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Paulos Abebe Wondimu

Early Contractor Involvement (ECI) Approaches for Public Project Owners

Doctoral thesis

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ISBN 978-82-326-3676-1 (printed ver.)
ISBN 978-82-326-3677-8 (electronic ver.)
ISSN 1503-8181

NTNU
Norwegian University of
Science and Technology

NTNU

Norwegian University of Science and Technology
Thesis for the Degree of
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IMT-report 2019:36

Doctoral theses at NTNU, 2019:36

Printed by NTNU Grafisk senter

Contents

Acronyms and Definitions

Acronyms

BVP	Best Value Procurement
CD	Competitive Dialogue
DB	Design-Build
DBB	Design-Bid-Build
ECI	Early Contractor Involvement
MEAT	Most Economically Advantageous Tender
NPRA	Norwegian Public Roads Administration

Definitions

ECI	contractor involvement in the early phase of project
ECI approach	way to involve the contractor in the early phase of a project
Early phase	phase of a project before construction commences

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Summary

Traditional project delivery methods, including, for example, design-bid-build with unit price contracting, open bidding, and owner quality control, facilitate transparent checks and balances. One shortcoming of traditional methods is that contractors who carry out the projects are not involved in developing them. The growth of increasingly more complex projects demands alternative and evolving project delivery methods to ensure appropriate project delivery, contract compliance, and quality assurance. One of these evolving approaches is early contractor involvement (ECI). ECI is defined in this thesis as involving the contractor during the early phase of projects.

According to the literature, ECI has several advantages. However, public owners must confront several barriers when they attempt to involve the contractor during the early phase of in their projects. These barriers primarily arise from the fact that the practices involved differ from traditional business practices. Of particular importance are formal barriers to the implementation of ECI, such as international and national legislation. Predominantly, public owners must face major challenges if they want to involve the contractor during the early phase of a project because the contractor selection methods involved typically defy established standards. Furthermore, public owners are obliged to use competitive and transparent contractor selection procedures based on both price and quality. They are also obliged to treat all tenderers with equality. Fulfilling such obligations is challenging, even with traditional project delivery methods. Thus, it becomes additionally challenging when this set of procurement requirements occurs concurrently with ECI.

The purpose of this thesis is to understand more about how to involve the contractor in the early phase of public projects in order to develop suggestions for the success of future projects. The research questions addressed in this thesis include the following: 1)

What do public owners do to involve the contractor in the early phase of projects? 2) What are the experiences with involving the contractor in the early phase of projects? 3) What measures ought to be implemented in future projects using ECI?

In order to address these research questions, three groups of case studies were conducted on three topics. The three topics were early contractor involvement (ECI), competitive dialogue (CD), and best value procurement (BVP). In addition to reviewing the literature and the document study, 64 semi-structured, in-depth interviews with key professionals from 32 cases selected from Norway and The Netherlands were conducted.

This Ph.D. thesis is based on three journal papers and one conference paper: this thesis is the binding, conclusive essay for these papers. Each of the three publications addresses different topics relevant to early contractor involvement (ECI). The research is based on a qualitative, multiple-case studies approach, with knowledge taken from practitioners to achieve an in-depth understanding of ECI. Following the initial literature study, semi-structured interviews with key actors from the selected cases were conducted in addition to a document study of selected cases.

There are several views regarding ECI. The view of this thesis is that ECI consist of involving the contractor in the early phase of a project. No one single formula exists to involve the contractor in the early phase of projects. Instead, several approaches exist to involve the contractor in the early phase of projects. The approaches vary depending on how many contractors are involved, how and why they are involved, in which phase they are involved and what kind of contract arrangement is used.

During the first group of case studies and literature review, 23 unique approaches to ECI were identified (16 from the literature and seven new from case projects). The findings provide a new direction for ECI by introducing new approaches to ECI identified from the case projects.

As one of the approaches to ECI, competitive dialogue (CD) procurement procedure is explored in this thesis in detail. CD is a relatively new procurement procedure that was introduced in 2004 by the European Parliament for particularly complex contracts. Public procurement regulations vary from country to country, even if all countries in Europe were to follow the EU public procurement directives. Procurement practices vary even more between countries. Experiences with the use of new procurement procedures are thus country specific. CD is a novel procurement procedure in Norway, and thus far,

the Norwegian Public Roads Administration (NPRA) has used it in only six projects. Limited research has been conducted on CD in the Norwegian context. For example, research thus far has identified neither the possible improvements nor the main challenges the use of CD poses to projects. This thesis fills in part of this knowledge gap by exploring the experiences of Norwegian practitioners.

Both clients and suppliers value the potential of CD. However, several challenges were identified in this study, such as lack of practical experience with CD, ethical challenges, determining the most economically advantageous tender (MEAT) criteria, evaluation based on the MEAT criteria, and varying market interest. The second group of case studies contributes to increases the understanding of CD by suggesting the kinds of measures that ought to be taken for the success of future projects using the procedure.

The other ECI approach that this thesis explores in detail is best value procurement (BVP). BVP is a method that focuses on gaining the best value for the lowest cost. A fundamental concept of BVP is selecting the vendor with the offer that is most advantageous for the client where price and other factors are considered. This thesis explores the BVP model that was introduced by Kashiwagi in 1991, known as the Performance-Based Procurement System (PBPS). The developers of BVP cite several internally conducted evaluations as providing success stories of BVP. However, few independent assessments have been conducted on the method. This thesis conducts independent assessments to fill in part of this knowledge gap by exploring the experiences of Norwegian and Dutch practitioners with the method.

The case study on BVP illustrates that, the BVP procedure described by the developer of the method is followed with small modification. All projects followed the four phases of the method (pre-qualifications, selection, clarification, and execution), but the elements used in case projects varied. Even when BVP is relatively well defined by the developer, by reviewing key elements of the method in 15 case projects, this study reveals that BVP is not being implemented in one consistent way. The industry has encountered both positive experiences and challenges during the practice of this approach. The conclusion is that providing education about the method to both the vendor and client personnel, using BVP experts on both the client and vendor sides, and using the method frequently can facilitate the successful implementation of the method.

Finally, this Ph.D. thesis makes three major contributions. First,it presents several

alternatives to involve the contractor in the early phase of public projects. Second, it explores Norwegian experiences from CD and BVP. It also explores Dutch experiences from BVP. In addition, it illustrates the kind of project situation in which CD and BVP are more appropriate. Third, the study provides suggestions regarding the type of measures that ought to be taken for the success of future projects that use ECI.

Preface

This thesis is the completion of my three years (12.2015 - 12.2018) of research. The work has been conducted at the Norwegian University of Science and Technology, Faculty of Engineering, Department of Civil and Environmental Engineering, Research Group Building and Construction Engineering, under programme Project Management. My Ph.D. position has been financed by the Norwegian Public Roads Administration (NPRA) through Norway's coastal highway route E39 (Ferjefri E39) projects (program), under the sub-project implementation strategies and contract types.

E39 is an 1100 km long European road that connects major cities on the western coast of Norway. It runs from Kristiansand in the south to Trondheim in central Norway. Today, eight wide and deep fjord crossings lie along the route, connected by ferry. A political wish and plan exist to make the route ferry-free by replacing these fjord crossings with fixed infrastructure (bridges or submerged tunnels). The NPRA is the client of the project. These fixed infrastructures require new technologies, massive investments, and longer spanning structures than have previously been installed in Norway. This thesis seeks to understand more about the contractor involvement in early phase of public projects.

This thesis is primarily based on three major topics and four core papers. The core papers are Paper 1, Paper 2, Paper 3 and Paper 4 as shown in Table 1. In addition to the three core journal papers and one core conference paper, three journal papers and 14 conference papers are the bases for this thesis. The three major topics are early contractor involvement (ECI) in general, competitive dialogue (CD), and best value procurement (BVP). The thesis starts with ECI in general and explores two ECI approaches (CD and BVP) in detail.

Acknowledgments

The financial support from the Norwegian Public Roads Administration (NPRA) through the ferjefri E39 projects (program) is greatly acknowledged. Several people have contributed directly or indirectly to this thesis. I would first like to thank my supervisor, Assoc. Prof. Ola Lædre, for taking me as his Ph.D. student, for his support, and for his feedback throughout the journey. I have learned a lot from you. I am grateful for your continuous motivation. I am also grateful for my co-supervisor, Prof. Herman Glenn Ballard, for discussing ideas and reviewing my papers and for the critical comments.

My gratitude also goes to Ali Hosseini, Eyuell Hailemichael, Fredrik Svalestuen, and Dr. Jardar Lohne for the interesting discussion and comments on our papers. The contributions you made by discussing ideas and reviewing papers improved the quality of the publications. I would also like to thank Dr. Asmamaw Tadege Shiferaw for helping with the proofreading of the thesis. It was a pleasure to work with all of you, and I thank you for your contributions.

I am also grateful for Assoc. Prof. Olav Torp for the interesting discussion and comments on our paper. Thank you for your constructive criticisms on our paper and valuable feedback on the thesis. I would also like to thank Prof. Ole Jonny Klakegg for the insightful and critical feedback on our papers and on the thesis. Your feedback helped me to improve the quality of my work. It was a pleasure to work with both of you.

Last but not least, I am grateful for the wonderful parents and siblings that I have. Your unconditional love and support have been a vital source of motivation. You have motivated me throughout my life to pursue higher education. I am also grateful for my wife, Helen, for being on my side during the ups and downs of this journey. This achievement would not have been possible without your support.

Trondheim, Norway Paulos Abebe Wondimu

Overview of Papers

This thesis is based on the work presented in the following papers. The papers are arranged in Table 1 according to their relevance to the thesis. The first three papers are at the core of the thesis, and they are attached with this thesis in the Appendix section. The other papers support the core papers. The core papers directly address the research questions of this thesis. Figure 1 illustrates how the papers are organized according to the three research topics.

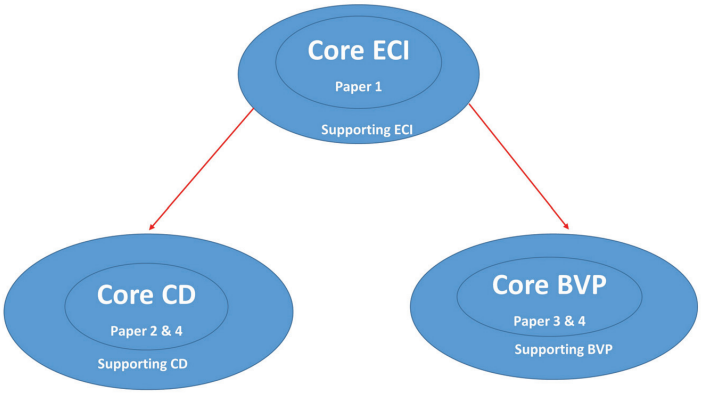

Figure 1: Illstration of core and supporting papers and topics

Table 1: An overview of papers

Paper	Topics	Paper type
1) WONDIMU, P. A., HOSSEINI, A., LOHNE, J. & LÆDRE, O. 2018. Early contractor involvement approaches in public project procurement. *Journal of Public Procurement*. (Published)	Core ECI	Journal paper
2) WONDIMU, P. A., LOHNE, J. & LÆDRE, O. 2017. Competitive dialogue in Norwegian public infrastructure projects. *Journal of Construction Engineering and Management*. (Published)	Core CD	Journal paper
3) WONDIMU, P. A., KLAKEGG, O. J., LOHNE, J. & LÆDRE, O. 2018. Experiences with Best Value Procurement (BVP) in Norway and the Netherlands. *Journal of Construction Engineering and Management*. (Will be resubmitted)	Core BVP	Journal paper
4) WONDIMU, P. A., KLAKEGG, O. J., LÆDRE, O. & BALLARD, G. 2018. A Comparison of Competitive Dialogue and Best Value Procurement. Proc. 26th Annual Conference of the International Group for Lean Construction (IGLC). Chennai, India.	Core CD and BVP	Double-blind, peer reviewed conference paper
5) WONDIMU, P. A., KLAKEGG O. J., & LÆDRE, O. 2018. Early Contractor Involvement (ECI): The way to do it. *Journal of Management in Engineering*. (Resubmitted)	Supporting ECI	Journal paper
6) WONDIMU, P. A., HOSSEINI, A., LOHNE, J., HAILEMICHAEL, E. & LÆDRE, O. Early Contractor Involvement in Public Infrastructure Projects. IGLC, 20-22 July 2016 Boston, MA, USA. In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, sect.3 pp. 13-22.	Supporting ECI	Double-blind, peer reviewed conference paper
7) WONDIMU, P. A., HAILEMICHAEL, E., HOSSEINI, A., LOHNE, J., TORP, O. & LÆDRE, O. Success Factors for Early Contractor Involvement (ECI) in Public Infrastructure Projects. SEB16 Build Green and Renovate Deep, 5-6 October 2016 Tallinn and Helsinki. Energy Procedia, 845-854.	Supporting ECI	Double-blind, peer reviewed conference paper
8) WONDIMU, P. A., SVALESTUEN, F., HAILEMICHAEL, E., HOSSEINI, A., LOHNE, J. & LÆDRE, O. Implementation of Early Contractor Involvement (ECI) in Norwegian Bridge Projects Procurement. CREON, 13-14 June 2017 at Chalmers University of Technology, Göteborg, SWEDEN. Proceedings of the 9th Nordic Conference on Construction Economics and Organization, 525-536.	Supporting ECI	Double-blind peer reviewed conference paper

Continued on next page

Table 1 – *continued from previous page*

Paper	**Topics**	**Paper type**
9) WONDIMU, P. A., LOHNE, J. & LÆDRE, O. Motives for the Use of Competitive Dialogue. IGLC, 10-12 July 2017 Heraklion, Greece. In: LC3 2017 Volume II – Proceedings of the 25th Annual Conference of the International Group for Lean Construction, 53-60.	Supporting CD	Double-blind, peer reviewed conference paper
10) HÖGNASON, G. O., WONDIMU, P. A. & LÆDRE, O. 2018. Best Value Procurement in Norwegian construction projects. *Periodica Polytechnica Architecture.*(Submitted)	Supporting BVP	Journal paper
11) OTTEMO, F. G., WONDIMU, P. A. & LÆDRE, O. Competitive Dialogue – experiences with the award criteria. ProjMAN - International Conference on Project MANagement, 21-23 November 2018 Lisbon, Portugal.	Supporting CD	Double-blind peer, reviewed conference paper
12) STORTEBOOM, A., WONDIMU, P., LOHNE, J. & LÆDRE, O. Best Value Procurement - The Practical Approach In The Netherlands. ProjMAN - International Conference on Project MANagement, 8-10 November 2017 Barcelona, Spain. Procedia Computer Science, 398-406.	Supporting BVP	Double-blind, peer reviewed conference paper
13) HÖGNASON, G. O., WONDIMU, P. A. & LÆDRE, O. Best Value Procurement – The First Experiences from Norway. In: HAJDU, M. J. S. M., ed. Creative Construction Conference 30 June - 3 July 2018 2018 Ljubljana, Slovenia	Supporting BVP	Blind, peer reviewed conference paper
14) NARMO, M., WONDIMU, P. A. & LÆDRE, O. Best Value Procurement (BVP) in a Mega Infrastructure Project. IGLC, 18-19 July 2018 Chennai, India. In: Proc. 26th Annual Conference of the International Group for Lean Construction.	Supporting BVP	Double-blind, peer reviewed conference paper
15) JOUDI, A., BREIVIK, I. B., WONDIMU, P. A. & HOUCK, L. D. Experience with Best Value Procurement in Norwegian Infrastructure Projects. ProjMAN - International Conference on Project MANagement, 21-23 November 2018 Lisbon, Portugal	Supporting BVP	Double-blind, peer reviewed conference paper

Continued on next page

Table 1 – *continued from previous page*

Paper	**Topics**	**Paper type**
16) HOSSEINI, A., WONDIMU, P. A., KLAKEGG, O. J., ANDERSEN, B. & LÆDRE, O. 2017. Project Partnering in the Construction Industry: Theory vs. Practice. *Engineering Project Organization Journal, 8.*(Published)	Supporting ECI	Journal paper
17) HOSSEINI, A., WONDIMU, P. A., BELLINI, A., HAUGSETH, N., ANDERSEN, B. & LÆDRE, O. Project Partnering in Norwegian Construction Industry. SBE16 Build Green and Renovate Deep, 5-7 October 2016 Tallinn and Helsinki. Energy Procedia, 241-252.	Supporting ECI	Double-blind, peer reviewed conference paper
18) AANDAHL, S. H., WONDIMU, P. A., LOHNE, J. & LÆDRE, O. Managing the Room of Maneuver in Design Build Contracts– A Comparative Study of Norwegian Road Projects. Creative Construction Conference, 19-22 July 2017 Primosten, Croatia. Procedia Engineering 187-194.	Supporting ECI	Blind, peer reviewed, conference paper
19) HAUGEN, A., WONDIMU, P. A., LOHNE, J. & LÆDRE, O. Project Delivery Methods in Large Public Road Projects– A Case Study of E6 Jaktøyen-Sentervegen. Creative Construction Conference 9-22 June 2017 Primosten, Croatia. Procedia Engineering, 391-398.	Supporting ECI	Blind, peer reviewed, conference paper
20) RØREN, J.-O. L., WONDIMU, P. A., LOHNE, J. & LÆDRE, O. Interweaving Zoning and Design in Road Projects. Creative Construction Conference, 19-22 June 2017 Primosten, Croatia. Procedia Engineering, 550-557.	Supporting ECI	Blind, peer reviewed, conference paper
21) TARIMO, M., WONDIMU, P., ODECK, J., LOHNE, J. & LÆDRE, O. Sustainable roads in Serengeti National Park:-gravel roads construction and maintenance. ProjMAN - International Conference on Project MANagement, 8-10 November 2017 Barcelona, Spain. Procedia Computer Science, 329-336.	Additional paper	Double-blind, peer reviewed conference paper

Chapter 1

Introduction

The Introduction section presents the background of this study, what the challenge is, the research gap, the purpose of the research and the research questions, the limitations of the study, and the structure and organization of the thesis.

1.1 Background

Public owners have the objective of realizing projects in a timely and cost-effective manner, but they are facing increasingly complex projects (Hoezen et al., 2012). For example, the Norwegian Public Roads Administration (NPRA) is currently planning a set of mega projects (program) for the E39 Coastal Highway Route (Ferjefri E39) along the west coast of Norway. One of the main ambitions of this program is to make the E39 ferry-free. As part of the E39 program, eight long and deep fjords need to be crossed by bridges and/or submerged tunnels. Most of them will be crossed by bridges of unprecedented complexity on a global scale. The E39 program is estimated to cost approximately 40 billion U.S. dollars (National Transport Plan, 2017). The NPRA requires innovative solutions for this program. How to procure contractors for this program and how to use their knowledge and experience to make the projects time- and cost-effective are among the challenges the NPRA is facing that need innovative solutions. In response to this challenge, involving the contractor in the early phase (ECI) has been suggested by the NPRA group of experts. ECI is proposed to facilitate contractor involvement during the project development stage to find an optimal solution. NPRA can use contractor competence to succeed with the projects. The other suggestion is to develop contract forms that facilitate risk sharing

and a win-win situation. Furthermore, the group of experts has proposed a detailed study of Public-Private Partnership (PPP), Engineering Procurement and Construction (EPC), Target sum contract and Competitive dialogue (Statens Vegvesen, 2012). In this Ph.D. thesis, I selected ECI to explore further in detail since it is a relatively broad topic and covers the other topics suggested by the group of experts.

Each project requires a project delivery method that is best suited for it. The characteristics of a particular project (complexity, size, schedule, and amount of innovation required) determine the correct choice. Furthermore, site characteristics and the expertise of the owner might have an influence on the selection of the project delivery method. Four categories of project delivery methods exist, including: 1) traditional delivery methods, 2) fast-tracking-orientated delivery methods, 3) the integrated delivery approach, and 4) life cycle-orientated delivery methods. Early contractor involvement (ECI) is one of the success factors when considering project delivery methods (Kantola and Saari, 2016).

In the literature, it is widely accepted that contractors have better construction knowledge and experience than clients or designers (Song et al., 2009; Walker and Lloyd-Walker, 2012). Traditional project delivery methods, including, design-bid-build with unit price contracting, open bidding, and owner quality control, facilitate transparent checks and balances. One shortcoming of traditional methods is that contractors who carry out the projects are not involved in the early project development phase. However, the growth of increasingly more complex projects demands alternative and evolving project delivery methods to ensure appropriate project delivery, contract compliance, and quality assurance (Molenaar et al., 2007). The need for improvement in value for money, an increase in collaboration between the various parties, long-term positive relationships, and project delivery time have driven the development of new approaches (Scheepbouwer and Humphries, 2011). One of the evolving approaches is ECI (Lahdenperä, 2016; Molenaar et al., 2007).

Traditional procurement methods make use of the main contractor and its sub-contractor only for the construction phase. This procedure does not facilitate obtaining the best contributions of all parties to a successful project because it excludes the main contractor and sub-contractors from the early design and project planning. This exclusion hinders opportunities for innovative solutions (Rahmani et al., 2013). According to Van Valkenburg et al. (2008), in traditional procurement procedures the tender starts after the plan

and design of the project is fully completed. This approach leaves little room for innovation by contractors. The consequence of this approach is that the contractors have very little flexibility to deviate from the solution as laid down by the client. As a result, opportunities for innovative ideas and alternative designs from the contractors are limited. Optimizing is only possible within the technical details (Van Valkenburg et al., 2008). The traditional procurement procedure leaves little room for innovation by contractors (Lahdenper, 2016).

The need for improvement in value for money, an increase in collaboration between the various parties, long-term positive relationships, and project delivery time have driven the development of new approaches (Scheepbouwer and Humphries, 2011). One of the evolving approaches is two-stage ECI (Lahdenper, 2016; Molenaar et al., 2007). The procedure of two-stage ECI is explained under Frame of Reference section.

The main ambition of two-stage ECI is typically understood as the attempt to bring the construction knowledge and experience of the contractors into the pre-construction phases to influence project costs and outcomes. Of particular interest is the improvement in value for money and project delivery time in comparison to traditional project delivery methods (Scheepbouwer and Humphries, 2011). Van Valkenburg et al. (2008) used case studies to document that it is possible to achieve time gains, project control, and innovation through ECI based on competitive dialogue (CD) approach.

The integration of construction knowledge and experience is most beneficial in the early phases of the project (Lahdenperä, 2013). These phases are usually characterized as having the largest potential to influence the design, with minimum impact on cost (Kristensen et al., 2015; Rekonen and Björklund, 2016). Research has identified that the construction industry has had positive experiences from practicing collaborative ECI (Lahdenperä, 2013; Naoum and Egbu, 2016).

Even if collaboration-based ECI has several advantages, it faces many barriers to implementation. These barriers primarily arise from the fact that the practice involved differs from traditional business practices (Song et al., 2009; Lahdenperä, 2013). Of particular importance are the formal barriers to the implementation of ECI from the owner's perspective, such as international and national legislation (Kolman, 2014). Predominantly, public owners face a major challenge if they want to involve the contractor in the early phase of a project because the contractor selection methods involved typically defy

established standards (Lahdenperä, 2013).

European public owners also find it challenging to involve the contractor before the project is described in detail because European Union (EU) public procurement directives oblige owners to use competitive and transparent team selection procedures. Using such procedures before the project is detailed is challenging because determining the selection criteria is difficult. Furthermore, the owners are obliged to use both price and quality as selection criteria during the early team selection. However, in the early phase of a project, using price as one of the selection criteria to create fair competition is challenging because estimating the price in the early phase of a project is difficult due to various uncertainties (Lahdenperä, 2013; European Parliament, 2004; European Parliament, 2014).

Norwegian public owners are obliged to follow international agreements through national public procurement regulations. These agreements include the World Trade Organization (WTO) and European Economic Area (EEA) agreements (Lædre, 2006). The main purpose of these agreements is to achieve equal treatment of all bidders by obliging public owners to clearly specify the procurement procedures they intend to use before starting to procure (Lædre, 2006; Schnitzer, 2010). However, these agreements create additional challenges for public owners considering early contractor involvement because they are required to take into consideration international agreements in addition to national regulations (Lahdenperä, 2013).

Norway's coastal highway route E39 projects have certain characteristics due to their size and complexity. The projects need to attract interest from both local and foreign contractors. The project development process must also enable effective and favorable competition at the tendering stage in order to increase competition and gain access to the experience and knowledge of international contractors. The development of the E39 projects also needs innovative approaches and new solutions. E39 projects are huge, complex and expensive. Innovative approaches and new solutions are needed in on order to decrease the project cost, increase safety and to realize the project. Besides finding innovative solutions to project implementation, the need to decrease the project cost is also a factor.

Currently, we have the following fjord crossings along the existing E39 from Stavanger to Trondheim that are connected by ferry:

- Boknafjorden (Rogfast under water tunnel is under construction)
- Bjørnafjorden (floating bridge is under planning)
- Sognefjorden
- Nordfjorden
- Vartdalsfjorden
- Sulafjorden
- Romsdalsfjorden
- Halsafjorden

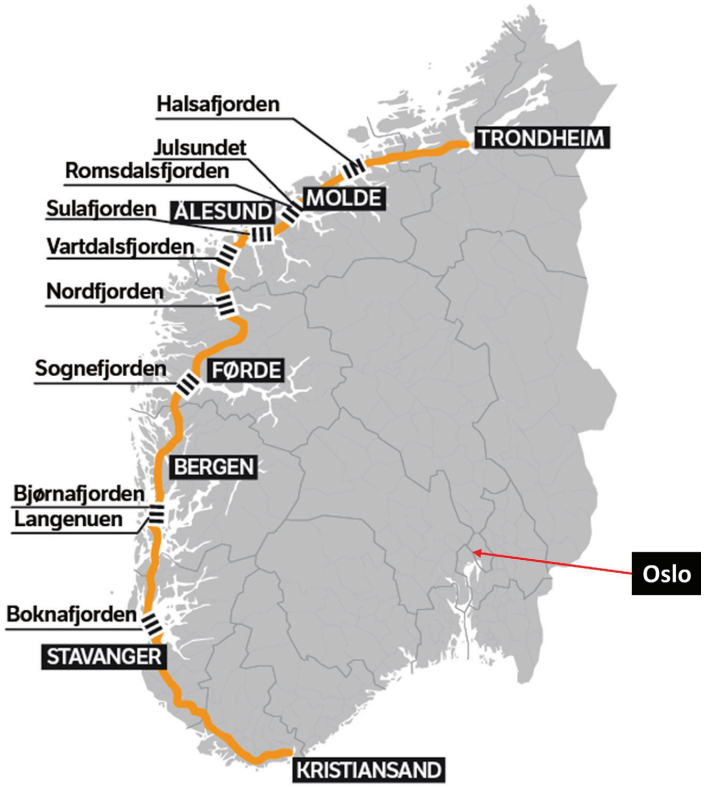

Figure 1.1: Ferjefri E39 map (source Statens Vegvesen Ferjefri E39 Flickr)

1.2 What is the challenge?

The complexity of construction projects is growing (Baccarini, 1996). This is due to an increase in the interdependence of elements and uncertainty in goals and means. Furthermore, projects are becoming shorter in duration; this combination of factors enforces parallelism and concurrency, which increases projects' complexity (Williams, 1999). According to Remington and Pollack (2016), four types of complexity exist, including:

1. structural complexity – seeing how projects fit together and how interdependencies create risk and uncertainty;
2. technical complexity – maturity of technology and how problems are solved through the design of processes or products;
3. directional complexity – alignment of people's objectives and motivation; and
4. temporal complexity – bringing on project parts or components at the correct time and the handling of changes, especially in design, as well as the cultural understanding of time.

The current project management practice is characterized by late delivery, overrun budget, reduced functionality, and questionable quality. As the complexity and scale of projects increase, the ability to bring these projects to successful completion decreases dramatically. Therefore, developing a new project management practice to tackle complex projects is essential (Williams, 1999). The type of contract and implementation strategy are important for proper completion of the project within the timeframe, quality, and budget. However, the type of contract and implementation strategy need to be decided at a very early stage of the project while having insufficient information about the project.

One example of such a complex project is the Ferjefri E39 program. The fjord crossings of the E39 offer unprecedented challenges. The best way to cross some of the fjords is not yet understood due to their depth and width. The projects' magnitude requires that requests for proposals be extended to international contractors. The complexity of this program will be very high, with a high degree of uncertainty about what needs to be done, how to do this, and who needs to be involved. Taking into consideration the magnitude and complexity of the program and the number of actors that will be involved at different

phases of the projects, the need exists for a study regarding alternative contract types and implementation strategies that suit the E39 projects. Intensive study at an early stage is mandatory for succeeding with the overall goal of the program and for bringing the desired benefit out of the projects. Thus, making sure that the decisions made in the early phase of the project will be beneficial for the whole of society is possible. This Ph.D. thesis is supported by the E39 program, so I have had a full access to the program information.

For the successful execution of these projects, the following four criteria are discussed in the Statens Vegvesen (2012) report.

1. the Norwegian Public Roads Administration (NPRA) needs to learn from qualified contractors;

2. design must be developed in close collaboration with constructors, and construction competence is needed in the early stages to develop optimal design;

3. management and procurement methods must promote innovation, reliability, efficiency, and flexibility to handle uncertainty, complexity, etc.; and

4. commercial terms must facilitate teamwork and flexibility, i.e., in-process reallocation of work scopes, capacities, and funding, to achieve better collaboration.

This study primarily focuses on early contractor involvement (ECI). In connection with ECI procurement methods, contract forms, organizational strategies, and management methods that can fulfill the four requirements listed above will be explored. Some of these elements have been previously used in Norwegian projects (infrastructure and oil and gas), but some have not been used. Consequently, the research will introduce new practices.

The body of knowledge on early contractor involvement in public projects is limited. There is only a limited amount of published literature on the topic. Therefore, it is necessary to conduct research to understand the topic. This the research introduces new practices.

1.3 Research gaps

In the following section, the rationales for the study of the three topics (early contractor involvement, competitive dialogue, and best value procurement) that are covered in this thesis are presented based on the research gaps.

1.3.1 Rationale for ECI topic of study

According to the literature, involving the contractor in the early phase has several advantages. It eliminates waste and promotes sustainability (Song and Liang, 2011), offers improvement in value for money and project delivery time (Scheepbouwer and Humphries, 2011), and enables better control over the project cost (Lenferink et al., 2012). Public owners, however, face challenges when they attempt to involve the contractor in the early phase since it is different from traditional business practices and because it defies established standards (Lahdenperä, 2013; Song et al., 2009).

Few sources have been identified within the EU context that have documented how public owners have been able to involve the contractors in the early phase of their projects and have faced the existing – mainly legal – barriers. Likewise, few authors have discussed the success factors of ECI with the intention of increasing the understanding of the concept from a public procurement perspective. In order to address these research gaps, a group of case studies was conducted (the first group of case studies is presented in the Research Method section 2.4.2). The purpose of the case studies is to explore which approaches are used to involve the contractor in the early phase of Norwegian bridge projects. In this group of case studies, the research question focused on how ECI ought to be implemented for the success of future projects using ECI.

1.3.2 Rationale for CD topic of study

While studying the ECI topic, CD emerged as an appropriate approach to study in further detail because it was used to involve the contractor in the early phase of a project in large and complex infrastructure projects in Norway. The NPRA's interest in documenting the limited experience with the method, the availability of cases, and access to data contributed to my decision to proceed with exploring this approach in detail.

CD was introduced by the EU public procurement directive to provide an improved method for awarding complex public contracts (Arrowsmith and Treumer, 2012). It is one of the ways for public clients in Europe to engage with suppliers and supplier market through public procurement (Korthals Altes and Tasan-Kok, 2010; Uyarra and Flanagan, 2010; Edler and Georghiou, 2007). It has been used to involve the contracor in the early phase of projects (Lenferink et al., 2012), to improve innovation opportunities (Lahdenperä, 2009), and to encourage innovation in green public procurement (Uttam and Le Lann Roos, 2014).

Public procurement regulations vary from country to country because they are governed by national rules and regulations, even if all European countries were to follow EU public procurement directives. Experiences with the use of new procurement procedures are thus country specific. CD is a novel procurement procedure in Norway, and thus far, the NPRA has used it in only six projects. As a result, limited research has been conducted on CD in the Norwegian context. For example, the research thus far has identified neither the possible improvements nor the main challenges that the use of CD poses to projects. In order to address these research gaps, a group of case studies was conducted (the second group of case studies is presented in the Research Method section 2.4.2). This case study focuses on how the CD procurement procedure should be done for the success of future projects using CD in Norway.

1.3.3 Rationale for BVP topic of study

While studying the ECI topic, best value procurement (BVP) emerged as an appropriate approach to study in further detail because it has had a lot of success in its history of use. Apart from the United States, this method has been used most extensively in the Netherlands. The Norwegian Agency for Public Management and eGovernment (Difi) has recently introduced BVP to Norway. The NPRA's interest in knowing more about the method, the availability of cases – both in a Norwegian and an EU context (from the Netherlands) – and access to data have contributed to my decision to proceed in exploring this approach in detail.

BVP is a procurement method that focuses on attaining the best value for the lowest cost (Snippert et al., 2015). A fundamental concept of BVP is selecting the vendor

with the offer that is most advantageous for the client when price and other factors are considered (Elyamany, 2010). BVP is one approach of early contractor involvement (ECI) (Wondimu et al., 2018a). Several models of BVP exist. This thesis explores the BVP model that was introduced by Kashiwagi in 1991, known as the Performance-Based Procurement System (PBPS). This model was modified to the Performance Information Procurement System (PIPS) to distinguish itself from other best value performance procurement systems (Kashiwagi, 2016). The method has been modified and used in the Netherlands (Storteboom et al., 2017). Recently, Norway has adapted the method from the Netherlands.

The developers of BVP cite several internally conducted evaluations as providing success stories (Kashiwagi, 2016). However, to our knowledge, few independent assessments have been conducted on the method. In order to address this research gap, a group of case studies was conducted (the third group of case studies is presented in the Research Method section 2.4.2). This case study thus focused on how BVP should be practiced for the success of future projects using BVP after evaluating the experiences with the method thus far in Norway and the Netherlands.

1.4 Scope

Clients should answer three core questions before involving contractors in an early phase of their projects. They include the following: 1) When do they want them to become involved? 2) Why do they want them to become involved? 3) How best to achieve this goal?

After clients have answered these questions, several ways for involving the contractor in the early phase of projects exist. The scope of this thesis is to address the third core question.

There are varying views on early contractor involvement. These views are explained in detail in section 3.1.1. In this Ph.D. thesis, I present ECI from a wider perspective: ECI is defined as involving the contractor in the early phase of project.

1.5 Purpose and research questions

The purpose of the research reported in this thesis is to understand more about how to involve the contractor in the early phase of public projects in order to develop suggestions for the success of future projects.

To achieve this purpose within the scope presented above, the following three research questions were developed:

RQ 1) What do public owners do to involve the contractor in the early phase of projects?

This research question explores which ECI approaches public owners are using and how they are using them. This is an exploratory study to establish to what degree and how the contractors are involved in the early phase of public projects.

RQ 2) What are the experiences with involving the contractor in the early phase of projects?

This research question explores both positive and challenging experiences of the implementation of ECI. The purpose is to understand the effects of involving the contractor in the early phase of projects.

RQ 3) What measures ought to be implemented in future projects using ECI?

This research question explores success factors of ECI and develops improvement measures that ought to be taken during the involvement of the contractor in the early phase of projects, at the project level. This research brings forward knowledge that helps project owners secure more value for money by involving the contractor early as the strategic approach.

1.6 Limitations

This study has some limitations. First, the research topic is limited to ECI and explores only two ECI approaches in detail: CD and BVP. Second, the case studies are limited to the project level. They are not extended to the company strategy level because the purpose of this research is to develop suggestions for the E39 program (E39 set of projects). Third, the case studies are limited to Norwegian and Dutch projects. All Norwegian cases are owned by public owners and are infrastructure projects, except in one case. Fourth,

the client perspective – or the NPRA perspective – will be used when answering the research questions because the NPRA has funded this research and the client of the E39 program. Fifth, this Ph.D. thesis is not extended to explore the effect of early contractor involvement in the studied cases. The limitation is a result of a lack of availability of comparative studies which could present early contractor involvement benefits in the project context.

1.7 Structure and organization of the thesis

This thesis is primarily based on three major topics, three groups of case studies, and three journal papers. The three major topics are early contractor involvement (ECI) in general, competitive dialogue (CD), and best value procurement (BVP). The thesis starts with ECI in general and explores two ECI approaches (CD and BVP) in detail, as illustrated in Figure 1.

This thesis is structured in five sections, a bibliography, appendices, and a preface, as shown in Figure 1.3. This first section introduces the background of the study, what the challenge is, research gaps, the aim of the research, research questions, and limitations of the study. Section 2 discusses the research methodology. In this part, the research process and the study design are discussed. Section 3 discusses the frame of reference for the three major topics of this study based on a literature review. In this part, early contractor involvement (ECI), competitive dialogue (CD) procurement procedure, and best value procurement (BVP) are defined and discussed. Section 4 provides the findings and discussion of the research. Finally, major contributions of the thesis and further research are presented in section 5.

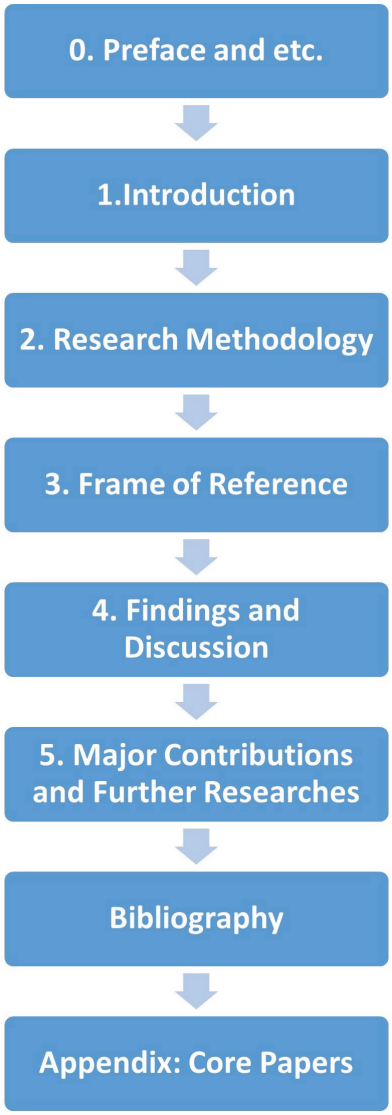

Figure 1.2: Thesis structure

Chapter 2

Research Methodology

This section illustrates how the research was conducted. The research design, process, and methods used to conduct the research will be described. Justification for the selection of the method will also be provided.

2.1 Philosophical worldviews

The approach to research involves the intersection of three components: philosophical worldviews, designs, and research methods. According to Creswell (2013), philosophical worldviews are mostly hidden in research, but they still influence the practice of research and must be identified.

Worldviews (a basic set of beliefs that guide action) are general philosophical orientations about the world and the nature of research that a researcher brings to a study. Others have called them paradigms. A paradigm is a theoretical framework (a lens) through which people view events (Fellows and Liu, 2015). They influence the practice of research. Philosophical worldviews is a vast topic. In the next section, I followed Creswell's (2013) classification of worldviews: postpositivist, constructivist, transformative, and pragmatic.

2.1.1 Postpositivist

Postpositivist assumptions are reflected in the traditional forms of research. Other names for this worldview includes positivist/postpositivist research, empirical science, and postpositivism. Positivist assumptions hold true more for quantitative research than for

qualitative research. Knowledge that develops through the postpositivist worldview is based on observation and measurement. Theory verification, empirical observation, and measurement are some of the major elements of this worldview. Postpositivists have a deterministic philosophy whereby cause governs effects. Thus, their studies reflect a focus on causes that influence outcomes (e.g., through experiments). There is a strong relation to quantitative approaches (Creswell, 2013; Fellows and Liu, 2015).

The key assumptions of this position include the following: 1) Knowledge is conjectural. Thus, absolute truth can never be found. 2) Research is the process of making claims and then refining or abandoning some of them for other claims more strongly warranted. 3) Data, evidence, and rational considerations shape knowledge. 4) Research seeks to develop relevant, true statements that can serve to explain the situation of concern or that describe the causal relationships of interest. 5) Being objective is an essential aspect of competent inquiry; the researcher must examine methods and conclusions for bias (Creswell, 2013). In the postpositivist worldview, the truth is out there. They search for an objective reality that exists 'out there' in the world. They hold a deterministic philosophy; that is, based on careful observations and measurements, they try to make implications to a general truth (Petersen and Gencel, 2013).

2.1.2 Constructivist/interpretivist

In this worldview, the researcher intends to make sense of the meanings others have about the world (many truths exist). This is typically seen as an approach to qualitative research. Rather than starting with a theory, as in postpositivism, inquiries generate or inductively develop a theory or pattern of meaning based on observation and interpretation. The basic assumptions include the following: 1) Humans construct meanings as they engage with the world they are interpreting. 2) Humans engage with their world and make sense of it based on their historical and social perspectives. 3) The basic generation of meaning is always social, arising in and out of interaction with a human community.

Theory generation, multiple participant meanings, and social and historical construction are some of the major elements of this worldview (Creswell, 2013). In the constructivist worldview, many truths exist. Truth is not absolute but relative in interpretivism. The interpretivist seeks subjective reality, constructed by how human beings see and

interpret the world in their respective context (Petersen and Gencel, 2013).

2.1.3 Transformative

This worldview is also called advocacy or participatory (Petersen and Gencel, 2013). The key features of the transformative worldview include the following: 1) It places central importance on the study of lives and experiences of diverse groups that have traditionally been marginalized. 2) Inequities based on gender, race, ethnicity, disability, sexual orientation, and socioeconomic class that result in asymmetrical power relationships are the focus of the researchers. 3) It links political and social action. 4) It addresses why the problems of oppression, domination, and power relationships exist.

The major elements of this worldview are political, power and justice-oriented, collaborative, and change-oriented (Creswell, 2013). In the transformative worldview, those in power decide what is true. The transformative researchers hold that research inquiry needs to be intertwined with politics and political agenda and contains an action agenda through intervention for reform that may change the lives of the participants (Petersen and Gencel, 2013).

2.1.4 Pragmatic

This worldview arises out of actions, situations, and consequences rather than antecedent conditions, as in postpositivism. Researchers emphasize the research problem more than the research methods. Pragmatism is not committed to any one system of philosophy and reality. Instead, individual researchers have a freedom of choice. For them, the truth is what works at the time. Thus, for the mixed methods researcher, pragmatism opens the door to multiple methods, different worldviews, and different assumptions and requires a different form of data collection and analysis (Creswell, 2013). In the pragmatic worldview, truth needs to be understood in context and seen from many angles. The pragmatists focus on the research problem and using all available approaches to understand the problem instead of focusing on the methods (Petersen and Gencel, 2013)

2.1.5 Philosophical worldview in this thesis

The purpose of this Ph.D. thesis is to understand more about early contractor involvement in public projects and to develop suggestions that work for the industry challenge, but not to find the final truth regarding early contractor involvement. The industry challenge is to develop solutions to effectively deal with complex projects, such as in Ferjefri E39 program. Generally, there is limited practice in involving the contractor in early phase of public projects. As a result, it is challenging to establish a definitive truth for the topic.

In this thesis, I chose the pragmatic worldview because it fits the research purpose. The pragmatic worldview allows for a high level of flexibility in answering the research questions and selecting the appropriate methods. I emphasize the research problem more than the methods. I use the appropriate research method that works at the moment to solve the particular research problem. During this Ph.D. research, a qualitative method was used because it was found to be the appropriate method to address the research questions.

Deductive and inductive strategies are used as tendencies rather than as a hard-and-fast distinction. In inductive strategies, findings are feedback into the theory and theory is the outcome of research. Researchers in inductive approaches infer the implications of their findings or observations for the theory. In inductive strategy, linking data and theory is typically associated with a qualitative research approach (Bryman, 2015). I primarily used the inductive approach during this study. That is, I used empirical data – interviews and document study data from case studies – to draw generalizable conclusions.

In order to address the research questions, gaining insights and understanding people's perceptions of the topics were necessary. During the study, the beliefs, understandings, opinions, and views of people were investigated. The research approach, design and process used in this thesis are explained in the next sections.

2.2 Research approaches

Depending on the nature of the study, different research approaches exist that are important to consider when planning research. Research approaches are the plans and procedures for research. They span the steps from development of broad assumptions

to implementation of detailed methods of data collection, analysis, and interpretation. Three research approaches exist: qualitative, quantitative, and mixed methods (Creswell, 2013).

2.2.1 Qualitative research

Qualitative research is an approach that can be used to explore and understand the meaning individuals or groups ascribe to a social or human problem. It concerns words and open-ended questions rather than numbers (Creswell, 2013). It seeks to gain insights and to understand people's perceptions of the world. The beliefs, understandings, opinions, and views of people are investigated. The data gathered may be unstructured but detailed and rich in content and scope. Thus, analysis of such data is challenging and requires a lot of filtering and sorting (Fellows and Liu, 2015). It emphasizes an inductive approach (generation of theories) to the relationship between theory and research (Bryman, 2015). According to Creswell (2013), the following are the main methods associated with qualitative data collection:

1. Observations – Four options exist within these types, including a complete participant, observer as participant, participant as observer, and a complete observer.

2. Interviews – The face-to-face, one-on-one, and in-person interview is the preferred interview option. Telephone, focus group, and e-mail internet interview are the other three options for interviews.

3. Documents – Public documents and private documents are the two options within this type of data collection.

4. Audio-Visual Materials – Photographs, videotapes, art objects, computer messages, sounds, and film are the various options within this type of data collection.

The more the research question seeks to explain some present circumstances (e.g., how or why some social phenomenon works) or requires an extensive and in-depth description, the more the case study method will be relevant (Yin, 2014).

Case studies use a variety of data collection techniques, including, for example, archival data, interviews, questionnaires, and observations (Fellows and Liu, 2015). They are

a design of inquiry found in many fields, especially evaluation, whereby the researcher develops an in-depth analysis of a case. The case can be a program, event, activity, process, or involve one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information over a sustained period of time (Creswell, 2013). This for of research can be single- or multiple-case in nature (Yin, 2014).

2.2.2 Quantitative research

Quantitative research is an approach for testing objective theories by studying the association among variables. It concerns numbers and closed-ended questions (Creswell, 2013). This research refers to studies in which data collection and analysis can be handled numerically. It tends to relate to positivism and seeks to gather factual data; that is, to study relationships between facts and how such facts and relationships accord with theories and literature (Fellows and Liu, 2015). It involves a deductive approach (testing of theories) to the relationship between theory and research (Bryman, 2015).

2.2.3 Mixed methods research

Mixed methods research resides in the middle of the qualitative and quantitative approaches (Creswell, 2013). Both the qualitative and quantitative approaches may adopt common research styles. Triangulated studies may be undertaken by employing two or more research techniques, qualitative and quantitative approaches, or more than one dataset. This may reduce the disadvantages of each individual approach and increase the advantages of each. Thus, triangulation may be used for entire studies using several research methodologies. Among methodologies, triangulation seeks to enhance a study's external validity. Triangulation may occur in four main ways: data, investigator, theoretical, and methodological/methods (for data collection and data analysis).

2.2.4 Triangulation

Despite its name, triangulation is not restricted to the use of three approaches (Fellows and Liu, 2015). It entails using more than one method or source of data to reach the same conclusion or answer. The term refers to an approach that uses multiple observers, theoretical perspectives, sources of data, and methodologies. Triangulation is being used to

refer to a process of cross-checking findings derived from both quantitative and qualitative research (Bryman, 2015).

Triangulation ensures that the study will be both accurate and credible through supporting evidence from different individuals, types of data, or methods of data collection. In doing so, the research result will be corroborating because the information is not drawn from a single source, individual, or process of data collection (Anfara Jr et al., 2002).

Data triangulation includes using a different source of information from the sources for examining evidence and using it to build a coherent justification for conclusions. It adds to the validity of the study if themes are established based on the convergence of several sources of data or perspectives of participants (Creswell, 2013).

2.2.5 Research approach used in this thesis

During this Ph.D. research, a qualitative method was used because it was found to be the appropriate method to address the research questions. In order to address the research questions, gaining insights and understanding people's perceptions of the topics was necessary. During the study, the beliefs, understandings, opinions, and views of people were investigated. I chose to use the case studies method because the purpose of the research is to explore present circumstances. Furthermore, in order to answer the research questions, I needed extensive and in-depth descriptions. The multiple-case study approach was favored in order to better understand the topic by studying similarities and differences among the cases. Additionally, it was favoured to discover the research questions from a wider perspective, to generate strong and reliable evidence, and to create a more convincing theory. Documentation and interviews were sources of evidence used during this study.

According to Blumberg et al. (2011), exploratory studies are useful to develop concepts more clearly, established priorities, develop operation definitions and improve the final research design. Early in the Ph.D. process, the perspective was broad; therefore, exploratory studies were used to better understand the more general topic of ECI to clarify and sharpened the next research topics (CD and BVP). Later on explanatory studies are used to study the two ECI approaches in detail.

2.3 Research design and process

A research design is a blueprint of research. Determining what question to study, what data are relevant, what data to collect, and how to analyze the results are the four problems that a researcher should deal with in the research design. The main purpose of the research design is to help to avoid evidence that does not address the initial research questions (Yin, 2014).

Research designs are types of inquiry within a research approach. Narrative research, phenomenology, grounded theory, ethnographies, and case studies are the alternative research designs under qualitative approaches (Creswell, 2013).

Case studies are a design of inquiry found in many fields. Researchers develop an in-depth analysis of cases and collect detailed information using a variety of data collection procedures over a sustained period of time (Creswell, 2013). Documentation, archival records, interviews, direct observation, participant-observation, and physical artifacts are some of the sources of evidence in a case study (Yin, 2014).

The strengths of interviews as sources of evidence are that they are targeted and insightful. Interviews focus directly on case study topics and provide explanations as well as personal views (e.g., perceptions, attitudes, and meanings). The weaknesses of interviews include that they could be biased due to poorly articulated questions and instances when a reflexivity-interviewee says what the interviewer wants to hear, and they can be inaccurate due to poor recall (Yin, 2014).

The strengths of documentation as a source of evidence include that it is stable, unobtrusive, specific, and broad. This means it can be reviewed repeatedly, is not created as a result of the case study, can contain exact names (references, details of an event), and can cover a long span of time (many events and many settings). The weaknesses are retrievability, bias, and access. This means that finding the source, biased selectivity if the collection is incomplete, or reporting bias of any given document's author is challenging, and access may be deliberately withheld (Yin, 2014). Figure 2.1 illustrates the research process followed during this research.

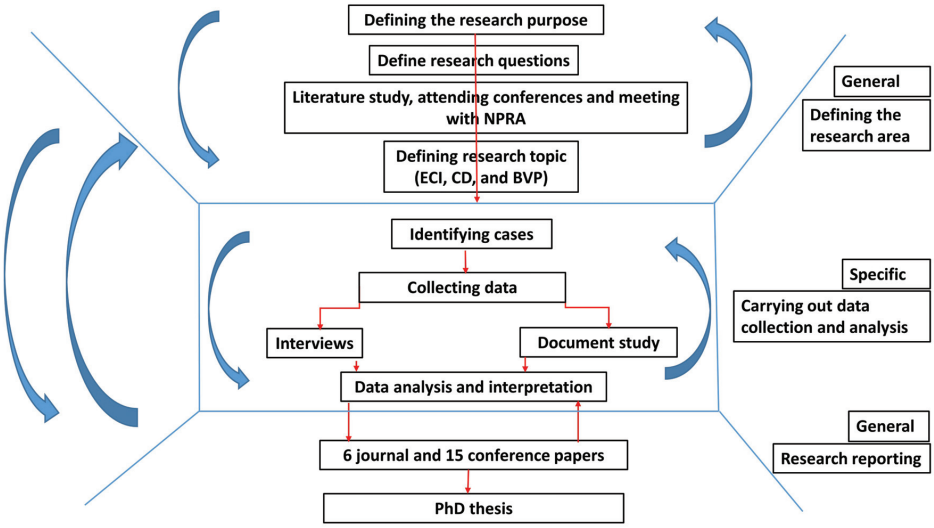

Figure 2.1: Research process adapted from Swales (1990)

First, the research area was defined based on the literature review, through attending conferences, and with consolations with the NPRA group of experts. After defining a research topic, the research method was chosen. A research method involves the forms of data collection, analysis, and interpretation (Creswell, 2013). I proceeded with researching by identifying cases, collecting data, and analysis. The data were collected from Norway and the Netherlands based on the purpose of the research and research questions. I collected data through interviews and document studies. The research results were reported in conference papers and journal papers. In the end, the research results were compiled in this thesis. The whole research process, defining the research area, and data collection and analysis were parts of the iteration process (indicated by arrows), as illustrated in Figure 2.1.

2.4 Research method of the core papers

The research reported in this study was based on a multiple-case study approach (divided into three groups of case studies), carried out according to the recommendation of Yin (2014). Following the initial literature study, semi-structured interviews with key actors from the selected cases in addition to a document study of selected cases were carried out.

2.4.1 Literature study

Some of the major purposes of scientific literature review are to establish the context of the problem based on previous work and to demonstrate to the reader the writer's understanding of the problem and what has been done previously. Additionally, it lays the foundations for what needs to be done based on existing knowledge (Blumberg et al., 2011). The review of the contemporary literature was undertaken using the search engines Google Scholar and Oria. First, a scoping literature review was conducted to map the fields of study according to the five stages described by Arksey and O'Malley (2005). Those stages include: 1) identifying the research question, 2) identifying relevant studies, 3) study selection, 4) charting the data, and 5) collating, summarizing, and reporting the results. Then, based on Blumberg et al. (2011), the recommendation for an iterative literature review was carried out to ensure search efficiency and to minimize the chances of relevant information being missed. The five steps in an iterative literature review include: 1) building an information pool, 2) applying a filter to reduce pool size, 3) gathering a rough assessment of the source to further reduce the pool size, 4) analyzing the literature in the pool, and 5) refining filters or stopping the search. Based on the literature review, a theoretical framework enabling the articulation of case-specific challenges was established.

A comprehensive literature review was carried out in order to identify similar work within the field of research and to gather background knowledge about the topics. Furthermore, the objective of the literature review was to identify previous relevant research and, thereafter, to establish a frame of reference. During the first group of case studies, search words used included ECI, public procurement, EU, infrastructure projects, success factors, and combinations of these. During the second group of case studies, search words used included competitive dialogue, public procurement, early contractor involvement, and combinations of these. During the third group of case studies, search words used included BVP, PIPS, early contractor involvement, procurement, and combinations of these. In addition to these steps, citation chaining according to the principles laid out by Ellis (1993) was also used to find new literature and to avoid missing any valuable sources. To filter the relevant literature, abstracts of the articles were read.

After identifying appropriate literature, the literature review was carried in accordance with the steps described by Galvan (2006). The steps are 1) analyze and organize the

literature, 2) summarize the literature, 3) synthesize the literature prior to writing the review, 4) write the review, and 5) develop a coherent essay.

2.4.2 Case studies

As part of the Ph.D. study, I conducted three groups of case studies. This study has focused on ECI in general and studied CD and BVP in detail. The cases were studied through interviews and document studies. Table 2.1 illustrates the three groups of case studies, topics, number of interviews in each group of case studies, and study area. The topic relationships and the three groups of case studies are illustrated in Figure 1.

Table 2.1: The three group of case studies

Case studies	**Topics**	**Research method**	**Study area**
The first group of case studies	ECI	14 in-depth, semi-structured interviews and document study	Studied 11 Norwegian bridge projects
The second group of case studies	CD	22 in-depth, semi-structured interviews and document study	Studied six infrastructure projects in Norway that have used CD procurement procedure
The third group of case studies	BVP	28 in-depth, semi-structured interviews and document study	Studied 15 projects that have used BVP in Norway and the Netherlands

Each group of case studies addresses all three research questions (RQ1, RQ2, and RQ3). In Paper 1, Paper 2 and Paper 3, the details about the 1st group of case studies, 2nd group of case studies and 3rd group of case studies are explained respectively.

The first group of case studies focus on to 11 Norwegian public bridge projects, and most of the interviewees were client representatives. The second group of case studies targeted six Norwegian public infrastructure projects. The interviewees were client representatives and major contractor representatives from one of the cases. The third group of case studies spotlighted four Norwegian and 11 Dutch projects. The interviewees were mostly best value experts and client representatives.

The first group of case studies was conducted to explore the which approaches are used to implement ECI in the Norwegian bridge projects. Based on recommendations from 20 key professionals with several years of experience within the NPRA and from studying the NPRA's yearly internal project reports from 2001 – 2013, 11 bridge projects were identified as cases relevant for study. The 20 key professionals recommended these projects (most of them were regional managers of the NPRA, and the rest were senior

representatives from the NPRA's head office). The justification behind their recommendation was that these projects were announced for bid in a manner that was relatively open to using contractors' knowledge and experience. The 11 bridge projects included in the study were characterized by a contract form (design-build) and implementation strategy (announcing with alternative technical solutions) that differ from the traditional design-bid-build. Four of the projects were announced for bid using design-build contracts, six projects were announced for bid with alternative technical solutions, and one was announced with both.

During the first group of case studies, CD emerged as an appropriate approach to study in further detail because it was used involve the contractor in the early phase of large and complex infrastructure projects in Norway. The NPRA's interest in documenting the limited experience in the method, availability of cases, and access to data contributed to my decision to proceed with exploring this approach in detail. Six cases were selected to be explored in the second group of case studies. These are the only projects where the NPRA has used the CD procurement procedure as of 2017. All six cases are considered to be complex. In four of the six projects, CD was used to procure suppliers that build infrastructure projects. In the other two projects, the approach was used to procure a company that operates a ferry service and to procure a company to study the feasibility of a fjord-crossing concept.

During the first group of case studies, BVP emerged as an appropriate approach to study in further detail because it was a new approach in Norway. The NPRA's interest in knowing more about the method, availability of cases both in the Norwegian and EU context, and access to data contributed to my decision to proceed in exploring this approach in detail. After the literature review, 15 cases were selected, four from Norway and 11 from the Netherlands. Following the success history of the Netherlands, Norway began using this method on pilot projects. The Dutch case projects cover both public and private procurements carried out from 2010 to 2016. The case projects were chosen based on availability and relevance. The list of Dutch cases identified as having practiced BVP included many projects, so only more recent projects were contacted (those begun after 2010). I focused only on recent projects because the BVP method has been continuously developing over time, and I wanted to explore the experiences of projects that have used the updated method. The four Norwegian case projects were selected because they are

the only projects that have used BVP so far. The availability of the key personnel and their willingness to share their experiences directed us to the selected 11 projects from the Netherlands.

2.4.3 Interview

Interviews vary in nature. They can be structured, semi-structured, or unstructured. The major difference lies in the constraints placed on the interviewer and interviewee. In structured interviews, the interviewer uses a questionnaire. Unstructured interviews can be almost a monologue. The interviewer introduces the topic briefly and then records the statements of the respondent. Semi-structured interviews lie between the two extremes (Fellows and Liu, 2015). For this study, a semi-structured interview was used. It was favored to collect comparable qualitative data and to identify new ways of viewing and understanding the topic. The nature of questions was open-ended, with an intention to bring the most out of the respondents' reflections.

Three different semi-structured interview guides were developed based on the topics. The interview guides were developed largely based on the research questions. The interview guides are attached in the Appendix section of each paper. In total, 64 key professionals were interviewed. The interviewees were selected based on their position in the case projects. They were actively involved in the procurement phases of the case projects. The professional roles of most informants included project manager, construction manager, procurement leader, and best value expert. The details for interviewees' positions for each case are presented in each of the core papers (Paper 1, Paper 2, Paper 3 and Paper 4).

The interviews were primarily semi-structured and one-to-one. The interviews were in-depth and case-specific and were conducted with key professionals involved in the case projects based on the interview guide.

Additionally, the interviewees could bring in personal experiences and discussion topics. To explore the responses of the interviewees and gather deeper information, most interviews were carried out face-to-face and lasted between one and two hours. In-depth interviews were preferred because of the explorative nature of this research, which assisted me in obtaining information on topics that were considered sensitive or controversial.

2.4.4 Document study

A document study was conducted to complement the findings and provide information for additional necessary interpretation. The document study consisted of internal digital case documents and documents received from interviewees, such as contract documents, dialogue invitation documents, offer evaluation protocols, and the NPRA internal reports. Data triangulation was used to cross-validate data from different sources (interviews and document study) and to capture different dimensions of the same phenomenon. Further, by having interviews with several different project participants about similar topics, data triangulation was achieved as well.

Since I was an employee with the NPRA during the research, full access to the internal digital case documents was ensured. This was another determining factor for the choice of case projects in the first and second group of case studies.

2.4.5 Data analysis

After the data collection, the data analysis continued based on the description of Creswell (2013). Data analysis steps described by Creswell (2013) include:

1. organizing and preparing raw data (transcripts, field-notes, images, etc.) for analysis;
2. reading through all data;
3. coding the data (hand or computer);
4. using the coding process to generate themes or description;
5. interrelating themes/descriptions; and
6. interpreting the meaning of themes/descriptions.

The data were coded and analyzed hand-in-hand with data collection and writing up the findings. A combination of emerging and predetermined codes were used. Through the coding process, themes or categories were generated based on importance and occurrence. These themes were interrelated and appeared as major findings and are also used as subheadings in the Findings and Discussion section. At last, the research questions are used to form the conclusion section.

2.5 Validity and reliability

Validity and reliability are conceptualized as trustworthiness, rigor, and quality in qualitative paradigm. Both Yin (2014) and Bryman (2015) suggest that a triangulation may apply to ensure the validity and reliability of research. That means researchers can eliminate bias and increase the researcher's truthfulness using triangulation. Validity and reliability determine how truthful the research results are. Alternatively, they also determine whether the research truly measures that which it was intended to measure. It is a question of whether the research method allows the researcher to hit the research object (Golafshani, 2003).

During this Ph.D. study, theory triangulation, data triangulation, and researcher triangulation were used to increase the validity and reliability of the study. Theory triangulation was achieved via a critical literature review for all the topics investigated. Data triangulation was realized using several sources of information (interviews with several actors and document study). Researcher triangulation was achieved by involving several investigators during the data collection, analysis, and writing process.

The strengths and weakness of literature study, interview, document study and data analysis of the case studies are discussed below.

2.5.1 Literature study

A strength of the literature study is that it provides a relatively quick, but comprehensive overview of the literature in the field. As the search is narrowed through combinations of keywords, operators, and filters, it becomes easier to select relevant literature. Furthermore, using different type of search engines produces a better result. For example, Google Scholar and Oria give a great overview and many hits, while Scopus only searches within peer-reviewed journals and journals. This ensures a broad search area while reducing the risk of missing central, peer-reviewed literature.

A basic weakness of the literature search is that there is a risk of not obtaining potentially relevant literature because it is not captured by the keywords. This weakness was attempted to be remedied by trying out different combinations and synonyms, but there is a possibility that the wrong keywords have been used. The other general challenge is that key terms and concepts change meaning over time. Furthermore, all scholars can-

not be trusted to have sufficient knowledge of the concepts practices even in their local context since many are not familiar with all sectors or with the contractual side of the relationships. This potential deficit was attempted to be remedied by reviewing government documents where possible. Statements made by other researches were double checked. In addition, more than one document is used to define key concepts; for example, several definitions of partnering are included.

2.5.2 Interview

A strength of the interviews is that both the client and contractors were interviewed. This method helps to provide a holistic perspective on the experiences with the approaches, since both the client and the contractor perspectives are mapped. Furthermore, it is a strength that losing contractors and external advisors were interviewed – on CD cases – since it helps to highlight experiences outside the project organizations.

However, the interview as method has some weaknesses. The choice of interviewees for the interviews may be such a weakness. The client chose the procurement methods, so it is likely that the client interviewees have faith in the approach. Similarly, the contractors have chosen to tender for the projects. This can create bias in the results in favor of a specific approach.

In general, interviews as a research method also may be affected by the wording of the questions or the inflections used when questions are asked, which can affect the answers provided. Attempts have been made to develop questions that are as open as possible, but it is not to be avoided that the question posed can put guidelines on the answers. This is, however, partly remedied by the fact that the interview form was semi-structured, since follow-up questions were asked as well.

Some measures that were taken during this study to increase the benefit from the strengths of interviews and minimize the weaknesses included the following: interview guides were used, all interviews were recorded, field notes were taken, and great care was taken during the selection of informants. The interviewees were considered reliable because all the respondents were actively involved in the case projects and have had key positions in the cases.

At the same time, there may be some inconvenience in the interviews being recorded.

This approach may raise the information sharing threshold, since informants may be uncomfortable to go into depth on sensitive information content. On the other hand, the recordings ensure a greater degree of verifiability, while at the same time the quality assurance records became more comprehensive than if only notes were taken along the way.

2.5.3 Document study

A strength of document studies is that documents may be used to supplement and cross check what was said in the interviews. Use of document studies became a form of data triangulation that could enhance the reliability of the information provided in the interviews. The documents also provide more detailed information in some areas; for example, with regard to the contract strategy used in the projects.

One weakness is that the documents originate from the client in the case projects. Furthermore, access was provided for documents intended only for external reading. Yin (2014) also shows that, on a general basis, one can not rely heavily on documents in a case study. Although the information has been written, the documents do not necessarily contain unrelated truths.

Furthermore, there is some weakness in the fact that internal documents about the implementation of the various phases of BVP and CD have not been provided, and thus have not been subject to inspection. Certain information provided in the interviews about the implementation of the approaches in practice has thus could not be verified through the document review. However, this weakness was mitigated by asking additional interviewees about the practical implementation of the different phases.

2.5.4 Data analysis

According to Golafshani (2003), a qualitative researcher can use researcher triangulation to improve the analysis and understanding of the data. Researcher triangulation consist of involving several investigators' or peer researchers' interpretation of the data at different times or locations.

During this Ph.D. study, investigator triangulation was achieved by involving several investigators during the data collection, analysis, and writing process. Whenever it

was possible, I collected data together with master's students. I also wrote all the papers together with other peer researchers. During the Ph.D. study, I collaborated with researchers from another department at NTNU, another Norwegian university, other international universities, the NPRA, and contractor organizations.

The multiple-case study approach was used in order to better understand the topics by studying similarities and differences between the cases. Furthermore, the multiple-case study was used to discover the research questions from a wider perspective, to generate strong and reliable evidence, and to create a more convincing conclusion.

2.6 Research method in each paper and my contribution

In this section, all papers published during the Ph.D. study with the topics they belong to, research methods used, which research question they addressed, and my contribution are presented. This thesis is based on the work presented in the papers presented in Table 1. The first three papers are at the core of the thesis work, and they are attached with this thesis in the appendix section. The other papers support the core papers. In Table 2.2, an overview of the method used in each paper and my contribution is presented.

Table 2.2: Overview of the method used in each paper and my contribution

RQ	**Papers title**	**Topic**	**Methods**			**My contribution**			
			1	**2**	**3**	**4**	**5**	**6**	**7**
RQ 1,2,3	1) Early Contractor Involvement Approaches in Public Project Procurement	ECI	11	14	X	MC	I	W	F
RQ 1,2,3	2) Competitive Dialogue in Norwegian Public Infrastructure Projects	CD	6	22	X	MC	MI	W	F
RQ 1,2,3	3) Best Value Procurement Experience in Norway and the Netherlands	BVP	15	28	X	MC	MI	W	F
RQ 1, 3	4) A Comparison of Competitive Dialogue and Best Value Procurement	BVP, CD	2	12	X	MC	I	W	F
RQ 1	5) Early Contractor Involvement(ECI): They way to do it in public projects	ECI	21	54	X	MC	I	W	F

Continued on next page

Table 2.2 – *continued from previous page*

RQ	**Papers title**	**Topic**	**Methods**			**My contribution**			
			1	**2**	**3**	**4**	**5**	**6**	**7**
RQ 1	6) Early Contractor Involvement in Public Infrastructure Projects	ECI	11	14	X	MC	I	W	F
RQ 3	7) Success Factors for Early Contractor Involvement (ECI) in Public Infrastructure Projects	ECI	11	14	X	MC	I	W	F
RQ 1,2,3	8) Implementation of Early Contractor Involvement (ECI) in Norwegian Bridge Projects Procurement	ECI	11	14	X	MC	I	W	F
RQ 1	9) Motives for the Use of Competitive Dialogue	CD	4	8	X	MC	I	W	F
RQ 1,2,3	10) Best Value Procurement in Norwegian construction projects	BVP	2	9	X	C	MI	CW	CF
RQ 1,2,3	11) Competitive Dialogue – Experiences with The Award Criteria	CD	1	14	X	C	MI	CW	CF
RQ 1,2	12) Best Value Procurement – The Practical Approach in The Netherlands	BVP	11	11	X	C	CD	CW	CF
RQ 1,2,3	13) Best Value Procurement – The First Experiences from Norway	BVP	2	9	X	C	MI	CW	CF
RQ 1,2,3	14) Best Value Procurement (BVP) in a Mega Infrastructure Project	BVP	1	11	X	C	MI	CW	CF
RQ 1,2,3	15) Experience with Best Value Procurement in Norwegian Infrastructure Projects	BVP	2	9	X	C	CD	CW	CF
RQ 1	16) Project Partnering in the Construction Industry; Practice vs. Theory	ECI	44	39	X	C	CD		CF
RQ 1	17) Project Partnering in Norwegian Construction Industry	ECI	26	26	X	C	CD		CF
RQ 1,2,3	18) Managing the Room of Maneuver in Design-Build Contracts– A Comparative Study of Norwegian Road Projects	ECI	3	12	X	C	CD	CW	CF
RQ 1,2,3	19) Project Delivery Methods in Large Public Road Projects– A Case Study of E6 Jaktøyen-Sentervegen	ECI	2	10	X	C	CD	CW	CF
RQ 1,2,3	20) Interweaving Zoning and Design in Road Projects	ECI	3	9	X	C	CD	CW	CF

Continued on next page

Table 2.2 – *continued from previous page*

RQ	Papers title	Topic	Methods			My contribution			
			1	2	3	4	5	6	7
-	21) Sustainable Gravel Road Construction and Maintenance in Serengeti National Park	Oth.	1	50	X			CW	CF

An explanation for the numbering (1–7) and coding used in Table 2.2 is provided below.

Research method

1. No. of cases
2. No. of interviews
3. Document study

My contribution

4. Contribution to research design and theoretical framework

   Main contributor to the research design and theoretical framework (MC), Contributed to the research design and theoretical framework (C)

5. Contribution to data collection

   Conducted all the interviews alone (I), Conducted most of the interviews together with MSc students (MI), Contributed to data collection (CD)

6. Contribution to writing the initial draft

   Wrote initial draft (W), Co-write initial draft (CW)

7. Contribution to finalize the paper

   Edited and finalized the paper (F), Contributed to editing and finalizing the paper (CF)

2.6.1 My role in the research

I have more than seven years of experience in the construction industry in Norway and Ethiopia. This experience gave me strong practical knowledge about the industry and how

it operates. I am doing this research on behalf of the Norwegian University of Science and Technology (NTNU), but I am simultaneously employed by the Norwegian Public Roads Administration (NPRA). This dual role has helped me significantly during data collection because full access to the NPRA internal digital case documents and interviewees was ensured. Getting in contact with the right interviewees and building trust was likely relatively easier. This access was one of the determining factors for the choice of selecting some of the case projects. This connection with the industry might raise the question of reliability. The reliability issue was addressed by using researcher triangulation and by following the data analysis process described in section 2.5. This is one of the reasons I included other researchers that have different backgrounds in the writing of all papers.

Chapter 3

Frame of Reference

This section presents the three research topics (ECI, CD, and BVP) based on a literature review. First, the section will start by explaining what ECI is and the actual practice of the various ECI approaches. Following this, CD and BVP will be explained in detail.

3.1 Early Contractor Involvement(ECI)

3.1.1 What is ECI?

The traditional construction contracts, whereby the client first appoints consultants to design the project in detail and then identifies a contractor construct the work, is fragmented. This approach does not give the contractor the opportunity to contribute to the development of the design.

Early contractor involvement (ECI) denotes 'a non-traditional procurement route, where a contractor's skills are introduced early into a project to bring design 'buildability' and cost efficiencies to the pre-construction phase'. Typically, ECI might be enabled by a two-stage tender process. Two-stage tender is the typical ECI approach in the UK (the process is explained in detail in Section 3.1.2). The process is used in the first stage to procure contractor involvement in the design process and in the second stage to procure construction of the work. Other procurement methods, such as design and build, construction management, or management contracting might also allow a contractor to become involved in the design stage (Designing Building Wiki, 2018).

Through the literature review leading up to this Ph.D. thesis, it was observed that

there are different views of ECI. Song et al. (2009) define ECI as contractor involvement in the design phase of a project, implemented by a design-build (DB) contract instead of design-bid-build (DBB). The aim of ECI in design is to integrate construction knowledge into the design process. Through this type of ECI, it is possible to improve information flow, drawing, material supply, and construction schedule performance.

Lenferink et al. (2012) and Valkenburg et al. (2008) analyzed road projects and defined ECI as contractor involvement in the planning phase of projects. Based on their definition, the aim of this ECI approach is to involve the contractors in the procurement process before the route determination decision is made. The purpose is to gather support from the contractors in determining the route of the road. Here the authors are referring collaboration-based ECI used in a competitive dialog procurement procedure.

Recently, Walker and Lloyd-Walker (2012) have developed a comprehensive definition of ECI and different models of ECI. According to their view, ECI can start in the internal or business development phase and can continue through the project completion and handover phases. That means ECI can take place during the internal phase, planning phase, design phase and in the project execution phase. The authors further divide ECI into five different models depending on which phase of the project the contractor involvement occurs. Their conclusion is that ECI can be implemented by a range of approaches that could include traditional DBB, DB, management contracting, project partnering and project alliancing (Walker and Lloyd-Walker, 2012).

Different owners have developed different ECI models based on their necessities and circumstances. Some owners have developed relationship-based ECI models for the whole life cycle of the project. Other owners have developed a more hybrid model. In the later ECI model, the contract starts with a collaborative approach in the early phase of a project and moves to a conventional type of contract in the project execution phase (Rahmani et al., 2013). The contractor can be involved through various approaches to implementing ECI (Rahman and Alhassan, 2012).

Walker and Lloyd-Walker (2012) developed a framework that illustrates the various ECI models. Figure 3.1 illustrates the three contract forms and how the five models of ECI can be mapped onto three of the identified four project life cycles phases.

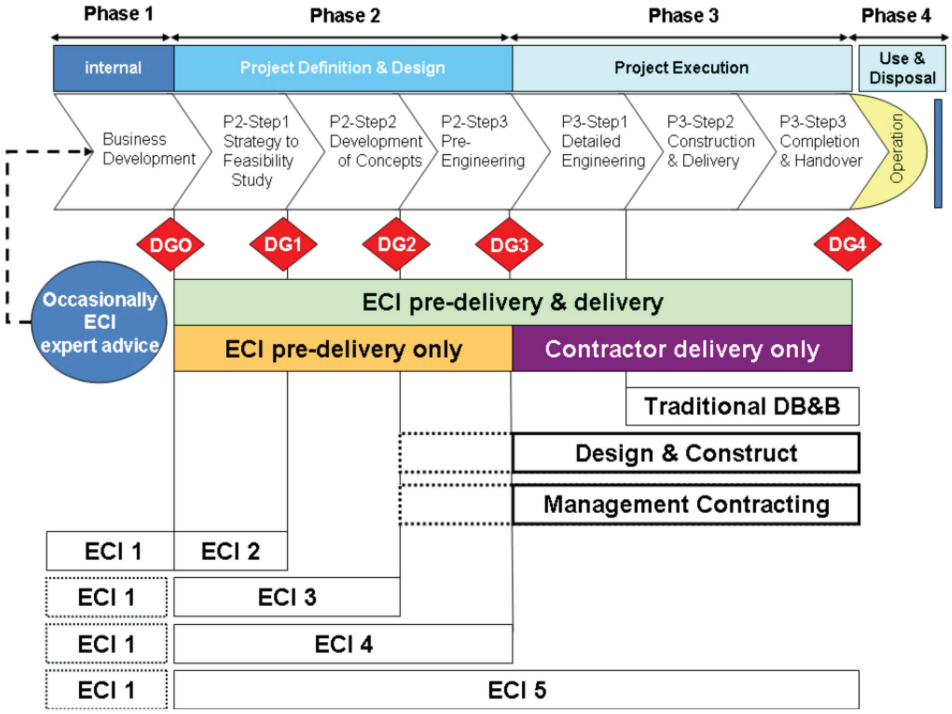

Figure 3.1: Project Life Cycle Phases

In Figure 3.1, DG denotes decision gates: DG0 = formally recognized idea, DG1 = acceptable initiative to investigate, DG2 = choice of concept, DG3 = go/no go, DG4 = accept outputs for the operation phase (Walker and Lloyd-Walker, 2012 adapted from Klakegg et al., 2010).

Collaboration-based ECI includes involving the contractor in the early stage of the project development process to get assistance with planning and buildability by working together as a team with the owner and consultant. This type of ECI contributes to better relationships, improved understanding of all parties, and reduce potential of adversarial relationships because the approach demands frequent interaction and communication. This close interaction and communication lead to developing shared goals and objectives that, in turn, build cooperative relationships (Rahman and Alhassan, 2012).

Different models of ECI exist, depending on when the contractor gets involved in the project. One model to combines the planning process and procurement procedure at an early stage and inviting the contractors to present their solutions. The drawback of this

model is the need for time-consuming formal administrative procedures. Change in the scope of the project, outdated data, and an increase in transaction costs are probable risks in the use of this model.

Another model is to combine the planning process and the procurement procedure at a later stage to avoid the drawback of early combining. However, in this model, the contractors does not get the opportunity to propose innovative solutions. Different intermediate models exist between these two extremes.

The later the combination of the planning process and procurement procedure, the more parallelization rather than interweaving occurs. Parallelization can be used to achieve time gains and improve project control. However, interweaving is mandatory if the goal is to add value in terms of innovation. An early start and an interweaving approach are important in creating an opportunity for the contractors to play an active role.

By applying collaboration-based ECI, the client can have more control over the project cost because the price of the bids is made clear earlier in the planning process. In addition, the client makes sure that the implementation of environmental and social measures is decided in the planning process. These steps benefit not only the client but also the stakeholders and shareholders. However, many risks also exist that are related to ECI (Lenferink et al., 2012; Van Valkenburg et al., 2008). Furthermore, clients often feel vulnerable in relation to contractors. As a result of this, traditional contractual arrangements are perceived as less risky than more collaborative ECI alternatives (Kadefors, 2004).

Since ECI is a concept that refers to engagement with the contractor at the early stage of project development through a wide range of methods, no one generic approach to ECI exists. The next section presents ECI approaches that can be used by public owners.

3.1.2 ECI approaches from the literature

The actual international practices of ECI approaches are presented in this section.

Integrated project delivery (IPD), alliance, and partnering are the three relational project delivery arrangements that stand out globally. One of the common motives of these approaches is ECI (Lahdenperä, 2012).

IPD is a project delivery arrangement that integrates people, systems, business struc-

tures, and practices into a process using relational contracts (Gokhale, 2011). Early involvement of all parties is the core of IPD (Kent and Becerik-Gerber, 2010; Lahdenperä, 2012). In the United States, IPD is used to involve the contractor in the early phase of projects. Even if ECI does not require use of technological tools, the coupling of building information modeling (BIM) with IPD can greatly increase the efficiency of collaboration in all phases of a project (Kent and Becerik-Gerber, 2010).

Partnering is a form of ECI that requires mutual commitment (Walker and Lloyd-Walker, 2012). According to Bresnen and Marshall (2002), there is no one strategy or template for effective partnering. Attributing project success (or failure) to partnering is not straightforward. There are many definitions of partnering in the literature. Table 3.1 presents a collection of some of the most-cited definitions.

Table 3.1: Partnering Definitions

Authors	**Definitions**
Barlow and Cohen (1996)	A spirit of cooperation that may occur on any type of project, collaborative or otherwise.
Bennett (1995)	A management approach used to achieve business value and increase the efficiency of the construction industry.
Black et al. (2000)	For the creation of effective working relationships.
Børve et al. (2017)	A relationship strategy between major contributors.
Chan et al. (2003)	A framework for improving working relationships between project participants.
Chan et al. (2010a)	A process to encourage good working relationships based on commitment, trust, and communication.
Cheung et al. (2003a)	An attempt to enable non-adversarial working relationships.
Cheung et al. (2003b)	A project management approach to improve performance through effective working relationships.
Eriksson (2010)	Cooperative governance based on cooperative procedures in order to facilitate cooperation.
Larson (1995)	Cooperative relationships that enable the creation of a project team with a single set of goals and procedures based on collaboration, trust, openness, and respect.
Larson (1997)	Formal management designed to overcome adversarial relationships in projects.
Lu and Yan (2007)	A process, initiated at the outset of a project, that is based on mutual objectives and specific tools (workshops, project charter, conflict resolution techniques and continuous improvement techniques).
Naoum (2003)	A framework based on trust, cooperation, and teamwork.
Nystrm (2005)	Trust and mutual understanding as the most important components of partnering will define this concept.
Thomas and Thomas (2008)	An integrated teamwork approach that could lead to the creation of value in projects.
Yeung et al. (2007)	Defined by soft components (trust, commitment, cooperation, and communication) and hard components (formal components, gain-share/pain-share).

Framework agreement is relation-based procurement that has been developed in the United Kingdom (Walker and Lloyd-Walker, 2015). It is an agreement between an employer and contractor to establish the terms governing contracts that are to be awarded during a given period. Establishing arrangements for ECI is suitable (Laryea and Watermeyer, 2016). It shares similarities with partnering and alliance (Walker and Lloyd-Walker, 2015).

Alliance is a relational project delivery arrangement whereby the client and contractor participants work together as an integrated, collaborative team and make unanimous decisions. According to Walker and Lloyd-walker (2012) alliancing is an ECI approach (Walker and Lloyd-Walker, 2012). In this approach, the project risks are managed jointly, and the outcome of the project is shared (Lahdenperä, 2012). Alliance is a collaboration between the client and contractors where they share and manage the risks of the project together. Multi-party risk sharing is the factor that defines alliance. In alliance, all parties' expectations and commercial arrangements are aligned with the project outcomes. Furthermore, the project is driven by a best-for-project mindset where all parties either win together or lose together (Walker and Lloyd-Walker, 2014).

The approaches used to involve the contractor during early phase for Australia's infrastructure projects can be divided into three activities: 1) selection of one contractor, 2) the alliance contract for the design development, and 3) the design-build (DB) contract in the design and construction phase (Scheepbouwer and Humphries, 2011).

In New Zealand, three different stages are used to involve the contractor in the early phase of projects. Investigation and research are included in the first stage. The second stage includes preparation of a detailed design, negotiation of commercial terms (fixed price negotiation), and contract duration. In the third stage, completion of the detailed design and physical works based on the DB contract are included (Scheepbouwer and Humphries, 2011). The second stage of this approach shares similarities with target-cost contract (TCC).

In TCC, a fixed target-cost is set based on given parameters at the beginning of a project by the client and the contractor. Any savings or overruns between target-cost and actual cost are shared between the contracting parties based on a pre-determined share ratio set out in the contract (Chan et al., 2010b).

Previously, public owners thought that EU procurement regulations ruled out project

alliancing. Currently, that attitude is being reconsidered, and project alliances that are similar in form to those delivered in Australia are being undertaken in Europe (Laan et al., 2011). Moreover, the emergence of the competitive-dialogue procurement procedure has facilitated the use of project alliances in Europe (Walker and Lloyd-Walker, 2015). Alliance project delivery arrangement can be divided into pure alliance and competitive alliance (Lahdenperä, 2010).

Pure alliance is based on a single target-cost contract (single TCC). In this approach, the owner selects only one contractor primarily based on experience, capability, and attitude. The target-cost is determined after the contractor and the client have developed the project together. In this approach, the same contractor executes the project. Pure alliance, however, might lead to difficulties with EU legislation (Lahdenperä, 2010).

In Finland, public project owners have developed competitive alliance as a solution to the challenges EU legislation might pose to the pure alliance. In a competitive alliance, the procurement procedure is either a negotiated procedure or a competitive dialogue. The selection criteria are the most economically advantageous tender (MEAT) (Lahdenperä, 2009).

In the competitive single target-cost contract, the owner selects two contractors based on the stage-wise process. Then, the owner selects one of the contractors them to the project development phase based on the MEAT selection criterion. The two competing contractors give quotes for fees before the project development phase starts. The selection is based on a joint assessment of the contractors' capability and comparative prices constructed from the quotes and the owner's cost estimate items. The selected contractor, together with the owner, develops the project and target-cost and executes the project (Lahdenperä, 2015). This approach is also called two-stage target-cost contract arrangement as it involves two steps to determine the target-cost (Lahdenperä, 2010).

In the multiple/dual target-cost contract, the owner selects multiple/dual competing contractors primarily based on experience, capability, and attitude. Then, each contractor, together with the owner, develops the designs, executions strategy, and target-cost. The owner selects one of the contractors based on the best options, with an emphasis placed on the price (Lahdenperä, 2010).

The United Kingdom qualification-based selection model is based on an assessment of the company's track record via its capability assessment toolkit after completion of

feasibility plans. This is followed by the development of an open-book target price system. Later on, the target price becomes the fixed baseline price of the project (Scheepbouwer and Humphries, 2011). The aim of the open-book target pricing process is to assure that the contractor designs or constructs the project on budget (Molenaar et al., 2007). The open-book target pricing process resembles TCC.

Additionally, in the United Kingdom, three procurement methods based on two-stage ECI have been developed. These methods are cost led procurement (CLP), integrated project insurance (IPI), and two-stage open book (Ciribini et al., 2016). These three methods are explained briefly below.

CLP is an approach that has been developed in United Kingdom and is comparable to target-cost contract (TCC) (Williams et al., 2013). In CLP, the client engages supply chain teams at the earliest possible moment to participate in a competition against each other on a particular scheme. It is a two-stage process, with two teams that are taken forward to develop the project together with the client and submit a final offer (Cabinet Office, 2014a). From the description above, CLP resembles the dual target-cost contract.

IPI is a form of insurance that provides single coverage for the whole construction project team (Connaughton and Weller, 2013). IPI is based on the alliance project delivery model, and an insurance provision is the novel idea on which the model is founded (Cabinet Office, 2014b).

In two-stage open book, the client invites the market to bid for a project on the basis of an outline brief and cost benchmark. In the first stage, a number of supplier teams compete with bidders and are chosen based on their qualification and price. The qualifications criteria include: 1) capacity, 2) capability, 3) stability, 4) experience, and 5) strength of their supply chain. Price criteria includes the suppliers' 1) profit, 2) fees, and 3) overheads and other cost proposals. In the second stage, the winning supplier is appointed to work up detailed proposals on the basis of an open book cost that meets the client's stated outcomes and cost benchmark (Cabinet Office, 2014c). Based on the above description, two-stage open book shares similarities with two-stage TCC.

The term ECI was first used in the UK and is strongly associated with working methods according to PPC2000 – standard form of contract for project partnering – two-stage tender and collaboration (Mosey, 2009; Kadefors and Eriksson, 2014). It is the most common ECI approach in Sweden and UK. A two-stage tender process has been advocated

for as an ECI approach that maintains the degree of competition for contractor selection. The first stage of the selection process is typically based on price and qualitative criteria. The price-based criteria include the following submissions from the contractor: 1) profit margin, 2) overheads, 3) pre-construction stage fee, and 4) approach to risk pricing and any other cost components. The qualitative criteria typically include: 1) the proposed construction method, 2) ability to deal with unanticipated problems, 3) ability to deliver similar-type projects on schedule, 4) experience with similar projects (track record), and 5) familiarity with local sub-contractors and suppliers. Then, the contractor is appointed conditionally to contribute to the delivery process (project development).

In the second stage, the contractor is typically required to provide a guaranteed maximum price (GMP) for the delivery of the project after being unconditionally appointed (Love et al., 2014; Mosey, 2009). GMP is one of the forms of TCC (Chan et al., 2010a). In the procurement process, the second stage can typically be: 1) traditional construct only contract (DBB), 2) design and construct contract (DB), 3) novated design and construct contract, or 4) construction management at risk (CMR) (Love et al., 2014; Mosey, 2009). In novated design and construct contract, the design team involved by the client for developing a preliminary design is inherited by the main contractor for detailed design (Doloi, 2008). Construction management at risk (CMR) is a delivery method that has been developed in the United States that implements collaborative principles on projects and facilitates ECI. CMR is intended to involve the construction manager in the pre-construction phase of the project to reduce risk and facilitate cost savings (Bilbo et al., 2015).

From the above description, the two-stage tender process shares similarities with competitive alliance based on the two-stage target-cost contract (two-stage TCC).

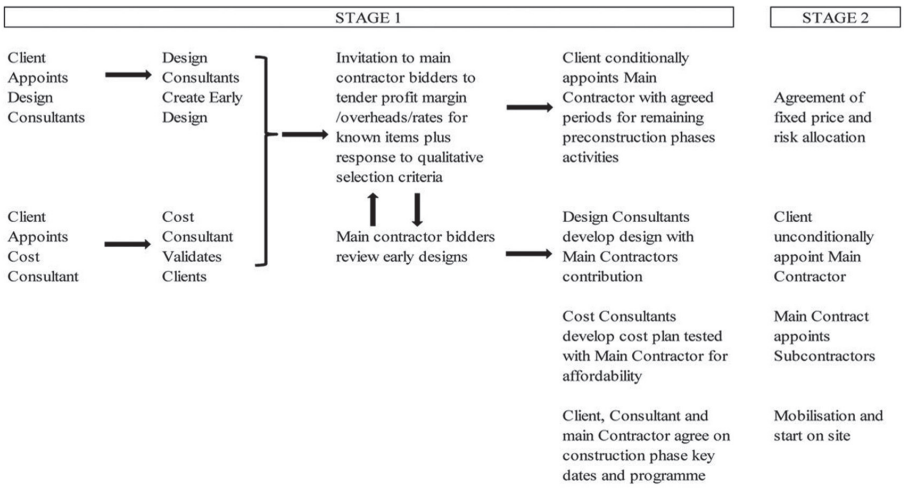

Figure 3.2: A two-stage tender process (Love et al., 2014) adapted from Mosey, 2009

The UK High-Speed Two (HS2) megaproject was developed using a two-stage ECI approach. Client and contractor personnel reported that the approach enhanced innovation and helped capture novel solutions before any construction work had started(Sergeeva and Zanello, 2018).

In the Netherlands, competitive dialogue (CD) and negotiated procedures are being used to achieve interweaving ECI. Based on their experience using these procurement procedures, it is possible to do functional specification, conduct a (confidential) dialogue, divide the procurement procedure, and perform competition throughout several phases (Lenferink et al., 2012; Van Valkenburg et al., 2008). For simple projects, applying negotiated procedure is possible (Lenferink et al., 2012; Van Valkenburg et al., 2008; Lædre, 2006). For more complex projects, however, CD may be suitable (Marique, 2013). In CD, functional specification, technical requirements, staged process bids, and competition over several stages, along with MEAT, can be used to develop a project (Lenferink et al., 2012; Van Valkenburg et al., 2008; Werner, 2011).

Furthermore, in the Netherlands, CD has been used together with public-private partnership (PPP) to involve the contractor in the early phase during the awarding of port contracts (Siemonsma et al., 2012). PPP is any contractual arrangement between a public-sector party and a private-sector party for the provision of public services. PPP is based

on private finance initiative contract nature (Demirel et al., 2017). The Netherlands PPP model is based on design-build-finance-maintain contracts (DBFM).

Riemann and Spang have proposed three ECI approaches for German public owners. The first one is through workshops with the contractors after the design phase but before the plan approval process begins. The second option is by allowing variant solutions by the bidders during the tendering phase. The third possibility is using the competitive dialogue procurement procedure. In allowing a variant solutions approach, the client allows variant solutions by the bidders during the tendering phase. Compared to other approaches of ECI, in this approach, contractor involvement, comes at a relatively later phase of the project (Riemann and Spang, 2014).

Regarding the selection of contractors that become involved in the early phase, several approaches have been developed and are practiced globally. The selection criteria for ECI cannot be based only on price. Instead, using various qualifications-based selection criteria is common (Lahdenperä, 2013). This is particularly true for collaboration-based ECI approaches. Qualifications-based selection can be accomplished using most economically advantageous tender (MEAT) awarding criteria (Falagario et al., 2012) or using best value procurement (BVP) (Kashiwagi, 2011; Van Valkenburg et al., 2008). Best value procurement (BVP) is an expanded form of negotiated procedures. It is an award method to procure contractors with the best expertise to complete the task (Hoezen, 2012).

To summarize, public owners from different countries' have developed different ECI approaches based on local necessities and circumstances. Comparable ECI approaches are given different names by the different countries. Consequently, there is no universal approach to ECI in public projects.

Public owners have several alternatives for involving the contractor in the early phase of projects implementing ECI. This thesis is based on a literature review that summarized several approaches that have been used globally to involve the contractor in the early phase of projects. Public owners can choose one or several of these approaches that suit their project situation to involve the contractor early.

I chose two of the approaches, competitive dialogue (CD) and best value procurement (BVP), to study in detail. Some of the reasons I chose to focus on these two approaches are the NPRA's interest in knowing more about the approaches and exploring the limited experiences with the approaches from Norway. Furthermore, the availability of cases and

access to data were reasons to study these approaches in detail.

3.2 Competitive Dialogue (CD)

3.2.1 What is CD?

The different procurement procedures that are identified by the EU directive for public works, supply, and service contracts include:

1. open procedure (without selection),
2. restricted procedure (with preselection, prequalification),
3. competitive procedure with negotiation,
4. competitive dialogue (CD), and
5. innovation partnership and use of the negotiated procedure without prior publication (European Parliament, 2014).

CD is a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidate admitted on that procedure with the aim of developing one or more suitable alternatives capable of meeting its requirements and on the basis of which the candidates chosen are invited to tender (OJEU, 2004).

CD procedure has five phases: preparation, pre-qualification, dialogue, evaluation and selection, and execution(see Figure 3.3).

CD is explicitly aimed at complex projects that require careful research and development of the best solution to address the specific client's needs. Furthermore, it is a flexible procedure that secures competition and dialogue (Albano and Sparro, 2010). CD consists of several round of dialogues between the client and the potential contractors. During the dialogue phase, all aspects of the tender can be discussed openly (European Parliament, 2014). This provides the contracting parties the possibility to discuss, among other things, sustainability and renewable energy objectives, and the client can ensure the long-term commitments are taken into account (O'Brien and Hope, 2010). Bougrain (2012) has also found that when CD is combined with public-private partnership (PPP), it helps

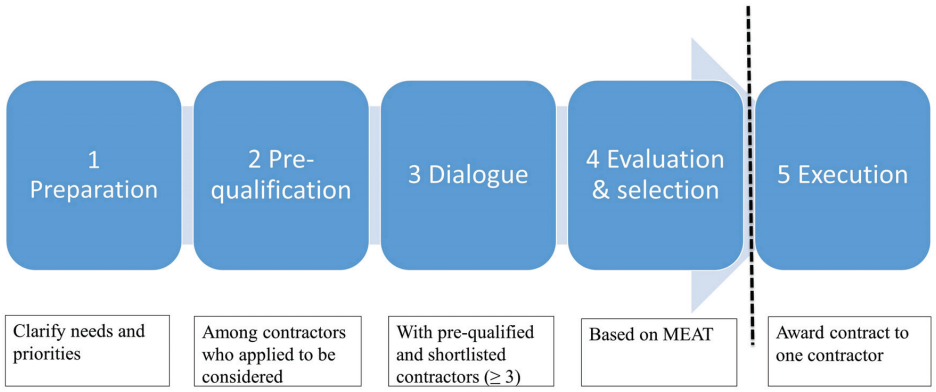

Figure 3.3: CD phases

create coherence in a project and minimizes life-cycle cost (Bougrain, 2012). More cost-effective and more closely matched requirements solutions typically are implemented. It also facilitates a better understanding to be developed between parties (Hood and Smith, 2013).

CD is a procurement procedure introduced by the EU directive for complex projects in order to provide more flexibility for public owners during the procurement phase. Early research conducted on this approach indicates that the procedure has several advantages for public owners.

3.2.2 Circumstances for using CD

The European Commission explains three circumstances in which CD can be used in its explanatory note published in 2006. The first circumstance is complexity and objective impossibility. That means the project should be particularly complex. Two types of project complexity exist. In the first, the client is not objectively able to define the technical means that are capable of satisfying their needs or objectives. In the second, the client is not objectively able to specify the legal and/or financial make-up of a project.

The second circumstance is technical complexity. Technical complexity can be divided and explained in the following two cases. The first is when the client is not able to define the technical means to be used to achieve the prescribed solutions. The other is when the client is unable to determine which of several alternative solutions would be appropriate.

The third circumstance is legal or financial complexity. In terms of legal or financial

complexity, public-private partnership (PPP), in which clients want to have a facility to be financed, built, and operated by an economical operator, can be a good example (European Commission, 2006).

In addition to the three circumstances above, the revised version of the EU directive, directive 2014/24/EU, states that the CD procedure can be used in two additional circumstances. The first is when the needs of the client demand readily available solutions. The second is when the award of works, supplies, or services includes design or innovative solutions (European Parliament, 2014). The revised version of the EU directive has widened the possibilities for using the CD procedure. The procedure is no longer limited to particularly complex projects, but can be used on the same grounds as the negotiation procedure. The new grounds for use are more straightforward and clearer than the previous ones (Telles and Butler, 2014).

According to European Parliament (2014), contracting authorities of EU member states shall apply CD in the following five situations:

1. *The needs of the contracting authority cannot be met without adaptation of readily available solutions;*

2. *They include design or innovative solutions;*

3. *The contract cannot be awarded without prior negotiations because of specific circumstances related to the nature, the complexity or the legal and financial makeup or because of the risk attaching to them;*

4. *The technical specification cannot be established with sufficient precision by the contracting authority concerning standards, European Technical Assessment, common technical specification or technical reference within the meaning of point 2 to 5 of Annex VII;*

5. *In response to an open or a restricted procedure, only irregular or unacceptable tenders are submitted.*

The use of competitive dialogue has significantly increased in Europe regarding contract value over the past years. It has mostly been used for technically complex projects when the client is not able to determine one solution out of several possible alternatives.

Technical complexity comprises risks that arise from the technical and physical characteristics of a project. Such risks can include the construction method, the area, and actors involved in the project (Uttam and Le Lann Roos, 2014).

Public owners cannot use CD in every project. Originally, the procedure was designed for complex projects. However, in 2014, the conditions to use the procedure were simplified, and now it is more straightforward to determine when CD is an option.

3.2.3 Most economically advantageous tender (MEAT)

During the use of CD, the client should assess the received tenders on the basis of the award criteria specified in the contract notice and select the most economically advantageous tender (MEAT). MEAT is the weighed sum of various aspects of a product or service that provides value to the project. It ensures that other selection criteria will be considered in addition to price by taking into consideration quality, environment, and social aspects (Uttam and Le Lann Roos, 2014). According to European directives, when a public owner awards a tender using the MEAT criteria, the owner has to decide the evaluation criteria of the bids in advance (European Parliament, 2014).

The MEAT evaluation method clarifies the winning chance of the most optimal value-price ratio. It needs additional objective criteria (e.g., innovation and sustainability) that can add value to the project rather than solely evaluating the contractor based on lowest price. Since the aim of MEAT is value-price optimization, it differs from other tender methods that focus only on price minimization or that focus only on value maximization. An example of tender that focuses only on price minimization can be lowest price bid for fixed requirements. An example of tender that focuses only on value maximization can be a fixed-price design contest (Sebastian et al., 2013).

Challenges to the implementation of the MEAT criteria exist since current regulations on public procurement do not specify how the MEAT evaluation procedure should be conducted. According to fundamental principles of public procurements, a client must present the method for the evaluation procedure in a transparent and foreseeable manner. However, the identification of MEAT might be a challenging task for the client. What criteria should be used? How should the criteria be evaluated? How should an evaluation model be constructed and applied? Special attention should be given when defining

the MEAT criteria. Both over-simplification and over-complication can have negative consequences on project performance. Standardization of the MEAT weighing factor is important for public clients (Sebastian et al., 2013).

The point system, ratio system, and price correction system can be used to evaluate the MEAT tender. In the point system, all aspects of the bid are converted into points according to an objective calculation reference. In this system, the bid with the most points becomes the winner. In the ratio system, the bid with the highest value/price ratio becomes the winner. Value is calculated by addition of the added value to the basic value. The basic value is the minimum tender requirements, and the added value is the bid above the minimum requirements. In the price correction system, the bid with the lowest corrected price becomes the winner. The corrected price is determined by first calculating the added value of each bid above the minimum requirements. Then, the offered price will be adjusted depending on the added value (Sebastian et al., 2013; Falagario et al., 2012).

In collaboration-based ECI, the selection of the contractor cannot be based only on price because estimating the price in the early phase of a project is challenging. Instead, the selection should be based on both price and qualification. One of the methods that can be used to select contractors based on price and qualification is MEAT. However, evaluations based on MEAT are not straightforward because the current regulations on public procurement do not specify how the MEAT evaluation procedure should be conducted.

3.3 Best Value Procurement(BVP)

3.3.1 What is BVP?

BVP is a client-driven program that focuses on improving quality of product by eliminating waste. It focuses on reducing the need for client decision making. Furthermore, it focuses on reducing the need for the client management, control, and direction of expert contractors (vendors). It eliminates the client's inefficient decision making and bias by replacing the selection of the vendor with an automated process that can best fulfill the owner's needs through the use of filters (Sullivan, 2010).

Management, control, and directing the vendor through a contract are the core of

traditional procurement system practices. However, using a contract for these purposes is inefficient, illogical, and time-consuming (Kashiwagi et al., 2012). The client's management, control, and decision making are a source of risk (Kashiwagi et al., 2009). BVP concentrates on minimizing client decision making (Kashiwagi et al., 2003). Furthermore, minimized management, direction, and control of expert vendors is the philosophy behind BVP. In BVP, both price and performance are considered during the selection instead of only price (Kashiwagi, 2011). Best value can be drawn out of a project by utilizing the specialist knowledge and expertise of vendors. This approach, in turn, can prevent problems and reduce program complexity, project duration, and costs, while also improving the overall quality of a project. The vendors' technical competence, problem-solving ability, honesty when facing challenges, innovative capability, and competencies in safety management are important to obtaining the expected results (Beach et al., 2005). BVP allows clients the ability to control the vendor selection process using performance information, and it assures that the right vendor is selected for each project (Kashiwagi and Byfield, 2002).

BVP is based on the premise that the vendor is an expert and should be allowed to evaluate the price and duration of a project based on the desired outcome of the project but not on the detailed specification from the client. Also, it relies on the premise that the vendors will deliver the best performance when they are responsible for the execution of the project and are required to identify, manage, and minimize the technical risks (Apostol, 2011).

The first significant step in the method is when the vendors are asked to identify their past performance through documentation. In the second step, the vendors are asked to identify the owner's risk and how they can minimize it. Then, the vendors compete based on past performance, current capability, and price (Kashiwagi et al., 2003). Even if BVP can be used in design-bid-build (DBB) projects, it is most efficient and effective if it is used in design-build, construction management at risk, indefinite delivery and quantity, and design-build-operate, private-public partnership projects (Apostol, 2011). BVP has lower transaction costs and delivers a higher value than traditional DBB contracts based on low-bid procurement (Kashiwagi and Savicky, 2003).

BVP is a method that has been developed to decrease the effort of all parties and client decision making by creating transparency during the procurement and project execution

phases.

3.3.2 BVP procedures and phases

The BVP method has four phases: prequalification, selection, clarification, and execution. See Figure 3.4. These phases are explained in detail below.

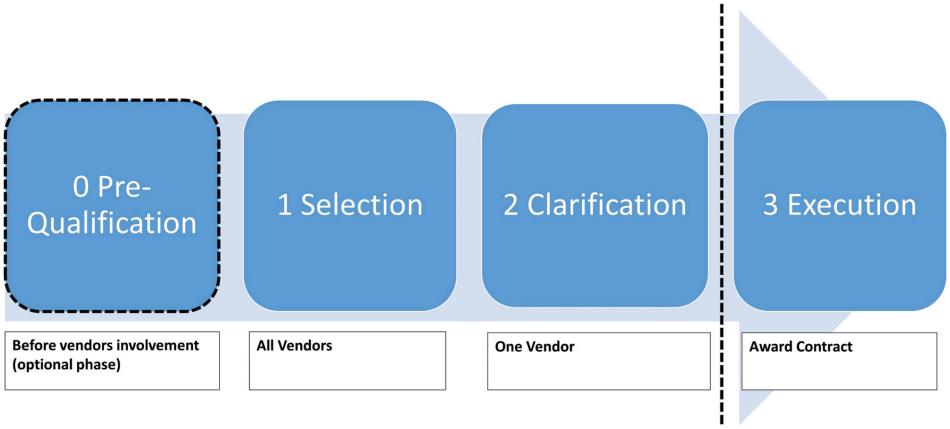

Figure 3.4: Four Phases of BVP PIPS (developed based on Kashiwagi (2016))

Prequalification phase

Extensive education of the client and the vendors about the paradigms of the BVP philosophy is the major activity in this phase. The paradigm includes minimized decision making by the client, transfer of risk, and control over the expert vendor. The client conduct quality assurance, whereas the vendor provides the quality control and risk management. The client is involved in minimal communication, direction, control, and management (Rijt et al., 2011). Paradigm shifts take time, regardless of how simple they seem (Bos et al., 2015). Especially large traditional professional organizations naturally will face more challenges changing their paradigm (Bosma et al., 2015).

Selection phase

The selection phase is concerned with differentiating the alternative submittals of the vendors. The client uses four filters and five selection criteria in this phase. The four filters include: 1) project capability, 2) interview, 3) prioritization of vendors, and 4) dominance check. The five selection criteria include: 1) level of expertise (LE), 2) risk assessment plan (RA), 3) value added (VA), 4) price, and 5) interview (Kashiwagi, 2016).

Figure 3.5 illustrates the four filters and the five selection criteria.

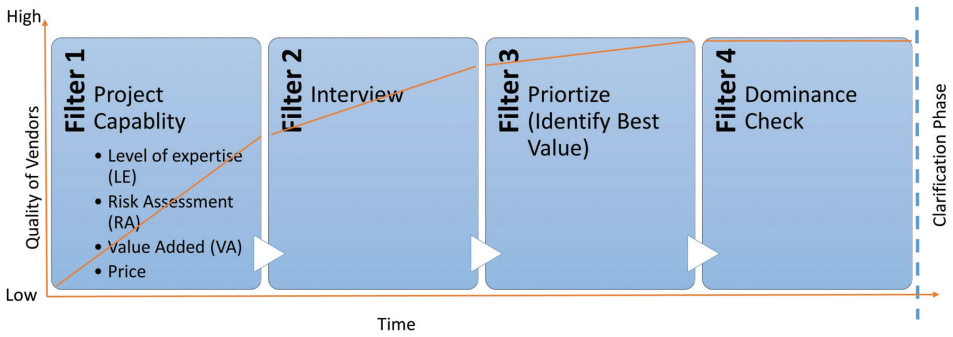

Figure 3.5: Five selection criteria and four filters of BVP (Kashiwagi, 2016)

During the selection phase, the vendors compete based on their level of expertise, past performance metrics, ability to identify risk, and capability of their key personnel. The vendor with the highest rank passes into the clarification phase (Rivera et al., 2016). Perrenoud et al. (2017), after studying several construction projects that have used BVP, emphasize the importance of using the vendor's ability to identify risk as selection criteria to select a higher performing vendor, to achieve greater customer satisfaction, and for project success.

The selection committee sees and rates only the level of expertise, risk assessment, and value added from the various submittals and interviews with key personnel. The price is removed by a contracting coordinator and put into the selection scoring matrix. These selections criteria are weighed to ensure that the project requirements are met. After the interviews have taken place, the vendors' alternative offers are prioritized based on a set of weights and the rating of the committee. When the offer from the best value vendor gets acceptance from the client, the clarification phase begins (Snippert et al., 2015; Kashiwagi, 2016).

Clarification phase

BVP is a self-regulating, closed-loop system whereby only one vendor at a time can move into the clarification phase (pre-award phase). If the vendor clarifies their risk management plan (RMP) and weekly risk report (WRR) and meets the client's technical intent and their proposal as specified in the technical specifications, the contract is awarded to the best value vendor (Kashiwagi, 2011). The clarification phase is critical because it is in this phase that the major paradigm shift takes place (Bos, 2012).

During the clarification phase, the vendor who is considered to offer the best value at the lowest cost clarifies his or her proposal. This comprises clarifying the proposal regarding the project scope, identifying whether the vendor's proposal is acceptable to the client, creating a clear definition of the client's expectations, and creating an offer that is acceptable to the buyer (Snippert et al., 2015).

In the clarification phase, the vendor is required to explain how they will accomplish the project efficiently and with high customer satisfaction. They are required to identify performance metrics that they will track throughout the contract. They do this by creating a plan that includes their scope, detailed and milestone schedules, budget, risk management plan, and performance metrics. Vendors then set up a meeting to clarify the project to the owner for approval. Upon approval of the project, the last phase vendors move through is execution (Rivera et al., 2016).

Execution phase

In the execution phase, the winning vendor receives the project. The vendor's progress is tracked in a weekly risk report (WRR). The WRR is an excel spreadsheet that measures cost and schedule deviations and is submitted each week to the client throughout the execution phase of the project. The WRR becomes performance documentation of the project after completion (Rivera et al., 2016).

In BVP, prequalification is an optional phase. Actually, open procurement procedure together with BVP is recommended so that the method filters the expert vendor. In this method, only one vendor becomes involved in the clarification phase and develops the project.

Chapter 4

Findings and Discussion

This section presents the findings from the case studies and discussions. The section is divided into three sub-sections based on the research questions that are presented in section 1 of this thesis.

4.1 ECI approaches and implementation

The first research question is addressed based on analyses of the three groups of case studies.

4.1.1 ECI approaches identified from case projects

Twelve approaches of ECI were identified during the interviews based on the interviewees' perceptions and are presented in this section. Of the 12 approaches identified in the interviews, seven did not form part of the 18 approaches identified in the literature.

Table 4.1 presents a matrix of approaches versus projects to show the correlation among the approaches as well as which approaches are mutually used in the target projects. It shows the 12 approaches, which are identified by this study in the first columns, and the 21 target projects in the first row. The approaches are presented based on a sequence from most used approach (A1) to least use (A12). The projects are arranged from the project that used the most approaches to the project that used the fewest in each group of case studies. In column 2 of the table, L stands for approaches identified in literature, and P stands for approaches identified from the case projects.

In Table 4.1, 1st group represents the bridge projects. 2nd group represents the CD case projects. 3rd represents the BVP case projects. Due to access limitation, I was not able to explore the cases from the Netherlands to answer this research question. Therefore, only some of the cases (only Norwegian case projects) from 3rd group of study are presented in Table 4.1.

Table 4.1: Matrix of ECI approaches versus case projects (Approaches (1-12) x projects (1-21))

No.	L/P	ECI approaches	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total Use
			1st group											2nd group						3rd group				
A1	P	Indirect approaches	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	21
A2	P	Information meetings	X	X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X		17
A3	L/P	Design-build (DB) contract		X	X			X		X	X			X	X	X	X		X	X	X	X	X	14
A4	P	A front-end partnering process	X	X	X	X	X	X	X	X				X	X	X	X	X	X					14
A5	P	Announcing with alternative technical solutions	X	X		X	X		X			X	X					X						8
A6	L/P	Design-bid-build contract (DBB)	X	X		X	X		X			X	X											7
A7	L/P	Competitive dialogue (CD)												X	X	X	X	X	X					6
A8	L/P	Best value procurement (BVP)																		X	X	X	X	4
A9	P	Direct contact with specialist contractors in the front-end phase of projects	X			X																		2
A10	P	Idea competition	X															X						2
A11	P	Contractors promote their ideas to the owner in the early phase		X																				1
A12	L/P	Negotiated bidding procedure			X																			1

In the following section, the 12 ECI approaches (A1– A12) presented in Table 4.1 are briefly described. Most of the approaches are presented in detail in Paper 1 (Wondimu et al., 2018a).

1. **Indirect approaches**: the use of a consultant with construction experience, a contractor during the development of handbooks and standards and/or in-house construction experience as an approach to ECI. Strictly speaking, this approach is not ECI, but instead use of contractor competencies without directly involving the contractor. Even when the approaches are indirect, it is possible to use contractors to integrate construction knowledge into the front-end phase of projects.

2. **Information meetings**: meetings before selection of a contractor to a project that are open to all contractors that may have an interest in the project. To obtain the most out of an open information meeting, it is best to hold it as early as possible in the front-end of the project. In addition, the client should be willing to accept the inputs and to implement them in the project. Undoubtedly, this openness by the client should be met by contractor willingness to share their knowledge in public meetings.

3. **Design-build contract (DB)**: the contractor is responsible for the design of a project in addition to building it. This approach was used in the first group of cases (bridge projects) without the collaboration element. In the second group of case studies, a DB contract was used together with CD. This implementation resembles to the so-called interweaving ECI as described by Lenferink et al. (2012). In the third group of case studies, is used together with BVP.

4. **A front-end partnering process**: this process is an approach developed and used by the Norwegian Public Roads Administration (NPRA). Typically, the client allocates four weeks during the project execution phase for this process. The process begins after contract signing but should be over before the contractor commences with construction. The major purpose of this approach is to have a common understanding of the contract and to set up a common goal with all contracting parties. Furthermore, it aims to let the contractor come up with optimization ideas. This approach should be combined with an open contract document; i.e., conditions that

can be decided after contract signing, to earn the most benefit out of it. Experience shows that both parties become motivated to work for optimization in a pain-share, gain-share arrangement.

5. **Announcing with alternative technical solutions:** the client prepares contract documents with several technical alternatives. To implement this approach, it should be technically possible to use alternative technical solutions without affecting the quality of the construction. Apparently, the contractors' willingness to evaluate all the alternatives presented by the owner and to calculate the cheapest option for the owner is equally important.

6. **Design-bid-build contract (DBB)**: the client designs the project, and the contractor is involved in the execution phase. In the case projects, this approach is used together with other ECI approaches to optimize the project solution before the construction commences. DBB is not an ECI approach itself but it can be used with ECI approaches.

7. **Competitive dialogue (CD)**: one of the public procurement procedures that was introduced by the European Parliament for complex projects. The stages described by the European Commission (2006) and European Parliament (2014) are followed during the implementation of this approach. This approach is explored in detail in this thesis and is presented in the following sections.

8. **Best value procurement (BVP)**: a method for contractor selection and project management that seeks to increase project value by emphasizing competence and expertise during the selection. During the implementation of this approach, the phases and elements described by Kashiwagi (2016) and Rijt et al. (2016) are followed. How this approach is implemented in the case projects is explored in detail in this thesis and is presented in the following sections.

9. **Direct contact with specialist contractors in the front-end phase of projects**: specialist contractors are those who have special competence and equipment that both owners and major contractors depend on to execute a project. It can be anticipated that this is a potential approach for future projects; however, the level of the owner's public procurement competence plays an important role

here. At the same time, it is also important to know which specialist contractor to contact since it might be misleading if the contacted specialist contractor does not have enough experience in the area the client is asking about.

10. **Idea competition**: an approach in which the client gathers initial ideas about how to solve a project through a bidding process in the front-end phase of a project. The crucial advantage of the idea competition approach is that it has a high potential for integrating contractor knowledge into the project due to its use early on in the front-end phase. The primary disadvantage of this approach is that it is a one-time involvement and lacks continuity throughout the whole project life cycle.

11. **Contractors promote their ideas to the owner in the early phase**: a contractor takes the initiative to promote an idea to the client during the planning and design phase. Obviously, it is uncommon for contractors to take this kind of initiative. Typically, they don't know the owner's challenges in the front-end phase. By using various approaches, public owners can inform contractors about the project challenges to motivate them to take the initiative to share their ideas.

12. **Negotiated bidding procedure**: a procurement procedure established by the EU. Using this procedure, it is possible to develop functional specification, conduct a (confidential) dialogue, divide the procurement procedure, and perform competition throughout several phases.The stages described by European Parliament (2014) are followed during the use of this approach.

The similarities and differences of the 12 approaches identified from the case projects and presented in Table 4.1 are discussed below. The 12 approaches identified from case projects could be divided into basic and advanced ECI models. A1, A2, A9, and A11 have some common characteristics since they don't involve any contractual agreements between the clients and the contractors. Rather, they are professional discussions with different motives and purposes. Thus, they could be categorized under the basic ECI model. A10 could also be included in the basic ECI model since there is no contractual agreement that could extend to the project execution phase. In the basic ECI model, the contractors are involved in a very early project stage or early planning phase. By using the basic ECI model, the client's expectation from contractors that are involved is to bring

in their know-how by contributing and participating in the planning. This contractors may or may not be involved during the project execution phase. They must be paid for their service and excluded from bidding in the same project if they have knowledge about the project that could give them a competitive advantage. The common characteristic of the basic approaches is low collaboration elements. Most of these approaches can be categorized under ECI 1 or ECI 2 models of ECI as illustrated by Walker and Lloyd-Walker (2012).

These approaches can be used in all types of projects and can be combined with any of the other ECI approaches. However, the basic ECI model cannot be considered as worthwhile as advanced approaches. Especially if contractors are excluded from bidding, they may decide not to participate fully or commit their knowledge in full during their early involvement so they don't create competitive advantages over their competitors.

These basic ECI approaches could also be categorized under one-time involvement of contractors. They could take place at any or all of phases of a project. They help public owners to have expert advice that can be useful at an early phase. A6 does not facilitate ECI by itself. It should, therefore, be combined with other ECI approaches.

The remaining six approaches (A3, A4, A5, A7, A8, and A12) could be categorized as advanced approaches since they involve the contractor in several phases of the project, including the early phase, in an integrated way. The collaboration level of these approaches, however, can differ significantly depending on the pain/gain share incentive arrangement.

4.1.2 CD implementation

How CD was used is explained based on the second group of case studies. Based on how it is used in the case projects, CD is categorized into four phases: the preparation phase, dialogue phase, evaluation phase, and execution phase. The NPRA has limited experience regarding the application of CD. Thus far, the procedure has been used on only six infrastructure projects in Norway. Table 4.2 illustrates how CD was practiced in the six case projects. Detailed case descriptions are presented in Paper 2 (Wondimu et al., 2018c).

Table 4.2: How CD was practiced in the case projects

Phases and elements	**Case 1**	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
Preparation phase						
Preparation of plan for dialogue phase	X	X	X	X	X	X
Assessing and communication with the supplier market	X	X	X	X	X	X
Preparing a draft tender document with award criteria	X	X	X	X	X	X
Prequalification	X	X	X	X	X	X
No. of suppliers that have shown interest to be pre-qualified	3	9	3	7	5	4
No. of prequalified suppliers	3	6	3	7	5	4
No. of contractors in the dialogue phase	3	3	3	4	5	4
Dialogue phase						
Dialogue approach	Sketch Solutions	Sketch Solutions	Sketch Solutions	Sketch Solutions	Sketch Solutions	Sketch Solutions
No. dialogue meetings with each supplier	Start-up meeting +3	Start-up meeting +3	Start-up meeting +5	Start-up meeting +3	Start-up meeting +3	Start-up meeting +3
No. of contractors in the dialogue phase	3	3	2	3	4	4
No. of contractor with valid offer	3	2	2	3	3	4
Evaluation phase						
Formula to calculate the winning offer	S=P-C1-C2-C3-C4	S=P-C1-C2-C3-C4	S=P+C1+C2+C3	S=P-C1-C2-C3	S=P+Q	S=P+Q
Selection criteria P=price Q=qualification C=criteria C1 C2 C3 C4	(MNOK) C1=150 C2=80 C3=30 C4=6	(MNOK) C1=110 C2=70 C3=50 C4=40	(MNOK) C1=+/-20 C2=+/-5 C3=+/-5	(MNOK) C1=35 C2=10 C3=10	(%) Price=40% Qual.=60% C1=20% C2=40%	(%) Price=60% Qual.=40% C1=18% C2=6% C3=6% C4=4% C5=4%
Evaluation scale	Direct NOK	0-4	Direct in NOK	0-10	0-10	0-10
Execution phase						
Implementation model (Fig. 9)	Model 3	Model 3	Model 2	Model 2	Model 4	Model 3
Compensation format	Fixed sum	Fixed sum	Fixed sum	Fixed sum	Fixed sum	Fixed sum
Loser fee in (MNOK)						
1) To submit the sketch	0.6	1	0	0	0.4	0
2) To submit the final offer	2	2.3	0.25	0.5	0.2/ solution	3

From the Table 4.2 it is possible to see that the CD procedure applied in all six case projects in a similar manner. However, different selection criteria, evaluation scales, and formulas to calculate the winning offer were used in the cases. Figure 4.1 illustrates procurement procedures while using CD. It contains five milestones and seven major activities.

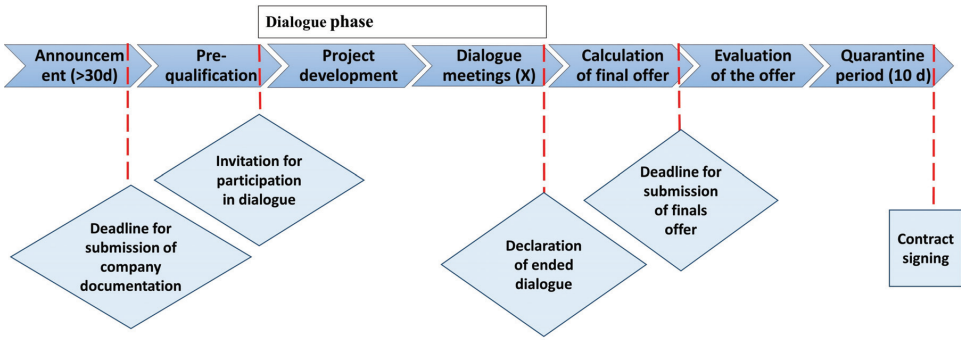

Figure 4.1: CD procedures (developed based on the studied cases)

In Table 4.3, the major activities of CD are divided into the four phases, and the suppliers' involvement is presented. Under the preparation phase, the first step is to attract as many qualified suppliers as possible to show interest in the project. This is followed by prequalifying the best-qualified suppliers based on the prequalification criteria. Ranking, shortlisting, and inviting the optimal number of best-qualified suppliers to the dialogue comes next. During the dialogue phase, developing project solutions that fulfill the awarding criteria and the project goals is the main activity. Under the evaluation phase, the main activity is evaluation of the tender documents or proposals based on the awarding criteria and awarding the contract to the selected supplier.

Table 4.3: Major activities in CD

Phases	**Activities**	**Supplier Involvement**
Preparation	Preparation of tender document	Before supplier involvement
	Preparation of plan for dialogue	
	Assessing and communication with the supplier market	
Prequalification	Client announcing the project and invitation to participate	Any supplier who applied to be considered
	Suppliers' submission of prequalification documents	
	Evaluation of prequalification documents	
	Prequalification and shortlisting	
Dialogue	Invitation to participants to dialogue and distribution of the draft tender document	Shortlisted suppliers (≥ 3)
	Suppliers develop and submit sketch proposals	
	Dialogue meetings and feedback on the suppliers' solutions (individual meetings with each supplier)	
Tender submission and evaluation	Client handout of the final tender document and invitation to competitive tender	
	Suppliers' preparation and submission of tender	
	Tender evaluation	
	Contract awarding	
Project execution	Contract signing	One supplier

During this study, three models of CD were developed depending on how it has been used in the case projects. These models are illustrated in Figure 4.2 as models 2, 3, and 4. The first model, Model 1, is based on a design-build (DB) contract and does not have a dialogue phase. It is presented in the figure to be used as a reference for explaining the other three models that have a dialogue phase. These three models illustrate how CD has been used in the DB contracts and design contracts. Model 2 was used in case project 3 and 4. Model 3 was used in case projects 1, 2, and 6. Model 4 was used in case project 5. This is to some extent in line with Walker and Lloyd-Walker (2012) claim; that is, there are several models of ECI based on when the contractors are involved and how long the involvement lasted.

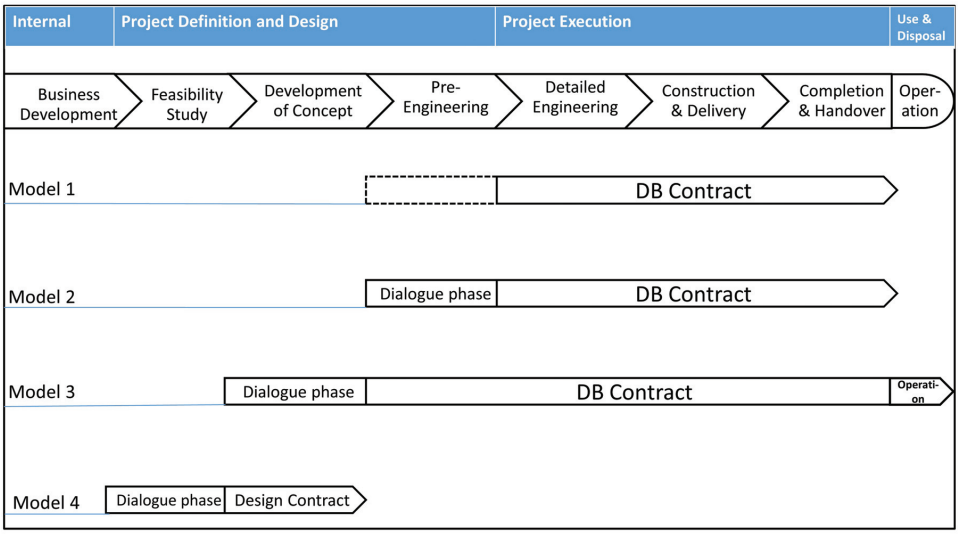

Figure 4.2: Project implementation models using CD

Those who were involved in the project development phase claim that they followed the same procurement procedure for the case projects. However, the findings of this study reveal that the procedure practiced in the different cases varied slightly. Based on the findings above, it is possible to claim that the CD is a flexible procedure and that it can be used at different phases of a project. Furthermore, CD can also be used together with different contract forms, such as design contract and design-build (DB) contracts, or it can also be combined with the operation contract.

4.1.3 BVP implementation

In order to illustrate how BVP was used, several BVP key elements were selected after analyzing the theoretical processes of both Kashiwagi (2016) and the Norwegian BVP book (Rijt et al., 2016). These elements were chosen because of their concreteness. Several elements were left out because of their lack of concreteness, such as transparency, vendors' willingness to take responsibility, less management from the client, less client decision making, and less control from the client. The results are presented in Table 4.4. The table illustrates to what extent the proposed elements were performed in the case projects. The elements and the projects presented in Table 4.4 are described in detail in Paper 3 (Wondimu et al., 2018b).

Table 4.4: BVP elements versus the case projects (1-15)

Included Elements/ Cases	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Prequalification Phase															
Choosing a sponsor	X	X		X	X	X	X	X		X	X	X	X	X	X
Involvement of (an external) BV expert	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Selection and educating core team	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Prequalification of vendors	X	X	X	On invite	X (5%)	X			X		X	X		X	
Training sessions for the vendors	X	X	X	X	X	X	X	X			X	X	X	X	X
Core document /request for proposal	X	X	X	X	X (15%)		X		X		X	X	X	X	X
Open budget (with ceiling)	X (X)	X (X)	X (X)	X (X)	X (-)	X (X)	X	X (X)	X (X)	X (X)	X (X)	X(X)	X(X)	X(X)	X(X)
Selection Phase															
Award criteria in prioritization assessment:															
Past performance information / level of expertise	15%	- %	10%	10%	- %	20%	N/A	15%	15%	15%	N/A	25%	20%	25%	25%
Risk assessment documents	20%	15%	20%		5%	25%		20%	20%	20%		15%	20%	15%	15%
Value added documents	10%	15%	15%	20%	- %	- %		10%	10%	15%		10%	15%	10%	10%
Interviews	2*15%	20%	2*15%	30%	29%			30%	2*15%	30%		25%	25%	25%	25%
Price	25%	20%	25%	20%	35%	25%		25%	25%	20%		25%	20%	25%	25%
Time-plan		30%		5%	10%										
Shortlisting		X		X	X		X						X		
Prioritization / dominance check				X	X					X		X	X		X
Multiple grading groups	X														
Clarification Phase															
Kick-off meeting	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Risk management plan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Detailed plan/ scope document	X	X	X	X (15%)	X	X	X	X	X	X	X	X	X	X	X
Elaboration of involvement subcontractors	X	X	X	X	X			X				X	X		X
Reassessment of interviews		X	X		X										X
Usage of key performance indicators (KPI)	Low	X	X	X	X	X	X	X	X	X			X	X	X
Dominance check	X	X	X												
Vendor involved in framing of contract	X	X	Limited	X	Limited	X	X	X		X		X	X	X	X
Owner financially responsible for all uncontrollable risks		X	X	X		X	X	X	X			X	X	X	X
Risk contingency fund	X		X					X	X	X				X	X
Execution Phase															
Weekly risk report (WRR)	X	Mth.	X					X	X	X	Temp.	X	X	X	X
Satisfaction measurements / performance evaluation	Quarter	X	X	X		X			X			X	X	X	X
Director's report	X		X			X			X						
Fixed sum	X	X		X		X		X	X	X	X	X	X	X	X
DB	X	DBM		X	X	X			X	X	X	X	X	X	X
Function description	X	X		X		X			X	X	X	X	X	X	X

All projects followed the four phases of the method (prequalification, selection, clarification, and execution), but the elements used in the case projects varied. Even when BVP was relatively well defined by the developer, by reviewing key elements of the method in 15 case projects, this study reveals that BVP was not being practiced in a single strict way.

4.1.4 Summary

Public owners use several approaches to involve the contractor in the early phase of their projects. This thesis, based on a literature review and case studies, presented several approaches that have been used globally to involve the contractor in the early phase of projects. Through the first group of case studies, ECI approaches used in the Norwegian bridge sector were identified. Most of the approaches identified from the literature can be used on highly complex projects whereas in the first group of case studies, several approaches that can be used on less complex projects were identified. Norwegian bridge projects primarily use basic approaches, such as information meeting and indirect approaches.

The primary approaches that are used globally to involve the contractor in the early phase of projects are IPD, partnering, PPP, alliancing, BVP, a two-stage tender process (two-stage ECI) and competitive dialogue. In addition to the above major approaches, this study identifies several additional approaches that public owners use to involve the contractor in the early phase of projects. These ECI approaches function at a different level. Some of them function as project delivery models. The other approaches function as selection criteria, tools, and elements. Basic ECI approaches that can be used in any project were also identified. Public owners can use only one of the approaches or a combination of several approaches to involve the contractor in the early phase of projects.

4.2 Experiences

The second research question is addressed based on the three groups of case studies and the three topics.

During the first group of case studies, timing of contractor involvement is used as

evaluation criteria to explore participant experiences with ECI. This criteria is included because the analysis shows that timing of contractor involvement is the most important factor for a successful implementation of ECI approaches. The benefits of ECI in terms of value for money and project delivery time are higher when it is carried out as early as possible.

During the second group of studies exploring Norwegian positive experiences and practical issues with CD is the focus. The decision was made to focus on CD because limited research has been done to date on CD in the Norwegian context. Furthermore, limited international research is available that describes practical issues of CD.

During the third group of case studies, the focus is on exploring the positive experiences and challenges of Norwegian and Dutch projects that used BVP. This choice was made because the developers of BVP cite several internally-conducted evaluations as providing success stories of BVP. However, to our knowledge, few independent assessments have been conducted on the method.

4.2.1 Experiences with ECI

In order to investigate experiences with ECI, 11 Norwegian bridge projects were studied (the first group of case studies). In Figure 4.3, solid lines indicate when each ECI approach was used in the case project. A1– A12 are ECI approaches identified from the 11 Norwegian bridge projects. Experience from the 11 cases and the 12 ECI approaches are presented in detail in Paper 1 (Wondimu et al., 2018a).

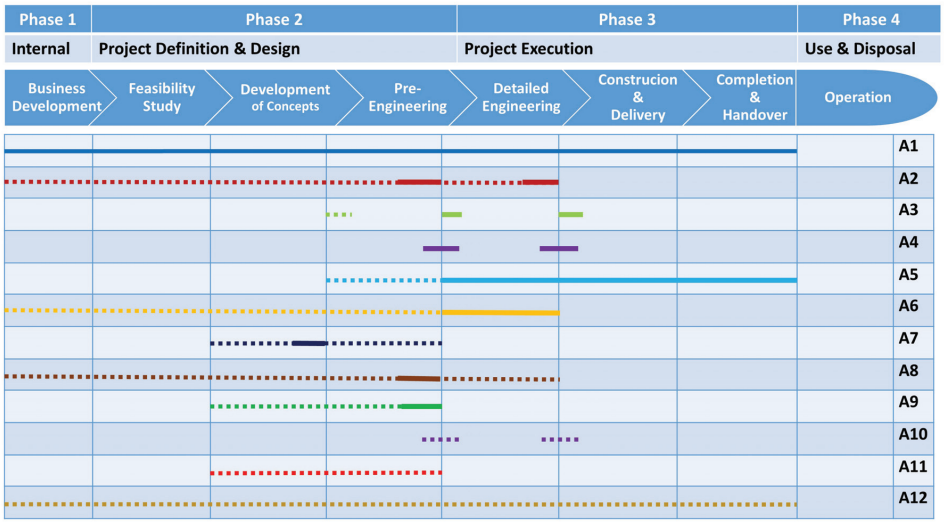

Figure 4.3: When ECI approaches were used /when they could have been used

In Figure 4.3, dotted lines indicate when the ECI approaches (A1– A12) could have been implemented. Solid lines indicate when the ECI approaches were used. Solid lines overlay dashed lines. The contractors' contributions vary considerably depending on which ECI approaches were used and when they are used in a project. This finding indicates that most of the ECI approaches identified in the case projects were used in relatively late phases of the projects. Most of the approaches, however, could have been implemented earlier. Therefore, the maximum potential approaches was not realized. One main finding from the investigated case projects was that the contractors could have been involved earlier to obtain as much potential benefit as possible. This is consistent with Van Valkenburg et al. (2008) findings. The earlier the contractors are involved, the more room for innovation is given to contractors.

4.2.2 Experiences with CD

Based on the second group of case studies, several experiences with the use of CD were identified. The experiences are a combination of both positive experiences and challenges that practitioners faced (practical issues). The positive experiences (+) are summarized under the following four sub-topics: 2.1) Innovation, 2.4) Risk transfer, 4.2) Cooperation, 4.4) Project Control. The remaining sub-topics are challenges (-) that were identified

during this study. Both the positive experiences and challenges are presented below in Table 4.5. In the table, P.1 to P.5 stand for the five phases illustrated in the Figure 4.4. The detailed case descriptions and experiences are presented in Paper 2 (Wondimu et al., 2018c).

Table 4.5: Major experiences and observations from the interviews

	Experiences	**Observations from the interviews**
P.1	1.1) Market interest (-)	Low market (supplier) interest in the projects constituted the major challenge in case projects 1 and 3. However, market interest increased significantly when comparable project implementation models were used for the second time in cases 2 and 4 respectively.
	1.2) Determine the loser's fee (-)	It was a challenging task for clients to determine the level of the losers' fee. On the one hand, the compensation should be attractive enough for suppliers to get involved in the project. On the other hand, the compensation should not significantly increase the project budget.
	1.3) Function descriptions (-)	One motive for using CD is to increase supplier involvement. The client in case 1, however, described the tasks in too much detail in the dialogue frame document. Based on lessons from case 1, the client provides less detail for the dialogue frame document in case 2.
	1.4) Number of suppliers in the dialogue phase (-)	The number of suppliers in the dialogue phase varied from 3 to 5 in the case projects. The client interviewees found it difficult to determine the number of suppliers that should be invited to the dialogue phase.
	1.5) Determining the MEAT criteria (-)	In all projects, the client determined the MEAT criteria and their weight in the preparation phase. However, it was difficult for the client in all projects to determine this before the range of the suppliers' solutions was known.
P.2	2.1) Innovation (+)	The client interviewees claimed to have acquired innovative, value-adding and improved solutions in all six case projects.
	2.2) Demanding (-)	All of the interviewees agreed that CD is a demanding, time-consuming and expensive procurement procedure. It demands the full attention and cooperation of the participants.
	2.3) Practical challenges during the dialogue (-)	The client representatives did not respond to solutions that were not the best. On the other hand, the client discovered that some of the suppliers did not share their solutions. More challenges are presented in Paper 2, Table 5.

Continued on next page

Table 4.5 – *continued from previous page*

	Experiences	Observations from the interviews
	2.4) Risk transfer (+)	CD reduces risk by facilitating information flow between the parties. As a result, the client obtains lower bids.
	2.5) The length of the dialogue phase (-)	According to interviewees, the length of the dialogue phase should suit the market situation to attract suppliers.
P.3	3.1) Evaluation based om MEAT criteria (-)	It was challenging for clients to evaluate the suppliers objectively on the MEAT criteria (Most Economically Advantageous Tender).
	3.2) The evaluation team composition (-)	The likelihood of a biased evaluation could be decreased by involving new personnel, while the knowledge from the dialogue phase could be retained by keeping the personnel involved in the dialogue in the evaluation team.
	3.3) Granting the loser's fee (-)	In case 4, one of the pre-qualified suppliers was not able to develop a solution that could fulfill the client's requirements. Regardless, the unqualified supplier was allowed to be involved in the entire dialogue phase and thereby became qualified for compensation via a losers' fee.
P.4	4.1) Compensation format (-)	In all the case projects, a fixed sum compensation format was used. This compensation format proved to entail challenges concerning optimization solutions found during the execution phase. One challenge with fixed sum is that the client does not benefit from savings developed by the suppliers during the project execution phase. At the same time, it is difficult to force the suppliers to suggest solutions that increase quality or reduce maintenance costs.
	4.2) Cooperation (+)	The client achieved good cooperation with the suppliers in all six case projects. The cooperation during the dialogue phase seemed to lead to improved cooperation during the project execution phase.
	4.3) Using the solution of losing suppliers (-)	All solutions developed during the dialogue belonged to the respective suppliers. So, the client was not able to implement solutions from the losing suppliers, even if their solutions were better.
	4.4) Project Control (+)	Both the client and supplier experienced better project control compared with their previous experience in projects with design-build contracts without a dialogue phase.
P.5	5.1) Lack of practical experience with CD (-)	Since CD is a new procedure, both the client and suppliers reported a lack of practical experience with the method.

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Table 4.5 – *continued from previous page*

	Experiences	**Observations from the interviews**
	5.2) Ethical challenges (-)	CD has ethical challenges when it comes to balancing confidentiality and equal treatment of the suppliers' suggested solutions. It is a challenge for the client to decide when to accept and when to deny when suppliers suggest new solutions. The client cannot say yes to all suggested solutions, but must guarantee fair competition between the suppliers.
	5.3) Human mistakes (-)	Human mistakes, both from the client's and suppliers' sides, have consequences. For example, in case 1, the client gave the wrong eRoom (an online project collaboration software) access to one of the suppliers' personnel. In case 4, one of the suppliers uploaded his documents into a common eRoom where all suppliers had access.
	5.4) Zoning plan (-)	The zoning plan was restrictive during the dialogue phase in case 1 and case 2. One of the restrictions was that the zoning plan corridor was too narrow.

Table 4.6 presents the interviewees' case by case experiences with CD.

Table 4.6: CD case by case experiences

Phases	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Preparation	Market interest, Determining the losers' fee, Function description, Determining the MEAT criteria	Deciding on the losers' fee, Determining the MEAT criteria	Market interest, Determining the losers' fee, Determining the MEAT criteria	Determining the losers' fee, Determining the MEAT criteria	Determining the losers' fee, Number of suppliers in the dialogue phase, Determining the MEAT criteria	Determining the losers' fee, Determining the MEAT criteria
Dialogue	Innovation, Demanding, Practical challenges to the dialogue	Innovation, Demanding, Practical challenges to the dialogue, Risk transfer	Innovation, Demanding, Practical challenges to the dialogue	Innovation, Demanding, Practical challenges to the dialogue	Innovation, Demanding, Practical challenges to the dialogue	Innovation, Demanding, Practical challenges to the dialogue, The length of the dialogue phase
Evaluation	Evaluation based on the MEAT criteria, Evaluation team composition	Evaluation based on the MEAT criteria, Evaluation team composition	Evaluation based on the MEAT criteria, Evaluation team composition	Evaluation based on the MEAT criteria, Evaluation team composition, Granting the losers' fee	Evaluation based on the MEAT criteria, Evaluation team composition	Evaluation based on the MEAT criteria, Evaluation team composition
Execution	Compensation format, Cooperation, Using the solution of losing suppliers, Project control	Cooperation, Using the solution of losing suppliers, Project control	Cooperation, Project control	Cooperation, Project control	Cooperation, Project control	Cooperation, Project control
Multi-phase	Lack of practical experience with CD, Ethical challenges, Human mistakes, Zoning plan	Lack of practical experience with CD, Human mistakes, Zoning plan	Lack of practical experience with CD	Lack of practical experience with CD, Ethical challenges, Human mistakes	Lack of practical experience with CD	Lack of practical experience with CD

The experiences are categorized into the four phases of the CD procedure and shown in Figure 4.4. The experience can be single-phase or multi-phase. The author has prioritized the experiences based on their perceived importance, with the most important at the top. The experiences of using CD have been categorized according to these four phases and are presented below. Each of the experiences are presented in detail in the findings and discussion section of Paper 2 (Wondimu et al., 2018c).

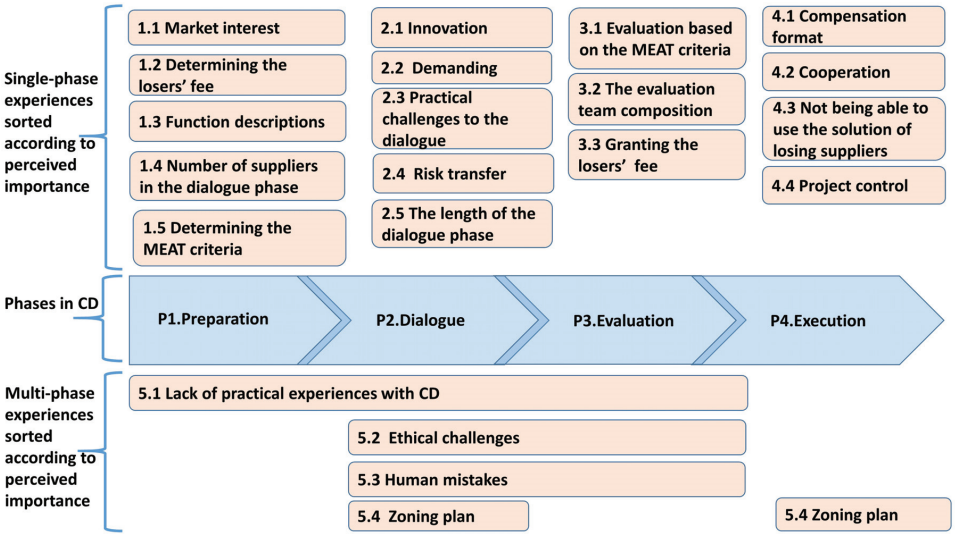

Figure 4.4: Overview of the experiences with CD

Based on the findings, a lack of experience with the procedure, which runs in several phases, may be one of the major challenges for both the client and suppliers. Several measures can compensate for the lack of practical experience with the CD procedure and make sure that experience is transferred from one project to another. First, the client can have one or a group of process leaders that are available to support projects using CD. Second, if the client uses the procedure more often in the future, both the client and the suppliers will gain experiences with the procedure. Third, establishing the project organization by combining experienced with inexperienced personnel will also compensate for the lack of practical experience with the CD procedure. Most of the experiences found in the Norwegian CD projects support the findings from Hoezen et al. (2015) in the Dutch CD projects. Some of the findings about CD from the Dutch projects are that CD improved trust, that innovative solutions were implemented and that the procedure has

high transaction cost.

4.2.3 Experiences with BVP

Based on the third group of case studies, several experiences from the practise of BVP were identified. The interviewees report a combination of positive experiences and challenges that practitioners faced (practical issues). The positive experiences (+) are summarized under the following six sub-topics: 3.1) innovation, 3.2) better end product, 3.3) better cooperation, relation, and satisfaction, 4.1) early project risk identification, better project control, and predictability, 4.2) meeting the vendors before contract signing, and 4.3) reducing resource use. The remaining sub-topics are challenges (-) that were identified during this study. Both the positive experiences and challenges are presented below in Table 4.7. In the table P.0 to P.4 stand for the five phases illustrated in Figure 4.5. The detailed case descriptions and experiences are presented in Paper 3 (Wondimu et al., 2018b).

Table 4.7: Major experiences and observations from the interviews

	Experiences	**Observations from the interviews**
P.0	0.1) Vendor skepticism about the method (-)	In some of the cases, the interest from the market was low because the BVP method was new to the organization. In other cases, client personnel experienced a drop in the number of vendors partaking in the tender when the client started to use BVP.
	0.2) Difficult to determine the ceiling budget (-)	In BVP, when the client uses an open budget with a ceiling, it is crucial that the client establish a realistic budget because vendors that submit an offer above the ceiling budget may be disqualified. However, it was difficult for the clients to determine the ceiling budget for the projects.
P.1	1.1) Failure of SMART in the offer (-)	Most of the interviewees pointed out that it was challenging to get an offer that is SMART (specific, measurable, ambitious, realistic, time-bound) along with a dominant information matrix from the vendors.

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Table 4.7 – *continued from previous page*

	Experiences	**Observations from the interviews**
	1.2) Challenging to do objective evaluations (-)	In case 9, they tried to have the same core team in every BVP project because educating a different set of people for each project takes a lot of time and other resources. However, they found that core team personal expertise resulted in subjective rather than objective judgments once their personnel became familiar with the process. According to interviewee 11, being objective to the matrix was a challenge.
	1.3) Difficult to know the reasonability of the risk corrective measures price (-)	According to the case 12 interviewee, the price for corrective measures to the client risks cannot be negotiated before the contract award, and it was not comparable with other suppliers' prices. Thus, the client found it difficult to know whether this price was reasonable (the correct market price) for the work.
P.2	2.1) Giving less attention to the clarification phase (-)	During the clarification phase, the vendors acted as if the contract had already been signed. They were already in the "execution mode," and were already working on their plans instead of understanding that they were still under evaluation.
	2.2) Difficult to disqualify a vendor from the clarification phase (-)	In case 8, there was a deviation from the proposed plan because the vendor's plan was unclear, leading to an increase in the budget during the clarification phase. The client continued with that vendor instead of disqualifying them and ended up restarting the clarification phase with a second vendor.
P.3	3.1) Innovation (+)	The value-adding document was a great source for innovative ideas in the projects. It gave the vendors a valuable opportunity to present the expertise and solutions that they had identified earlier but were not able to implement.
	3.2) Better end product (+)	BVP gave the vendors more room to come up with their solution to the project and to implement it. As a result, it produced greater project success and better end products.
	3.3) Better cooperation, relations, and satisfaction (+)	During this study, not all the case projects were finished with the project execution phase. However, most of the case projects that had completed the execution phase experienced better cooperation and client/vendor relations during the execution phase and better satisfaction with the end product.

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Table 4.7 – *continued from previous page*

	Experiences	**Observations from the interviews**
P.4	4.1) Early project risk identification, better project control, and predictability (+)	Earlier risk identifications, better project time, and budget control were raised by interviewees as positive experiences with the use of the BVP method. The BVP method facilitates early identification of project risk because the assessment of the client's risk was used as one of the selection criteria.
	4.2) Meeting the vendors before contract signing (+)	According to most interviewees, the interactions with the vendors during the interview process and clarification phase provided them with excellent knowledge of the vendor. Through these interactions, the client was able to evaluate the vendors as a company and the persons that would be involved in the project before contract signing.
	4.3) Reduced resource needs (+)	Several interviewees described the BVP method as an effective way to procure. The clients were able to carry out the procurement faster because they were not expected to specify the project in detail. The clients' preparation phase before the procurement began was also shorter because they were not expected to prepare detailed specifications. Furthermore, BVP was considered effective by most interviewees since only one vendor develops the project together with the client during the clarification phase.
	4.4) Failure of paradigm shift (-)	Most of the interviewees experienced both the client and the vendor falling back into their traditional roles.
	4.5) Difficult to find the balance between letting go and involvement (-)	In most of the cases, the client found it challenging to let go of their traditional control because the outcome was unknown and because the client technicians were used to working with particular risk profiles. It was difficult for the client to find the balance between letting go and being involved in the project.
	4.6) Misunderstanding the BVP method (-)	In some of the case projects, both the client and the vendor misunderstood the BVP method. In the selection phase, some vendors saw the interview process and documents as 'sales talk.' Also, during the clarification phase, some of the client personnel thought that they could direct, control and manage the vendor.
	4.7) Limited time frame (-)	Limited time frame for some of the vendors because their position in the supply chain was identified as a challenge.

In Table 4.8, the interviewees' experiences with BVP are presented case by case. The numbering for the experiences from Table 4.7 is used. Also, the frequency of these experiences is summarized at the end of the table.

Table 4.8: BVP case by case experiences

Cases	**0)Prequalification**	**1)Selection**	**2)Clarification**	**3)Execution**	**4)Multi-phase**
1	0.1	1.1			
2				3.2; 3.3	4.3; 4.6; 4,1
3			2.1	3.1	4.6
4		1.1	2.1	3.2; 3.3	4.1; 4.5; 4.4
5	0.1	1.1		3.1; 3.2; 3.3	4.6; 4.7
6		1.1		3.2	4.6
7				3.1; 3.3	4.6; 4.3
8	0.1		2.1; 2.2	3.2; 3.3	4.6
9		1.2	2.1		
10					4.3; 4.6
11		1.1; 1.2		3.1; 3.2; 3.3	4.3; 4.5
12	0.2	1.1; 1.3	2.1	3.1	4.1; 4.2; 4.3
13	0.1; 0.2	1.1			4.1; 4.2; 4.3; 4.4; 4.5
14		1.1		3.1; 3.3	4.1; 4.2; 4.3
15			2.1		4.3
Frequency	0.1*4; 0.2*2	1.1*8; 1.2*2; 1.3*1	2.1*6; 2.2*1	3.1*6; 3.2*6; 3.3*7	4.1*5; 4.2*3; 4.3*8; 4.4*2 ;4.5*3; 4.6*7; 4.7*1

Figure 4.5 illustrates an overview of experiences with BVP from the 15 cases divided into the four BVP phases. Single-phase experiences are presented above the four phases diagram, and multi-phase experiences are provided below it.

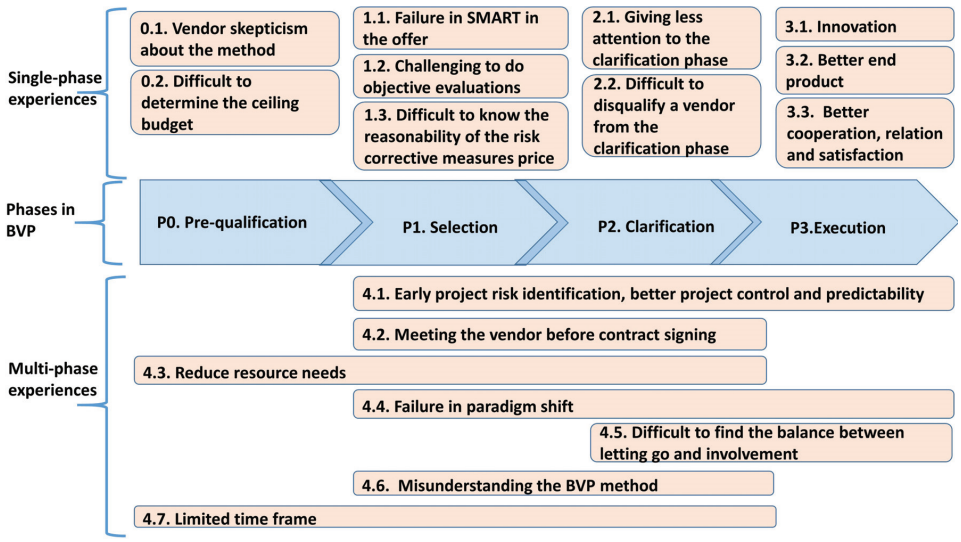

Figure 4.5: Overview of the experiences with BVP

Failure of offer to be SMART (specific, measurable, ambitious, realistic, time-bound) in the vendor's offer was one of the findings of this study, and is considered to be the major challenge of the BVP method. Challenges that are associated with failure of SMART offers were observed in eight of the cases. This deficts pressures the clients to make decisions during the selection phase, which is against the basic principles of BVP. This study also identified that vendors struggled with SMART during the different phases of BVP because they were not used to it. During prequalification – training sessions for the vendors – emphasis and attention should be given to the importance of SMART offers and on how to prove one's capability by showing SMART and dominant information.

4.2.4 A comparison of CD and BVP

This section compares CD and BVP to determine the similarities and differences between them, and discusses which approach suits what kind of project situation. Two case studies (see Paper 5 in Table 1) that used interviews and document study helped to add to the knowledge gained through the literature review and to understand how CD and BVP were interpreted in practice. Furthermore, the case studies contributed to determining the comparison factors and facilitated the analysis process. The two approaches have similarities, including, for example:

1. both are approaches used to involve the contractor in the early phase of projects;
2. both can be used under the EU legislation;
3. both are more suitable for a design-build (DB) contract than a design-bid-build (DBB) contract; and
4. both allow interaction between the client and suppliers during the procurement phase but before contract award, such as, for example, during the interview, dialogue, and clarification stages.

A summary of major differences between the two approaches is presented in Table 4.9 without recommending one of them over the other.

Table 4.9: Comparison between competitive dialogue (CD) and best value procurement(BVP)

No.	Comparison factors	CD	BVP
1	Timing of selection	Late selection	Early selection
2	Prequalification	Mandatory	Optional
3	Interaction	Dialogue	Clarification
4	No. of competitors that develop a project	≥ 3	1
5	Client's control over the details of the supplier's solution during the procurement	High control (the client knows best – the contractor is hired to do the job)	Low control (the contractor knows best – they are selected because of their expertise)
6	Client's role in the selection of the solution	The client can filter the contractors' solutions in the dialogue phase	The contractor presents the solution in the clarification phase
7	Client's resources needed during the procurement	Demanding	Less demanding
8	Suppliers' resource needs during the procurement	All shortlisted suppliers are required to develop solutions, and it is demanding for all suppliers	Only one supplier develops solutions, and it is demanding only for only one of the suppliers
9	Selection criteria	Technical and varies with project	Non-technical and standardized
10	Weight qualification / price	10% to 40% / 90% to 60%	75 % / 25%
11	Suppliers compete and are evaluated based on	Project-specific solutions and price	Four standard criteria and price
12	Evaluation method/scale	Not standardized	Standardized
13	Documents from the competitors to be evaluated by the client	Comprehensive documentation	Maximum of six pages documents
14	Historical origin	EU	USA
15	On what kind of projects can it be used?	EU public procurement directive describes five circumstances in which the approach can be used	On all kinds of projects
16	Client access to suppliers' ideas	The client gets access to several ideas at a time	The client gets access to only one idea
17	In what situation is the approach suitable	If a client wants to choose a supplier based on their solution for a specific project	If a client is looking for an expert who has done relevant things several times with high performance

The first comparison factor is the timing of the selection. In CD, the selection phase is after the dialogue phase. In BVP, the clarification phase, which is comparable to the dialogue phase in CD, comes after the selection phase. The purpose of the selection phase in the two approaches differs. In BVP, the purpose is to shortlist and select the best-qualified contractor for the clarification phase, whereas in CD, the purpose is to award the contract. Furthermore, even if the dialogue phase in CD and the clarification phase in BVP are comparable regarding the client meeting with suppliers before contract

signing, they have a different purpose. The purpose of the clarification phase in BVP is for the selected supplier to explain the scope of the project to the client. The purpose of this discussion is to clarify what is included and not included in the scope of the project. Alternatively, the purpose of the dialogue phase in CD is to discuss all aspects of a project with several prequalified and shortlisted suppliers to find, develop, or select an optimal solution. These differences between the two approaches provide a signal for both clients and suppliers regarding the amount of extra resources the contracting parties use in the procurement phase by choosing one approach over the other.

In CD, prequalification is mandatory before the dialogue phase because the dialogue phase is demanding. In BVP, prequalification is optional because the whole BVP phase can function as prequalification. This means using BVP together with open or restricted procurement procedures is possible whereas CD should be used together with the restricted procedure.

In CD, the interaction between the client and suppliers is dialogue with the purpose of developing an optimal solution for the project. In BVP, the interaction consists of the best value supplier clarifying the scope of the project and presenting a detailed schedule. In CD, during the dialogue phase, the suppliers and client work together to develop an optimal solution. In BVP, the supplier that is selected for the clarification phase is considered the expert. Therefore, the supplier is best positioned to clarify the scope.

The next comparison factor is the number of suppliers (competitors) who develop a solution for the project. In CD, at least three suppliers should develop solutions to make sure enough competition exists, and losers are paid some amount against their cost. This approach is reasonable because the selection of a supplier is based on their solution to a specific project and because the selection phase is not over yet. However, in BVP, only one supplier should develop a project because the selection phase is already over.

The client's control of the details of the supplier's solutions during the procurement phase is another comparison factor. In CD, a client selects suppliers based on their solution to the project. This means the client must know details of the suppliers' solutions during the procurement. In BVP, a client selects suppliers based on their past performance. The philosophy behind BVP is to decrease a client's decision making, management, and control of the expert supplier. All of these factors lead to less focus on the supplier's detailed solutions during the procurement.

The next comparison factor is the resources (time and money) spent by the client and suppliers during procurement. In CD, several suppliers develop solutions for a project during the dialogue phase. The client should have parallel confidential dialogues with each supplier that is involved in this phase. At the same time, the client should give similar information and treat all suppliers equally to avoid giving any kind of competitive advantage to one over the other. All of these factors make CD demanding for the client and for all suppliers that are involved in the dialogue phase. In BVP, only one supplier develops a solution during the clarification phase. This makes the procurement phase less demanding for the client and for suppliers that are not selected.

The next comparison factor is the selection criteria. Both CD and BVP use MEAT as a selection method. However, how MEAT is interpreted differs in the two approaches. In CD, the MEAT criteria are technical and vary from project to project. In BVP, the MEAT criteria are non-technical and are the same for all types of projects. In BVP, the same five criteria (past performance metrics, ability to identify risk, additional value they can provide, the capability of their key personnel, and price) should be used in all kinds of projects, even if the weighting could vary based on the project's needs.

The volume of documents the suppliers submit varies in the two approaches. In CD, since the selection of a supplier is based on their solution to a project, suppliers describe their solutions in detail in the form of comprehensive documentation. In BVP, the suppliers can submit a maximum of six pages (two pages of performance matrix, two pages of the client's project risk, and two pages of the value adding plan).

European public procurement directives specify five situations in which CD may be used in a project. At least one of the circumstances should be fulfilled to use this method. However, no public procurement laws and regulations exist that regulate or prohibit use of BVP in public sectors. As long as BVP is used within the existing basic public procurement laws and regulations, implementing the approach in all types of projects is possible.

In CD, the client gets access to several suppliers' ideas at the same time during the dialogue phase. The selection in this approach is based on the best idea for the project. Therefore, CD provides the client with an opportunity to see multiple alternatives and to select an optimal and innovative solution for the project. In BVP, the client only recives a single proposal/solution from the prequalified supplier during the clarification phase.

The selection in this approach is based on best past performance. Only one supplier (the best value supplier) presents a plan for the project during the clarification phase. The client asks questions and comments during this phase if they think major concerns are not adequately addressed by the plan. If the client manages to document the scope presented by the supplier and it does not address their major requirements, the client can disqualify the supplier from the clarification phase. Then, the client can invite the second-best value supplier to the clarification phase to present a plan.

In sum, one may conclude that CD suits instances when clients want to choose a supplier based on a solution for a specific project. BVP suits instances when a client is looking for an expert that has completed relevant projects repeatedly with high performance.

4.2.5 Summary

ECI has several advantages for both clients and contractors, and the participants value the potential of it. However, ECI is a new experience for the NPRA and its contractors. The Norwegian bridge sector has insufficient experience with early contractor involvement. Most of the approaches used in the Norwegian bridge projects are basic and indirect approaches. Furthermore, they were implemented in the late phases of the projects. Other Norwegian public infrastructure sectors have relatively better experience than the bridge sector because the CD and BVP approaches have been attempted to a certain extent. The bridge sector can learn a lot from other public infrastructure projects regarding how to involve the contractor in the early phase of projects.

In addition to the involvement of contractors in the early phases of the project, the dialogue phase in the CD/clarification phase in BVP provides an ideal opportunity for both the clients and suppliers to understand each other's needs better before contract signing. In these meetings, the focus is on how to reduce the risk of the project, which, in turn, leads to better project control and cooperation during the project execution phase.

As CD and BVP should be used together with MEAT, clients were forced to think about the value for the project and the end product users' needs during the planning phase to use as selection criteria for MEAT. Thus, it can be said that ECI based on CD and BVP approaches forces public clients to consider the long-term effect of their projects and the value they want to achieve through the project in the preparation phase.

4.3 Measures

The third research question is addressed based on the three groups of case studies and the three topics.

For the first topic, the success factors of ECI are the basis for develop suggestions regarding the measures that ought to be implemented in future projects using this approach. Few authors have discussed the success factors of ECI with the intention of increasing the understanding of the ECI concept from a public procurement perspective.

For the second topic, the practical issues identified from Norwegian CD projects can be used as the basis for developing suggestions regarding the measures that ought to be implemented in future projects using CD. The limited amount of research in practice issues in CD opens up these types of measures for new consideration.

For the third topic, success factor and pitfalls of BVP provide the basis for developing suggestions regarding measures for future projects using the method. Few researchers have studied success factors and pitfalls of BVP, creating the opportunity to improve using new measures.

4.3.1 Measures for ECI

Six general measures that should be implemented for the success of ECI were identified during the first group of case studies. Each measure is presented in detail in Paper 1 (Wondimu et al., 2018a).

Table 4.10: Measures that ought to be implemented for the success in ECI

No.	Measures that ought to be implemented for the success of ECI
1	Involve contractors early enough
2	Manageable risk transfer to the contractors
3	Increase project owners' competence in public procurement using ECI
4	Proper compensation for the contractors' contribution
5	Selection of contractors based on higher weight on qualification
6	Build trust between the project owner and contractors

These measures would be valuable in formulating effective and practical strategies to improve the overall implementation of ECI.

1. **Involve contractors early enough**: When the contractors are involved early enough, their contribution and influence on major decision making can be strong.

Despite this, for standard and less complex projects, there may be less value that can be added by involving them too early. Furthermore, contractor involvement too early in the procurement process increases bureaucracy and expenses. On the other hand, if contractors get involved too late, they will make little contribution because many decisions will have been made in the earlier phases. Due to the time required to complete the control and approval process of projects as well as client resistance. Therefore, finding an optimal time for the contractor's involvement in each project is important.

2. **Manageable risk transfer to the contractors**: A project owner should work on risk distribution of a project to make it fair, to make the project attractive for contractors, and to motivate them to participate in the early phases. This effort can also help avoid conflicts later in the project execution phases. If the project risk level that will be transferred to the contractors is high, attracting interested contractors who are willing to do the job could be difficult. Unfair transfer of risks to the contractor does not necessarily mean that a consequence exists only for the contractor, but it may make the project unnecessarily expensive and also affects the owner. Lack of participation in the bidding of such projects would likely be accompanied by a higher risk buffer being set by the contractors.

3. **Increase project owners' competence in public procurement using ECI**: The ECI procurement procedure can be demanding. If the owner makes a minor mistake during the procurement process, it may cause a major interruption in a project. Furthermore, it may lead to difficult court proceedings and damages. Therefore, it is important that project owners develop their public procurement competence regarding ECI.

4. **Proper compensation for the contractors' contribution**: The main goal for contractors is to get profit from a project. The contractors' interest in participating in an early phase of a project and their eagerness to contribute vary significantly depending on the compensation arrangement. Therefore, a client should compensate contractors properly to ensure that the contractors share their knowledge with the client.

5. **Selection of contractors based on higher weight on qualification**: When a public owner invites contractors to be involved in the early phases of a project development process, the intention is to take advantage of the contractors' experience that has been acquired from previous similar projects. Therefore, the contractor should be capable and be able to contribute to the new project based on previous experiences. Thus, the selection criteria should be based on a higher weight on qualification.

6. **Build trust between the project owner and contractors**: No contractor wants to share their knowledge, experience, or ways of solving project challenges with their competitors. Therefore, public project owners should first develop an appropriate plan to make sure that the contractors' solutions stay confidential in the client's system before inviting them for early involvement. A one-on-one dialogue in a closed environment increases the contractors' trust level regarding the client. As a result, it makes the contractors more open and allows them to share new ideas. According to Kadefors (2004), higher level of trust would improve project performance.

4.3.2 Measures for CD

Based on the second group of case studies, several measures are identified that ought to be implemented for the success of future projects using CD are identified. These measure are presented in detail in Paper 2 (Wondimu et al., 2018c). In the following section, five of them – one from each phase – are presented briefly.

Table 4.11: Measures that ought to be implemented for the success in CD

No.	Measures that ought to be implemented for the success of CD
1	Secure sufficient competition
2	Provide flexibility to the contractors
3	Standardize the evaluation process
4	Provide Proper compensation for the contractors' contribution
5	Transfer experiences between projects

These measures would be valuable in to improve the practice of CD in future projects. The above five measures are discussed briefly below.

1. **Secure sufficent competition**: In the preparation phase, the client should take

several measures both to attract market interest and to develop a strong base for the next phases. First, the client should work to increase market interest. Clients can increase market interest through communication with suppliers, repeated use of the same implementation models, and preparing strategic plans and communicating them with the supplier market. Furthermore, the client should pay reasonable compensation or losers' fees for the suppliers to be involved in the project. More focus should be given to the preparation phase of the CD process because the core factors are determined at this phase. In order to develop a strong base for the next phases, the client should use less detailed function descriptions, inviting only three suppliers into the dialogue phase and should select MEAT criteria and weigh them based on key factors of the project. These measures are likely to secure sufficient competition while decreasing the resource demands and increasing the suppliers' flexibility to come up with innovative solutions in the next phases.

2. **Provide flexibility to the contractors**: To encourage suppliers to develop innovative solutions during the dialogue phase, the client representatives should be open to new ideas. Using the procedure in the early phase of a project provides more flexibility for the contractors to suggest new solutions and makes it easier for the client to accept new solutions because major decisions have not been made (earlier use of the procedure). The client should prepare a dialogue frame document that demands innovation and provides flexibility. Specifications should be minimized and more function description used to provide more room for the suppliers. The client should be willing to accept new and innovative solutions during both the dialogue phase and execution phase. More flexibility should be provided to the suppliers in the dialogue phase and execution phase. Furthermore, the client should involve necessary expertise at the appropriate time during the dialogue. CD demands honesty, openness, and trust. Both the client and suppliers should be in the mode the procurement form demands. Regarding the sub-awarding criteria, determining them and weighing them in the preparation phase is not easy. However, the client should communicate the sub-awarding criteria while emerging in the dialogue phase. More focus should also be given to decreasing project risk in the dialogue phase. To have flexibility in the length of the dialogue phase depending on the market situation and

project complexity is also an important measure.

3. **Standardize the evaluation process**: In the evaluation phase, standardization of the evaluation process and increasing transparency of the evaluation process could remove the challenges that are related to the evaluation based on MEAT criteria. Selection criteria that demand innovative and new solutions should be determined. Regarding the evaluation team composition, the possibility for a biased evaluation could be decreased, and the knowledge from the dialogue phase could be maintained by involving new personnel that were not involved in the dialogue phase of the evaluation team. Regarding granting the losers' fees, having two stages of losers' fee arrangements is reasonable. However, the client should evaluate the suppliers through the dialogue phase and compensate only those who are qualified.

4. **Provide proper compensation for the contractor**: In the execution phase, the compensation format should facilitate better cooperation between the client and suppliers. The compensation format could influence how the client reacts to different solutions from the supplier in the project execution phase. If the supplier comes up with solutions during the execution phase that demand cooperation and a significant contribution from the client, the client might be less motivated to cooperate or to take a significant risk. However, if the supplier comes up with a solution that also enables savings during operation and maintenance, such a solution could be interesting for the client. Furthermore, if the client wants to use the solution of the losing suppliers, the client should pay higher losers' fees and thereby buy the concepts developed by the losing suppliers, or the client should share the savings resulting from the losing suppliers' solutions.

5. **Transfer experiences between projects**: Several measures can compensate for the lack of practical experience in the CD procedure and make sure that experience is transferred from one project to another. First, the client can have one or a group of process leaders that are available for projects using CD. Second, if the client uses the procedure more often in the future, both the client's and the suppliers' will increase. Third, establishing the project organization by combining experience with new personnel will also compensate for the lack of practical experience in the CD procedure.

More measures that ought to be taken for the success of future projects using CD are summarized and presented in Figure 4.6. Each measure is presented in detail in Paper 2 under findings and discussion section (Wondimu et al., 2018c).

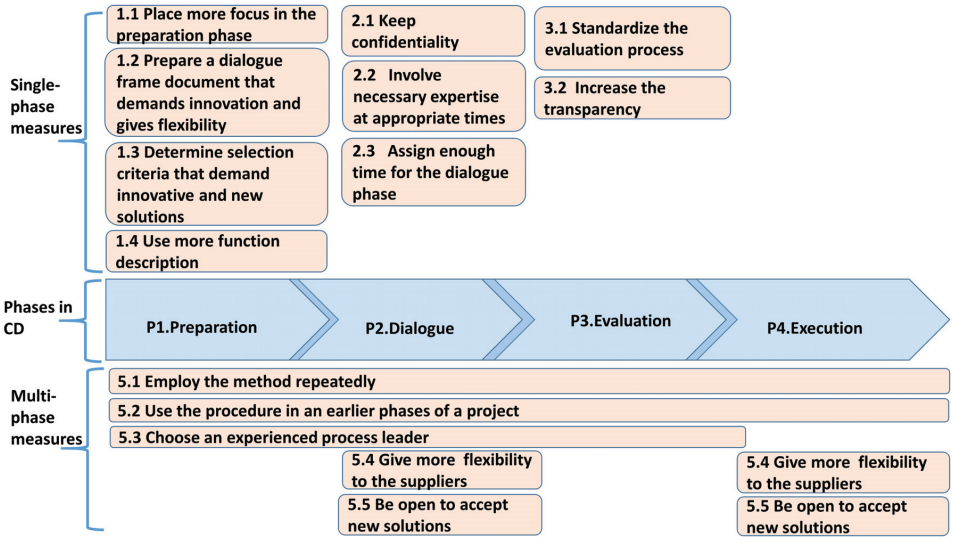

Figure 4.6: Measures that ought to be taken for the success of future CD projects

4.3.3 Measures for BVP

Based on the second group of case studies several measures that that ought to be implemented for the success of future projects using BVP are identified. The measure are presented in detail in Paper 3 (Wondimu et al., 2018c). In the following section, five of them – one from each phase – are presented briefly.

Table 4.12: Measures that ought to be implemented for the success in BVP

No.	Measures that ought to be implemented for the success of BVP
1	Enable early phase resource investment
2	Confirm contractor claims
3	Creat good documentation
4	Use the method throughout the project phases
5	Choose a visionary leader

These measures would be valuable in to improve the practice of BVP in future projects. The above five measures are discussed briefly below.

1. **Enable early phase resource investment**: During the pre-qualification phase, the client should spend enough time in the early phase to define good, clear, and

project-specific overall project goals. Furthermore, focus should be given to the selection criteria weight and the task division. The client's ability to identify the entirety of project goals in a clear and precise way and to include lifetime perspectives in project goals should help achieve a better result in the project output. The project budget should be enough to have margins and make tunings, provide more freedom, and create the opportunity for better solutions.

2. **Confirm contractors claims**: During the selection phase, the client should be particularly careful when evaluating each vendor's offer since it might give the wrong image of the vendor. How the vendor really performed should be checked with an independent source. Whatever claims they make should be verifiable. Additionally, during the interview, having follow-up questions could help to differentiate sellers from experts. To increase transparency in the method, the developer of the BVP method suggests that instead of rating vendors as non-expert with a rating below 5 out of 10, using 5 as the lowest rating works best.

3. **Create good documentation**: The clarification phase should be well documented in case the client wants to disqualify a vendor from the clarification phase and go to vendor number two. Persons that have soft skills in group dynamics. Involving lawyers from both the client and vendor sides as BVP core team members could help create a better and clearer line between scope negotiation and scope clarification. Using this approach, the likelihood of making mistakes and ending up in a lawsuit may be mitigated.

4. **Use the method throughout the project phases**: The BVP philosophy works best when implemented throughout the entire project rather than only during the procurement phase. Continuous improvement in the client's and the vendor's competence in the method is important to achieving the goal of following the philosophy. Implementing BVP in slightly different ways might create confusion, especially for vendors. Future projects should follow the standard BVP procedure. Furthermore, the method should be more standardized to avoid confusing vendors when the method is used in different projects. At the same time, it needs to keep its flexibility to be used for any kind of project.

5. **Choose a visionary leader**: A visionary leader in the core team can decrease the probability of falling back into traditional roles. It can also motivate others to use the method on several other projects in an organization because a visionary leader has the potential for serving in a promoter role. Furthermore, having a BVP advisor on both sides is recommended; this step is expected to lead to the best execution of BVP. Hiring a BVP expert to provide assistance throughout the project phases and taking courses about the method can help both the clients and vendors develop their capacity on the method. The client can include it as a requirement in the contract, or the client can arrange a course at the beginning of the project to facilitate the vendors' adaptation to the method. Most of the above recommendations are also discussed by Kashiwagi (2016). The importance of a visionary leader when starting to use the method in an organization is emphasized in his book because the method demands a paradigm shift.

More measures that ought to be taken for the success of future projects using CD are summarized and presented in Figure 4.7. Each measure is presented in detail in Paper 3 under findings and discussion section (Wondimu et al., 2018b). To answer how BVP should be implemented in future projects, I studied success factors and pitfalls of the method. The pitfalls are summarized and presented under the following subtopics: 1.1) A good seller can sell his solution easily 2.1) Higher probability of legal cases 2.2) Difficult to disqualify a vendor from the clarification phase. The remaining subtopics are measures that ought to be implemented for the success of future projects using BVP.

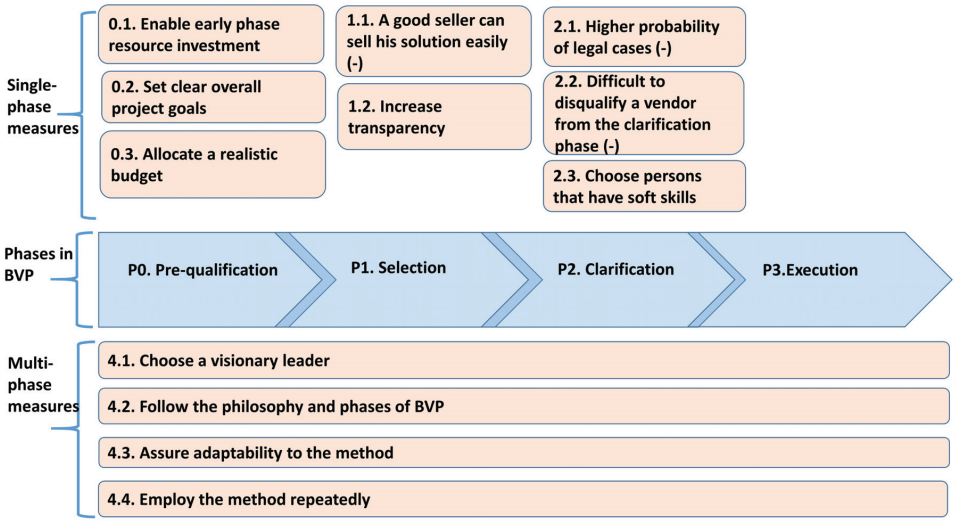

Figure 4.7: Measures that ought to be taken for the success of future BVP projects

4.3.4 Summary

Public owners in Europe can involve the contractor during the early phase of projects using various approaches. Furthermore, based on the measures identified above, effective practical strategies for the successful implementation of ECI may be generated. The findings provide several useful insights for assisting public owners in determining important success elements when attempting to involve the contractor in the early phase of projects. Such identification of improvement measures would be valuable in formulating effective practical strategies to improve the overall implementation of ECI.

During the involvement of contractors in the early phase of future projects, focus should be given to the general measures of ECI and specific measures of individual ECI approaches to get as much potential benefit as possible. Additionally, since ECI has several advantages over traditional procurement methods, it should be used more often, and in more projects, than in current practice. Different approaches to ECI than those attempted thus far should be experimented with in the Norwegian construction industry. The purpose of such experimentation would be to identify appropriate approaches that suit the Norwegian construction industry needs and culture. Furthermore, it is can increase the experience for both clients and the contractors with different ECI approaches.

Chapter 5

Major Contributions and Further Research

This section presents the major contributions of the thesis, contribution to practice, and areas for further research.

5.1 Major contributions

The purpose of this thesis is to understand more about how to involve the contractor in the early phase of public projects in order to develop suggestions for the success of future projects. While achieving this aim, this thesis makes three major contributions. First, it explores Norwegian experiences from CD and BVP approaches. In addition, it explores Dutch experiences with the BVP approach. Second, it describes the type of project situations in which CD and BVP are more appropriate. Third, the study provides suggestions regarding the type of measures that ought to be taken for the success of future projects that are going to use ECI. The first two major contributions address the primary purpose of this thesis, which is to understand more about how to involve the contractor in the early phase of public projects. The third major contribution addresses the second purpose of this thesis, which is to develop suggestions for the success of future projects. Each of these contributions is explained in detail below.

ECI is a concept that refers to the engagement of contractors during the early stage of project development through a wide range of methods. Public owners from different

countries can involve contractors in the early phase of projects through various methods. Public owners from different country have developed various ECI models based on their necessities and circumstances. Consequently, no universal way exists to implement ECI. Instead, several implementation approaches exist. As the first major contribution, this thesis presents several alternative ECI approaches that can be used to involve the contractor in the early phase of public projects.

As the second major contribution, this thesis explores in detail two ECI approaches – namely CD and BVP. It also explores Norwegian experiences from CD and BVP approaches. In addition, it explores Dutch experiences from BVP approach. Furthermore, it develops an explanation about the kinds of project situations for which each approach is best suits. The primary similarity between BVP and CD is that public owners can use this approaches to involve the contractor during the early phase of projects. The other similarity is that they allow interactions between the client and suppliers before contract signing. The major differences include the following: In CD, several suppliers develop solutions for a project, whereas only one supplier clarifies and develops the project in BVP. Furthermore, BVP is a standardized and effective method compared to CD during the procurement phase. These factors are illustrated in detail in Table 4.9.

BVP is suited for instances when a client looks for a supplier who has significant experience in relevant projects with documented high performance. CD is suitsed for instances when a client is willing to invest more in the procurement phase to increase the product value by allowing competition between several ideas (solutions) suggested from different interested suppliers. BVP is an effective procedure and reduces expenses during the procurement phase. CD is an expensive procedure during the procurement phase, but it is a good method for increasing the value of the end product. It facilitates selecting and implementing project solutions that suit the project and the client's needs.

The third major contribution of this thesis is a set of suggestions on the measures that ought to be taken for the success of future projects implementing ECI. Some of the suggestions include: involving contractors early enough, transferring manageable risks to the contractors, increasing project owners' competence in public procurement using ECI, ensuring proper compensation for the contractors' contribution, selecting contractors based on higher weight on qualification, and building trust between the project owner and contractors. In addition to the six major measures above, more specific measures are

developed for CD and BVP approaches. These measures are divided into four phases and presented in Figures 4.6 and 4.7.

This research proves that several alternative forms of ECI exist that can be used in the public sector. ECI in the public sector is, in fact, possible. Involving contractors earlier in a project than is currently practiced is highly recommended. Complex projects, such as Norway's coastal highway route E39 projects, can benefit from involving the contractor early. This study contributes to these projects by presenting alternative approaches that can be used to involve the contractor in the early phase. Furthermore, this study contributes by studying two ECI approaches in detail and by focusing on how to use them for the success of future projects using the approaches.

5.2 Further research

Several practical challenges with the practise of CD and BVP are identified during this study. These challenges are potential areas for further study. Furthermore, the findings from this study, in combination with future findings, will be valuable for researchers who want to develop a set of best practice guidelines for ECI. This study also identifies potential ECI approaches that can be studied in detail.

Only two out of the several ECI approaches are studied in detail in this thesis. In the future, further detailed research can be conducted on other ECI approaches. Future studies should focus on the conditions under which the various ECI approaches are used. The studies should also explore participant experiences of using the different ECI approaches. Furthermore, what measures ought to implemented in future projects using the approaches should be explored. International experiences with ECI should also be studied to cross-reference experiences with different ECI approaches. The long-term effects of implementing ECI can also be studied through life-cycle assessment of completed projects.

This Ph.D. thesis explores ECI used for infrastructure projects from the client's perspective and at a project level. In the future, ECI should also be studied in projects other than infrastructure from a non-client perspective and at a company strategy level to get a broader understanding of the topic.

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Appendix: Core Papers

A Core paper 1

EARLY CONTRACTOR INVOLVEMENT APPROACHES IN PUBLIC PROJECT PROCUREMENT

Journal of Public Procurement

B Core paper 2

COMPETITIVE DIALOGUE
IN NORWEGIAN PUBLIC INFRASTRUCTURE PROJECTS

Journal of Construction Engineering and Management

C Core paper 3

EXPERIENCES WITH BEST VALUE PROCUREMENT (BVP) IN NORWAY AND THE NETHERLANDS

Journal of Construction Engineering and Management

D Core paper 4

A COMPARISON OF COMPETITIVE DIALOGUE AND BEST VALUE PROCUREMENT

In: Proc. 26 th Annual Conference of the International Group for Lean Construction (IGLC)

Wondimu, P.A., Klakegg, O.J., Lædre, O., and Ballard, G. (2018). "A comparison of competitive dialogue and best value procurement" In: *Proc. 26th Annual Conference of the International. Group for Lean Construction (IGLC), González, V.A. (ed.)*, Chennai, India, pp. xx–xx. DOI: https://doi.org/10.24928/2018/0248. Available at: <www.iglc.net>.

A COMPARISON OF COMPETITIVE DIALOGUE AND BEST VALUE PROCUREMENT

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ABSTRACT

Competitive Dialogue (CD) and Best Value Procurement (BVP) are two different approaches to early contractor involvement (ECI) in public projects. However, it is not clear which approach is best suited for what kind of project situations, and which is better for implementing lean in public procurement. The purpose of this paper is to explore the similarities and differences of these approaches to develop recommendations for how to match approach with project situations. In addition to literature study, two large infrastructure projects were studied through 12 in-depth semi-structured interviews and review of documents. The findings from this study indicate that the two approaches have several similarities; e.g., both give a better result when they are used together with a design-build contract than design-bid-build contract, and they give clients possibilities to meet suppliers and clarify projects before contract signing. However, they also have a number of differences such as the number of competitors that develop a project and a supplier selection premises varies. The study concludes that BVP is a more effective procurement process than CD as regards procurement phase. However, CD gives more room for the clients to influence supplier solutions than BVP.

KEYWORDS

Best value procurement (BVP), competitive dialogue (CD), lean, early contractor involvement (ECI), public procurement.

INTRODUCTION

Main contractors have more experience than clients and designers in construction materials, methods, and local practice. Therefore, they can provide relevant information not only about generic constructability but also about resources availability and limitations in terms of cost, performance, access and site conditions. Construction knowledge and experience is an important element of lean construction. One of the ways to integrate construction knowledge and experience in early phases of a project is early contractor involvement (ECI) (Song et al. 2009). The main goals of ECI are project control, time gains, and innovation (Mosey 2009). ECI can eliminate waste of time, cost and effort that bedevils projects

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(Walker and Lloyd-Walker 2015). How clients design the procurement procedure decides how well organizations can be integrated and how well the competence may be utilized. The procurement procedure should create room for creative solutions and intensive exchange of ideas. Early start and an interweaving approach are important in order to create an opportunity for the contractors to play an active role (Lenferink et al. 2012). There are different models of ECI depending on when the contractor gets involved in the project. CD and BVP are two interweaving approaches of ECI that European public owners can use. Both approaches allow interactions between a client and suppliers in early phases of projects and before contract signing (Storteboom et al. 2017; Wondimu et al. 2017).

There is a limited examination of lean thinking in public procurement (Schiele and McCue 2011). There is lack of research in the IGLC community in the area of public procurement, and there is no literature comparing BVP and CD. This paper contributes to addressing this issue by addressing the following research questions.

- What are the similarity and differences between BVP and CD?
- Which approach is best suited for what kind of project situations?
- Which approach is better to implement lean in public sector projects?

This study has some limitations since the cases are limited to only two Norwegian public road projects.

METHOD

The research reported in this study includes literature review and two case studies. The two cases were chosen because they are the first large infrastructure projects in Norway that have used the two approaches. The methodological approaches described by Yin (2014) was used during the case studies.

Literature review formed the basis for the theoretical background. The review of literature was undertaken using IGLC.net conference papers database in addition to the search engines Oria and Google Scholar. Oria is a Norwegian University library resource. Besides, citations chaining according to the principles laid out by Ellis (1993) was also used to find new literature.

The two cases were studied based on 12 in-depth semi-structured interviews with senior professionals from both client and contractor organization. Each interview was carried out face-to-face based on an interview guide and lasted between 60 minutes to 90 minutes. All interviewees were recorded and later transcribed.

A document study was carried out after the literature review and interviews. The document study included tender documents, tender evaluation protocols, and contracts. The purpose of the document study was to supplement the literature review and interviews and to achieve data triangulation. The data were hand-coded and analyzed while data were collecting and writing up the findings based on the description of Creswell (2013).

Table 1: Overview of cases and the respective interviewee's position

Client/Project name	Project Description (Budget €)	Proj. start-finish	Interviewee's position	ECI Approach
1) Nye veier/E18 Rugtvedt-Dørdal	16.5 km new four-lane highway (€200 mill)	2017 - 2019	Project director, Assistant project director, Contract and procurement director, Construction manager, Environmental advisor, & Construction discipline leader (6 from the client).	BVP
2) Statens Vegvesen/E6-Helgeland North	62 km new two-lane highway (€170 mill)	2015 - 2019	Construction manager, project manager and a representative from Statens Vegvesen head office (3 from the client) & project manager, quality manager and geotechnical engineer (3 from the contractors)	CD

THEORETICAL BACKGROUND

LEAN AND EARLY CONTRACTOR INVOLVEMENT (ECI)

Based on the Lean Construction Institute recommendation for projects to approach optimality, three elements are required. Those are an integrated organization, aligned commercial interest, and lean management. These elements are also called LCI triangle, see Figure 1. An integrated organization can be interpreted as one in which downstream industry actors participate in upstream activities, and vice-versa. The underlying principle for this side of the LCI triangle is that all relevant competence/knowledge are to be applied simultaneously to the generation, evaluation, and selection of product and process design alternatives. This is based on the view that different actors have relevant knowledge, and consequently must be engaged in generating and selecting from alternatives (Ballard 2012).

One of the main goals of ECI is time gains by conducting parallel or interweaving procedures rather than conducting them sequentially (Lenferink et al. 2012). Based on this goal, the authors of this paper consider ECI as one of the means to create an integrated organization and to approach project optimality. Furthermore, based on the authors' interpretation, both CD and BVP cover the first side of the LCI triangle since the purpose of the approaches is to involve contractors in the early phase.

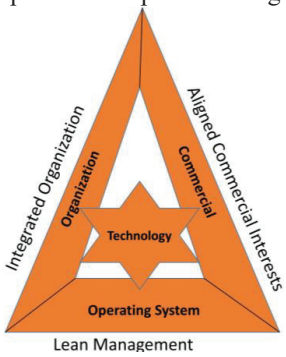

Figure 1: LCI Triangle (Ballard 2012)(driven from Thomsen et al. (2009))

COMPETITIVE DIALOGUE (CD)

The CD procurement procedure was introduced in 2004 by the European Parliament for particularly complex contracts (European Commission 2006). This procurement procedure

allows clients to discuss requirements with shortlisted suppliers before inviting final written tenders (Uttam and Le Lann Roos 2014). EU public procurement directive describes five circumstances in which the approach can be used (European Parliament 2014).

It was introduced to provide an improved method for awarding complex public contracts (Arrowsmith and Treumer 2012). It is also intended to give public clients a flexible procurement procedure to enable a dialogue concerning all aspects of the contract with several competitors. The dialogue is an intervening stage between the tender announcement and the submission of final tenders. It is intended to help the client identify and define the means best suited to meeting its objectives. The awarding method in CD procedure is always most economically advantageous tender (MEAT) (Hoezen and Dorée 2008). MEAT (price-inclusive multi-criteria selection) is the weighted sum of various aspects of products or service that provides value to the project (Wondimu et al. 2016). Public owners can use CD to stimulate innovation through dialogue (Uttam and Le Lann Roos 2014). CD procedure has five phases; preparation, pre-qualification, dialogue, evaluation & selection, and execution, see Figure 2.

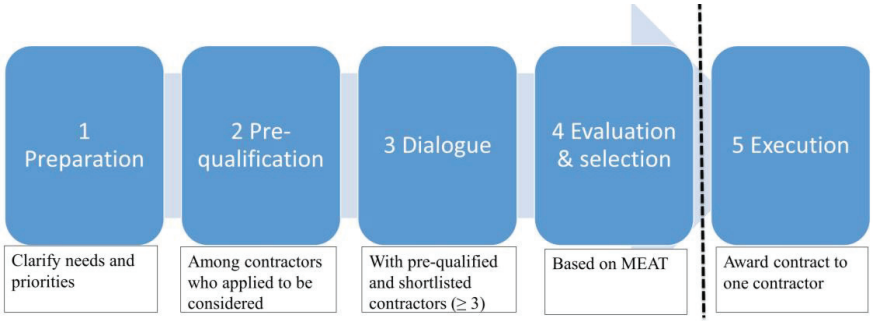

Figure 2: CD phases and major client activities

BEST VALUE PROCUREMENT (BVP)

Best Value Procurement (BVP) BVP is a procurement method that focuses on gaining the best value for the lowest costs (Snippert et al. 2015). A fundamental concept in BVP is the focus on selecting the supplier with the offer that is most advantageous to the client where price and other factors are considered (Elyamany 2010). There are different models of BVP (Perrenoud et al. 2017). This paper explores the BVP model that was introduced by Dean Kashiwagi in 1991 as best value performance information procurement system (BV- PIPS). Regarding BVP there are no EU public procurement laws and regulations that regulate or prohibit from using the approach in public sector.

This BVP model concentrates on minimizing decision making of clients. One of the fundamental things of this BVP model is that the client should not try to be more expert than the real expert is. The client task is to get the right supplier, and they will deliver the best results. Minimizing the none expert (the client) management, direction, and control of

expert suppliers are the philosophy behind BVP. In BVP both price and performance are considered during the selection instead of only price (Kashiwagi 2016).

BVP is an information-based procurement method that predicts the performance of suppliers based on past performance information. Suppliers are ranked and then selected based on past performance, current capability, price, risk management and the quality of key personnel (Duren et al. 2015).

BVP method has four phases; pre-qualification, selection, clarification, and execution, see Figure 3.

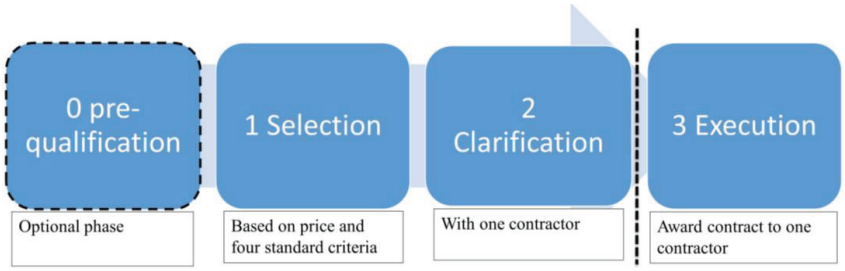

Figure 3: BVP phases and major client activities (developed based on Kashiwagi (2016))

FINDINGS AND DISCUSSION

COMPARISON OF CD AND BVP

This section explores the two approaches to determine the similarities and differences between them and to identify which approach suits for what kind of projects. The two case studies through interviews and document study helped to add to the knowledge gain through literature review and to understand how CD and BVP were interpreted in practice. Furthermore, the case studies contributed in determining the comparison factors and facilitate the analysis process.

The two approaches have similarities such as 1) can be used as an approach to implement ECI, 2) can be used under the EU legislation, 3) work best with a design-build contract than design-bid-build contract, and 4) allow interaction between a client and suppliers during the procurement phase before contract award such as during interview, dialogue and clarification. A summary of major differences between the two approaches is presented in Table 2 without recommending one of them over the other.

Table 2: Comparison between CD and BVP

No.	Comparison factors	CD	BVP
1	Timing of selection	Late selection	Early selection
2	Pre-qualification	Mandatory	Optional
3	Interaction	Dialogue	Clarification
4	No of competitors develop a project	≥ 3	1
5	Client's control on the detail of the supplier's solution during procurement	High control (The client knows best – the contractor is hired to do the job)	Low control (The contractor knows best – they are selected because of their expertise)
6	Client's role in the selection of solution	The client can filter the contractors' solutions in the dialogue phase	The contractor present their solution in the clarification phase
7	Client's resources need during the procurement	Demanding	Less demanding
8	Suppliers resources need during the procurement	All Shortlisted suppliers are required to develop solutions for the project, and it is demanding for all suppliers	Only one supplier develop a solution to a project, and it is demanding only for one of the suppliers
9	Selection criteria	Technical and varies with project	Non-technical and standardized
10	Weight qualification/ price	10% to 40% / 90% to 60%	75 % / 25 %
11	suppliers compete and evaluated based on	Project-specific solutions and price	Four standard criteria and price
12	Evaluation method/scale	Not standardized	Standardized
13	Documents from the competitors to be evaluated by the client	Comprehensive documentation	Max 6 pages document
14	Historical origin	EU	USA
15	On what kind of projects can it be used?	EU public procurement directive describes five circumstances in which the approach can be used	On all kinds of projects
16	Client access to suppliers' idea	The client gets access to several ideas at a time	The client gets access to only one idea
17	In what situation is the approach suitable	If a client wants to choose a supplier based on their solution for a specific project	If a client is looking for an expert that has done relevant things several times with high performance

The most interesting aspects of table 2 invite some comments:

The first comparison factor is the timing of the selection. In CD, the selection phase is after the dialogue phase. Whereas in BVP the clarification phase that is comparable with dialogue phase in CD is after the selection phase. The purpose of the selection phase in the two approaches differ. In BVP, the purpose is to shortlist and select the best-qualified contractor to the clarification phase, whereas in CD, the purpose is to award the contract. Furthermore, even if the dialogue phase in CD and the clarification phase in BVP are comparable regarding the client meeting with suppliers before contract signing, they have a different purpose. The purpose of the clarification phase is a selected supplier explains the scope of the project to the client. That is to clarify what is included and not included in the scope of the project. Whereas the purpose of dialogue phase is to discuss all aspects of a project with several pre-qualified and shortlisted suppliers to find, develop or select an optimal solution to a project. The difference means a lot to both clients and suppliers regarding how much resources both contracting parties use in the procurement phase.

In CD, pre-qualification is mandatory before the dialogue phase since the dialogue phase is demanding. In BVP pre-qualification is an optional phase since the whole BVP phases can function as pre-qualification. That means it is possible to use BVP together with open or restricted procurement procedure. Whereas CD should be used together with restricted procedure.

In CD, the interaction between the client and suppliers is dialogue with a purpose of developing an optimal solution for the project. In BVP, the interaction is that the best value supplier clarifies the scope of the project and present a detailed schedule. In CD during the dialogue phase, the suppliers and a client work together to develop an optimal solution for a project. In BVP the supplier that is selected for the clarification phase is considered as the expert. Therefore, the supplier is best positioned to clarify the scope.

The next comparison factor is the number of suppliers (competitors) that develop a solution for the project. In CD, at least three suppliers should develop solutions to make sure enough competition, and losers are paid some amount against their cost. This is reasonable since the selection of a supplier is based on their solution to a specific project, and since the selection phase is not over yet. However, in BVP only one supplier should develop a project since the selection phase is already over.

The client control during the procurement is the other comparison factor. In CD, a client selects suppliers based on their solution to the project. That means the client should know details of the suppliers' solutions during the procurement. Whereas, in BVP a client selects suppliers based on their past performance. The philosophy behind BVP is to decrease a client's decision-making, management, and control of the expert supplier. All these factors lead to less knowledge and control during the procurement.

The next comparison factor is the resource (time and money) spent by client and suppliers during procurement. In CD, several suppliers develop solutions for a project during the dialogue phase. The client should have a parallel confidential dialogue with each supplier that is involved in this phase. At the same time, the client should give equal information and treat all suppliers equally to avoid giving a competitive advantage to anyone. All these factors make CD demanding for the client and for all suppliers that are involved in the dialogue phase. In BVP, only one supplier develops a solution for a project

during the clarification phase. This makes the procurement phase less demanding for the client and for suppliers that are not selected.

The next comparison factor is the selection criteria. Both CD and BVP use MEAT as a selection method. However, how MEAT is interpreted differs in the two approaches. In CD, the MEAT criteria are technical and vary from project to project. Whereas, in BVP the MEAT criteria are non-technical and are the same for all kind of projects. In BVP, the same five criteria (past performance metrics, ability to identify risk, additional value they can provide, capability of their key personnel (interview), and price) should be used in all kinds of projects even if the weighting could vary based on the project's needs.

The length of the documents the suppliers should submit varies in the two approaches. In CD, since the selection of a supplier is based on their solution to a project, they describe their solutions in detail in the form of comprehensive documentation. In BVP the suppliers can submit maximum six pages (two pages performance matrix, two pages client's project risk and two pages value adding plan).

European public procurement directives specify five situations when CD may be used in a project. At least one of the circumstances should be fulfilled in order to use the method. However, regarding BVP there are no public procurement laws and regulations that regulate or prohibit from using the approach in public sector. As long as it is implemented within the existing basic public procurement laws and regulations, it is possible to implement the approach in all kinds of projects.

In CD, the client gets access to several suppliers' idea at the same time, the during individual dialogue phase. The selection in this approach is based on the best idea to the project. Therefore, CD gives the client to select an optimal and innovative solution for the project. In BVP, the client gets access to only one supplier plan to the project during the clarification phase. The selection in this approach is based on best past performance. Only one supplier (the first best value supplier) present their plan to the project during the clarification phase. The client asks questions and comment during this phase if they think their major concerns are not addressed adequately by the plan. If the client manages to document the scope presented by the supplier does not address their major requirements, the client can disqualify the supplier from the clarification phase. Then, they can invite the second best value supplier to the clarification phase to hear their plan.

In sum, one may conclude that CD suits when clients want to choose a supplier based on their solution for a specific project. BVP suits when a client is looking for an expert that has done relevant things several times with high performance.

CONCLUSIONS

This paper addressed three research questions.

1) What are the similarity and differences between BVP and CD?

The major similarity of BVP and CD is that public owners can use them to implement ECI. Since ECI is one of the important elements of Lean, BVP and CD can be used to implement lean in public sector. The other similarity is that they allow interaction between a client and suppliers before contract signing. Regarding their differences, the major ones are: In CD, several suppliers develop solutions for a project whereas only one in BVP.

Furthermore, BVP is standardized and effective method compared to CD during the procurement phase.

2) Which approach suits for what kind of project situations?

The selection premises in BVP are based on the suppliers' past performances and ability to understand the current project requirement. Therefore, BVP suits when a client looks for a supplier that has done relevant things several times with high performance. The selection premises in CD are based on the suppliers' documentation of their solution to a specific project. Therefore, CD suits when a client is willing to invest more in the procurement phase to increase the product value by competing several suppliers based on their solutions to the project.

3) Which approach is better to implement lean in public sector?

Both BVP and CD can be used to implement lean in public sector. BVP reduce waste and CD increase value. BVP is an effective procedure during the procurement phase, and it reduces waste in this phase. CD is relatively an expensive procedure during the procurement phase. However, it facilitates selecting and implementing project solutions that suit the project and the client needs. Therefore, CD increase project value with minor increase of cost during the procurement phase.

This paper contributes to IGLC community by explaining and comparing two methods that can be used by public owners to implement lean during procurement. Future study may explore the potential that the two approaches can from each other achieve both increases in value and reduce waste simultaneously.

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