted with integrated project delivery methods. Projects procured through IPD contracts and PPP require a greater degree of collaboration and can have numerous benefits such as innovation.

In order to get the full benefits of collaboration the NPRA needs to introduce the concept of collaboration early in the project cycle and continue it to the end. By reducing the distance between the client, main contractor and subcontractor and thus reducing the uncertainty between each party that true collaboration can occur and give way for those benefits that transpire from working together. Only by acquiring more information as early on as possible can one reduce the level of uncertainty associated with projects and thus collaboration should be utilised as a viable tool to gather information. These hurdles can be met head on and thus prevent them into manifesting into large public issues.

The NPRA should continue to utilise DBB contracts and begin to form a clear line between projects where standard repetitive projects deemed simple and straightforward are automatically processed as DB. The move from comfort to something unknown is never as easy road to navigate, however the NPRA have proved that with some confidence and the recognition that change is required in a bid to keep with changing times that having an agile mentality is key. Ultimately, design-build projects have some useful aspects and some negatives and thus my recommendation is to continue on the road that they have begun on. However, the NPRA must keep in mind that they must keep evolving and strive for more collaboration so that they may continue to make advances in engineering as well as to pioneer the public roads sector for Northern Europe.

7.1 Recommendations for further study

This master's thesis has examined how relationships vary between the client, main contractor and subcontractor and whether they use transactional or collaborative processes. The findings presented in this thesis indicate that collaboration is a key element that determines innovative and successful project delivery. While the findings have made a contribution in helping to understand the different aspects of collaboration further research is needed. The recommendations aim to cover what the Norwegian Public Roads Authority should do for future contracts and whether ultimately the move to procure via design and build contracts is the right direction.

Further research should be on comparing more collaborative project delivery methods such as IPD and PPP and comparing these against design-build. Moreover, further research should be conducted from the beginning or start of a project until completion to assess the levels of collaboration through the life cycle of the project.

The NPRA should change their norms and procedures that are based upon traditional project delivery in order to facilitate design-build more readily. The NPRA should also consider up skilling their workforce, so that the staff are confident in not only utilizing design and build contracts but have had previous experience of utilising and working on IPD and PPP projects. They should also utilise training programmes or introduce seminars from other private sector companies that have been utilizing design-build for longer. Additionally, ensure that future employment strategies fulfil the need to acquire staff with knowledge in collaborative project delivery methods.

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APPENDIX 1: NSD FORM

Vil du delta i forskningsprosjektet?

Collaborative Partnering: Understanding how main contractor and subcontractor relationships vary between transactional and collaborative processes

This is a request for you to take part in a research project where the aim is to answer fundamental questions about collaboration. Ultimately, the focus is to not only provide justification for my area of chosen study but to encourage a company to cooperate and share resources such as projects, documents and experiences. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

The following research aims to examine collaborative and transactional relationships between main contractors and their subcontractors within the public procurement sector. Fundamentally, the research will focus on whether collaborative relationships offer greater benefits than transactional relationships and to ascertain with rational factors drive satisfaction and performance for both collaborative and transactional relationship types. The level of overall satisfaction will be broken into two separate entities the first being the satisfaction within the relationship and the latter regarding the satisfaction of the results obtained so in this case the project success. Ultimately, trust will play a vast part in the level of satisfaction and performance irrespective of the type of relationship. However, the extent of this is still rather unclear and one that can perhaps be simplified and rationalized through this study.

The study will offer an insight to the inspiration for the topic chosen for my master's thesis.
The study will offer a comparison between the two types of relationship and lay the foundations for areas that can be improved.
What is required? In order to correctly conduct this study, one will need to use resources, documents and call upon project team members for interviews.

In order to understand how the relationship between the main contractor and subcontractor varies between the two relations, the following entities are required:

1Access to project cases: It is imperative that project cases are studied, analyzed and compared.*

Please Note: projects* - classified into the following types (depending on availability): urban Projects, complex projects, large Projects or projects in the same region.

2 Access to Documents and Interviewees: Access to documents outlining relational transactions, aims and procedures for work processes as well having the contact to conduct interviews.

Empirical Study

	Case 1	**Case 2**
Case Description	Characteristics 1	Characteristics 2
Delivery Model	Transactional	Collaborative
Org. structure	Org 1	Org 2
Delivery Strategy	Str 1	Str 2

The following study will not be re-used for teaching purposes or further research but will be published as a master's thesis at NTNU. However, all persons included will be unidentifiable and data recordings of interviews will be deleted.

Hvem er ansvarlig for forskningsprosjektet?

Norges teknisk-naturvitenskapelige universitet*]* er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

The sample will be drawn by the company who are collaborating, they will ultimately decide based on my criteria of interest who will be interviewed and what projects will be chosen.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

The only people will access to your opinions and experiences will be myself and if shared with my supervisor names will be removed and coded. However, beyond this it will not be shared or processed by any other person. All data will be locked, encrypted with numerous key chain security passcodes. It is important to remember that for the purposes of my study names and personal data are not required it is merely opinions and understanding that one is trying to gage.

Data will not be stored or used by persons from other institutions as no one will have access nor will it be processed outside the EU. Participants will not be able to be recognized through the publication as all views will be collated and no singular view will be pin pointed.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er *11.06.2020.* Once the data has been collated, all names will be anonymized so they will not need to wait until the project has been completed all that is needed to be known is was it the subcontractor or main contractor side that had these viewpoints. All data Will be dalete by 16.07.2020.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene, - å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra *NTNU* har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- NTNU ved student: Aynie Ismail and Supervisor: Ole Jonny Klakegg
- Vårt personvernombud: Thomas Helgesen: *thomas.helgesen@ntnu.no*: 93079038 Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:
- NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Prosjektansvarlig (Ole Jonny Klakegg)

Eventuelt student (Aynie Ismail)

Jeg har mottatt og forstått informasjon om prosjektet *Understanding how main contractor and subcontractor relationships vary between transactional and collaborative processes*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i *intervju*
- ☐ *at Aynie Ismail kan gi opplysninger om meg til prosjektet – hvis aktuelt*

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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-- (Signert av prosjektdeltaker, dato)

APPENDIX 2: CLIENT SURVEY

Client Survey: NPRA

In a few lines below, summarise a brief introduction of yourself and your role within the project. The questions that are illustrated below may be utilized as a preliminary framework to assist you, should you require

How would you describe your project in terms of working on a transactional or collaborative project?

How would you best describe the level of satisfaction in the relationship between yourselves and the main contractor?

How satisfied were you on the delivery of the project, did the main contractors deliver their part of the work assignments within the scheduled requirement for main construction milestones?

How satisfied were you with communication on the project, was it in line with what was expected or (below/above)?

How would you summarize your satisfaction with the emphasis on safety by the main contractors?

In your opinion, how satisfied were you with the main contractor's ability to capture your project brief?

What was the level or degree of cooperation on the project?

What was the level of cost control demonstrated? For example, did the main contractors take action/ attempt to save project expenditures or assist to design cost-reduction plans?

What was the level of adherence to time constraints on the project?

In your opinion, how well do you think the main contractors managed to collaborate with other project participants? for example, the subcontractors and suppliers, etc?

How would you rank the main contractor's performance at the completion of the project?

At the point of hiring, did you feel the main contractors had a relatively high level of construction technical ability? E.g. technical support, technical coordination, and technical management compared with any other competitors.

Regarding innovation, did you find that the main contractor had opportunities to innovate in construction and management style, including construction technology improvement, organization innovation, etc.

Did the main contractors' company culture seem consistent and complementary to your company culture?

Did you find that the level of collaboration had an effect on the number and severity of any disputes?

Were the main contractors' tendering prices for the project were more competitive than those of other candidates?

At the point of biding, did you know or have an idea of who the project manager was on the project prior to submitting the bid on the project?

In order to summaries the above questions, what are the top priorities for your firm when selecting a main contractor?

If you selected 'a summation of the above' please can you elaborate on what this means for you and your company?

How would you describe what it means for your firm to perform well?

How does that align with performance in this project?

In your opinion, to summate what should be a firm's top priority for good performance? For example, suggestions and recommendations for changes.

APPENDIX 2: MAIN CONTRACTOR SURVEY

Main Contractor Survey

In a few lines below, summarise a brief introduction of yourself and your role within the project. The questions that are illustrated below may be utilized as a preliminary framework to assist you, should you require

How would you describe your project in terms of working on a transactional or collaborative project?

How would you best describe the level of satisfaction in the relationship between yourselves and the subcontractor?

How satisfied were you on the delivery of project, did subcontractors can achieve or deliver their work assignments within the scheduled requirement for main construction milestones?

How satisfied were you with communication on the project, was it in line with what was expected or (below/above)?

How would you summarize your satisfaction with the safety level and risk management demonstrated by the subcontractors?

In your opinion, how satisfied do you think the subcontractors were regarding enhanced financial capability e.g. financial stability, a positive cash flow profile, working capital?

What was the level or degree of cooperation on the project?

What was the level of cost control demonstrated? For example, did subcontractors take action to save project expenditures or how they design cost-reduction plans?

What was the level of adherence to time constraints on the project?

How did the subcontractors manage to collaborate with other project participants, including the main contractor, other subcontractors, suppliers, etc.?

How would you rank subcontractor performance at the completion of the project?

At the point of hiring, did you feel the subcontractors have a relatively high level of construction technical ability? E.g. technical support, technical coordination, and technical management compared with any other competitors.

Were the subcontractors' tendering prices for the subcontracted project more competitive than those of other candidates.

Regarding innovation, did the subcontractors have an opportunity or take measures to innovate in construction and management style, including construction technology improvement, organization innovation, etc.

Did the subcontractors' company culture seem consistent and complementary to those of the main contractors?

In order to summaries the above questions, what are the top priorities for your firm when selecting a subcontractor?

If you selected 'a summation of the above' please can you elaborate on what this means for you and your company?

How would you describe what it means for your firm to perform well?

How does this compare with how performance is measured at your firm?

How does that align with performance in this project?

How effective do you consider these measures?

In your opinion, to summate what should be a firm's top priority for good performance? For example, suggestions and recommendations for changes.

Have you ever worked with project managers that you liked? If so, what factors contributed to your evaluation?

Have you ever sought out a subcontractor in order to establish a working relationship because the general contractor had significant work opportunities?

APPENDIX 3: SUBCONTRACTOR SURVEY

Subcontractor Survey

In a few lines below, summarise a brief introduction of yourself and your role within the project. The questions that are illustrated below may be utilized as a preliminary framework to assist you, should you require

How would you describe your project in terms of working on a transactional or collaborative project?

How would you best describe the level of satisfaction in the relationship between yourselves and the main contractor?

How satisfied were you on the delivery of the project, did the main contractors deliver their part of the work assignments within the scheduled requirement for main construction milestones?

How satisfied were you with communication on the project, was it in line with what was expected or (below/above)?

How would you summarize your satisfaction with the emphasis on safety by the main contractors?

What was the level or degree of cooperation on the project?

What was the degree of emphasis placed upon the financial capacity of the main contractor on the likelihood of submitting a bid?

What was the level of cost control demonstrated? For example, did the main contractors take action/ attempt to save project expenditures or assist to design cost-reduction plans?

Would you ever consider future work when deciding to establish a relationship with a general contractor?

How did main contractors perceive the importance of payment issues and contract issues in maintaining the relationship?

What was the level of adherence to time constraints on the project?

How did the main contractors manage to collaborate with other project participants? for example, the subcontractors and suppliers, etc?

How would you rank the main contractor's performance at the completion of the project?

At the point of biding, did you know or have an idea of who the project manager was on the project prior to submitting the bid on the project?

If you did know, would it affect your bidding decisions?

Have you ever bid a project or signed a subcontract solely because of your relationship with a particular project manager?

Did you feel pressure to provide more competitive bids? in terms of providing lower tendering prices than those of other subcontractors

Did you appreciate the emphasis on safety by main contractors throughout the project?

Regarding innovation, did you find that the main contractor took measures to allow subcontractors space to innovate in construction and management style? for example, including construction technology improvement, organization innovation, etc.

Did the main contractor's company culture seem consistent and complementary to those of the subcontractors?

In order to summaries the above questions, what are the top priorities for your firm when selecting a main contractor?

If you selected 'a summation of the above' please can you elaborate on what this means for you and your company?

How would you describe what it means for your firm to perform well?

How does this compare with how performance is measured at your firm?

How does that align with performance in this project?

How effective do you consider these measures?

In your opinion, to summate what should be a firm's top priority for good performance? For example, suggestions and recommendations for changes.

Have you worked with project managers that you liked? If so, what factors contributed to your evaluation?

Have you ever sought out a main contractor in order to establish a working relationship because the general contractor had significant work opportunities?

Have you ever sought out the main contractor in order to establish a working relationship because the general contractor had significant work opportunities?