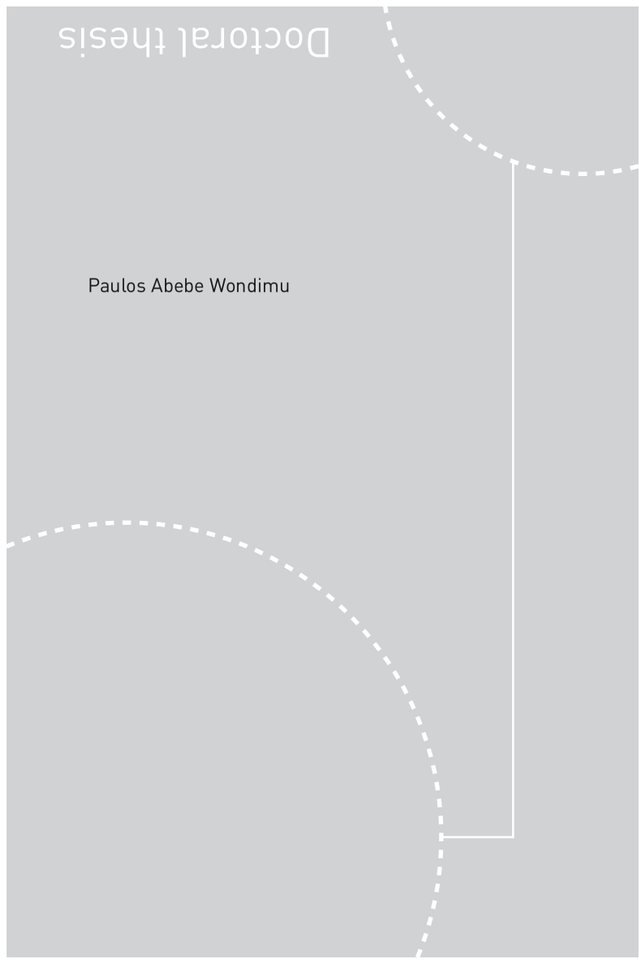
Doctoral theses at NTNU, 2019:36

Paulos Abebe Wondimu

Early Contractor Involvement (ECI) Approaches for Public Project Owners



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
Philosophiae Doctor
Faculty of Engineering
Department of Civil and Environmental
Engineering

Doctoral theses at NTNU, 2019:36

NTNU
Norwegian University of
Science and Technology

Paulos Abebe Wondimu

Early Contractor Involvement (ECI) Approaches for Public Project Owners

Thesis for the Degree of Philosophiae Doctor

Trondheim, March 2019

Norwegian University of Science and Technology
Faculty of Engineering
Department of Civil and Environmental Engineering

NTNU
Norwegian University of
Science and Technology

NTNU
Norwegian University of Science and Technology

Thesis for the Degree of Philosophiae Doctor

Faculty of Engineering
Department of Civil and Environmental Engineering

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

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

List of Figures

List of Tables

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.

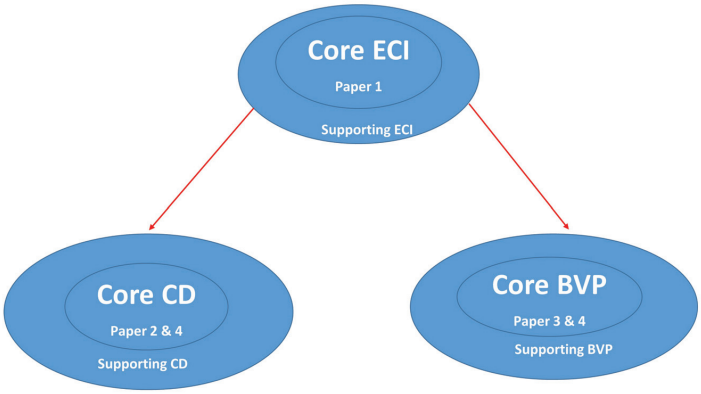


Figure 1: Illstration of core and supporting papers and topics

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

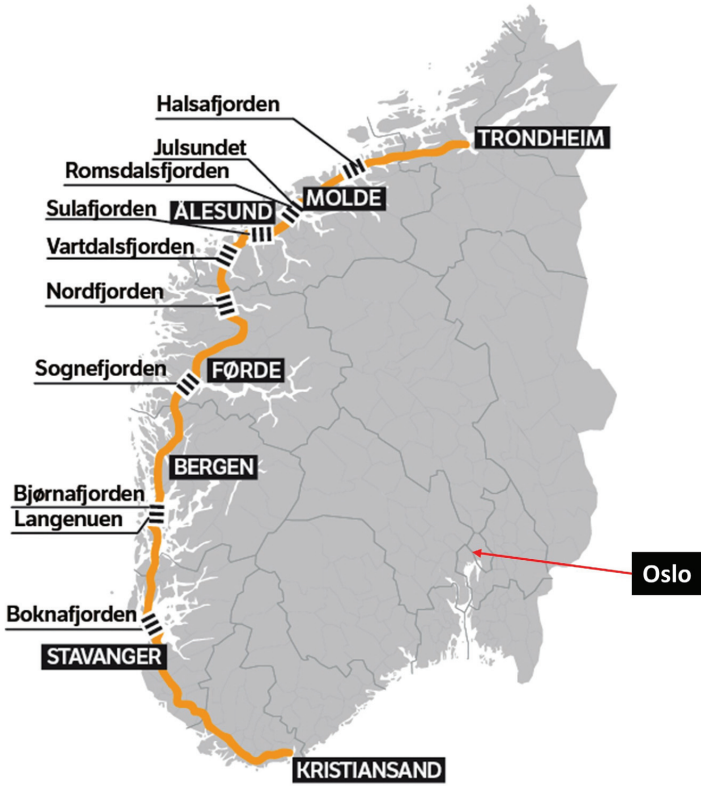


Figure 1.1: Ferjefri E39 map (source Statens Vegvesen Ferjefri E39 Flickr)

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.

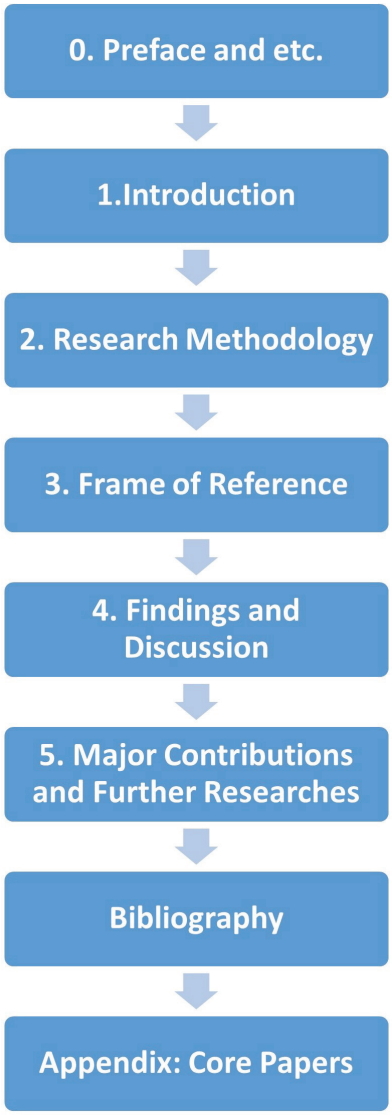


Figure 1.2: Thesis structure

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.

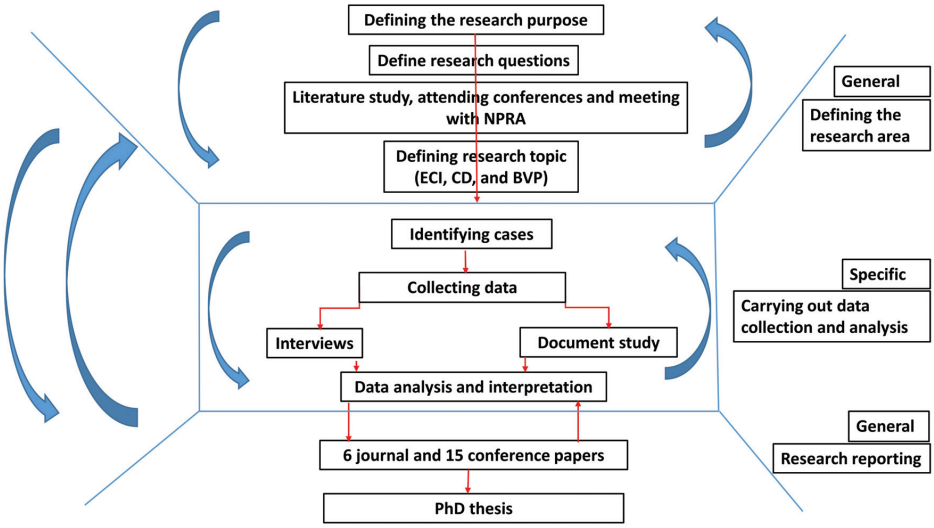


Figure 2.1: Research process adapted from Swales (1990)

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.

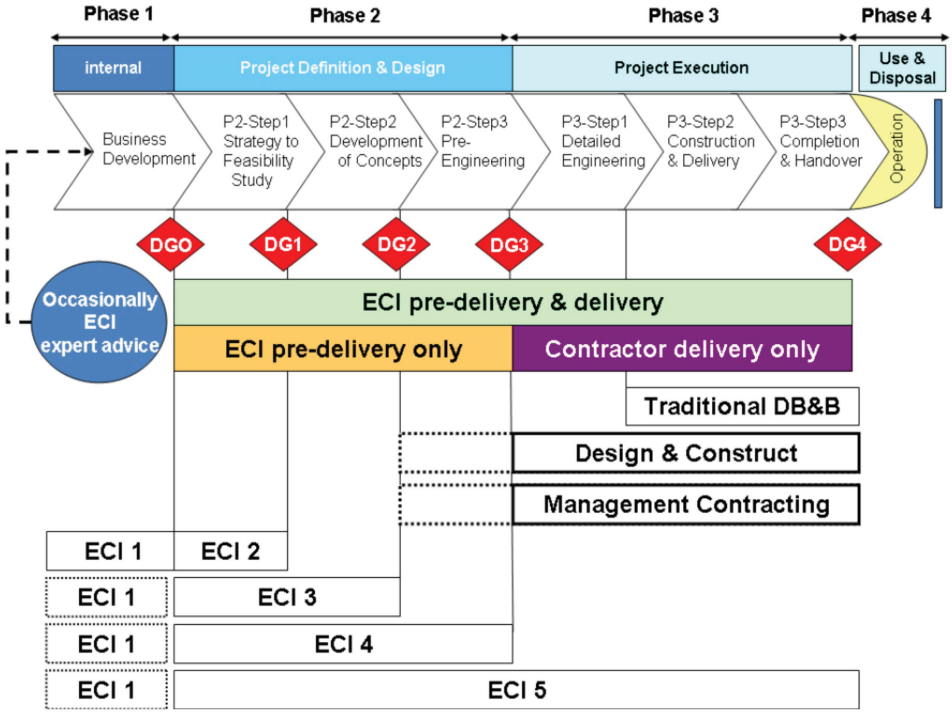


Figure 3.1: Project Life Cycle Phases

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).

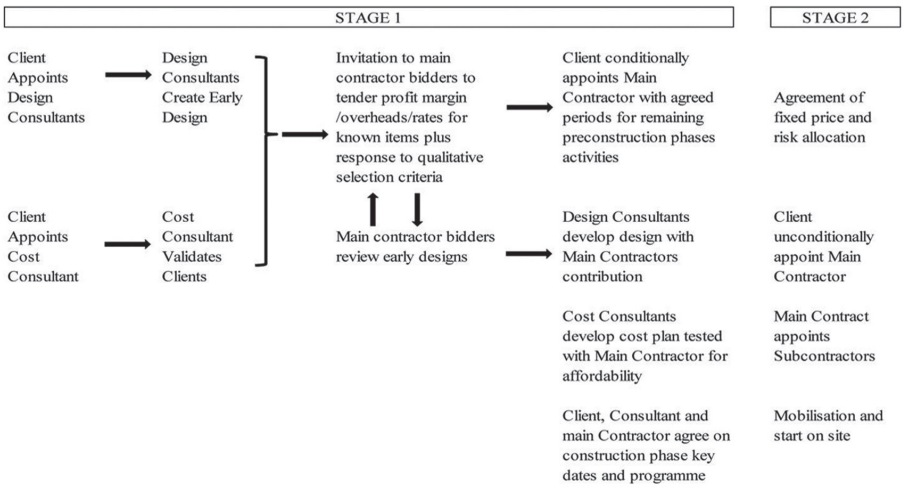


Figure 3.2: A two-stage tender process (Love et al., 2014) adapted from Mosey, 2009

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

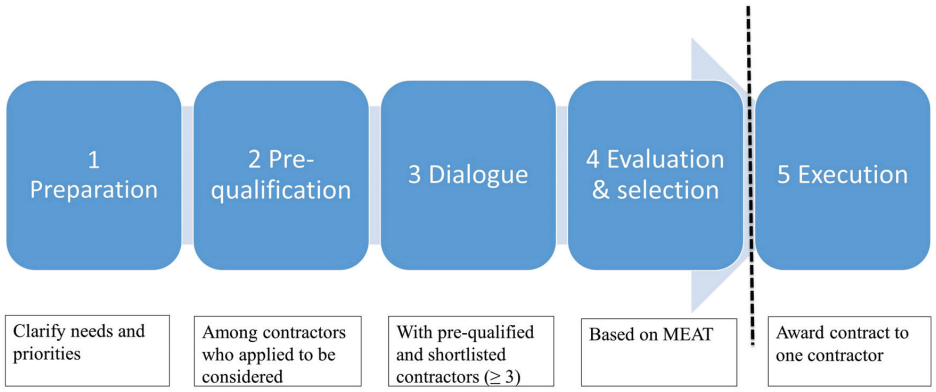


Figure 3.3: CD phases

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.

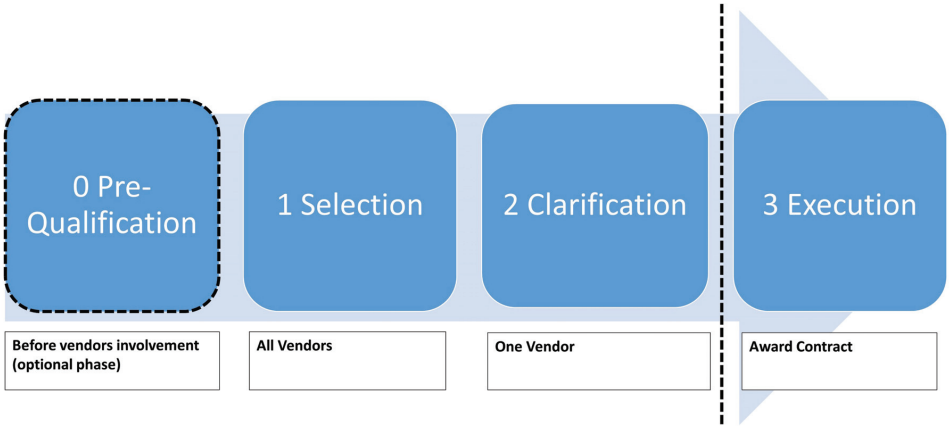


Figure 3.4: Four Phases of BVP PIPS (developed based on Kashiwagi (2016))

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.

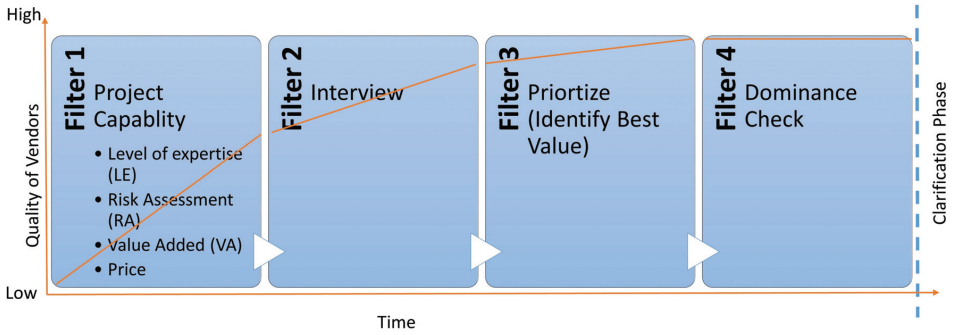


Figure 3.5: Five selection criteria and four filters of BVP (Kashiwagi, 2016)

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.

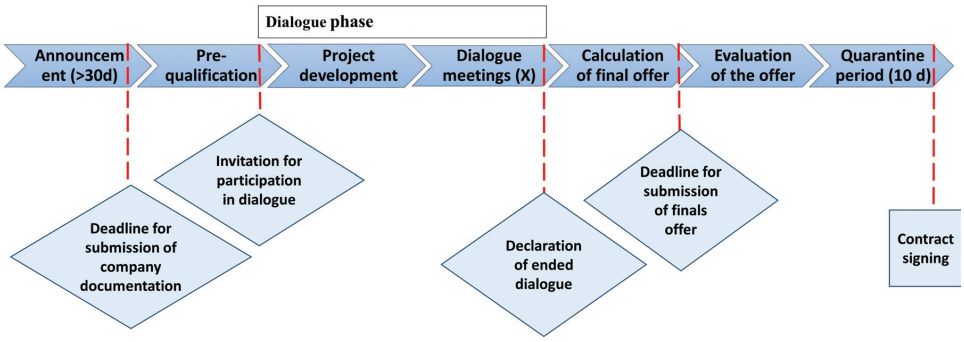


Figure 4.1: CD procedures (developed based on the studied cases)

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.

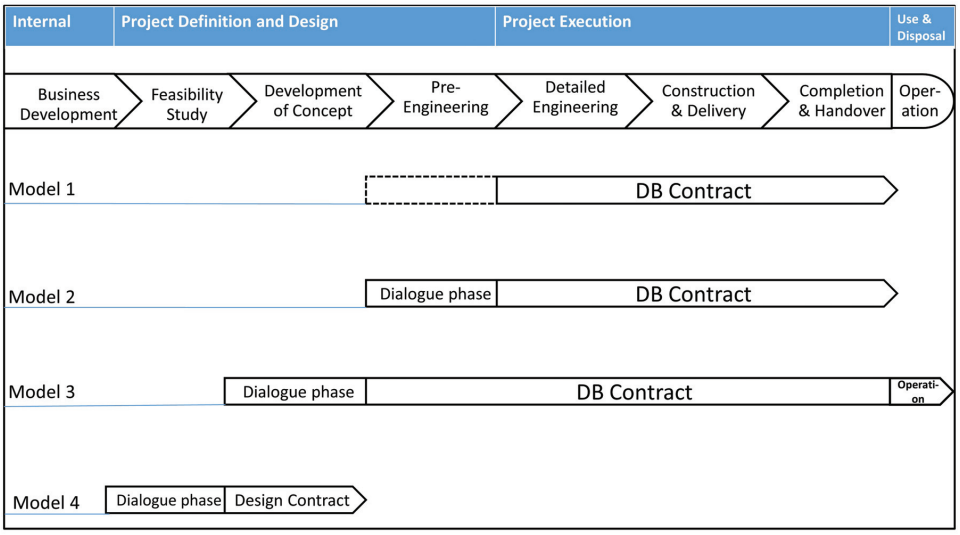


Figure 4.2: Project implementation models using CD

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).

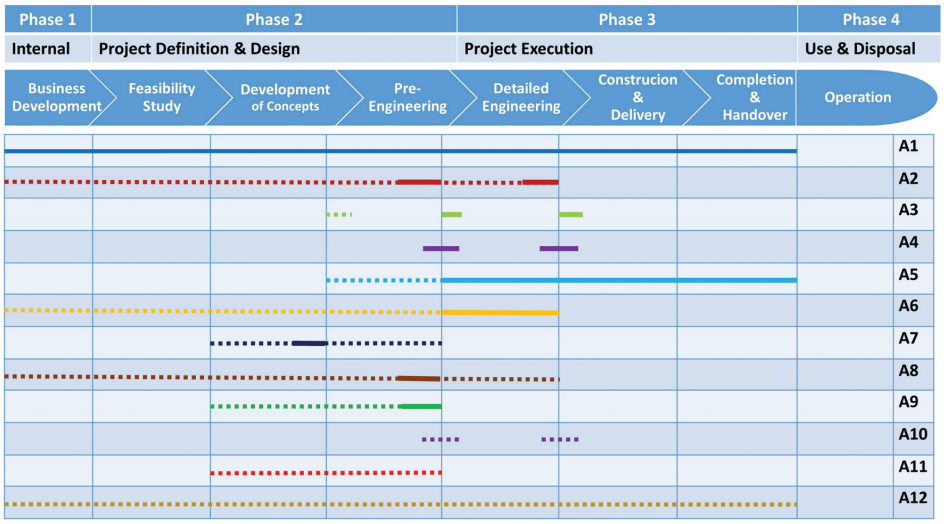


Figure 4.3: When ECI approaches were used /when they could have been used

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.

Continued on next page

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).

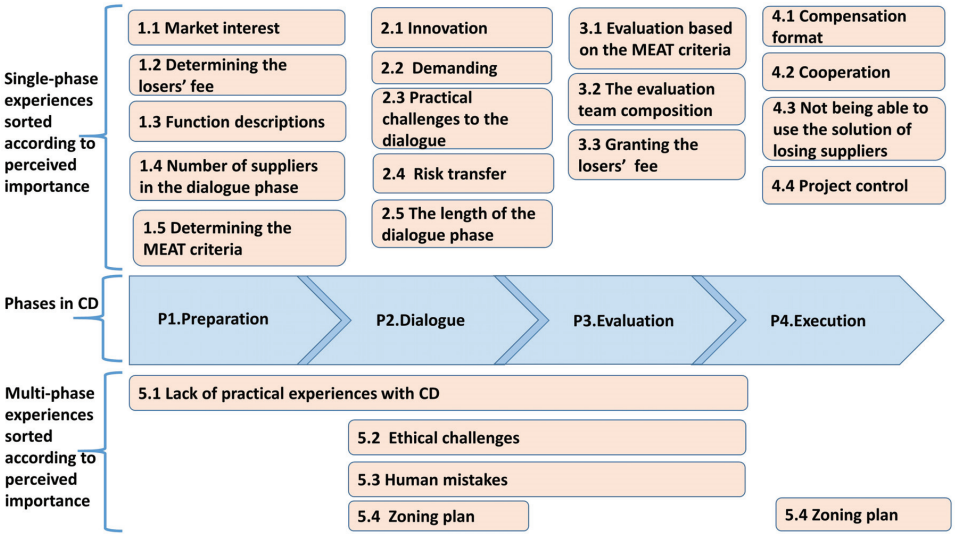


Figure 4.4: Overview of the experiences with CD

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.

Continued on next page

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.

Continued on next page

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)Multiphase**
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.

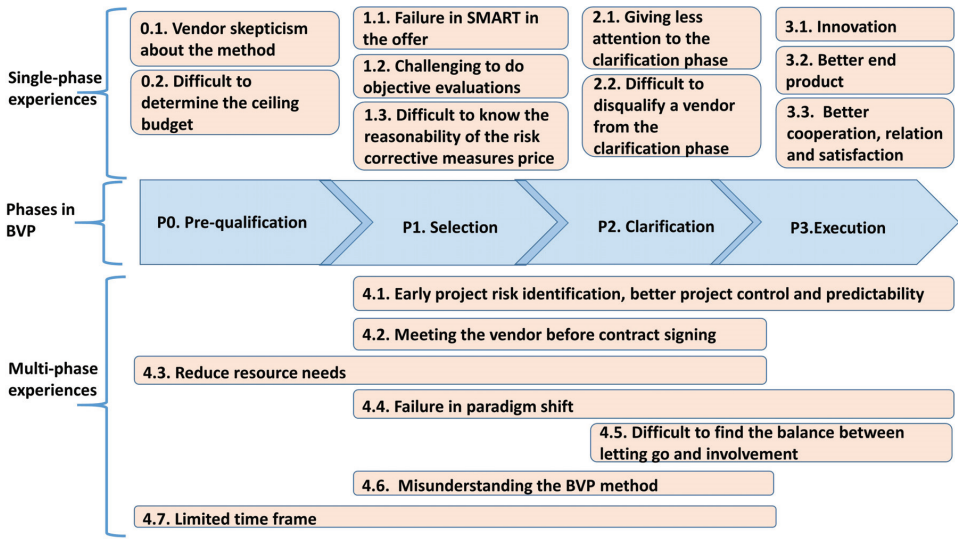


Figure 4.5: Overview of the experiences with BVP

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).

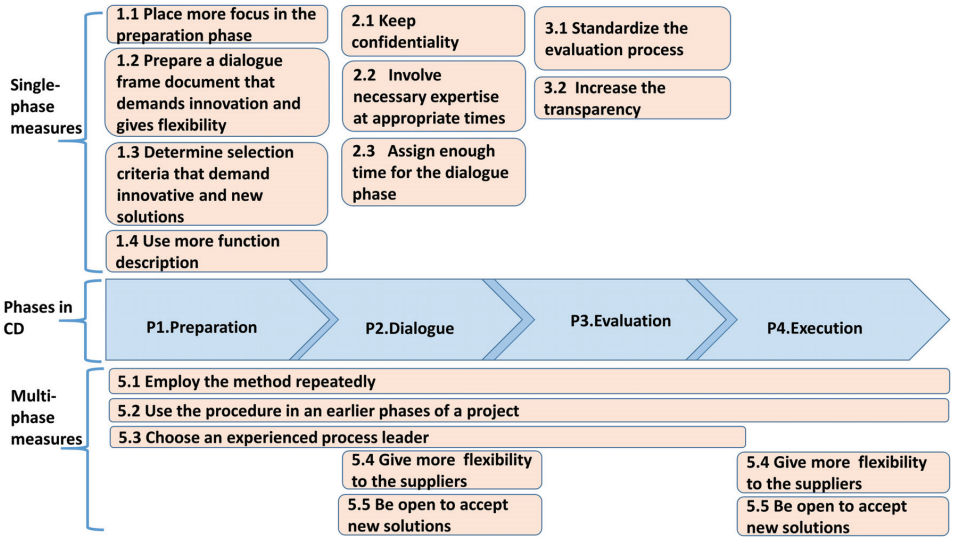


Figure 4.6: Measures that ought to be taken for the success of future CD projects

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.

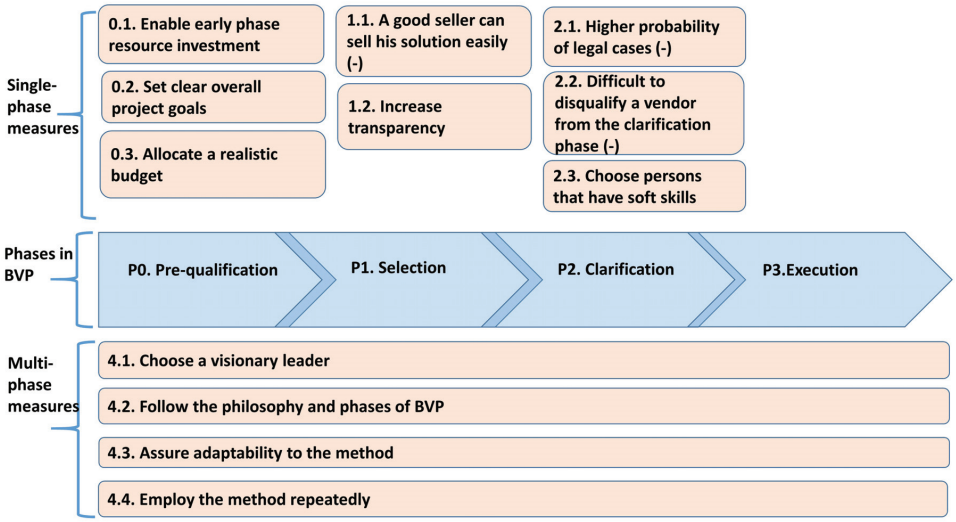


Figure 4.7: Measures that ought to be taken for the success of future BVP projects

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.

Bibliography

ALBANO, G. L. & SPARRO, M. 2010. Flexible strategies for centralized public procurement. *Review of Economics and Institutions,* 1(2).

ANFARA JR, V. A., BROWN, K. M. & MANGIONE, T. L. 2002. Qualitative analysis on stage: Making the research process more public. *Educational researcher,* 31(7), 28-38.

APOSTOL, R. 2011. Legal Perspective: Is Best Value Procurement achievable within the framework of the ARW 2005? *Journal for the Advancement of Performance Information & Value,* 3(1).

ARKSEY, H. & O'MALLEY, L. 2005. Scoping studies: towards a methodological framework. *International journal of social research methodology,* 8(1), 19-32.

ARROWSMITH, S. & TREUMER, S. 2012. *Competitive dialogue in EU procurement,* Cambridge University Press.

BACCARINI, D. J. I. J. O. P. M. 1996. The concept of project complexitya review. *International Journal of Project Management,* 14(4), 201-204.

BARLOW, J. & COHEN, M. Implementing partnering: some common red-herrings in the literature. ESRC/EPSRC Workshop on Partnering in Construction, University of Salford, 1996.

BEACH, R., WEBSTER, M. & CAMPBELL, K. M. 2005. An evaluation of partnership development in the construction industry.*International Journal of Project Management,* 23(8), 611-621.

BENNETT, J. J., SARAH 1995. *Trusting the team: the best practice guide to partnering in construction,* Thomas Telford.

BILBO, D., BIGELOW, B., ESCAMILLA, E. & LOCKWOOD, C. 2015. Comparison of construction manager at risk and integrated project delivery performance on healthcare projects: A comparative case study. *International Journal of Construction Education and Research,* 11(1), 40-53.

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

BLUMBERG, B., COOPER, D. R. & SCHINDLER, P. S. 2011. *Business Research Methods,* 3rd European Edition. Mcgraw-Hill Education.

BOS, A. 2012. Case Study: Implementation at Hanze University of Applied Sciences. *Journal for the Advancement of Performance Information & Value,* 4(2).

BOS, A., KASHIWAGI, D. & KASHIWAGI, I. 2015. Changes Required to Sustain a Best Value Environment. *Journal for the Advancement of Performance Information & Value,* 7(1).

BOSMA, E., VAN DER VEN, M., KERKHOVEN, O. & KASHIWAGI, D. 2015. A Large Dutch Engineering Service Adopts the Best Value Approach. *Journal for the*

Advancement of Performance Information & Value, 7(1).

BOUGRAIN, F. 2012. Energy performance and public private partnership. *Built Environment Project and Asset Management, 2(1),* 41-55.

BRYMAN, A. 2015.*Social research methods,* Oxford university press.

BØRVE, S., ROLSTAD ÅS, A., ANDERSEN, B. & AARSETH, W. 2017. Defining project partnering. *International Journal of Managing Projects in Business,* 10(4), 666-699.

CABINET OFFICE 2014a. Cost Led Procurement Guidance. London, UK: Queen's Printer and Controller of HMSO.

CABINET OFFICE 2014b. The integrated Project Insurance (IPI) Model. London, UK: Queen's Printer and Controller of HMSO.

CABINET OFFICE 2014c. Project procurement and delivery guidance: Using two stage open book and supply chain collaboration. London, UK: Queen's Printer and Controller of HMSO.

CHAN, A., CHAN, D. & HO, K. 2003. Partnering in Construction: Critical Study of Problems for Implementation.*Journal of Management in Engineering,* 19(3), 126-135.

CHAN, A. P., CHAN, D. W., CHIANG, Y., TANG, B., CHAN, E. H. & HO, K. S. 2004. Exploring critical success factors for partnering in construction projects. *Journal of Construction Engineering and Management,* 130(2), 188-198.

CHAN, A. P. C., CHAN, D. W. M. & HO, K. S. K. 2010a. An empirical study of the benefits of construction partnering in Hong Kong. *Construction Management and Economics,* 21(523-533.

CHAN, D. W., CHAN, A. P., LAM, P. T. & WONG, J. M. 2010b. Empirical study of the risks and difficulties in implementing guaranteed maximum price and target cost contracts in construction. *Journal of construction engineering and management,* 136(5), 495-507.

CHAN, D. W., LAM, P. T., CHAN, A. P. & WONG, J. M. 2010c. Achieving better performance through target cost contracts: the tale of an underground railway station modification project. *Facilities,* 28(5/6), 261-277.

CHEUNG, S.-O., NG, T. S. T., WONG, S.-P. & SUEN, H. C. H. 2003a. Behavioral aspects in construction partnering. *International Journal of Project Management,* 21(5), 333-343.

CHEUNG, S. O., SUEN, H. C. H. & CHEUNG, K. K. W. 2003b. An automated partnering monitoring systemPartnering Temperature Index. *Automation in Construction,* 12(3), 331-345.

CIRIBINI, A. L. C., CARATOZZOLO, G., BOLPAGNI, M., VENTURA, S. M. & DE ANGELIS, E. 2016. The Implementation of Building Information Modelling within an Integrated Public Procurement Approach: The Main Contractor's Perspective.

CONNAUGHTON, J. & WELLER, S. Improving collaboration in construction: an opportunity for action research. Proceedings 29th Annual ARCOM Conference, Reading, 2013.

CRESWELL, J. W. 2013.*Research design: Qualitative, quantitative, and mixed methods approaches,* Sage publications.

DEMIREL, H. ., LEENDERTSE, W., VOLKER, L. & HERTOGH, M. 2017. Flexibility in PPP contractsDealing with potential change in the pre-contract phase of a construction project. *Construction Management and Economics,* 35(4), 196-206.

Designing Buildings Wiki 2018. Early contractor involvement. Retrieved January 21, 2019, from https://www.designingbuildings.co.uk/wiki/Early_contractor_involvement

DOLOI, H. 2008. Analysing the novated design and construct contract from the client's, design team's and contractor's perspectives. *Construction Management and Economics,* 26(11), 1181-1196.

EDLER, J. & GEORGHIOU, L. 2007. Public procurement and innovationResurrecting the demand side. *Research policy,* 36(7), 949-963.

ELLIS, D. 1993. Modeling the information-seeking patterns of academic researchers: A grounded theory approach. *The Library Quarterly,* 63(4), 469-486.

ELYAMANY, A., AND MAGDY ABDELRAHMAN 2010. Contractor performance evaluation for the best value of superpave projects. *Journal of Construction Engineering and Management* 136(5), 606-614.

ERIKSSON, P. E. 2010. Partnering: what is it, when should it be used, and how should it be implemented? *Construction Management and Economics,* 28(9), 905-917.

EUROPEAN COMMISSION, P. P. P. 2006. Explanatory Note-Competitive Dialogue-Classic Directive. *Directorate General Internal Market and Services.* European Commission: European Commission.

EUROPEAN PARLIAMENT, C. O. T. E. U. 2004. Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the Coordination of Procedures for the Award of Public Works Contracts, Public Supply Contracts and Public Service Contracts.*Official Journal of the European Union.*

EUROPEAN PARLIAMENT, C. O. T. E. U. 2014. Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC Text with EEA relevance. *Official journal of the European Union.*

FALAGARIO, M., SCIANCALEPORE, F., COSTANTINO, N. & PIETROFORTE, R. 2012. Using a DEA-cross efficiency approach in public procurement tenders. *European Journal of Operational Research,* 218(2), 523-529.

FELLOWS, R. F. & LIU, A. M. 2015.*Research methods for construction,* John Wiley & Sons.

GALVAN, J. 2006. Writing literature reviews: A guide for students of the behavioral sciences. Glendale. CA: Pyrczak Publishing.

GOKHALE, S. Integrated project delivery method for trenchless projects. In: RESTON, V., ed. Proceedings of the International Conference on Pipelines and Trenchless Technology October 26-29 2011 Beijing, China. American Society of Civil Engineers.

GOLAFSHANI, N. 2003. Understanding reliability and validity in qualitative research. *The qualitative report,* 8(4), 597-606.

HOEZEN, M., VOORDIJK, H. & DEWULF, G. 2012. Contracting dynamics in the competitive dialogue procedure. *Built Environment Project and Asset Management,* 2(1), 6-24.

HOEZEN, M., VOORDIJK, H. & DEWULF, G. 2015. Procuring complex projects using the competitive dialogue. *International Journal of Project Organisation and Management,* 6(4), 319-335.

HOEZEN, M. E. L. 2012. *The competitive dialogue procedure: negotiations and commitment in inter-organisational construction projects,* University of Twente.

HOOD, J. & SMITH, T. 2013. Perceptions of quantifiable benefits of local authority risk management. *International Journal of Public Sector Management,* 26(4), 309-319.

JACOBSSON, M. & WALKER, D. H. Alliancing within a Public-Private Partnership. Steinthorsson RS, The 22nd Nordic Academy of Management (NFF) Conference, 2013 Reykjavik, Iceland. 21-23.

KADEFORS, A. 2004. Trust in project relationshipsinside the black box. *International Journal of project management,* 22(3), 175-182.

KADEFORS, A. & ERIKSSON, P.-E. 2014. Forskningssammanstllning, Utkad samverkan / Partnering.

KANTOLA, M. & SAARI, A. 2016. Project delivery systems for nZEB projects. *Facilities,* 34(1/2), 85-100.

KASHIWAGI, D. 2011. Case study: Best value procurement/performance information procurement system development. *Journal for the Advancement of Performance Information & Value,* 3(1).

KASHIWAGI, D. 2016. *2016 Best Value Approach,* USA, Kashiwagi Solution Model (KSM).

KASHIWAGI, D. & BYFIELD, R. E. 2002. Selecting the best contractor to get performance: On time, on budget, meeting quality expectations. *Journal of Facilities Management,* 1(2), 103-116.

KASHIWAGI, D., KASHIWAGI, J., SMITHWICK, J. & KASHIWAGI, I. Changing the paradigm. the proceedings of the 5th International Public Procurement Conference, 2012. 1074-1095.

KASHIWAGI, D., PARMAR, D. & SAVICKY, J. 2003. The impact of minimising specifications and management at the University of Hawaii.*Journal of Facilities Management,* 2(2), 131-141.

KASHIWAGI, D. & SAVICKY, J. 2003. The cost of best value' construction.*Journal of Facilities Management,* 2(3), 285-297.

KASHIWAGI, J., SULLIVAN, K. & KASHIWAGI, D. T. 2009. Risk management system implemented at the US Army Medical Command. *Journal of Facilities Management,* 7(3), 224-245.

KENT, D. C. & BECERIK-GERBER, B. 2010. Understanding construction industry experience and attitudes toward integrated project delivery. *Journal of construction engineering and management,* 136(8), 815-825.

KLAKEGG, O. J., ANDERSEN, B., MAGNUSSEN, O. M., WALKER, D. & WILLIAMS, T. 2010. *Early warning signs in complex projects,* Newtown Square, Project Management Institute.

KOLMAN, R. 2014. Early contractor involvement; Improving complex maritime infrastructure projects. *PIANC World Congress* San Francisco, USA 2014.

KORTHALS ALTES, W. K. & TASAN-KOK, T. 2010. The impact of European public contract law on networks of governance: a relational approach. *European Planning Studies,* 18(6), 971-988.

KRISTENSEN, K., LÆDRE, O., SVALESTUEN, F. & LOHNE, J. 2015. Contract models and compensation formats in the design process *In: Proc 23rd Ann. Conf. of the Int'l. Group for Lean Construction.* Perth, Australia.

LAAN, A., VOORDIJK, H. & DEWULF, G. 2011. Reducing opportunistic behaviour through a project alliance. *International Journal of Managing Projects in Business,* 4(4), 660-679.

LAHDENPERÄ, P. 2009. Project alliance. The Competitive Single Target-Cost Approach. VTT Tiedotteita– Research Notes, 2472(

LAHDENPERÄ, P. 2010. Conceptualizing a two-stage target-cost arrangement for competitive cooperation. *Construction Management and Economics,* 28(7), 783-796.

LAHDENPERÄ, P. 2012. Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery. *Construction Management and Economics,* 30(1), 57-79.

LAHDENPERÄ, P. 2013. Determining 'the most economically advantageous tender based on capability and fee-percentage criteria. *Journal of Public Procurement,* 13(4), 409.

LAHDENPERÄ, P. 2015. The beauty of incentivised capability-and-fee competition based target-cost contracting. *Procedia Economics and Finance,* 21(609-616.

LAHDENPERÄ, P. 2016. Preparing a framework for two-stage target-cost arrangement formulation. *International Journal of Managing Projects in Business,* 9(1), 123-146.

LARSON, E. 1995. Project Partnering: Results of Study of 280 Construction Projects. *Journal of Management in Engineering,* 11(2), 30-35.

LARSON, E. 1997. Partnering on construction projects: a study of the relationship between partnering activities and project success. *IEEE Transactions on Engineering Management,* 44(2), 188-195.

LARYEA, S. & WATERMEYER, R. 2016. Early contractor involvement in framework contracts. *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law,* 169(1), 4-16.

LENFERINK, S., ARTS, J., TILLEMA, T., VANVALKENBURG, M. & NIJSTEN, R. 2012. Early Contractor Involvement in Dutch Infrastructure Development: Initial Experiences with Parallel Procedures for Planning and Procurement. *Journal of Public Procurement,* 12(1), 1-42.

LOVE, P. E., O'DONOGHUE, D., R. DAVIS, P. & SMITH, J. 2014. Procurement of public sector facilities: Views of early contractor involvement.*Facilities,* 32(9/10), 460-471.

LU, S. & YAN, H. 2007. A model for evaluating the applicability of partnering in construction.*International Journal of Project Management,* 25(2), 164-170.

LÆDRE, O. 2006. *Valg av kontraktsstrategi i bygg-og anleggsprosjekt.* Degree of doctor, NTNU.

MARIQUE, Y. 2013. Cooperation and competition in complex construction projects: Implementation of EU procurement rules in England and Belgium.*International Journal of Law in the Built Environment,* 5(1), 53-70.

MOLENAAR, K., TRIPLETT, J., PORTER, J., DEWITT, S. & YAKOWENKO, G. 2007. Early contractor involvement and target pricing in US and UK highways. Transportation Research Record: *Journal of the Transportation Research Board,* 2040(01), 3-10.

MOSEY, D. 2009. *Early contractor involvement in building procurement: contracts, partnering and project management,* John Wiley & Sons.

NAOUM, S. 2003. An overview into the concept of partnering.*International Journal of Project Management,* 21(1), 71-76.

NAOUM, S. G. & EGBU, C. 2016. Modern selection criteria for procurement methods in construction: A state-of-the-art literature review and a survey. *International Journal of Managing Projects in Business,*9(2), 309-336.

NATIONAL TRANSPORT PLAN 2017. The Norwegian National Transport Plan 2018-2029. Report no 33 to the parlament Norway: Minsitry of Transport and Commu-

nications.

NYSTRÖ M, J. 2005. The definition of partnering as a Wittgenstein family-resemblance concept. *Construction Management and Economics,* 23(5), 473-481.

O'BRIEN, G. & HOPE, A. 2010. Localism and energy: Negotiating approaches to embedding resilience in energy systems. *Energy Policy,* 38(12), 7550-7558.

PERRENOUD, A., LINES, B. C., SAVICKY, J. & SULLIVAN, K. T. 2017. Using Best-Value Procurement to Measure the Impact of Initial Risk-Management Capability on Qualitative Construction Performance.*Journal of Management in Engineering,* 33(5), 04017019.

PETERSEN, K. & GENCEL, C. Worldviews, research methods, and their relationship to validity in empirical software engineering research. 2013 Joint Conference of the 23nd International Workshop on Software Measurement (IWSM) and the Eighth International Conference on Software Process and Product Measurement (Mensura), 2013. IEEE, 81-89.

RAHMAN, M. & ALHASSAN, A. 2012. A contractor's perception on early contractor involvement. *Built Environment Project and Asset Management,* 2(2), 217-233.

RAHMANI, F., KHALFAN, M. M. & MAQSOOD, T. The application of Early Contractor Involvement (ECI) in different delivery systems in Australia. International Conference on Construction in a Changing World, 2014. University of Salford, 1-12.

REKONEN, S. & BJÖRKLUND, T. A. 2016. Perceived managerial functions in the front-end phase of innovation. *International Journal of Managing Projects in Business,* 9(2), 414-432.

REMINGTON, K. & POLLACK, J. 2016.*Tools for complex projects,* Routledge.

RIEMANN, S. & SPANG, K. 2014. Application of Contractor's Knowledge in Public Financed Infrastructure Projects in Germany. *Procedia-Social and Behavioral Sciences,* 119(2014), 202-209.

RIJT, J. V. D., SANTEMA, S. C. & SOILAMMI, A. 2016. *Best Value Procurement/prestasjonsinnkkøp,* RIF, Oslo.

RIJT, J. V. D., WITTEVEEN, W., VIS, C. & SANTEMA, S. 2011. Best Value at the Directorate-General for Public Works and Water Management in The Netherlands: A Case Study of the Procurement of Infrastructure Projects Worth $1,200 M. *Journal for the Advancement of Performance Information & Value,* 3(1).

RIVERA, A., KASHIWAGI, J. & KASHIWAGI, D. 2016. Improving the Management of Environmental Engineering Projects through the Best Value Project Management Model for a State Agency. *Journal for the Advancement of Performance Information & Value,* 8(1).

SCHEEPBOUWER, E. & HUMPHRIES, A. 2011. Transition in adopting project delivery method with early contractor involvement. *Transportation Research Record: Journal of the Transportation Research Board,* 2228(06), 44-50.

SCHNITZER, J. S. 2010. Regulating Public Procurement Law at Supranational Level:The example of EU agreements on public procurement. *Journal of Public Procurement,* 10(3), 301-334.

SEBASTIAN, R., CLAESON-JONSSON, C. & DI GIULIO, R. 2013. Performance-based procurement for low-disturbance bridge construction projects. *Construction Innovation,* 13(4), 394-409.

SIEMONSMA, H., VAN NUS, W. & UYTTENDAELE, P. 2012. Awarding of Port PPP contracts: the added value of a competitive dialogue procedure. *The flagship journal*

of international shipping and port research, 39(1), 63-78.

SERGEEVA, N. & ZANELLO, C. 2018. Championing and promoting innovation in UK megaprojects. *International Journal of Project Management,* 36(8), 1068-1081.

SNIPPERT, T., WITTEVEEN, W., BOES, H. & VOORDIJK, H. 2015. Barriers to realizing a stewardship relation between client and vendor: the Best Value approach. *Construction management and economics,* 33(7), 569-586.

SONG, L. & LIANG, D. 2011. Lean construction implementation and its implication on sustainability: a contractor's case study. *Canadian Journal of Civil Engineering,* 38(3), 350-359.

SONG, L., MOHAMED, Y. & ABOURIZK, S. M. 2009. Early Contractor Involvement in Design and Its Impact on Construction Schedule Performance. *J. Manage. Eng.,* 25(1), 12.

STATENS VEGVESEN 2012. Ferjefri E39 delprosjekt gjennomføringsstrategier og kontraktstyper.

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.

SULLIVAN, K. T. 2010. Quality management programs in the construction industry: Best value compared with other methodologies. *Journal of Management in Engineering,* 27(4), 210-219.

SWALES, J. 1990. *Genre analysis: English in academic and research settings,* Cambridge University Press.

TELLES, P. & BUTLER, L. 2014. Public Procurement Award Procedures in Directive 2014/24/EU.

THOMAS, G. & THOMAS, M. 2008.*Construction partnering and integrated teamworking,* John Wiley & Sons.

UTTAM, K. & LE LANN ROOS, C. 2014. Competitive dialogue procedure for sustainable public procurement. *Journal of Cleaner Production,* 403-4016.

UYARRA, E. & FLANAGAN, K. 2010. Understanding the innovation impacts of public procurement. *European Planning Studies,* 18(1), 123-143.

VAN VALKENBURG, M., LENFERINK, S., NIJSTEN, R. & ARTS, J. Early contractor involvement: a new strategy for buying the best in infrastructure development in the Netherlands. Third International Public Procurement Conference (IPPC), 2008.

WALKER, D. H. & LLOYD-WALKER, B. 2012. Understanding early contractor involvement (ECI) procurement forms. 28th Annual ARCOM Conference, 3-5 September 2012 Edinburgh, UK. Association of Researchers in Construction Management, 877-887.

WALKER, D. H. & LLOYD-WALKER, B. M. 2015. *Collaborative project procurement arrangements,* Project Management Institute.

WALKER, D. H. T. & LLOYD-WALKER, B. M. 2014. The ambience of a project alliance in Australia. *Engineering Project Organization Journal,* 4(1), 2-16

WERNER, M. J. 2011. Applicability and Organisation of the Competitive Dialogue in Operator Models. *ERA Forum,* 12(SUPPL. 1), 267-284.

WILLIAMS, T., WILLIAMS, M. & RYALL, P. 2013. Target cost contracts: adopting innovative incentive mechanisms to improve the project delivery process. *Procs. 29th Annual ARCOM Conference, 759-768.*

WILLIAMS, T. M. 1999. The need for new paradigms for complex projects. *International journal of project management,* 17(5), 269-273.

WONDIMU, P. A., HOSSEINI, A., LOHNE, J. & LÆDRE, O. 2018a. Early contractor involvement approaches in public project procurement. *Journal of Public Procurement.*18(4),355-378

WONDIMU, P. A., KLAKEGG, O. J., LOHNE, J. & LÆDRE, O. 2018b. Experiences with Best Value Procurement (BVP) in Norway and the Netherlands.*Journal of Construction Engineering and Management.*

WONDIMU, P. A., LOHNE, J. & LÆDRE, O. 2018c. Competitive dialogue in Norwegian public infrastructure projects. *Journal of Construction Engineering and Management.* 144(10, 05018011

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.

YEUNG, J. F. Y., CHAN, A. P. C. & CHAN, D. W. M. 2007. The definition of alliancing in construction as a Wittgenstein family-resemblance concept. *International Journal of Project Management,* 25(3), 219-231.

YIN, R. K. 2014.*Case study research: Design and methods,* Thousand Oaks, CA, Sage publications.

Appendix: Core Papers

A Core paper 1

EARLY CONTRACTOR INVOLVEMENT APPROACHES IN PUBLIC PROJECT PROCUREMENT

Journal of Public Procurement

The current issue and full text archive of this journal is available on Emerald Insight at:
www.emeraldinsight.com/1535-0118.htm

Early contractor involvement approaches in public project procurement

Paulos Abebe Wondimu, Ali Hosseini, Jadar Lohne and Ola Laedre
Norwegian University of Science and Technology, Trondheim, Norway

Abstract

Purpose – Early contractor involvement (ECI) faces many barriers when it is implemented in public procurement, given that it is different from traditional business practices. Primarily, public owners face a major challenge, as they should treat all bidders equally. The purpose of this paper is to explore suitable ECI approaches that public owners could use.

Design/methodology/approach – In addition to a literature and document study, 14 semi-structured in-depth interviews with key personnel from 11 cases selected from Norwegian public bridge projects were carried out.

Findings – In all, 23 unique approaches of ECI were identified during this research (16 from literature and 7 new from case projects). The findings provide a new direction to ECI through introducing new approaches of ECI from the case projects.

Originality/value – This paper for the first time presents several alternatives of ECI approaches for public owners with the intention of illustrating ECI is actually possible in the public project procurement. Furthermore, it presents for the first time success factors of ECI with the intention of increasing the understanding of ECI concept from a public procurement perspective.

Keywords Public procurement, Early contractor involvement

Paper type Research paper

1. Introduction

Public owners have the objective to realize projects in a timely and cost-effective manner, but they are increasingly facing complex projects. For example, the Norwegian Public Roads Administration (NPRA) is currently planning a mega project, E39 Coastal Highway Route, along the west coast of Norway. One of the main ambitions of this project is to make the E39 ferry free. Eight long and deep fjords need to be crossed by bridges and tunnels. Most of them will be crossed by bridges of unprecedented complexity. The project is estimated at a cost of approximately US$40bn (NTP, 2016). NPRA needs innovative soltuions for this project. How to procure contractors for these complex bridge projects to obtain innovative solutions – and how to use their knowledge and experience to make the project time and cost-effective – is challenging for the NPRA. In response to this challenge, early contractor involvement (ECI) has been identified as one of the solutions proposed by an NPRA group of experts (Vegvesen, 2012).

In the literature, it is widely accepted that contractors have better construction knowledge and experience than the client and the designer (Song *et al.*, 2009; Walker and Lloyd-Walker, 2012). Traditional project delivery methods (for example, design-bid-build [DBB] with unit price contracting, open bidding and owner quality control) facilitate transparent checks and balances. One shortcoming of the traditional methods is that contractors – who are going to carry out the projects – are not involved in developing them. However, the growth of increasingly more complex projects demands alternative (evolving) project delivery methods to ensure appropriate project delivery, contract compliance, and

Journal of Public Procurement
Vol. 18 No. 4, 2018
pp. 355-378

1535-0118
DOI 10.1108/JOPP-11-2018-021

quality assurance (Molenaar *et al.*, 2007). One of the evolving approaches is ECI (Lahdenperä, 2016; Molenaar *et al.*, 2007).

The main ambition of ECI is typically understood to be bringing construction knowledge and experience into the pre-construction phases of projects. 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).

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

Even if ECI has several advantages, it faces many barriers to implementation. These barriers mainly 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 – such as international and national legislation – to the implementation of ECI (Kolman, 2014). Predominantly, public owners face a major challenge if they want to implement ECI as the contractor selection methods involved typically defy established standards (Lahdenperä, 2013). For instance, it is demanding for European public owners to involve the contractor before the project is described in detail as EU public procurement directives oblige owners to use competitive and transparent team selection procedures. It is difficult to use competitive and transparent team selection procedures before the project is detailed. Furthermore, they are obliged to use both price and quality as selection criteria during the early team selection. However, in an early phase of a project, it is challenging to use price as one of the selection criteria due to various uncertainties (Lahdenperä, 2013; European Parliament, 2004; European Parliament, 2014).

Norwegian public owners are obliged to follow international agreements throughout national public procurement regulations. This includes the World Trade Organization (WTO) and European Economic Area (EEA) agreements (Lædre, 2006). The main purpose of these agreements is to achieve the equal treatment of all bidders by obliging public owners to specify clearly what procurement procedures they intend to use before starting to procure (Lædre, 2006; Schnitzer, 2010). However, these agreements create additional challenges for public owners considering ECI (Lahdenperä, 2013).

The few sources identified from within the EU context have documented how public owners implement ECI in their projects and faced the existing (mainly legal) barriers. Likewise, many authors have not discussed the success factors of ECI with the intention of increasing the understanding of the ECI concept from a public procurement perspective. By using a multiple-case study approach, this paper addresses the knowledge gaps.

The research questions addressed are:

RQ1. What do public owners do to implement ECI?

RQ2. What are the success factors for ECI?

RQ3. How could the implemented ECI approaches be improved in practice?

The first research question is addressed through a literature review and empirical research in 11 Norwegian bridge projects. The second research question is addressed through empirical research into these bridge projects. The third research question is addressed by analyzing the findings from the first and second research questions.

2. Method

The research reported in this study was based on a multiple-case study approach, carried out according to the recommendations of Yin (2013). The multiple-case study approach was favored to understand the topic better by studying similarity and differences between the cases. Furthermore, it was favored to discover the research questions from a wider perspective, to generate strong and reliable evidence and to create a more convincing theory (Gustafsson, 2017). Following the initial literature study, a document study of selected cases, in addition to 14 interviews with key actors from the selected cases, were carried out.

The review of the contemporary literature was undertaken using the search engines Oria and Google Scholar. Oria is a Norwegian University library resource that includes academic journal papers, conference papers, reports, dissertations, etc. The search words used included ECI, public procurement, EU, infrastructure projects, success factors and the combination of these. Besides, citation chaining according to the principles laid out by Ellis (1993) was also used to find new literature. To filter the relevant literature, abstracts of the articles were read. Based on the literature review, a theoretical framework with case-specific challenges was established after the recommendations of Blumberg *et al.* (2014).

Based on recommendations from 20 key professionals with several years of experience with in NPRA and from studying NPRA's yearly internal project reports from 2001-2013, 11 bridge projects were identified as cases relevant for study. The cases are presented in Tabel I.

The 20 key professionals (most of them are regional managers of NPRA and the rest are senior representatives from NPRA's head office) recommended these projects. The argument behind their recommendation was that these projects were announced for bid in a manner that was relatively open to using contractors' knowledge and experiences. The 11 bridge projects included in the study were characterized by using a contract form (design-build [DB]) and implementation strategy (announcing with alternative technical solutions) that differ from the traditional DBB. Four of the projects were/will be announced for bid using DB contracts, six projects were/will be announced for bid with alternative technical solutions, and one was announced with both.

Given that one of the authors was an employee with NPRA during the research, full access to the internal digital case documents and interviewees was ensured. This access was another determining factor for the choice of case projects. However, some of the projects were old, so digital documents were not available in the NPRA database. In the selected cases, copies of relevant material, including contract documents, project end reports, and tender documents,

Cases	Informants	Project description	
		Length	Year completed
1.Tresfjordbrua	PM([a]) &CM	1,290 m	2015
2.Gullibrua	CM and the contractor PM	740 m	2014
3.Paradisbrua	PM, PuM &DM	53 m	Not started
4.Sykkylvsbrua	CM	860 m	2000
5.Lepsøybrua	PM and CM	800 m	Not started
6.E6*E16 Flyplasskrysset	CM	350 m	2016
7.Smålenenebrua	DM	300 m	2011
8.E39 Godsterminalenbrua	APM	–	Planning phase
9.Linesøybrua	CE	315 m	2011
10.Tjønnøybrua	PM([b])	270 m	2003
11.Straumsbrua	PM ([c])	290 m	2004

Note: In three of the projects the project manager (PM) was the same person

Table I. Description of the projects and informants

were requested, obtained, and analyzed. These documents supported opinions and information gathered during the interviews. After the interviews, these documents were scrutinized closely to validate the information provided in the respective interviewees.

In total, 14 semi-structured, in-depth, case-specific interviews were conducted. Each interview was conducted at the interviewee's office based on an interview guide that was established based on research questions (Appendix). The interviews lasted between one and two hours. All the interviews were recorded and later transcribed into written dialogues. Thirteen of the interviews were with client personnel and one with contractor personnel; all interviews were conducted according to the methodological approach described by Yin (2013). More client representatives were interviewed because this study aims to explore ECI approaches from the client's perspective. Furthermore, the fact that the client is the party that selects the contract strategy supports this selection. The professional role of most respondents was a manager. The functions included one assistant project manager (APM), one purchasing manager (PuM), one control engineer (CE), three project managers (PM), three design managers (DM), and five construction managers (CM). The choice of using semi-structured interviews was based on a desire to give flexibility for the interviewees and to identify new ways of seeing and understanding the topic. The nature of the questions was open-ended with the intention to bring the most out of the respondent's own reflection, while the interviewees were encouraged to express their views on the subject without being restrained by the predetermined questions related to the studied cases.

The interviewees were considered reliable as all the respondents were actively involved in the procurement phase of the case projects. The validity of the interviewees was considered as the case projects were picked based on the recommendation of the 20 key professionals. Then, the project managers of these case projects were contacted in each case. In some of the cases, the project managers were not available, were not the most knowledgeable persons in the procurement process, had changed employer or retired. These unavailabilities resulted in contacting the other key informants through the project managers' channel.

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

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

The data were hand-coded and analyzed hand-in-hand with data collection and findings write up. The codes were developed based on the theory being examined. They are success factors and ECI approaches. Through the coding process, themes or categories were generated. These themes were interrelated and appeared as major findings and are also used as sub-headings in the findings section.

3. Theoretical background

3.1 Early contractor involvement definition

Different terms have been used for the phenomena here called ECI (Turner and Riding, 2015). ECI has also been associated with popular terms such as early supplier involvement

and supply chain management (Lenferink *et al.*, 2012). The main idea of ECI consists of involving the competence of a contractor in the early stage of a project. Through teamwork with owners and consultants, the contractors contribute construction knowledge to the early processes (Scheepbouwer and Humphries, 2011; Song *et al.*, 2009). Direct and early involvement of the contractor in the front-end phase increases the benefits of ECI. Better cooperation can be facilitated by direct involvement while better contribution can be facilitated by early involvement (Song *et al.*, 2009).

Scheepbouwer and Humphries (2011) have identified the difference between ECI practices in the USA and countries such as the UK and Australia. The ECI approach in the USA is a type of construction management (CM) contracting. In this ECI approach, the owner holds two contracts, one with the designer and the other with the contractors. In the ECI approach that is practiced in the UK and Australia, however, the owner holds a single contract with the contractor. This latter type of ECI resembles alliancing during the design phase and DB contract during the project execution phase (Scheepbouwer and Humphries, 2011).

Through the literature review leading up to this paper, it was observed that there is ambiguity on the subject of the definition of ECI.

Song *et al.* (2009) define ECI as contractor involvement in the design phase of a project, implemented by a DB contract instead of 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.

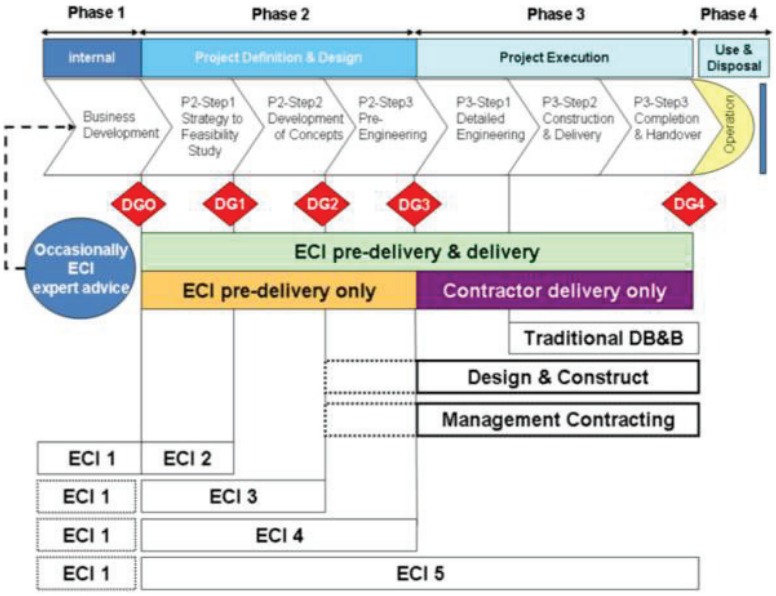
Lenferink *et al.* (2012) and Van Valkenburg *et al.* (2008) analyzed road projects and defined ECI as contractor involvement in the planning phase of projects. Based on their definition, the aim of this ECI approach is to involve the contractors in the procurement process before the decision of the route determination is made. The purpose is to gather support from the contractors in determining the route of the road.

Recently, Walker and Lloyd-Walker (2012) have developed a comprehensive definition of ECI and the different models of ECI. According to their definition, ECI can start in the internal or business development phase and can last until the project completion and handover phase. That means it can take place in the internal phase, planning phase, design phase and in the project execution phase. They 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 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 model that illustrates the various ECI models. Figure 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.

The main goals of ECI are to facilitate innovation, improve project control and reduce time to completion (Lenferink *et al.*, 2012; Van Valkenburg *et al.*, 2008; Mosey, 2009). Furthermore, the literature has discussed several advantages of ECI, including improved constructability, increased product information, better profitability and feasibility analyses, better



Notes: DG denotes to 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
Source: (Walker and Lloyd-Walker, 2012) adapted from (Klakegg *et al.*, 2010)

Figure 1.
Project life cycle phases

communication, better risk management, better plan for construction (Sødal *et al.*, 2014). ECI contributes to better relationships, increases understanding among parties and decreases the potential of adversarial relationships. These beneficial factors stem from the fact that the approach demands frequent interaction and communication. This close interaction and communication lead to the development of shared goals and objectives that in turn builds cooperative relationships (Rahman and Alhassan, 2012; Scheepbouwer and Humphries, 2011).

The authors understand ECI to be a measure to involve construction knowledge and experience in early phases of a project, directly or indirectly. The early phases of a project are understood in the following as the internal phase, planning phase and design phase. However, in line with the argument of Walker and Lloyd-Walker (2012), we equally consider some ECI activates to take place in the execution phase of a project (see Figure 1).

3.2 Early contractor involvement approaches

Table II presents possible approaches of ECI that public owners in the EU can implement. The table is based on a contemporary literature review of the authors of this paper.

3.3 Success factors

To ensure successful project completion and to minimize surprising variations during the project implementation phase, early identification of success factors is crucial (Torp *et al.*, 2006). The idea behind the identification of success factors is that there are certain major factors that have considerable influence on project performance, and if identified during the front-end phase, will enhance the successful completion of projects

No.	Approaches of ECI	Literature (Authors)
1	Building Information Modelling (BIM) – tool and process, enabling a high level of design integrity through the common use of BIM platform in early phases	(Gransberg, 2016), (Kent and Becerik-Gerber, 2010), (Walker and Lloyd-Walker, 2015)
2	Integrated Project Delivery (IPD) – integrates people, systems, business structures and practices through relational contracting	(Gransberg, 2016), (Kent and Becerik-Gerber, 2010), (Lahdenperä, 2012) (Gokhale, 2011)
3	Most Economical Advantageous Tender (MEAT) – qualifications-based selection of design and construction parties	(Scheepbouwer and Humphries, 2011), (Lahdenperä, 2013), (Falagario *et al.*, 2012)
4	Open book target pricing – pricing process is to make the contractor to design or construct the project on budget	(Gransberg, 2016), (Scheepbouwer and Humphries, 2011), (Rahman and Alhassan, 2012), (Molenaar *et al.*, 2007)
5	Cost led procurement – procurement methods that have been developed in the UK comparable to target pricing	(Ciribini *et al.*, 2016), (Williams *et al.*, 2013)
6	Integrated Project Insurance – an alternative form of insurance providing single cover for the construction project team as a whole	(Ciribini *et al.*, 2016), (Connaughton and Weller, 2013)
7	Opening for alternative tenders – the client, allow variant solutions by the bidders during the tendering phase	(Riemann and Spang, 2014)
8	Alliancing – is a project delivery method where the client and contractor participants work together as an integrated, collaborative team and making unanimous decisions	(Walker and Lloyd-Walker, 2012), (Rahmani *et al.*, 2014), (Lahdenperä, 2012),(Rahman and Alhassan, 2012)
9	Competitive dialogue – procurement procedure for awarding complex public projects	(Lenferink *et al.*, 2012), (Hoezen, 2012), (Kolman, 2014), (Lenferink *et al.*, 2013), (Marique, 2013), (European Parliament, 2014)
10	Best value procurement (BVP) – It is an award method to procure contractor with the best expertise to complete the task	(Hoezen, 2012), (Kashiwagi, 2016)
11	Negotiated procedure – Procurement procedure like competitive dialogue but can be applied in simpler public projects	(Van Valkenburg *et al.*, 2008), (Lenferink *et al.*, 2012), (Hoezen, 2012), (European Parliament, 2014)
12	Partnering – a long-term commitment between the client and contractor for the purposes of achieving specific business objectives	(Rahman and Alhassan, 2012), (Walker and Lloyd-Walker, 2012), (Lahdenperä, 2012), (Löwit and Dostálová, 2014), (Chan *et al.*, 2004)
13	Framework agreement – a procurement arrangement to buy goods and services over a certain period of time	(Walker and Lloyd-Walker, 2015), (Albano and Sparro, 2010)
14	Design and construct contract/Design and build contract – contract form where the contractor has the responsibility of design in addition to the construction of the project	(Rahmani *et al.*, 2014), (Song *et al.*, 2009)
15	Management contracting – contract form when a project owner outsources the project management	(Rahmani *et al.*, 2014), (Walker and Lloyd-Walker, 2015), (Rahman and Alhassan, 2012)
16	Public–private partnerships – a design-construct-operate-maintain contract and it is similar to Build Own Operate Transfer (BOOT)	(Walker and Lloyd-Walker, 2012), (Rahmani *et al.*, 2014), (Jacobsson and Walker, 2013), (Löwit and Dostálová, 2014), (Hans Voordijk *et al.*, 2016)

Note: All 16 approaches fall within the understanding of ECI outlined in the previous section

Table II.
ECI approaches identified from the literature

(Torp *et al.*, 2004). The purpose of identifying success factors is not to avoid problems; it is rather to aim at knowing how to respond before the problems occur. It is found equally to help project teams minimize firefighting, minimize spontaneous approaches in managing uncertainties and minimize the changes encountered during project implementation (Torp *et al.*, 2004). For these reasons, the authors of this paper have found it essential to study the success factors of ECI in public projects.

4. Findings and discussion

4.1 Early contractor involvement approaches implemented in the Norwegian public owned bridge projects

In total, 12 ECI approaches were identified during interviews. Findings from interviews and discussions, as well as recommendations, are presented in this section. Of the 12 approaches identified in the interviews, seven are not found in the 16 approaches identified in the literature. The implication of these unidentified approaches is that the literature focuses on advanced ECI approaches that can be implemented for very complex projects; however, the findings from the case studies indicate that there are relatively simpler ECI approaches that can be implemented on less complex projects.

Approaches one to nine have been implemented in the studied projects during different phases of the project. Whereas, approaches ten to 12 were not implemented in the target projects. Instead, interviewees proposed them as a potential approach for future use.

Table III presents a matrix of approaches versus projects to show which approaches are mutually implemented in the target projects. Only three ECI approaches occur in an individual manner; i.e. without any other approach being co-implemented. It shows the 12 approaches identified by this study in the first columns and the 11 target projects in the first row. The approaches are presented based on a sequence from most implemented (A1) to least implemented (A12). The projects are arranged by the project that used the most approaches (6) to the project that used the fewest (2). In column two of the table, L stands for approaches identified in literature and P stands for approaches identified by the case projects.

In the following sections, the 12 approaches identified during the interviews are briefly described and discussed.

Table III.
ECI approaches identified by interviewees (1-12) × projects (1-11) matrix

No	L/P	ECI approaches	1	2	3	4	5	6	7	8	9	10	11	Total
A1	P	Indirect approaches	X	X	X	X	X	X	X	X	X	X	X	11
A2	P	Information meetings	X	X	X	X	X	X	X		X			8
A3	P	A front-end partnering process	X	X	X	X	X	X	X	X				8
A4	P	Announcing the project with alternative technical solutions	X	X		X		X	X			X	X	7
A5	L/P	Design and construct contract		X	X		X			X	X			5
A6	P	Direct contact with specialist contractors in the front-end phase of projects	X			X								2
A7	P	Idea competition	X											1
A8	P	Contractors sell their idea to the owner in the early phase		X										1
A9	L/P	Negotiated bidding procedure			X									1
A10	L/P	Opening for alternative tenders												0
A11	L/P	Competitive dialogue												0
A12	L/P	Project partnering												0

4.1.1 Indirect approaches. This is a set of approaches. The interviewees have mentioned the use of consultant and in-house construction experience as an approach to implement ECI. Furthermore, the involvement of contractors in the preparation of handbooks and standards are also mentioned. In the case projects, this approach was implemented in all phases of projects.

According to interviewees, there is an ongoing bridge component standardization project initiated by the NPRA. With the intention of integrating contractors' knowledge into the standardization project, the NPRA has invited contractors to participate in this project. Furthermore, the NPRA, depending on necessity, invites contractors into a project's price estimation process and to update handbooks and standards workshops.

These approaches of integrating construction knowledge into the front-end of projects are categorized under indirect approaches by the authors of this paper. The reason for this is that there is no direct involvement of contractors in a specific construction project. Even when the approaches are indirect, it is possible to use contractors to integrate construction knowledge into the front-end phase of projects. Furthermore, the approaches do not involve public procurement complications like the other approaches identified by this study.

4.1.2 Information meetings. The interviewees have mentioned information meetings with the contractors' branch as one of the appropriate approaches to implementing ECI. The approach was used to various degrees by the studied projects. In Case Project 1, the NPRA has used this approach to obtain feedback from the contractors on the contract strategy plans of the project. On this occasion, a meeting was held during the very early phase of the project and the feedback was used to determine the contract strategy of the project. This was not in conflict with public procurement regulations as the client has invited the entire contractors' branch to this meeting and the same information was provided to all contractors. However, in most of the case projects, information meetings were held during the later phases, just prior to announcing the project for tender or after the tender announcement at the tender conference (Figure 2). The NPRA's intentions during such meeting, when it is held in the later phases, are to attract contractors to the project, to

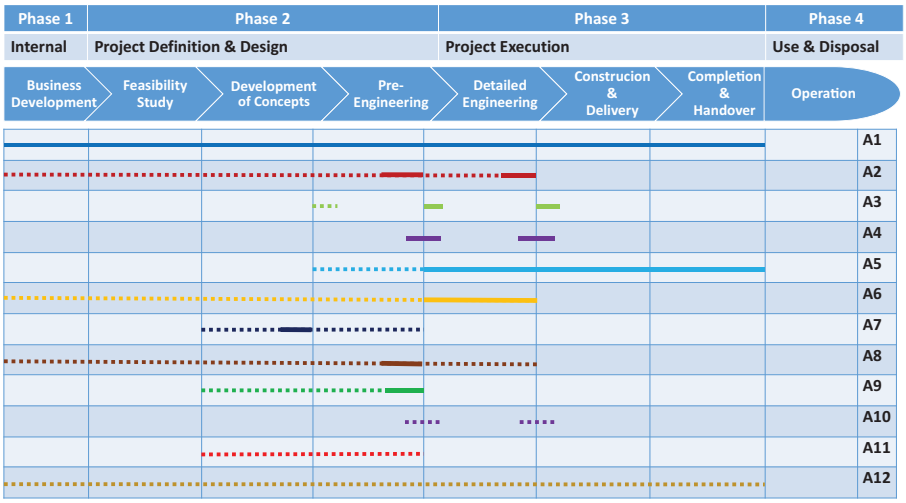


Figure 2. Illustration of the phases-steps during which each ECI approach was implemented and which phases-steps they could have been implemented

explain the project, and to answer questions that may arise, but it is not to achieve input from the contractors.

Yet according to most of the interviewees' experience from such informational meetings, contractors do not usually contribute much in these meetings. The primary reason for the lack of contractor contribution in information meetings is a fear of revealing the company's strategies. One of the interviewees stated:

> Apparently, no contractor dares to expose the company's strategies for solving the project challenges to competitor contractors.

Indeed, such kinds of information meetings are held publicly while all the contractors are gathered in one meeting room.

To obtain the most out of an open information meeting, it is best to hold them as early as possible in the front-end of a 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. It appears that it is not easy for public owners to have a closed meeting with contractors in the front-end phase of a project.

The influence of an information meeting is significantly dependent on which phase of a project it is held. If it is held in the early phase of the project, it is easier for the client to include the inputs from the meeting in the front-end phase of a project. However, if it is held during the later phases of the project, like during the case of a tender conference, it is difficult to adopt the inputs into the project. This is because most of the important work is already done and the fundamental decisions have already been made during the tender conference of a project. Encouraging contractors to share their knowledge in early phase meetings is consequently essential.

4.1.3 A front-end partnering process. According to NPRA internal regulations, all NPRA projects should pass through a front-end partnering process phase. This approach overcomes the legal barriers as this phase starts after the contract signing. This phase should be completed before the contractor commences with construction. The length of this phase can vary depending on project needs. The main aim of this process is to create an opportunity for the project team to get to know each other, as well as to set common goals. However, as the contractor has not started with the execution phase of the project yet, during the front-end partnering process phase there is still the possibility for the contractor to come up with optimization ideas.

According to the interviewees, the success of this approach depends on what optimization ideas the contractor comes up with, and how flexible the owner is to accept new ideas from the contractors during this phase. The common challenges are limited time for the contractors to come up with new ideas and the fact that it is mostly those in the management level, not technical people, who are involved in this meeting. As a result, it is difficult to discuss technical details. As a solution to the second challenge, in Case Project 2, the NPRA has arranged two parallel meetings in the front-end partnering process phase. The purpose of the first meeting was to discuss general conditions of the project; the purpose of the second meeting was to discuss technical details to find optimal technical solutions.

In some of the studied cases, the NPRA has not designed the project in detail but instead postponed the detailed design until after contract signing. Eventually, in the front-end partnering phase, both the owner and the contractor worked to find an optimal solution for the project. A pain-share gain-share agreement in this phase motivates the contractor to come up with optimization ideas. In Case Project 2, the pain-share gain-share agreement was

60/40; that is, 60 per cent to the contractor and 40 per cent for the client. The reference point for the pain/gain share was related to the bid from the contractor.

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. This explains why the front-end partnering process should be combined with a more open contract document, proper compensation, and flexibility of the owner to accept changes during this phase to succeed with this approach.

4.1.4 Announcing the project with alternative technical solutions. As mentioned by interviewees, for some projects the NPRA prepares contract documents with several technical alternatives. The aim of the NPRA in providing alternatives is to give the contractors the ability to influence the production method and material selection during the project delivery phase. The alternatives include all necessary detailed designs and respective procurement documents. The primary motive of the NPRA while using this approach is to reach a wider supplier market and obtain multiple bidders for a project to increase the competition and to obtain the cheapest price to build the project.

This approach has been/will be used in seven of the studied 11 projects. In addition, the NPRA has had positive experience using it, according to interviewees. The planning cost can be comparatively higher as all the alternatives should be planned to a reasonable detail before the tender announcement. However, the NPRA's experiences so far verify that it is a rewarding early investment, considering that the benefit on the latter phase is rather high. One of the interviewees who was involved in several of projects that used this approach stated:

> It was possible to get higher market interest for the projects when they were announced in several alternatives. The increase in market interest has secured enough competition for bid. As a result, the NPRA has obtained lower construction cost, which was one of the aims behind using this approach. The approach should be used more in the future complex bridge projects.

In the case projects, this approach has been used in the concept development and pre-engineering phases of the projects. In some of the case projects, the bridge type is announced with several alternatives. In the other cases, the bridge type was already resolved but the construction methods, the foundation type, and other bridge components were announced with several optional technical solutions. During the implementation of this approach in the case projects, legal barriers were not encountered.

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. The contractors do not get paid directly for this work but they get an indirect benefit as their probability of winning the bid increases significantly if they consider all options thoroughly.

According to the findings, the direct purpose of the owner while using this approach is to achieve low construction costs for the project. While indirectly, the contractors gain some possibilities of using their experience and knowledge to propose the optimal solution out of the options given by the owner. The limitation of this approach is that the contractors' options are restricted by the owner's options and their involvement is neither direct nor early enough.

4.1.5 Design-build contract. A DB contract based on an open procurement procedure was used as an approach to involve a contractor starting from the design phase of the projects. In this approach, the contractor gets the freedom and responsibility to design the project even

if the NPRA Vegdirektoratet (Head office) for quality assurance should approve the design later on. This approach has been used in the case projects during the execution phase, starting from detail engineering.

The interviewees mentioned four major reasons why the NPRA decided to use a turnkey contract in these projects. The first reason was to save time as they had quite a short time until the opening of the road. The second reason was due to the unavailability of in-house competence, skill, and experience with special construction materials and construction method. The third reason is due to the fact that there was interest from the contractor branch in using turnkey contracts. The last reason is due to the desire of the NPRA to try a new type of contract form.

As declared by the interviewees of Case Project 6, even if a DB contract is a suitable approach to implementing ECI, the downside of it is that the owner loses some control and the ability to contribute to the detailed design phase of the project. The interviewee from Case Project 6 stated:

> When the owner loses control in the design phase, consequently it is difficult to regain control in the construction phase.

The interviewee proposed resolving this control issue by implementing a longer front-end partnering process phase and assuring the involvement of the owner in the detailed design phase.

Both interviewees and the literature argued that there are different types of turnkey contracts. They range from the functions description of one of the processes in a DBB contract, in its simplest version, to public–private partnership without private financing for complex projects, in its complex version. They also vary depending on to what extent the project owner has designed the project (preliminary design) and based on the compensation format.

In Case Project 6, the owner has divided the bridge into two contracts. A turnkey contract with a fixed sum compensation format was used for the super structure of the bridge, the part of the bridge where the owner expected less risk and uncertainty. In contrast, a performance contract with a unit-price compensation format was used for the underwater section of the bridge, the part of the bridge where the owner expected high risk and uncertainty. Furthermore, as stated by the interviewees, function descriptions were used in several suspension bridge projects for the steel section of the bridge. This indicates that it is possible to adapt a turnkey contract and use it for a range of projects to achieve ECI.

To get enough bidders and decrease the probability of conflict afterward while using a DB contract, the project should have neither very high uncertainty nor high complexity. Therefore, the owner should be able to define the project to an optimal level to minimize the risk and uncertainty and know what the owner expects from the contractors. It can also be discussed that effective control is evidenced by the achievement of objectives. If this can be done by aligning the commercial interests of the contractors with the owner's objectives, it can be considered a different method of control than giving orders or directing contractor decisions and actions.

The challenge in DB contracts is to avoid bids being inflated to buffer against uncertainty and complexity. However, that concern should be balanced with the ability of aligned and collaborative design and construction to handle uncertainty and complexity. The problem, of course, is that many DB projects do not align the commercial interests of the DB players and do not promote collaboration between them. If these elements can be specified as requirements for selection and payment, a DB contract can be appropriate for complex and uncertain projects.

4.1.6 Direct contact with specialist contractors in the front-end phase of projects. According to the interviewees, to implement ECI, the focus should not only be on the main contractors. Instead, enough attention should also be given to specialist contractors. Specialist contractors are those that have special equipment and competence that both project owners and main contractors are dependent on to execute a project. Examples of specialist companies are bridge foundation specialists, diving companies, and pile foundation specialist companies. This approach has been used in the concept development and pre-engineering phases of the case projects.

The NPRA uses this approach often and benefits significantly from the competence of specialist contractors by having a professional discussion in the front-end phase of projects. The approach was described as an effective ECI approach as it is based on direct contact, not indirectly through the main contractors. In addition, it mostly addresses one specific challenge and discusses it with highly experienced and specialist contractors. According to some interviewees, this approach is just on the boundary of the EU public procurement law; others explained that if the owner takes care not to expose project specific information, it is a legitimate procedure. According to the advocates of the approach, as specialist contractors are not directly involved in the bid for the construction of projects, this approach does not create problems regarding the EU public procurement regulations. In addition, the NPRA takes great care not to expose project specific information.

As argued by interviewees, three important factors should be considered while using this approach. The first factor is that public owners need to have proper competence in the procurement procedures. The second factor is the specialist contractors' ability to understand the owner's challenge with limited information. This factor is important as public owners cannot ask project-specific questions directly for fear of exposing project-specific information that could give them a competitive advantage later on in the bid for the construction phase. Limited information about the project limits the benefits that the specialist contractors can provide the owner. Finally, the client's description of the challenges should be satisfactory.

It can be anticipated that this is a potential approach for future projects; however, the owners' public procurement competence plays an important role here. At the same time, it is also important to know which specialist contractor to contact as it might be misleading if the contacted specialist contractor does not have enough experience on what the client is asking. The simplest way to get around the regulatory concern of unfair advantage and still benefit from specialist contractors participation in project design is to award the contract to an integrated team of designers, engineers, specialty contractors, and a main contractor prior to design.

4.1.7 Idea competition. As identified by both the interviews and the document study, idea competition is one of the approaches used by public owners to implement ECI in the planning phase of projects. Idea competition is 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. In Case Project 1, this approach was used in the concept development phase of the project. However, the participants in the idea completion are mostly consulting companies and companies that provide both consultancy and construction services. One of the interviewees stated:

> The challenge of public owners in using this approach is whether contractors involved in the idea competition should or should not be disqualified from the bid for construction of the same project.

The cause of the dilemma is how to treat all contractors equally during the use of this approach; i.e. not to give project specific information to some contractors that could give a competitive advantage over other contractors during the bid.

Regarding this approach, three undesirable scenarios that could make the competition imbalanced in the bid for the construction were compiled from the interviews. The first one is that bidders that are not involved in the idea competition may not have the same information as those who are involved. The second scenario is that patent and compensation related problems may arise. The last scenario is that contractors who participate in the idea competition may come up with ideas that are suitable for themselves but are not an optimal solution for the project. In all of the undesirable scenarios described above, it is difficult for public owners to practice the EU public procurement requirements. A possible alternative could be design competition, with the award for detailed design, procurement, and construction going to the winner. Competing alternatives could be evaluated for benefits relative to cost.

It can be seen that the crucial advantage of the idea competition approach is that it has a high potential to integrate the contractors' 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 and interweaving throughout the whole project life cycle. To decrease the probability of occurrence of the undesirable scenarios described above, proper documentation during the idea competition process could be used as a protective measure. In addition, a well-prepared contract document could also be used as protective measures. Furthermore, owners should be proactive in evaluating each idea before selecting one.

4.1.8 Contractors sell their idea to the owner in the early phase. In Case Project 2, one contractor has taken the initiative to promote an idea to the NPRA during the pre-engineering phase. The contractor strongly believed that the company had the appropriate knowledge and equipment to deal with the project in an optimal way. In this case, the contractor thought they were the only competitor able to execute their idea. The NPRA used their idea after detail designing as an alternative technical solution to avoid legal issues.

Obviously, it is not too common that the contractors take such initiative. This is because 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. For example, by using an information meeting and promoting the project challenges, the client can advocate that contractors promote their ideas.

4.1.9 Negotiated bidding procedure. Negotiated bidding procedure is one of procurement procedures accepted by the EU. The NPRA is planning to use this procedure by combining it with a turnkey contract in Case Project 3. The reason why the project owner is planning to use this approach is due to a lack of internal competence in the subject matter regarding this specific project. Thus, the NPRA needed to use the contractors' experience in the pre-engineering phase of the project to obtain help for the decision process. This will be the case for all the E39 fjord-crossing projects. The NPRA's challenge in using this approach is a lack of experience with this procedure.

By using this approach, it is possible to achieve both direct and early involvement of contractors. However, it can't be used in all types of projects as the procurement process is demanding for both the client and the contractors. To reduce the challenge of a lack of experience, the NPRA can implement various measures. Ensuring proper experience transfer from one project to another can be the first measure. The second measure can be a continuous use of the approach. By taking these measures, the client can ensure the continuous accumulation of experience.

4.1.10 Opening for alternative tenders. The interviewees mentioned opening the project for alternative offers in addition to what the owner provides. In this approach, the

contractors can give bids based on alternative solutions to a project. However, this approach was not practiced in the case projects.

In most projects, contractors are not permitted by the NPRA to submit alternative offers because of two major reasons. The first reason is that it is usually challenging to control the features of the alternative offers in the short period between the bid opening and the awarding of the contract. Secondly, it is difficult to compare bidders based on different competition grounds, as the lowest price is most commonly used as the competition base. The first reason is particularly the case with bridge projects as these have relatively longer control and approval process. The entire project delivery will most probably be delayed if the contractors come up with alternative tenders based on a new solution. This demonstrates that the owner may need to be careful of this approach as the cost and duration of a project could be affected by the variety of alternative offers.

4.1.11 Competitive dialogue. Competitive dialogue is one of the procurement procedures which are approved by EU. It was introduced in 2004 for particularly complex projects by the European Parliament. This approach was not implemented in the studied projects; however, interviewees have proposed this procurement procedure as a potential approach for the future projects to implement ECI.

This approached has only been tried on five road projects by the NPRA so far. The experience from these projects should be studied before further practicing the approach.

4.1.12 Project partnering. Project partnering is a long-term commitment between the client and contractor for the purposes of achieving specific business objectives. Interviewees have proposed project partnering as a potential approach for the future projects even if the NPRA has no experience with this approach.

This approach is practiced more in the building sector than in infrastructure projects in Norway. Therefore, the Norwegian bridge sector should learn from the building sector to ensure successful implementation of the approaches.

4.2 Success factors for early contractor involvement

The interviewees have described several success factors of ECI. The authors of this paper have analyzed, compiled and categorized them into six major success factors. They are presented in Table IV. Brief descriptions and detailed discussions are presented in the following sections.

4.2.1 Timing of early contractor involvement application. According to most of the interviewees, to involve contractors early enough when they can make a real difference and offer them a real possibility of influencing the outcomes of the project is important.

When the contractors are involved too early, their contribution and influence on major decision-making can be too high. Despite this, for standard and less complex projects there may be less value that can be added by using ECI. Furthermore, contractor involvement too early in the process increases bureaucracy and expenses due to the procurement process. On

No.	Identified ECI success factors
1	Timing of ECI application
2	Risk distribution
3	Project owner's competence
4	Appropriate compensation
5	Qualification of the contractors
6	Trust

Table IV.
ECI Success factors

the other hand, if contractors get involved too late, it is difficult to accept their contributions and implement them in the project. This is due to the time required to complete the control and approval process of projects, as well as due to client resistance.

The findings from the case studies prove that ECI is not a "one size fits all quick fix" solution for all projects. Instead, it is important to develop different models of ECI, depending on the level of contractor involvement needed for each project. The consensus is that if the project is very complex, the contractors should be involved at the earliest during the business development phase (see Figure 1).

4.2.2 Risk distribution. The interviewees indicated that having a fair risk distribution between the contractor and the client is a success factor for ECI. Due to lack of information and project uncertainties, the risk level of projects is high in the early phases. 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 could also help to avoid conflict afterward in the project execution phases. If the project risk level that will be transferred to the contractors is high, it could be difficult to find a capable contractor that is willing to carry it.

This discussion indicates that unfair transfer of risk to the contractor could make the project unnecessarily expensive for 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. Based on the experience of the case projects, there could be three different approaches to minimizing project risk. The first approach would be to divide one extra-large project into manageable smaller contracts, which could contribute to significant risk reduction. The second approach would be to have a compensation format that suits the risk level. The third approach would be to try to decrease the uncertainties of the project by performing a detailed study before announcing for bid.

4.2.3 Project owner's competence. The project owner's competence and experience in ECI public procurement were raised as an important success factor by interviewees. This concern is due to the fact that 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.

The interviewees have also raised discrimination issues. Regardless of what the client does to avoid disputes and court proceedings, there is always a certain level of risk if the owner includes some, and not all, of the contractors in the early phase of projects. The contractors who are not included may believe that they have been discriminated against. They may also feel that they do not have the same project background information as those who are included in the early phase.

The project owner's competence should not be limited to ECI public procurement procedure; technical knowledge competence is also essential. Even if, in some of the ECI models, owners transfer a significant amount of a project risk and responsibility of the technical design work to the contractor, the owners should still have control over what they have ordered and what they shall receive at the end of the project. Furthermore, the owners should also be able to describe appropriately the scope of a project. Therefore, in-house technical competence is vital success factor of ECI. In cases where ECI approaches are used due to the lack of in-house competence, other quality assurance mechanisms should be used. These mechanisms could be transferring the operation/maintenance responsibility of the project to the contractor or selection of the contractor based on past performance like in the case of Best Value Procurement (BVP).

These potential issues demonstrate the significance of using a suitable procurement procedure that outfits a project. Additionally, they identify the necessity for the owner to be

competent in technical and public procurement. Similarly, transparency during the procurement process, as well as making available all project information for all contractors afterward, could forestall charges of discrimination.

4.2.4 Appropriate compensation. Appropriate compensation for the contractors' contribution is another success factor the informants raised during the interviews. The main goal for contractors is to receive profit from a project. Therefore, a client should compensate contractors properly to ensure that the contractors share their knowledge with the client. Based on the experience of the interviewees, the contractors' interest in participating in an early phase of a project and their eagerness to contribute varies significantly depending on the compensation format.

This finding confirms the significance of developing an appropriate compensation format that suits the different ECI models. Furthermore, it also illustrates the importance of developing a compensation format that facilitates a win-win situation for both contracting parties.

4.2.5 Qualification of the contractors. Assuring the qualifications of contractors that get involved in the early phase was raised as success factor of ECI by several interviewees. When a public owner permits contractors to become involved during the early phases of a project, the intention is to use the experience the contractors have from other comparable projects. Therefore, the contractor should be generally capable and be able to contribute to the new project based on previous experience. How public owners can be assured that the contractors have the necessary qualifications should be identified in advance of the choice of each contractor. Therefore, the contractor's preceding practice in comparable projects could be used as a selection principle.

The findings validate the significance of using ECI with a combination of various qualifications-based selection criteria, such as the most economically advantageous tender, instead of using only the lowest price. By using qualifications-based selection criteria, public project owners could be relatively certain regarding the qualifications of the contractors that are involved in the early phases of a project.

4.2.6 Trust. The trust between the client and the contractor is another success factor identified from interviews. No contractor wants to share their knowledge, experience or ways of solving project challenges with their competitors. Based on most of the interviewees' experience, if an owner brings together several contractors in one place to obtain solutions for project challenges, it is seldom that there will be a beneficial discussion in these meetings. Therefore, public project owners should first develop an appropriate plan to assure a method of keeping the contractors' solutions confidential before inviting them for early involvement. One-on-one dialogue in a closed environment increases the contractors' trust level regarding the client. As a result, their openness to share creative ideas increases significantly.

Mostly, contractors want to have contractual protection for their creative ideas, feel safe and be sure about how the information they deliver will be used by the client. Furthermore, due to the nature of the business, they want to be compensated for their expertise as well.

The importance of trust indicates the significance of closed and one-on-one dialogue between the contractor and the client supported by contractual protection and can result in obtaining the most out of the contractors' early involvement. The higher trust level could lead to a more openness and facilitate more input from the contractors.

On the other hand, interviewees also raised the issue of the client's trust in contractors. The owner's trust level with the contractors is the critical factor for how much accountability the owner transfers. For example, in a DB contract, an owner does not precisely know before the project is completed what he will get at the completion of the

project. So when a public owner favors DB instead of DBB, it indicates that the owner has a greater level of trust, allowing him to hand over accountability to the contractors by involving them early.

4.3 How could the implemented early contractor involvement approaches be improved in practice?

The analysis shows that time 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. As a consequence, this paper uses *time* as evaluation criteria of the implemented ECI approaches in practice.

Figure 2 illustrates the phases-steps in which the nine ECI approaches were implemented. In addition, it illustrates in which phases-steps the 12 ECI approaches could have been implemented in, based on the understanding of the authors of this paper. The latter information is provided to illustrate the potential of each of the 12 ECI approaches identified during the interview. In the figure, A1-A12 stands for ECI approaches identified by interviewees (see Table III). Solid lines indicate when the approaches were implemented in the case projects. Dashed lines indicate when the approaches could have been implemented. Solid lines overlay dashed lines.

During the evaluation of the implemented approaches by the determined evaluation criteria, *time*, it is observed that most of the identified ECI approaches were implemented during relatively late phases of the projects. However, as shown in Figure 2, most of the approaches have a higher potential of being implemented earlier in the target projects. This disconnect indicates that the full potential of the implemented ECI approaches was not exploited by NPRA. The first success factor that was identified by the client interviewees themselves was not realized when approaches of ECI were in use. Based on this observation, we concluded that with regard to bridge projects, the NPRA has a lot to learn when it comes to implementing ECI. In many cases, the perceived barriers seem to stop public owners from implementing ECI even though they are surmountable. A lack of familiarity with ECI approaches, lack of awareness on the importance of ECI, and a lack of experience in the use of the ECI approaches could all be the barriers to full implementation.

In the future, public owners should give emphasis to the success factors of ECI while implementing ECI approaches. The recommendation of this paper is that the implemented ECI approaches could be improved if public owner give appropriate consideration to the success factors of ECI while implementing the approaches.

5. Conclusion

The research questions addressed in this study are as follows:

RQ1. What do public owners do to implement ECI?

RQ2. What are the success factors for ECI?

RQ3. How could the implemented ECI approaches be improved in practice?

The literature reports that severe barriers exist – primarily legal ones – that exclude the public owners from introducing contractors into the earlier phases of a project. The research reported on in this paper shows that – based on experiences in Norwegian bridge

construction – the difficulties of overcoming these hindrances are exaggerated. The analysis presented in this paper shows that lack of experience, lack of awareness regarding the importance of ECI and lack of familiarity with ECI approaches are equally important barriers. ECI is, in fact, possible and several approaches to it are explored above. The overall finding of this paper is that involving contractors earlier in a project than is practiced today is highly recommended.

The literature study identified 16 approaches and the case studies identified 12 approaches. Of these 12 approaches, 7 are not found in the 16 approaches identified in the literature. The implication of these unidentified approaches is that the literature focuses on advanced ECI approaches that can be implemented for very complex projects; however, the findings from the case studies indicate that there are relatively simpler ECI approaches that can be implemented on less complex projects. The addition of these seven approaches not recognized by the literature enriches the selection possibilities of public owners. Furthermore, it provides a new direction for the literature of ECI by introducing new approaches as potential topics of further study.

This paper has also identified six major success factors of ECI from the interviews, namely, the timing of ECI application, risk distribution, project owner's competence, appropriate compensation, qualification of the contractors and trust.

The evaluation of the approaches was based on *time*, which is also one of the success factors identified by this study: timing of ECI application. The evaluation shows that most of the identified approaches were used in the late phases of the case projects. The analysis shows, however, that most of the identified approaches could have been implemented earlier in the process. Based on this observation, it is possible to conclude that the primary success factor for the use of ECI identified by the owners themselves was not realized when approaches of ECI were implemented. As a result, the potential of the ECI approach was not fully exploited by NPRA. Public owners who plan to implement ECI should also consider the other five success factors. Therefore, the recommendation of this paper is that the implemented ECI approaches could be improved if public owners give appropriate consideration to the success factors of ECI while implementing the approaches.

The study involved some limitations. The empirical study was based only on Norwegian bridge projects, specifically projects of the NPRA. Moreover, the scope of the study was restricted to bridge projects that were completed after 2001 and to bridge projects which were in the planning and design phase during the course of this study.

Although this research is based on Norwegian public bridge projects, the study findings and practical experiences may be used as a basis for similar investigations by other public owners in Norway or in other parts of the world. The study contributes to the field of public procurement by introducing new ECI approaches from the case studies. Furthermore, it provides useful insights to assist public owners in selecting and implementing ECI approaches.

In the future, more case studies in other infrastructure projects, as well as projects other than bridges, may reveal new approaches and validate the findings. The international experience of ECI could also be studied to investigate what others outside Norway have done. For example, Finland and The Netherlands have extensive experience with engaging contractors in the project definition and design phases within the EU public procurement directives. Furthermore, each of the approaches identified in this paper could be studied in-depth to relate them to international experience. It may then be possible to prioritize one approach over the other for future use. This investigation could be conducted by weighing potential benefits against associated efforts and risks.

References

Albano, G.L. and Sparro, M. (2010), "Flexible strategies for centralized public procurement", *Review of Economics and Institutions*, Vol. 1 No. 2.

Blumberg, B.F., Cooper, D.R. and Schindler, P.S. (2014), *Business Research Methods*, McGraw-hill education.

Chan, A.P., Chan, D.W., Chiang, Y., Tang, B., Chan, E.H. and Ho, K.S. (2004), "Exploring critical success factors for partnering in construction projects", *Journal of Construction Engineering and Management*, Vol. 130 No. 2, pp. 188-198.

Ciribini, A.L.C. Caratozzolo, G. Bolpagni, M. Ventura, S.M. and DE Angelis, E. (2016), "The implementation of building information modelling within an integrated public procurement approach: the main contractor's perspective".

Connaughton, J. and Weller, S. (2013), "Improving collaboration in construction: an opportunity for action research", *Proceedings 29th Annual ARCOM Conference*, *Reading*.

Creswell, J.W. (2013), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage publications.

Ellis, D. (1993), "Modeling the information-seeking patterns of academic researchers: a grounded theory approach", *The Library Quarterly*, Vol. 63 No. 4, pp. 469-486.

European Parliament, C. O. T. E. U (2004), "Directive 2004/18/EC of the European parliament and of the council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. Official journal of the European union".

European Parliament, C. O. T. E. U (2014), "Directive 2014/24/EU of the European parliament and of the council of 26 February 2014 on public procurement and repealing directive 2004/18/EC text with EEA relevance. Official journal of the European union".

Falagario, M., Sciancalepore, F., Costantino, N. and Pietroforte, R. (2012), "Using a DEA-cross efficiency approach in public procurement tenders", *European Journal of Operational Research*, Vol. 218 No. 2, pp. 523-529.

Gokhale, S. (2011), "Integrated project delivery method for trenchless projects", in: Reston, V., (Ed.)/ *Proceedings of the International Conference on Pipelines and Trenchless Technology October 26-29*, *American Society of Civil Engineers*, *Beijing, China*.

Gransberg, D.D. (2016), "Comparing construction manager–general contractor and federal early contractor involvement project delivery methods", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2573, pp. 18-25.

Gustafsson, J. (2017), "Single case studies vs multiple case studies: a comparative study".

Hans Voordijk, D., Janssen, R., Graaf, R.D., Smit, M. and Voordijk, H. (2016), "Why local governments rarely use PPPs in their road development projects: understanding the barriers", *International Journal of Managing Projects in Business*, Vol. 9 No. 1, pp. 33-52.

Hoezen, M.E.L. (2012), *The Competitive Dialogue Procedure: Negotiations and Commitment in Inter-Organisational Construction Projects*, University of Twente.

Jacobsson, M. and Walker, D.H. (2013), "Alliancing within a public-private partnership. Steinthorsson RS", *The 22nd Nordic Academy of Management (NFF) Conference*, *Reykjavik, Iceland*, pp. 21-23.

Kashiwagi, D. (2016), *2016 Best Value Approach*, Kashiwagi Solution Model (KSM), USA.

Kent, D.C. and Becerik-Gerber, B. (2010), "Understanding construction industry experience and attitudes toward integrated project delivery", *Journal of Construction Engineering and Management*, Vol. 136 No. 8, pp. 815-825.

Klakegg, O.J., Andersen, B., Magnussen, O.M., Walker, D. and Williams, T. (2010), *Early Warning Signs in Complex Projects*, Project Management Institute, Newtown Square.

Kolman, R. (2014), *Early Contractor Involvement; Improving Complex Maritime Infrastructure Projects*, *PIANC World Congress* San Francisco, USA.

Kristensen, K., Lædre, O., Svalestuen, F. and Lohne, J. (2015), "Contract models and compensation formats in the design process", in *Proc 23rd Ann. Conf. of the Int'l. Group for Lean Construction. Perth, Australia*.

Lædre, O. (2006), *Valg av Kontraktsstrategi i Bygg-og Anleggsprosjekt*.

Lahdenperä, P. (2012), "Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery", *Construction Management and Economics*, Vol. 30 No. 1, pp. 57-79.

Lahdenperä, P. (2013), "Determining `the most economically advantageous tender′ based on capability and fee-percentage criteria", *Journal of Public Procurement*, Vol. 13 No. 4, pp. 409.

Lahdenperä, P. (2016), "Preparing a framework for two-stage target-cost arrangement formulation", *International Journal of Managing Projects in Business*, Vol. 9 No. 1, pp. 123-146.

Lenferink, S., Tillema, T. and Arts, J. (2013), "Public-private interaction in contracting: governance strategies in the competitive dialogue of dutch infrastructure projects", *Public Administration*, Vol. 91 No. 4, pp. 928-946.

Lenferink, S., Arts, J., Tillema, T., Vanvalkenburg, M. and Nijsten, R. (2012), "Early contractor involvement in dutch infrastructure development: initial experiences with parallel procedures for planning and procurement", *Journal of Public Procurement*, Vol. 12 No. 1, pp. 1-42.

Löwit, H. and Dostálová, M. (2014), "Defining of decision-making criteria for optimum construction procurement system selection for public works", *Creative Construction Conference*.

Marique, Y. (2013), "Cooperation and competition in complex construction projects: implementation of EU procurement rules in England and Belgium", *International Journal of Law in the Built Environment*, Vol. 5 No. 1, pp. 53-70.

Molenaar, K., Triplett, J., Porter, J., Dewitt, S. and Yakowenko, G. (2007), "Early contractor involvement and target pricing in US and UK highways", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2040 No. 1, pp. 3-10.

Mosey, D. (2009), *Early Contractor Involvement in Building Procurement: contracts, Partnering and Project Management*, John Wiley and Sons.

Naoum, S.G. and Egbu, C. (2016), "Modern selection criteria for procurement methods in construction: a state-of-the-art literature review and a survey", *International Journal of Managing Projects in Business*, Vol. 9 No. 2, pp. 309-336.

NTP (2016), *National Transportplan 2018-2029*, in Plan, T.N.N.T. (Ed.).

Rahman, M. and Alhassan, A. (2012), "A contractor's perception on early contractor involvement", *Built Environment Project and Asset Management*, Vol. 2 No. 2, pp. 217-233.

Rahmani, F., Khalfan, M. and Maqsood, T. (2013), *The Use of Early Contractor Involvement in Different Countries. AUBEA 2013*, University of Auckland, pp. 1-10.

Rahmani, F., Khalfan, M. and Maqsood, T. (2014), "The application of early contractor involvement (ECI) in different delivery systems in Australia", *International Conference on Construction in a Changing World*, *University of Salford*, pp. 1-12.

Rekonen, S. and Björklund, T.A. (2016), "Perceived managerial functions in the front-end phase of innovation", *International Journal of Managing Projects in Business*, Vol. 9 No. 2, pp. 414-432.

Riemann, S. and Spang, K. (2014), "Application of contractor's knowledge in public financed infrastructure projects in Germany", *Procedia – Social and Behavioral Sciences*, Vol. 119 No. 2014, pp. 202-209.

Scheepbouwer, E. and Humphries, A. (2011), "Transition in adopting project delivery method with early contractor involvement", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2228 No. 1, pp. 44-50.

Schnitzer, J.S. (2010), "Regulating public procurement law at supranational level: the example of EU agreements on public procurement", *Journal of Public Procurement*, Vol. 10 No. 3, pp. 301-334.

Sødal, A.H., Lædre, O., Svalestuen, F. and Lohne, J. (2014), "Early contractor involvement: advantages and disadvantages for the design team", *22nd Annual Conference of the International Group for Lean Construction, 25-27, Oslo, Norway*, pp. 519-531.

Song, L., Mohamed, Y. and Abourizk, S.M. (2009), "Early contractor involvement in design and its impact on construction schedule performance", *Journal of Management in Engineering*, Vol. 25 No. 1, p. 12.

Torp, O. Austeng, K. and Wubishet, J.M. (2004), "Critical success factors for project performance: a study from front-end assessments of large public projects in Norway".

Torp, O., Magnussen, O.M., Olsson, N. and Klakegg, O.J. (2006), Cost uncertainty in large public investment projects. Concept-report no 15.

Turner, N. and Riding, M. (2015), "Early contractor involvement in Australia: learnings from transfield services projects", *Small Enterprise Research*, Vol. 22 Nos 2/3, pp. 173-184.

Van Valkenburg, M., Lenferink, S., Nijsten, R. and Arts, J. (2008), "Early contractor involvement: a new strategy for "buying the best" in infrastructure development in The Netherlands", *Third International Public Procurement Conference (IPPC)*.

Vegvesen, S. (2012), "Delprosjekt gjennomføringsstrategier og kontraktstyper".

Walker, D.H. and Lloyd-WALKER, B.M. (2015), *Collaborative Project Procurement Arrangements*, PMI.

Walker, D.H. and Lloyd-WALKER, B. (2012), "Understanding early contractor involvement (ECI) procurement forms", *Procs 28th Annual ARCOM Conference, 3-5 September 2012, Association of Researchers in Construction Management, Edinburgh, UK*, pp. 877-887.

Williams, T., Williams, M. and Ryall, P. (2013), "Target cost contracts: adopting innovative incentive mechanisms to improve the project delivery process", *Procs 29th Annual ARCOM Conference, Association of Researchers in Construction Management, Reading, UK*, pp. 759-768.

Yin, R.K. (2013), *Case Study Research: Design and Methods*, Sage publications.

Appendix. Interview guide

(1) Introduction
- Can you tell me about your background?
- Information about the case project (a separate cheek list was used to gather information about the case projects).

(2) How can public owners integrate contractors' knowledge and experience in project planning/project design (general questions)?
- In your opinion, what kind of implementation strategies and contract forms can public owners use to integrate contractor knowledge and experience in project planning/project design?
- How can these implementation strategies and contract forms help to integrate contractors' knowledge and experience in project planning/project design?
- What are the advantages and disadvantages of these implementation strategies and contract forms?
- What could government owners achieved by integrating contractors' knowledge and experience in project planning/project design?

(3) What did NPRA to integrate contractors' knowledge and experience in project planning/project design (project specific questions)?

- Previous project specific experience
  - What is your prior experience with integrating contractors' knowledge and experience in project planning/project design?
  - Based on your prior experience, what are the advantages and disadvantages of integrating contractor knowledge in project planning/project engineering? Can you give me some specific examples?
- Specifically on the case project
  - Can you tell me about what you have done/will you do differently to integrate contractors' knowledge in project planning/project design in this specific project?
  - Why do you want to integrate the entrepreneurs' knowledge in project planning/project design?
  - Why were this specific contract strategy, contract form, and procurement procedure chosen?
  - What did/will NPRA achieve by integrating contractors' knowledge in project planning/project design in this specific project?
  - Which challenges bring this contracting strategy? Why?
  - What can be done to improve this strategy for future use? Or what should be done differently?
  - Do you have experience from other projects with similar or other contractual strategies that are used to integrate contractors' knowledge and experience in project planning/project design?

(4) What are the success factors for integration of entrepreneur knowledge in project planning/project engineering (project specific questions)?
- In your opinion, what were the success factors of integrating contractor knowledge and experience in project planning/project design in this specific project?
- In your opinion, what were the challenges for NPRA by integrating constrictions` knowledge in project planning/project design? Why?

(5) How can NPRA integrate contractor knowledge and experience in project planning/project engineering in future projects (general questions)?
- Do you think that there is a need to integrate contractors' knowledge in project planning/project design in NPRA's future projects?
- When shall the contractor's knowledge integrate into project planning/project design?
- In general, what are the success factors of integration contractors' experience or knowledge and experience in project planning/project design in NPRA's future projects?

About the authors

Paulos Abebe Wondimu (MSc) is a PhD Student at the Department of Civil and Environmental Engineering at Norwegian University of Science and Technology. Paulos Abebe Wondimu also has a senior engineer position at Norwegian Public Roads Administration. Wondimu's research interests include early contractor involvement, public procurement, competitive dialogue and best value procurement. Paulos Abebe Wondimu is the corresponding author and can be contacted at: paulos.wondimu@ntnu.no and paulos.wondimu@vegvesen.no

Ali Hosseini (MSc) is a PhD Student at the Department of Civil and Environmental Engineering at Norwegian University of Science and Technology. Hosseini's research interests include partnering, alliancing and relational contract. e-mail ali.hosseini@ntnu.no

Jardar Lohne (PhD) is a researcher at the Department of Civil and Environmental Engineering at Norwegian University of Science and Technology. Lohne's research interests include design management, construction management and project management. e-mail jardar.lohne@ntnu.no

Ola Lædre (PhD) is an Associate Professor at the Department of Civil and Environmental Engineering at Norwegian University of Science and Technology. Lædre's research interests include contracts and contract strategies, viability for investment, property managment and disput settlement. e-mail ola.laedre@ntnu.no

B Core paper 2

COMPETITIVE DIALOGUE IN NORWEGIAN PUBLIC INFRASTRUCTURE PROJECTS

Journal of Construction Engineering and Management

Case Study

Competitive Dialogue in Norwegian Public Infrastructure Projects

Paulos Abebe Wondimu[1]; Jardar Lohne[2]; and Ola Lædre, Ph.D.[3]

Abstract: Competitive dialogue (CD) is a relatively new procurement procedure introduced in 2004 by the European Parliament for particularly complex contracts. The Norwegian Public Roads Administration (NPRA) has limited experience with the procedure, but they are planning to use it in several future projects. Limited research was found concerning the practical issues of CD. This paper explores the experiences of Norwegian practitioners to identify such issues and suggests measures for the success of future projects using the procedure. In addition to a literature study, a document study and 22 semistructured in-depth interviews with key informants from six cases selected from the Norwegian public infrastructure projects were carried out. Both the client and the suppliers value the potential of CD. However, several challenges were identified, 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. This paper contributes to construction engineering and management practice to increase the understanding of CD by suggesting what kinds of measures ought to be taken for the success of future projects using the procedure. **DOI: 10.1061/(ASCE)CO.1943-7862.0001540.**

Author keywords: Competitive dialogue; Procurement procedure; Public projects; Innovation; Early contractor involvement.

Introduction

Public procurement can be used as an instrument for advancing the goals of innovation policy (Uyarra and Flanagan 2010). Public procurement carried out in a way that facilitates early contractor involvement (ECI) has been found to stimulate innovation, increase project control, and achieve time gains (Lenferink et al. 2012; Chen and Manley 2014). ECI is one method that can be used to reduce rework (Love Peter et al. 2015) and transaction costs in projects (Li et al. 2013). Globally, several approaches have been used to implement ECI within the context of public procurement. These include alliancing, best value procurement (BVP), partnering, public-private partnership (PPP), integrated project delivery (IPD), and competitive dialogue (CD) (Kent and Becerik-gerber 2010; Wondimu et al. 2017b).

CD is a relatively new procurement procedure introduced in 2004 by the European Parliament for particularly complex contracts (European Commission Public Procurement Policy 2006). It is a procedure that can be used to engage suppliers in the early phase of a project to support innovation (Edler and Georghiou 2007; Korthals Altes and Taşan-Kok 2010). In Finland, for instance, public traffic infrastructure owners have developed an alliancing project delivery method based on CD in order to implement ECI (Lahdenperä 2009). In the Netherlands, CD and BVP have been used as approaches to implement ECI in the public sector (Van Leeuwen 2011; Lenferink et al. 2012). Van Leeuwen (2011) explains how it is possible to combine CD with BVP to establish a procurement procedure that prioritizes qualification over price. In sum, CD has been found to enable the market to suggest innovative solutions (Kautsch et al. 2015) through the early involvement of suppliers, and to establishing an innovative public client-supplier relationship (Essig and Batran 2005).

The Norwegian Public Roads Administration (NPRA) is currently planning a mega project, the E39 Coastal Highway Route along the west coast of Norway. The project cost is estimated to be approximately $40 billion. One of the main ambitions of the project is to make the E39 ferry free by replacing the eight ferry services crossing the major fjords with bridges and submerged tunnels. The fjords are up to 1,300 m deep and 7,500 m wide. As a consequence of the technical challenges involved, the NPRA needs to bring suppliers' knowledge and experience into the project to boost innovation. The NPRA plans on using CD to achieve innovation through early contractor involvement.

Public procurement regulations vary from country to country, this even if all countries in Europe should follow the EU public procurement directives. Experiences with the implementation of new procurement procedures are thus country specific. The EU directive (2004/18/EC) does not regulate in detail how CD should be conducted, nor what phases should be included in CD (European Commission Public Procurement Policy 2006). Thus, CD has been practiced in different ways in different countries. CD is a novel procurement procedure in Norway. The NPRA has used the procedure in only six projects. So far, limited research has been done on CD in the Norwegian context. Furthermore, limited international research has identified practical issues of CD.

This study fills addresses the experiences of Norwegian practitioners through the following research questions:

- How is CD implemented?
- What are the experiences from using CD?

[1]Ph.D. Candidate, Dept. of Civil and Environmental Engineering, Norwegian Univ. of Science and Technology, 7491 Trondheim, Norway; Senior Engineer, Dept. of Road and Transport, Norwegian Public Roads Administration, 6404 Molde, Norway (corresponding author). Email: paulos.wondimu@ntnu.no; paulos.wondimu@vegvesen.no

[2]Research Scientist, Dept. of Civil and Environmental Engineering, Norwegian Univ. of Science and Technology, 7491 Trondheim, Norway. Email: jardar.lohne@ntnu.no

[3]Associate Professor, Dept. of Civil and Environmental Engineering, Norwegian Univ. of Science and Technology, 7491 Trondheim, Norway. Email: ola.ladre@ntnu.no

Note. This manuscript was submitted on December 7, 2017; approved on March 21, 2018; published online on July 27, 2018. Discussion period open until December 27, 2018; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Construction Engineering and Management***, © ASCE, ISSN 0733-9364.

- What measures ought to be implemented for the success of future projects using CD?

Primary data collection is limited to six public infrastructure projects. Three of the projects are yet not completed. The long-term effects of the procurement procedure are consequently not explored in this study.

Theoretical Background

Procurement Procedures

The European Public Procurement Directive (2014/24/EU) identifies six procurement procedures for public works, supply, and service contracts, notably:

1. Open procedure;
2. Restricted procedure;
3. Competitive procedure with negotiation;
4. CD with prequalification dialogue with competitors before bidding;
5. Innovation partnership; and
6. Use of the negotiated procedure without prior publication (European Parliament CotEU 2014).

CD is of particular interest since it is a procedure that can be used to involve contractors—through individual dialogue with prequalified and shortlisted suppliers—in early phases of complex projects.

Competitive Dialogue

CD was introduced in 2004 by the European Parliament for particularly complex public contracts (European Commission Public Procurement Policy 2006) with special concern for providing an improved method for awarding such contracts (Arrowsmith and Treumer 2012). Its introduction could be regarded as evidence of public clients seeking to foster an increased level of collaboration (Plane and Green 2012). It is explicitly aimed at projects that require careful research and development of the best solution to address a specific client's needs (Wondimu et al. 2017a). Furthermore, it is a flexible procedure that ensures competition and dialogue (Albano and Sparro 2010).

The revised version of the European Public Procurement Directive (2014/24/EU) has widened the possibilities of using CD in 2014. The procedure is no longer limited to particularly complex projects. Instead, the revised directive describes five circumstances in which the procedure can be used: now it can be used on the same grounds as the competitive procedure with negotiation. The revised version of the EU directive is clearer and more straightforward than previous versions regarding when it is possible to use CD (Telles and Butler 2014).

In CD, all interested suppliers can apply to participate in the project and provide company information. In the next stage, after prequalification and shortlisting based on the information provided by suppliers, the client invites a limited number of suppliers to participate in the dialogue phase (Wondimu et al. 2017a). After the dialogue phase, the client should assess the received tenders by the award criteria specified in the contract notice and select the most economically advantageous tender (MEAT) (Hoezen et al. 2014). MEAT (price-inclusive multicriteria selection) is the weighted sum of various aspects of a product or service that provides value to the project (Wondimu et al. 2016). It makes sure that other selection criteria are considered in addition to price, notably by taking into consideration qualitative environmental and social aspects (Uttam and Le Lann Roos 2014). The MEAT evaluation method clarifies the winning probability of the most optimal value-price ratio (Sebastian et al. 2013).

CD originated as a means to facilitate procurement of complex projects where procurement is based on open output specifications in order to leave room for private innovation, e.g., through ECI and through giving suppliers flexibility to suggest their solutions (Petersen 2010). In addition, the procedure was meant to create more dialogue, competition, and mutual trust in the procurement of complex projects (Hoezen et al. 2014). Bougrain (2012) illustrates that when CD is combined with PPP, it helps to create coherence in a project and to minimize lifecycle cost. Furthermore, the solutions implemented on the projects were more cost-effective and more closely matched the client's requirements. The flexibility the procedure provides in the precontract and tendering phases has been found to force suppliers into a more proactive mindset. CD has played a central role in the formation of integrated teams (Aapaoja et al. 2013). It has also facilitated a better understanding between parties (Hood and Smith 2013). CD is a procurement procedure that allows a dialogue between a client and several suppliers before contract signing. International qualitative cases studies show that actors value the potential of CD.

Dialogue Phase

The EU directive does not regulate in detail how the dialogue should be conducted nor what phases are included in CD (European Commission Public Procurement Policy 2006). Thus, CD has been practiced in different ways. For example, Sundaraj and Eaton (2013) state that the three main phases in CD are predialogue, dialogue, and postdialogue. According to Burnett (2009), the number of dialogue meetings varies. This author also found variation in the objectives of the dialogue phases, how the different subdialogue phases are conducted, the time assigned for the dialogue phase, and the information to be requested from the bidders. Furthermore, variances were found concerning whether or not solutions should be eliminated in the dialogue phase and, crucially, the position that the project client needs to arrive at by the end of the dialogue phase.

The dialogue is an intervening phase between the tender announcement and the submission of final tenders. CD consists of several rounds of closed one-to-one dialogue meetings between the client and the potential suppliers. During the dialogue phase, all aspects of the tender can be discussed openly (European Parliament CotEU 2014). The client can ensure that its long-term commitments are taken into account since CD offers the contracting parties the opportunity to discuss subjects such as sustainability and renewable energy objectives (O'Brien and Hope 2010).

The current methods of conducting the dialogue phase of CD can be summarized as (1) merging solutions, (2) sketch solutions, 3)) consecutive, (4) consultative (Burnett 2009), and (5) successive stages approaches (Soliño and Gago de Santos 2010).

In (1), a merging solutions approach, the client invites several solutions and then narrows the differences between them toward a single merged solution before the final bid (Burnett 2009). Following this, the suppliers subsequently submit tenders based on the merged solution. Such submission makes it easier for the client to compare the tenders (Haugbølle et al. 2015). In (2), a sketch solutions approach, the client first asks for sketch solutions and then one or more progressively detailed solutions. In (3), a consecutive approach, the dialogue is divided into technical/operational and financial aspects of the offer. The dialogue meetings are arranged successively, first on technical and then on financial aspects. In (4), a consultative approach, the dialogue occurs on a provisionally preferred solution of the client. Then, the client invites the suppliers to propose amendments or comment on this solution and

develops the solution based on the dialogue (Burnett 2009). Finally, in (5), a successive stages approach, the dialogue typically takes place in several stages to reduce the number of solutions discussed and bidders involved (Soliño and Gago de Santos 2010). Since the EU directive does not regulate in detail how the dialogue phase should be conducted, this phase is practiced in different ways in different countries.

Earlier Studies and Practical Issues of CD

International research on CD seems to have mainly concentrated on its legal complexities and consequences, while only a limited number of earlier studies have identified practical issues. For example, Arrowsmith and Treumer (2012) critically examine legal difficulties in the application of CD across Europe by describing gray areas and legal complexity. Nagelkerke et al. (2008) compare CD with the negotiated procedure regarding room for flexibility. Eriksson and Westerberg (2011) discuss project performance as consequences of procurement procedures, such as CD, on a conceptual level. Soliño and Gago de Santos (2010) discuss the probable effect of CD when it is used to launch PPP projects from a transaction cost economics perspective. Korthals Altes and Taşan-Kok (2010) discuss CD from a governance perspective on relational networks. The only exceptions identified—having their research mainly on practical experiences—are Hoezen et al. (2012), who discuss contracting dynamics, and Lenferink et al. (2013), who discuss public-private interaction. However, both studies are limited to Dutch cases.

A review of CD carried out in the United Kingdom indicates that the procedure does reach its objectives when implemented in an appropriate manner (Sundaraj and Eaton 2013). The European Union has tried to improve the procedure with a revised version of Public Procurement Directive 2014/24/EU. However, according to Telles and Butler (2014), the revised version ought to have made CD even more useful and easier to use. They pointed out some practical issues that should have been resolved by the revised directive, such as payment of solution development (it says nothing about a loser's fee), high transaction costs (the procedure is not simplified) and nonbinding dialogue (what the supplier's "offer" during dialogue can be changed at the tender stage).

The major disadvantage of CD is its relatively high transaction cost. This transaction cost was calculated based on transaction costs economics theory published by Williamson (1985) and is supported by researchers' experiences and observation in case studies (Siemonsma et al. 2012). CD is time-consuming and labor-intensive for both the client and suppliers. In order to select the qualified supplier, the client ought to conduct several dialogues and document each of them for the sake of transparency. The suppliers prepare detailed documentation after each dialogue meeting as well. This is equally resource demanding (Wondimu et al. 2017a). Nagelkerke et al. (2008) claim that the procedure is not as flexible as it supposed to be. Furthermore, Dorn et al. (2008) claim that fraud and corruption risks may be increased, especially when the procedure is entered into repeatedly, since the procedure implies an extended period of discussion between public officials and representatives of firms.

Based on the above, CD is of interest as a subject for study because it is a procedure that can be used to improve outcomes through ECI by involving contractors in early phases of complex projects. The procedure allows a dialogue between a client and several suppliers before contract signing. International qualitative cases studies show that actors value the potential of CD. However, since the EU directive does not regulate in detail how CD should be conducted, it has been practiced in different ways in different countries. Identifying how it is practiced in Norway and exploring the experiences of clients and contractors for that country adds new information to the body of knowledge about CD. Furthermore, CD is a relatively new procurement procedure, and the number of studies on practical issues concerning CD is limited. This study fills part of this knowledge gap by exploring the experiences of Norwegian practitioners.

Methodology

The overall approach used to address the research questions is qualitative, comprising a literature review followed by six Norwegian case studies using semistructured interviews and a document study to collect data. This method is preferred over other possible methods because we seek to shed light on present circumstances. According to Yin (2014), the choice of research method in large part is dependent on the chosen research questions. The more the research questions seek to explain present circumstances (e.g., how and why some social phenomenon works), the more that case study will be relevant.

Literature Review

A comprehensive literature review—using the search engines Google Scholar and Oria—was carried out to identify similar work within the field of research. The search words used include competitive dialogue, public procurement, early contractor involvement, and combinations of these. Citation chaining according to the principles laid out by Ellis (1993) was also used to identify relevant literature. Based on the review, a theoretical framework with case-specific challenges was established following the recommendations of Blumberg et al. (2014).

Case Projects and Interviewees

Following the literature review, six cases were selected. These were the only projects where the NPRA has used CD. All six cases are considered to be complex since the client was not able to determine which of several possible solutions would be best suited to satisfy its needs. In four of the six projects, CD was used to procure suppliers that build infrastructure projects. In the other two projects, it was used to procure a company that operates a ferry service and to procure a company that studies the feasibility of a fjord-crossing concept. Table 1 provides an overview of the six examined cases. The losers' fee (the third column in the table) is illustrated in the "Findings and Discussion" section, under "Determining the Losers' Fee" sub-heading. The interviewees' position in each case is presented in Table 2.

Data Collection

Twenty-two in-depth semistructured interviews with key professionals involved in CD were carried out using an interview guide based on the research questions according to the prescriptions of Yin (2014). All the interviews except one were carried out face-to-face. They lasted between 1 and 2 h. All interviews were recorded, transcribed, and the transcriptions were sent to the interviewees for confirmation.

The case study was followed by a document study, carried out in order to complete the findings. The document study included internal documents and documents received from interviewees such as contract documents, dialogue invitation documents, offer evaluation protocol, and the NPRA internal report. Given that one of the authors of this paper was employed by the NPRA during

Table 1. Overview of case projects, and of the respective interviewees

Case	Contract size (MEUR)	Losers' fee[a] (1,000 EUR)	Project type	Contractual agreement	Startup year
1. E6 Helgeland North	180	60 + 200	62-km new road	Design-build (DB) with 15 years of operation and maintenance	2015
2. E6 Helgeland South	205	100 + 230	58-km new road	DB with 15 years of operation and maintenance	2016
3. E6 Trondheim-Stjørdal	55	25	0.6-km new road	DB	2009
4. Fv32 Lilleelvkrysset, Porsgrunn	17	50	0.5-km new tunnel	DB	2015
5. E39 Sognefjorden	N/A	40 + 20	Feasibility study	Design contract	2012
6. E39 Lavik—Oppedal	93	300	Ferry service	10 years of operation	2012

[a]Losers' fee is illustrated in the "Findings and Discussion" section, under "Determining the Losers' Fee" sub-heading.

Table 2. Overview of interviewees' positions

Case	Interviewees' positions
1	Construction manager, project manager[a] and representative from NPRA head office (3 from client) & project manager, quality manager[a] and geotechnical engineer[b] (3 from contractors).
2	Three construction managers, project manager[a] and representative from NPRA head office (5 from client) & quality manager,[a] tender manager, project director, tender manager, geotechnical engineer[b] and regional tender manager (6 from contractors).
3	Construction manager, project manager and process manager[c] (3 from client) & geotechnical engineer[b] (1 from contractor).
4	Construction manager, project manager and process manager[c] (3 from client) & geotechnical engineer[b] (1 from contractor).
5	Project manager and process manager[c] (2 from client).
6	Two procurement leaders from NPRA and process manager[c] (3 from client).

[a]The project manager and the quality manager were involved in the dialogue phase of Cases 1 and 2.
[b]The geotechnical engineer was involved in the dialogue phase of Cases 1, 2, 3, and 4.
[c]The process manager in Cases 3, 4, 5 and 6 was the same person.

the research, full access to internal case documents stored digitally was ensured.

Data Analysis

After the data were collected through interviews and the document study, the analysis followed the recommendations of Creswell (2013). The data analysis steps described by Creswell (2013) are as follows:

1. organize and prepare raw data (transcripts, field notes, images, etc.) for analysis;
2. read through all data;
3. code the data (hand or computer);
4. use the coding process to generate themes or description;
5. interrelate themes/description; and
6. interpret the meaning of themes/descriptions.

The data—transcripts from the 22 interviews—were hand-coded and analyzed hand-in-hand with data collection and findings write-up. The codes were developed based on the theory being examined. The codes are categorized into phases and challenges/positive experiences. Through the coding process, themes for challenges and positive experiences were generated. These themes were interrelated and appeared as major findings and are also used as subheadings in the "Findings and Discussion" section.

Findings and Discussion

CD Implementation

Five phases of CD have been identified from this study. These are the preparation phase, prequalification phase, dialogue phase, evaluation phase, and project execution phase. Under the preparation phase, the first step is to attract as many qualified suppliers as possible to show their interest in the project. It is followed by prequalifcation phase. In this phase the client major activities are ranking, shortlisting, and inviting optimal numbers of best-qualified suppliers to the dialogue based on prequalification criteria. During the dialogue phase, the main activity is developing project solutions that fulfill the award criteria and the project goals. In the dialogue phase, competitors are dealt with individually. Each of them present their solution during individual dialogue meetings and obtain feedback from the client on their proposed solution. At the end of the dialogue phase, the client distributes the final tender document and invitation to competitive tender. Under the evaluation phase, the client awards the contract to the winning supplier based on the evaluation result of awarding criteria. In Table 3, the major activities in CD divided into the five phases and suppliers involvement are presented.

During this study, three major project implementation models used with CD were identified. These models are illustrated in Fig. 1 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 Fig. 1 as a reference to explain the other three models that include a dialogue phase. These three models illustrate the approaches that CD was used together with a DB contract in the case projects. Model 2 was used in case projects 3 and 4. Model 3 was used in case projects 1, 2, and 6. Model 4 was used in case project 5.

Experiences and Measures

This section is organized according to (1) experiences from using CD and (2) discussions and recommendations on what measures ought to be implemented for the success of future projects using CD. The experiences presented below are a combination of both positive experiences and challenges practitioners faced (practical issues). These experiences are categorized into four phases as

Table 3. Major activities in CD

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

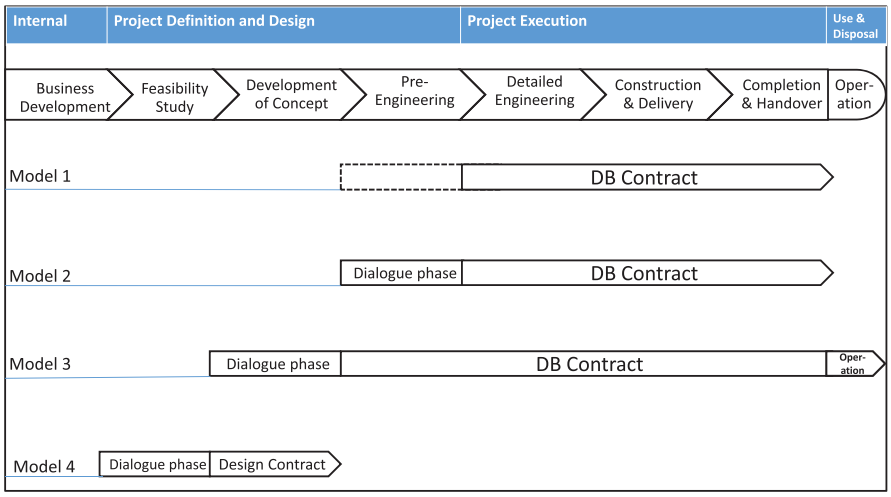


Fig. 1. Project implementation models using CD.

presented in Fig. 2. The experience can be single-phase or multiphase. The authors have prioritized these experiences based on their perceived importance, with the most important at the top. The major findings from each case are presented in Table 4.

Preparation Phase

Market Interest

1. 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. Three major challenges were identified for the suppliers.

Finding a Competent Local Partner. One of the prequalification criteria in Case 2 was experience in winter operations of roads. For this, suppliers were dependent on the experience of local subcontractors. However, all potential subcontractors were already teamed up with established suppliers. As a result, the international suppliers were not able to fulfill the prequalification requirements.

Understanding the Prequalification Criteria. In Case 2, all of the international suppliers found it difficult to provide the correct prequalification information. They submitted irrelevant documents, rendering it difficult for the client personnel to evaluate them. In addition, reference persons were too high up in the organization to be able to properly describe the suppliers' potential project contributions.

Understanding the Project Risk. In Case 3, the risk was described only in Norwegian. As a result, it was difficult to find any international supplier interested in the project. In total, only three suppliers showed interest in participating in this project. According to the interviewees, the interest should have been higher. For all

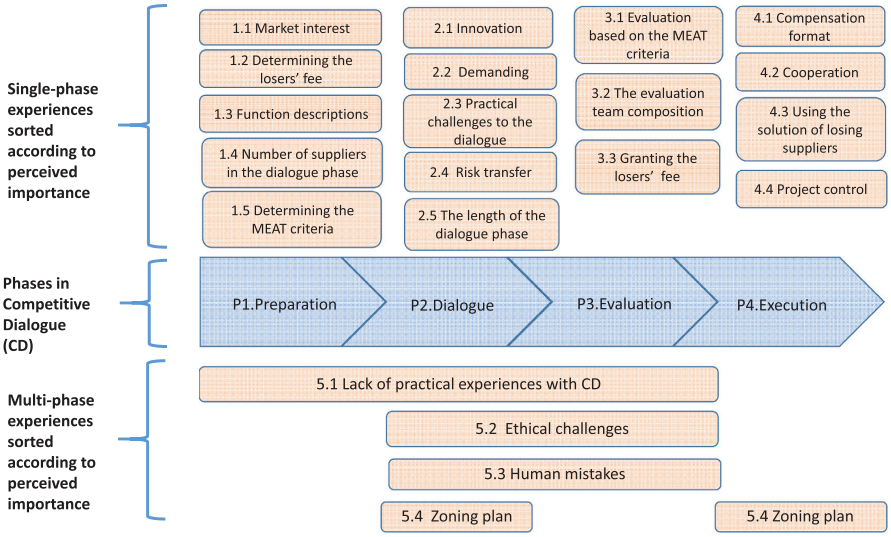


Fig. 2. Overview of the experiences with CD from the six cases examined (P denotes phase).

suppliers, the understanding of risk was challenging since the procedure was perceived to be new.

2. In sum, the challenges proved to be more significant for international suppliers than for the suppliers already established in the Norwegian market. Three measures have been identified to increase overall market interest, notably, communication with suppliers, repeated use of implementation models, and strategic plans.

First, clients need to gain attention from the market and to get support from the suppliers regarding the major project challenges. To obtain attention from the market, an initial information meeting and consecutive one-on-one meetings should to be held at the beginning of the preparation phase. In this information meeting, an overall description of the project, its implementation model, and the implementation model risk should be explained. The latter is of particular importance since clarity concerning risk is the key factor suppliers consider before they decide to get involved or not. Secondly, an information meeting ought to be held with interested suppliers just before announcing the project. In this meeting, the potential suppliers obtain relatively detailed information about the project to decide whether to participate in the project.

The communication should not be limited to suppliers already established in the Norwegian market, but should also reach international suppliers. Of particular importance is that the project and the implementation model risk are explained in an understandable way for international suppliers.

Market interest increased significantly when implementation models were used the second time. Even if the sample size is too limited to come up with a clear conclusion, the findings suggest that market interest increases with repeated use of a model. One possible explanation is that suppliers' awareness of the risk level increased when the implementation models were used for the second time.

When the suppliers become sure that they will make money when participating in this way, successful completion of the first project and repeated use of the same implementation model can thus increase market interest significantly. Furthermore, a strategic plan showing the upcoming projects' implementation model could also contribute to increased market interest. When the suppliers' market sees that several projects are coming in the near future with similar procurement procedures and implementation models, they typically become more prepared.

Determining the Losers' Fee

1. CD is a demanding procedure for both client and suppliers. As a consequence, the client in the examined cases compensated the suppliers with a losers' fee. In three of the six cases, the fee was paid in two stages. The first stage fee compensated for submitting the initial sketch solution. The second stage fee compensated for participating in the dialogue phase and developing the project together with the client. However, 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. If the suppliers in the market are busy, it is even more important that the loser's fee be sufficient. On the other hand, the compensation should not significantly increase the project budget. Likewise, it should not be so high that it attracts suppliers not interested in executing the project. It should suit the market situation.
2. One coherent method of calculating this compensation could be to cover the external expenses of the suppliers, such as expenses for consultant services up to a maximum level. The suppliers shall not expect to obtain profit from participating in the dialogue phase; their potential profit would instead come during the project execution phase. The suppliers themselves, as in the case of a traditional procurement procedure, would cover their internal expenses. It is their cost of doing business. The problem with this philosophy is that companies will include recovery of losses in their next project bid(s), thus making the next client the losers. Breaking this pattern would be a significant and innovative achievement for CD.

Function Descriptions

1. 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 detailed the dialogue frame document far less

Table 4. Major experiences of each case

Phase	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
Multiphase	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

in Case 2. It was a shift from input-based toward outcome-based requirements.
2. One advantage of detailed function descriptions is that the client controls the technical solutions. The advantages of having less detailed function descriptions are increased flexibility for the suppliers, fewer potential conflicts, fewer constraints in the discussions during the dialogue phase, and facilitating innovative solutions in the project.

Number of Suppliers in the Dialogue Phase
1. The number of suppliers in the dialogue phase varied from 3 to 5 in the case projects. The interviewees found it difficult to determine the number of suppliers that should be invited to the dialogue phase. By inviting many suppliers, the client is able to obtain several innovative solutions. In addition, and equally important, having more competing suppliers increases the likelihood of lower prices. Since CD has been used only in a few projects in Norway, it will be beneficial if more suppliers participate and thereby become experienced with the procedure. As a probable consequence, it will be easier for the client to get a sufficient number of participants in future CD projects.
2. One of the advantages of inviting few suppliers is that the suppliers' probability of winning the project (hit rate) increases significantly. This limited invitation could motivate the suppliers to invest more resources in the project development phase. The second advantage could be that fewer suppliers need to spend resources in the dialogue. The client typically also needs to spend fewer resources when the dialogue includes fewer suppliers.

The optimal number of suppliers can vary depending on project size, complexity, and the client's interest/ability to expend resources. However, the interviewees—both from the client and supplier side—tended to propose three as an optimal number of suppliers in the dialogue phase.

Determining the MEAT Criteria
1. 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.
2. The client's previous experience from similar types of projects is the easiest way to determine the MEAT criteria. Consulting suppliers, designers, and subsuppliers in a branch meeting is another possible way to find reasonable, objective MEAT criteria. The branch meeting provides ideas, but the client is still in charge. Furthermore, the project risk analysis from quality assurance (QA2) report could be used to decide the MEAT criteria and weighting. In the QA2 report, external consultants evaluate the project and identify the major risks of the project on behalf of the Norwegian Ministry of Finance.

Dialogue Phase

Innovation
1. The client interviewees claimed that they have acquired innovative, value-adding, and improved solutions in all six case projects. One of the client representatives from Case 4 stated:

   We had 12 alternative solutions before the dialogue phase started. However, at the end of the dialogue phase, one of the suppliers came up with a new solution better than all these 12.

   One of the client representatives from Case 3 stated:

   The CD lasted longer and cost almost NOK 3 million extra compared with the estimated cost of using a traditional procedure. However, the client saved approximately NOK 300 million as the winning supplier developed an innovative foundation solution for quick clay.

2. When suppliers come up with innovative solutions not described in handbooks and standards, they are more vulnerable than suppliers who come up with standard solutions. The reason is that suppliers that have new solutions just get temporary approval during the dialogue phase by the control and approval department of the NPRA. After the contract is signed, the supplier must go through a new process to get final approval. It is the supplier's responsibility to fulfill all documentation and get approval after contract signing. Without this final approval, the supplier must come up with a standard or another acceptable solution. The final approval process might take a long time, which could affect the supplier in the project execution phase. When the NPRA has both the client and the approval roles—while the suppliers take the risk of obtaining the final approval—this may discourage innovations.

To some degree, close cooperation during the dialogue phase between the client representatives and the control and approval department of the NPRA could decrease the vulnerability of innovative suppliers.

Demanding
1. 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. It is time-consuming due to the dialogue phase. It is expensive due to the losers' fee. Furthermore, each dialogue meeting involves much work both before and after the meeting for both contracting parties.
2. Smaller and less complex projects typically require comparatively simple forms of dialogue. Such a dialogue could prevent turnkey contract offers being rejected because of not fulfilling the client's requirements. A simpler dialogue could help the suppliers to discuss and understand the client's expectations in small and customary projects. Such a dialogue could help both the client and supplier to understand the project before they submit the final offer. It could also help to prevent conflicts during project execution due to unclear contract documents and project descriptions. CD is too demanding for small and less complex projects, and unfortunately, the current EU directive does not allow for simple dialogue.

Practical Challenges to the Dialogue
Several practical challenges were identified in the dialogue phase. They are presented in Table 5. In the table, the challenges were identified by interviewees, and the recommendations are based on data analysis.

Risk Transfer
1. One of the reasons for using CD is to decrease risk. During the dialogue phase, suppliers can discuss unclear contract conditions. Consequently, the risk transferred to the supplier decreases and the supplier might reduce the risk buffer in the price. Quite simply, CD reduces risk by facilitating information flow between the parties. As a result, the client obtains lower bids.
2. Based on experiences from the case projects, clients and suppliers can decrease the project risk in the dialogue phase. As a result, the client obtains bids with lower risk buffers.

Table 5. Practical challenges to the dialogue (not in prioritized order)

Challenges	Explanation of the challenges	Recommendations
Unnecessary documentation	In Cases 1 and 2, the client requested unnecessary documentation that was not used later.	Starting from the first dialogue meeting, the suppliers should build only the necessary documentation that will be used to evaluate the final offer.
To have active 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.	It is important to have a process leader with experience that activates and guides the dialogue phase in the right direction.
To have qualified persons	Clients experienced lack of sufficiently qualified persons to answer the questions of the suppliers.	It is important that the client involves necessary expertise—in-house or external—at appropriate times.
Demands honesty, openness, and trust	Both the suppliers and the client found it challenging to be as honest, open and trustful as the procurement procedure demands.	Honesty, openness, and trust are at the core of CD. If one of the parties has a hidden agenda, the dialogue could be challenging.
Lack of transparency	The suppliers maintained that a lack of transparency characterized the client concerning the weighting of subawarding criteria. Due to this, some suppliers reported having spent significant resources on unimportant factors.	The client cannot determine the weighting of subawarding criteria in the early phase of the project. However, that weighting should be communicated during the dialogue phase (while emerging).

Length of the Dialogue Phase

1. According to interviewees, the length of the dialogue phase should suit the market situation to attract suppliers. If the project development phase is taking place in a busy market, it is better if the dialogue period last longer. Project complexity should also be considered. For very complex projects, the dialogue phase should be sufficiently longer.
2. Prolongation of the dialogue phase ensures that the suppliers have enough resources and time to develop solutions that fulfill the client's requirements. Dialogue meetings typically takes place as frequently as every 14th day, so if the number of meetings is not substantially increased, this does not affect total execution time significantly. This measure renders the project attractive for the market, thus increasing market interest, which in return benefits the client.

Evaluation Phase

Evaluation Based on the MEAT Criteria

1. It was challenging for clients to evaluate the suppliers objectively on the MEAT criteria. Clients used different procedures in the case projects. First, it was challenging to determine which evaluation scale to use. For example, it is possible to use a categorical 1–4 scale or 1–10 scale, where the difference between 1 and 2 equals the difference between 2 and 3 with subjective evaluation.

   Second, using the scale can also be challenging. One approach is that the best one gets the highest score and the worst one gets the lowest score. The opposite approach is to allow all the contractors to get the same score. If all contractors get a similar score on each of the MEAT criteria, the price will be the decisive criteria, and this is not the intention for using MEAT.

   Third, there are two possible ways to agree on the specific scores for the suppliers. Each member of the evaluation group can give their scores before a common average is calculated. The other approach is to use one agreed-upon score for each supplier for each criterion. If the commonly agreed-upon score between the team members is used, loud speaking members might influence the evaluation too much.

   Fourth, the suppliers did not know if they were being evaluated on an absolute basis or relative to each other. With absolute evaluation, fulfilling the minimum requirements gives a full score. That means suppliers will strive to fulfill the basic requirements, but not more than that. With the relative evaluation, the suppliers get rewarded for suggesting innovative solutions above the minimum requirements.

   Fifth, it was not clear for the suppliers if they would share a preset number of points or if all the suppliers could get the maximum number of points. If the suppliers share a preset number of points, and all of them suggest the best solutions, they still are rewarded an average number of points. The other option is that all suppliers with innovative solutions obtain the maximum number of points.
2. These five challenges can be resolved by standardization of the evaluation process and increased transparency. Without this, the client can manipulate the prioritization of the suppliers. The most significant problem for the suppliers seems to be the uncertainty regarding how the evaluation was conducted.

Evaluation Team Composition

1. There are two possible ways to compose the evaluation team. The first one is to use personnel involved in the dialogue phase. The second is to bring in completely new personnel.
2. If the same personnel are involved in the dialogue and participate in the evaluation team, they could be biased if they developed a good impression of one supplier during the dialogue phase. A good impression does not guarantee good performance.

On the other side, using the same personnel during the dialogue and evaluation phase could make the evaluation process easier. These personnel have an understanding of the project from the dialogue phase and they have contributed to the supplier solutions. Therefore, it could be advantageous to use the same personnel in both processes.

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.

Granting the Losers' Fee

1. In Case 4, one of the prequalified 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 to a losers' fee compensation. This case indicates that the losers' fee led some suppliers to stay unnecessarily long in the process,

in fact, longer than they would have done without the possibility of compensation.

Compensation should be paid for those who are involved in the entire dialogue phase. In three of the six cases, the losers' fee was paid in two stages. The first one was for those who submitted the initial sketch and the second one was for those who participated through the entire dialogue.

2. It is reasonable to have a losers' fee arrangement with two stages. However, the client should evaluate the suppliers through the dialogue phase to compensate only those qualified.

Execution Phase

Compensation Format

1. 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 the fixed sum format 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. Nonetheless, in Case 1 the supplier managed to come up with significant savings during the project execution phase. After negotiation, the suppliers accepted a contract to prepare the road for a speed limit at 90 km/h instead of the original 80 km/h. Even though the formal dialogue was over, the parties continued the dialogue during the project execution phase. In return for the cost savings of the suppliers, the client negotiated for better quality.

   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 in 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.
2. In future projects, other alternative compensation formats could be tried to extend the cooperation between the client and the supplier from the dialogue phase into the execution phase regardless of the type of solution.

Cooperation

1. 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.

   In Case 1, a cooperation group of two individuals from the supplier and three from the client at a senior level was established. This group met four times a year and discussed challenges that the project execution group was not able to solve. The purpose of this group was to see the challenges from a big-picture perspective, avoid conflict, and maintain cooperation. So far, none of the projects has experienced conflicts that has ended up in court.

   A feeling of "this is our project" was observed on the supplier side. As the supplier developed the project through the dialogue phase, all members of the supplier's organization were more motivated than usually. For example, in Case 3, the client observed that the supplier was motivated on basis of the solutions chosen being their own. The client experienced that the discussions in the project execution phase were based on a common desire for better solutions for the project. One of the client representatives stated:

   They were not in the old paradigm where "the solution is the client's solution." They worked hard to prove to the world that it was possible to build with their solutions within the estimated cost.

   Since both the consulting company and the operation and maintenance supplier participated in the dialogue phase, cooperation with the major supplier was improved. This cooperation resulted in a perception of improved project execution and better quality end-product in all six cases.
2. The findings indicate that the dialogue phase can be the basis for good cooperation during the execution phase.

Using the Solutions of Losing Suppliers

1. In the case projects, the client let the suppliers develop their tender based on their solutions. However, the winning supplier might not be the only one that has developed good solutions for the project. Due to the confidentiality requirements in the dialogue phase, the client could not share the loser suppliers' solution with the winner. 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.
2. A means of addressing this challenge could be that the client pays a higher losers' fee and thereby buys the concepts developed by the losing suppliers. However, this alternative could affect the dialogue phase. The suppliers might not be as open as they could be since it might benefit their competitors. Another option could be to share the savings resulting from the losing suppliers' solutions. An approach where the winner's and losers' solutions are merged, as described in the theoretical section of this paper, could also be used.

Project Control

1. Both the client and supplier experienced better project control compared with their previous experience in projects with design-build contracts without a dialogue phase. The client identified three reasons for better project control. First, the client can influence the suppliers' solutions during the dialogue phase by adapting the MEAT criteria. Second, in Cases 1 and 2, CD was combined with a design-build contract and fixed sum compensation, leaving much of the responsibility to the supplier. Third, in Cases 1 and 2, the suppliers were responsible for 15 years of operations and maintenance. Following this, the client felt better project control during the execution phase. Furthermore, there was less need for quantity control. As a result, the client needed only a small staff during the execution phase.

   For the supplier, there were two reasons for experiencing improved project control. First, the supplier gained a thorough understanding of the project during the dialogue phase when the client and the supplier developed the solutions together. Second, the suppliers could discuss their solutions with the client. The suppliers felt it was possible to influence the project and use their construction experience from previous projects. This early involvement led to a better start for the supplier compared to their previous experience with traditional project delivery models.
2. Improved project control provides a win-win situation for both the client and the supplier. They both control matters that are important to them, and the dialogue is used to clarify what matters to the other side. In this way, both the project performance and the end-product can be improved.

Multiphase

Lack of Practical Experience with CD

1. Since CD is a new procedure, both the client and suppliers reported a lack of practical experience with the method. Hiring an external process leader—with expertise in CD (in Cases 3–6)—and transferring knowledge between projects (from Case 1 to Case 2) are the approaches used by the NPRA to overcome this challenge. According to one of the interviewees in Case 3, assigning an enthusiastic person willing to learn and implement new solutions helped the client to achieve good results. If the personnel who get involved in CD do not adapt their attitude, they can threaten the success of the entire procedure.

   One of the interviewees in Case 1 stated:

   Personnel with experience from traditional procurement procedures found it difficult to adapt their attitude. Some of the client personnel had to leave the project, while others managed to change attitude after internal discussions.

2. Several measures can compensate for the lack of practical experience with CD and make sure that experiences are transferred between projects. First, the client can have one or more process leaders that are available for projects using CD. Second, if the client repeats the procedure in future projects, both the client's and the suppliers' experience levels will increase. Third, including experienced personnel in an inexperienced project organization will compensate for the lack of practical experience.

Ethical Challenges

1. The interviewees identified at least two ethical challenges from CD. When a client decides to use CD, he should make sure that the dialogues with the respective suppliers are confidential. The client cannot expose one supplier's solution to the other suppliers.

   In Case 1, one of the suppliers' solutions forced the client to accept a change in the zoning plan. Since the client had to give the same information to all the suppliers, other suppliers were made aware of the changes in the zoning plan. That made it clear for the competing suppliers that one of the suppliers had an improved solution within that part of the zoning plan. The challenge for the client is whether to accept the supplier's idea (thereby optimizing the project, but partly revealing the supplier's solutions) or to reject the change (thereby keeping it confidential, but missing the optimization possibilities).

   In Case 4, the client had listed 12 different technical tunnel solutions in advance of the procurement phase. One of the losing suppliers suggested a thirteenth solution, which was considered too far out of the box. The client was not prepared for this to happen and rejected this solution. The winning supplier suggested a fourteenth solution that the client accepted.
2. 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. To sum up, CD has ethical challenges when it comes to balancing confidentiality and equal treatment of the suppliers' suggested solutions.

Human Mistakes

1. Human mistakes, both from the client's and suppliers' sides, could 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. These mistakes could lead to disqualification of the entire procurement process. The client responded to the mistakes in both cases by being open and informing all the suppliers about what happened.

   In Case 2, one of the suppliers submitted the envelope with the final price offer to the wrong address, disqualifying this supplier from the project. The supplier lost the money invested in the dialogue phase and the development of project solutions. Furthermore, the supplier was not eligible to receive the second stage losers' fee because of this disqualification.
2. In future projects, the use of an electronic bid submission system could prevent mistakes such as submitting the bid envelope to the wrong address. Using separate eRooms for each supplier could prevent uploading of documents in wrong eRooms. In addition, establishing a procedure where at least two persons participate during uploading of sensitive information into an eRoom could prevent similar mistakes.

Zoning Plan

1. The zoning plan was restrictive during the dialogue phase in Cases 1 and 2. One of the restrictions was that the zoning plan corridor was too narrow. In both cases, the client had made a 30-m-wide zoning plan following the center line of the existing road. To keep the existing road open for traffic while building the new road is demanding for the supplier. Thus, it can be convenient to let the traffic use the existing road while building a new, parallel road. With only 15 m available on each side of the center line, it was difficult to build a new road without traffic disturbances.

   Another restriction experienced was the fact that it was time-consuming to change the zoning plan. In Case 1, several sections of the zoning plan were changed during the execution phase. Every time the suppliers came up with a solution that was not in alignment with the approved zoning plan, it had to be changed.
2. If the zoning plan were 30 m wide on one side of the center line of the existing road, the supplier would have been able to construct the new road beside the existing road. This would have decreased the traffic disturbance. Another approach would have been to have a 60-m-wide zoning plan with 30 m on each side of the road. Then, it would have been possible to build the new road while keeping the existing one and may also have reduced the need for changes in the zoning plan. A wider plan could have helped the project to meet both of the restrictions.

The third approach to mitigating the restrictions could be to have a longer dialogue phase in which the zoning plan could have been revised. However, this solution has its shortcomings. CD is demanding and expensive for both the client and suppliers. Having a longer dialogue phase could affect the market interest when the suppliers find out that the dialogue phase is becoming even more demanding and expensive. The client risk could also increase if the zoning plan revision and approval process take longer than expected. Thus, the project execution phase might be delayed.

The fourth possible approach could be to involve the suppliers and to have the dialogue phase before the zoning plan is approved. The fourth approach could look like the ideal situation for using CD, but then the project might turn out to be unattractive for suppliers, since they will not bind their key personnel to a single project for an extended time. Another drawback for the client is that it would be difficult to fairly evaluate the bids of the suppliers if they suggest solutions that are difficult to compare.

The zoning plan restricts possibilities for new solutions. The cases met the restrictions with different approaches. However, since

each project is unique, the same approaches might not work for all projects.

Conclusions

The study reported on in this paper set out to (1) explore how CD has been implemented in Norway, (2) explore experiences from using the procedure, and (3) suggest measures that ought to be implemented for the success of future projects using CD.

Even if the Interviewees claim to use the same procurement procedure, it appears that the procedure was practiced in slightly different ways. Overall, the analysis of the experiences from the six Norwegian projects shows that both the client and the suppliers value the potential of CD. No major differences in responses regarding interviewee roles and status were observed. This result aligns with findings from international cases where the actors also valued the potential of CD.

However, several challenges were identified, such as lack of practical experience with CD, ethical challenges, determining the MEAT criteria, evaluation based on the MEAT criteria, and varying market interest. Fig. 2 provides a complete overview of the experiences that the client and the suppliers faced while practicing CD in the six examined cases. Some of the experiences originate from the preparation, dialogue, evaluation and project execution phases (single phase). Some of the experiences stem from several phases. The first contribution of this study is that it can be concluded that conducting dialogues between the client and suppliers during the procurement before contract signing positively influences the cooperation and project control of both parties during the execution phase.

Some of the measures that need to be implemented by clients entering CD projects are as follows:

- Increase the use of function descriptions during the preparation of the tender document;
- Provide awarding criteria that demand innovation;
- Be prepared to hear and accept new solutions/ways of working during the dialogue phase; and
- Learn to give more freedom for the suppliers during the project execution phase in order to stimulate innovation.

On the other side, suppliers should also be prepared to exercise the freedom the procedure provides them to suggest new and innovative solutions. Additionally, individual improvements addressing the respective experiences identified in Fig. 2 are presented in the Discussion section. Many of the suggested improvements could be implemented in the *project preparation* phase by the client. Furthermore, in the *dialogue phase*, the benefit of the supplier's contribution could increase if the client gives even more flexibility than was provided in the examined cases. The client and the supplier can reinforce positive experiences and weaken challenging experiences by implementing the individual improvements suggested in this study. This study complements the limited earlier research that addressing practical issues of CD to improve the procedure in practice. The second contribution of this study is the identification of how CD practice can be improved.

This paper contributes to construction engineering and management practice to increase the understanding of CD by suggesting what kind of measures should be taken for the success of future projects using the procedure. Although this research is based on the NPRA's infrastructure projects, the study findings and practical experiences will be relevant for other public owners in Europe that are planning to use CD.

The third contribution of this study is the identification of areas in CD that could be focused on future research. In the future, experiences from additional cases could be explored in order to strengthen the findings of this study and to explore whether other projects have experienced the same or different challenges related to CD. Furthermore, the long-term effect of CD could be studied through a lifecycle assessment of finished projects.

Appendix. Interview Guide

1. Startup questions
   a. Can you tell me about your background/experience?
   b. What is your position in the company and in this project?
   c. What was your previous experience of competitive dialogue (CD) procurement procedure before this project?
   d. Why did the project use competitive dialogue?
   e. What factors meant to use competitive dialogue procurement procedure in this project?
   f. For which projects is competitive dialogue suitable?
2. How was competitive dialogue done (timeline, selection criteria, and participants)?
   a. Prequalification phase
      (1) How many showed interest in participating? How many were prequalified?
      (2) What were the prequalification criteria?
      (3) How were prequalification criteria set?
      (4) What is your opinion about the prequalification criteria?
   b. Dialogue phase
      (1) How many dialogues have you had?
      (2) How was the dialogue phase carried out?
      (3) Which persons participated in the dialogue and were they the right person?
      (4) What were the topics in the dialogue meetings?
      (5) To what extent did municipal zoning plan create obstacles in the choice of solutions (was the regulatory plan restrictive in the dialogue)?
      (6) Were there different themes for the various dialogue meetings?
   c. Evaluation Phase
      (1) What were the final award criteria?
      (2) How were the award criteria determined?
      (3) Why exactly were these criteria used/why not other criteria?
      (4) To what extent did these criteria work according to the Norwegian Public Roads Administration's expectations?
      (5) How can these award criteria add value (in terms of project control, time gains and innovation?)
3. What are the experiences from using competitive dialogue?
   a. What are the positive experiences from using competitive dialogue?
   b. What were the biggest challenges of using competitive dialogue (internally in SVV, between SVV and the contractor)?
   c. How did you overcome the challenges?
   d. How was the cooperation between SVV and the contractor?
   e. How was the collaboration internally with the contractor (between the operation & maintenance contractor, the consultant and the major contractor)?
   f. How does the competitive dialogue improve quality of the project (both in process and perhaps in product)?
   g. Should the dialogue phase be longer or shorter? Why?
   h. What benefit came out of the process (quality, process and maybe in product?)?
   i. How much additional cost was competitive dialogue compared to a traditional procurement process (in time and money)?
   j. What ethical challenges did you encounter during the process?
   k. Did you experience that actors use the process in an ethical way?

4. What could have been done differently?
   a. What do you think of competitive dialogue procedures in future projects?
   b. What is your opinion about the award criteria?
   c. Which award criteria should be changed, removed or added to future projects?
   d. What should the Norwegian Public Roads Administration do to reinforce the positive experiences and avoid the challenges in the future use of competitive dialogue?
   e. What should be done by contractors in order not to meet the same challenges in future use of competitive dialogue?
   f. What do you think of compensation for approved offers?
   g. How much compensation is attractive enough for contractors?

Data Availability Statement

Data generated or analyzed during the study are available from the corresponding author by request. Information about the *Journal*'s data sharing policy can be found here: http://ascelibrary.org/doi/10.1061/%28ASCE%29CO.1943-7862.0001263.

References

Aapaoja, A., M. Herrala, A. Pekuri, and H. Haapasalo. 2013. "The characteristics of and cornerstones for creating integrated teams." *Int. J. Managing Projects Bus.* 6 (4): 695–713. https://doi.org/10.1108/IJMPB-09-2012-0056.

Albano, G. L., and M. Sparro. 2010. "Flexible strategies for centralized public procurement." *Rev. Econ. Inst.* 1 (2): 1–32. https://doi.org/10.5202/rei.v1i2.4.

Arrowsmith, S., and S. Treumer. 2012. *Competitive dialogue in EU procurement*. Cambridge, UK: Cambridge University Press.

Blumberg, B. F., D. R. Cooper, and P. S. Schindler. 2014. *Business research methods*. London: McGraw-Hill.

Bougrain, F. 2012. "Energy performance and public private partnership." *Built Environ. Project Asset Manage.* 2 (1): 41–55. https://doi.org/10.1108/20441241211235044.

Burnett, M. 2009. "Using competitive dialogue in EU public procurement—Early trends and future developments." *Eipascope* 2: 17–30.

Chen, L., and K. Manley. 2014. "Validation of an instrument to measure governance and performance on collaborative infrastructure projects." *J. Constr. Eng. Manage.* 140 (5): 04014006. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000834.

Creswell, J. W. 2013. *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: SAGE Publications.

Dorn, N., M. Levi, and S. White. 2008. "Do European procurement rules generate or prevent crime?" *J. Financial Crime* 15 (3): 243–260. https://doi.org/10.1108/13590790810882847.

Edler, J., and L. Georghiou. 2007. "Public procurement and innovation—Resurrecting the demand side." *Res. Policy* 36 (7): 949–963. https://doi.org/10.1016/j.respol.2007.03.003.

Ellis, D. 1993. "Modeling the information-seeking patterns of academic researchers: A grounded theory approach." *Lib. Q.* 63 (4): 469–486. https://doi.org/10.1086/602622.

Eriksson, P. E., and M. Westerberg. 2011. "Effects of cooperative procurement procedures on construction project performance: A conceptual framework." *Int. J. Project Manage.* 29 (2): 197–208. https://doi.org/10.1016/j.ijproman.2010.01.003.

Essig, M., and A. Batran. 2005. "Public–private partnership—Development of long-term relationships in public procurement in Germany." *J. Purchasing Supply Manage.* 11 (5–6): 221–231. https://doi.org/10.1016/j.pursup.2006.01.001.

European Commission Public Procurement Policy. 2006. *Explanatory note-competitive dialogue-classic directive*. Brussels, Belgium: Directorate General Internal Market and Services: Public Procurement Policy.

European Parliament CotEU. 2014. "Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC text with EEA relevance." *Off. J. Eur. Union* 96 (309): 29.

Haugbølle, K., D. Pihl, and S. C. Gottlieb. 2015. Competitive dialogue: Driving innovation through procurement? *Proc. Econ. Finance* 21: 555–562. https://doi.org/10.1016/S2212-5671(15)00212-9.

Hoezen, M., H. Voordijk, and G. Dewulf. 2012. "Contracting dynamics in the competitive dialogue procedure." *Built Environ. Project Asset Manage.* 2 (1): 6–24. https://doi.org/10.1108/20441241211235017.

Hoezen, M., H. Voordijk., and G. Dewulf. 2014. "Procuring complex projects using the competitive dialogue." *Int. J. Project Org. Manage.* 6 (4): 319–335.

Hood, J., and T. Smith. 2013. "Perceptions of quantifiable benefits of local authority risk management." *Int. J. Publ. Sect. Manage.* 26 (4): 309–319. https://doi.org/10.1108/IJPSM-01-2012-0016.

Kautsch, M., M. Lichoń, and G. Whyles. 2015. "Tools of innovative public procurement in health care in Poland." *Innovation* 28 (3): 312–323.

Kent, D. C., and B. Becerik-Gerber. 2010. "Understanding construction industry experience and attitudes toward integrated project delivery." *J. Constr. Eng. Manage.* 136 (8): 815–825. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000188.

Korthals Altes, W. K., and T. Taşan-Kok. 2010. "The impact of European public contract law on networks of governance: A relational approach." *Eur. Plann. Stud.* 18 (6): 971–988. https://doi.org/10.1080/09654311003701522.

Lahdenperä, P. 2009. *Project alliance: The competitive single target-cost approach*. VTT Tiedotteita–Research Notes 2472. Vuorimiehentie, Finland: VTT Technical Research Centre of Finland.

Lenferink, S., J. Arts, T. Tillema, M. Vanvalkenburg, and R. Nijsten. 2012. "Early contractor involvement in dutch infrastructure development: Initial experiences with parallel procedures for planning and procurement." *J. Publ. Procurement* 12 (1): 4–42. https://doi.org/10.1108/JOPP-12-01-2012-B001.

Lenferink, S., T. Tillema, and J. Arts. 2013. "Public-private interaction in contracting: Governance strategies in the competitive dialogue of Dutch infrastructure projects." *Pub. Admin.* 91 (4): 928–946. https://doi.org/10.1111/padm.12033.

Li, H., D. Arditi, and Z. Wang. 2013. "Factors that affect transaction costs in construction projects." *J. Constr. Eng. Manage.* 139 (1): 60–68. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000573.

Love Peter, E. D., F. Ackermann, P. Teo, and J. Morrison. 2015. "From individual to collective learning: A conceptual learning framework for enacting rework prevention." *J. Constr. Eng. Manage.* 141 (11): 05015009. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001013.

Nagelkerke, M., M. Van Rijn, G. Huith, and M. Van Valkenburg. 2008. "Competitive dialogue: Abyss or opportunity?" In *Proc., 3rd Int. Public Procurement Conf.*, 275–294. Amsterdam, Netherlands.

O'brien, G., and A. Hope. 2010. "Localism and energy: Negotiating approaches to embedding resilience in energy systems." *Energy Policy* 38 (12): 7550–7558. https://doi.org/10.1016/j.enpol.2010.03.033.

Petersen, O. H. 2010. "Emerging meta-governance as a regulation framework for public-private partnerships: An examination of the European Union's approach." *Int. Publ. Manage. Rev.* 11 (3): 1–21.

Plane, C. V., and A. N. Green. 2012. "Buyersupplier collaboration: The aim of FM procurement?" *Facilities* 30 (3–4): 152–163. https://doi.org/10.1108/02632771211202851.

Sebastian, R., C. Claeson-Jonsson, and R. Di Giulio. 2013. "Performance-based procurement for low-disturbance bridge construction projects." *Constr. Innov.* 13 (4): 394–409. https://doi.org/10.1108/CI-06-2012-0033.

Siemonsma, H., W. Van Nus, and P. Uyttendaele. 2012. "Awarding of Port PPP contracts: The added value of a competitive dialogue procedure." *Flagship J. Int. Shipping Port Res.* 39 (1): 63–78. https://doi.org/10.1080/03088839.2011.642314.

Soliño, A. S., and P. Gago De Santos. 2010. "Transaction costs in transport public–private partnerships: Comparing procurement procedures." *Transp. Rev.* 30 (3): 389–406. https://doi.org/10.1080/01441640903037941.

Sundaraj, G., and D. Eaton. 2013. "Quantifying robustness in PFIs." *J. Financial Manage. Property Constr.* 18 (1): 26–52. https://doi.org/10.1108/13664381311305069.

Telles, P., and L. Butler. 2014. "Public procurement award procedures in Directive 2014/24/EU." *Novelties in the 2014 directive on public procurement*. Denmark: Djof Publishing.

Uttam, K., and C. Le Lann Roos. 2014. "Competitive dialogue procedure for sustainable public procurement." *J. Cleaner Prod.* 86: 403–416. https://doi.org/10.1016/j.jclepro.2014.08.031.

Uyarra, E., and K. Flanagan. 2010. "Understanding the innovation impacts of public procurement." *Eur. Plann. Stud.* 18 (1): 123–143. https://doi.org/10.1080/09654310903343567.

Van Leeuwen, M. 2011. "Using best value PiPS procurement in Europe, need for compromise?" *J. Adv. Perform. Inf. Value* 3 (1): 56–71.

Williamson, O. 1985. *The economic institutions of capitalism: Firms, markets, relational contracting*. New York: Free Press.

Wondimu, P. A., E. Hailemichael, A. Hosseini, J. Lohne, O. Torp, and O. Lædre. 2016. "Success factors for early contractor involvement (ECI) in public infrastructure projects." In *SEB16 build green and renovate deep*. Helsinki: Elsevier's Energy Procedia.

Wondimu, P. A., J. Lohne, and O. Lædre. 2017a. "Motives for the use of competitive dialogue." In Vol. 2 of *Proc., 25th Annual Conf. of the Int. Group for Lean Construction*. edited by K. Walsh, R. Sacks, and I. Brilakis, 53–60. Heraklion, Greece.

Wondimu, P. A., F. Svalestuen, E. Hailemichael, A. Hosseini, J. Lohne, and O. Lædre. 2017b. "Implementation of early contractor involvement (ECI) in Norwegian bridge projects procurement." *Home of construction researchers on economics and organisation in the Nordic Region*. Gøteborg, Sweden: Polyteknisk Forlag.

Yin, R. K. 2014. *Case study research: Design and methods*. Thousand Oaks, CA: SAGE Publications.

C Core paper 3

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

Journal of Construction Engineering and Management

Experiences with Best Value Procurement (BVP) in Norway and the Netherlands

Paulos Abebe Wondimu, Ole Jonny Klakegg, Jardar Lohne and Ola Lædre

Abstract

Best Value Procurement (BVP) is new in Norway, but there is a plan to use it in several mega infrastructure projects. There is no an independent research that illustrates what measures ought to be implemented for the success of future projects using BVP. The purpose of this study is to describe BVP method thoroughly, to explore the experiences with the method from the Netherlands and Norway, and to develop suggestions for what measures ought to be implemented for the success of future projects using BVP. In addition to a literature review and document study, 11 Dutch cases and 4 Norwegian cases were studied through semi-structured interviews with twenty-eight key informants. This study identified several practical challenges that practitioners are facing while using the method. To avoid the problems documented in the case projects, both the method and its implementations should be improved continuously based on the current experiences. Recommendations for improving the method are mead in this paper. Testing their effectiveness is a topic for future research.

Keywords –Best Value Procurement (BVP), Performance information procurement system (PIPS), The Netherlands, Norway, Procurement methods

1 Introduction

Due to contractual and product development processes, the construction industry is faced with numerous problems among which are schedule delays, budget overruns, and an inability to meet the expectations of clients (Oyegoke, 2011). Procurement procedures based

on low cost do not equate to best value for money (Naoum and Egbu, 2016; Singh and Tiong, 2005; Ballesteros-Prez et al., 2016). Best Value Procurement (BVP) is a method that seeks to produce best value for the lowest cost (Snippert et al., 2015). A fundamental concept in BVP is selecting the vendor with the offer most advantageous considering price and other key factors to enhance long term performance and value of construction (Elyamany, 2010; Schttle and Arroyo, 2017).

There are various models of BVP (Perrenoud et al., 2017). This paper explores the BVP model that was introduced by Kashiwagi in 1991 (Kashiwagi, 2016). This BVP models formal name is Performance Information Procurement System (PIPS) or BVP-PIPS (for the purposes of this paper, BVP) (Witteveen and Van de Rijt, 2013). Apart from the U.S., the method has been used most extensively in the Netherlands (Bos, 2012). The Norwegian Agency for Public Management and eGovernment (Difi) has recently introduced BVP to Norway. The Norwegian Government recently established a new public company called New Roads. New Roads is planning to use BVP on several mega infrastructure projects.

BVP developers cite internally-conducted evaluations as evidence of BVPs benefits. However, to our knowledge, there is no an independent research that illustrates what measures ought to be implemented for the success of future projects using BVP. The purpose of this study is to describe BVP method thoroughly, to explore the experiences with the method from the Netherlands and Norway, and to develop suggestions for what measures ought to be implemented for the success of future projects using the method. This paper is the first an independent study that developed suggestions on what measures ought to be implemented for the success of future projects using BVP.

The research questions addressed are:

- How was BVP implemented?
- What are the experiences with BVP?
- What measures ought to be implemented for the success of future projects using BVP?

To address these questions, the research presented in this paper reviewed BVP projects from the Netherlands and Norway. This study explored only the experiences with the

procurement process, but it was not extended to examine the effect of the method on the end-product since some of the projects studied are still not completed.

2 Theoretical background

Early contractor involvement (ECI) is growing trend over the last two decades (Turner and Riding, 2015; Mosey, 2009). ECI is a concept that refers to engagement of contractor at the early stage of project development through wide range of approaches (Rahmani et al., 2014). The purpose of ECI is to deliver the best value to a project (Song et al., 2009). ECI in the design phase facilitates technical collaboration and joint problem solving. This increases integrating of work and knowledge exchange while promoting value engineering and risk management (Eriksson et al., 2009). BVP is one of the approaches of ECI (Wondimu et al., 2017).

2.1 The philosophy behind BVP

Clients management, control, and decision-making is a source of risk (Kashiwagi et al., 2009). Clients wishes to control a project design and lack of adequate clients brief have adverse impact on the contractors ability to add value in a project (Doloi, 2008). To reduce risks caused by clients, BVP concentrates on minimizing on client decision-making. Furthermore, minimized management, direction, and control of expert vendors (Kashiwagi, 2011).

BVP is a procurement method that is intended to eliminate waste through reducing client decision-making, management, control, and direction. It removes clients inefficient decision-making and bias by replacing the selection of the vendor with an automated process that can best fulfill the owners needs through the use of filters (Sullivan, 2010).

BVP is based on the premise that the vendor is an expert and they 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 specifications from the client. Additionally, it relies on the premise that the vendor will deliver the best performance when they are responsible for the execution of the project and required to identify, manage and minimize the technical risks (Apostol, 2011).

Information about the vendors technical competence, problem-solving ability, honesty when facing challenges, innovative capability and competencies in safety management is essential to obtaining the intended results (Beach et al., 2005). BVP allows clients the ability to control the vendor selection process by using performance information, and it assures that the right vendor is selected for each project (Kashiwagi and Byfield, 2002).

To reduce client decision-making during the selection phase, the offer from the vendors should be based on the SMART framework. SMART is an acronym for Specific, Measurable, Attainable, Relevant and Time-bound. This requirement is said to be essential for making appropriate contract awards, and is also required for continuous improvement within organizations. The importance of using SMART offers is to provide clear answers, to describe agreed-to activities, and to avoid the use of unclear statements that can result in misunderstandings during project execution and ineffective use of project resources (Booij et al., 2013).

BVP has lower transaction costs and delivers higher value than traditional DBB contracts based on low-bid procurement (Kashiwagi and Savicky, 2003). However, there is no an independent study that proofs this claim. It also delivers a better result regarding project schedule and cost than low bid procurement (Molenaar et al., 2010).

2.2 MEAT vs. BVP

Some authors presents Most Economically Advantageous Tender (MEAT) as an approach to obtain the best value in procurement (Sebastian et al., 2013; Naoum and Egbu, 2016; Abdelrahman et al., 2008). Others present BVP as a comparable method to using MEAT (Santema et al., 2011; Wang et al., 2013; Palaneeswaran et al., 2003; Park et al., 2014; Tran et al., 2017). According to Nguyen et al. (2018) BVP represents the most advantageous procurement method for the project client. In both methods more key factors than price are considered in the evaluation and selection process (Rijt and Witteveen, 2011; Gransberg and Shane, 2013). However, according to Witteveen and Van de Rijt (2013), BVP-PIPS is commonly misunderstood as another form of MEAT. In this paper, we consider BVP to be an own method.

With MEAT, the score on pre-defined selection criteria for a product or service that provides value to the project. It makes sure that like quality, environment, and social

aspects selection criteria will be considered in addition to the price (Uttam and Le Lann Roos, 2014). BVP-PIPS (for the purpose of this paper, BVP) predicts the performance of vendors based on past performance information. It helps clients to rank vendors based on past performance, current capability, price, risk management and the quality of key personnel (Duren et al., 2015).

Some of the major differences between MEAT and BVP-PIPS is that BVP-PIPS has a clarification phase, which is considered to be the most important phase of the method. In addition, the vendor uses weekly risk reports (WRR) in the execution phase to deviations regarding schedule, cost, and/or client satisfaction (Witteveen and Van de Rijt, 2013).

As a summary, in Europe when lowest price is not used as the selection method, the alternative is to use MEAT. BVP is the name for similar type of method in the USA. BVP-PIPS is more than just BVP since it has mandatory phases and elements. Clarification phase and WRR in BVP are explained in detail under heading BVP phases and elements.

2.3 Value in BVP

Best value refers to the optimum outcome of a business process (Akintoye et al., 2003). According to Cooke-Davies (2002) distinctions must be made between project success and project management success. Project success is measured against the overall objective of the project. Project management success is measured against the traditional performance measures cost, time and quality. Distinctions must also be made between project output value and project use value. Project output value is measured on cost, time and quality. Project use value is described by the effects project output has on the running operations.

Based on the explanations above, it is possible to correlate project output value with project management success, and project success with project use value. BVP concentrates more on project management success (getting the job done on time and within cost) than on project success (use value).

2.4 Critical analysis of the current literature

The weakness with the current literature is that the core literatures in the topic are written by persons that have financial interest in the method. Kashiwagi is the developer of the method and he has several economical interest on the method. He licenses the method,

gives courses on the method and sells books about the method. Several authors that wrote about the method work as consultants advising clients about BVP. BVP experts and give consultancy service on the method. The main author of Norwegian BVP book Van de Rijt (Rijt et al., 2016) also sells courses on the method for his personal gain. There is no an independent assessments that has been conducted on the method. This research is an independent assessment that attempt explore the experiences with BVP from Norway and the Netherlands to develop suggestion on what measures ought to be implemented for the success of future projects using BVP.

2.5 BVP phases and elements

The BVP method consists of four phases: pre-qualification, selection, clarification, and execution. These phases are illustrated in Figure 1. From each of the BVP phases, key elements that represent BVP are selected. In the following section, each element that will be presented in Table 3 will be introduced.

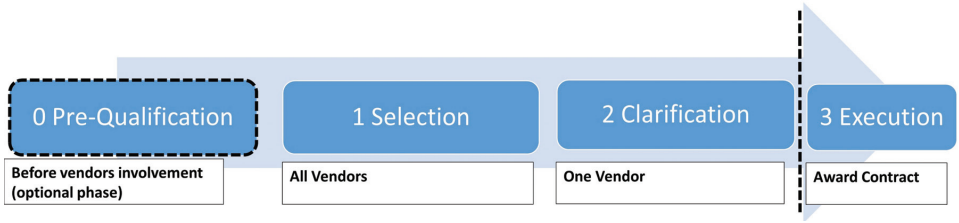


Figure 1: Four phases of BVP PIPS (developed based on Kashiwagi (2016))

2.5.1 Pre-qualification phase

Extensive education of the client and the vendors about the paradigms of the BVP philosophy is the principal activity in this phase (Rijt et al., 2011). Paradigm shifts take time regardless of how simple the change seems (Bos et al., 2015). Especially large traditional professional organizations naturally will face more difficulty in changing their paradigms (Bosma et al., 2015). The key elements in this phase are explained below.

A **sponsor** is an entity that represents the owner and recognizes the need for increasing efficiency and accountability and has recognized the potential of BVP. A **BV expert** ensures the quality of the BVP execution and generates transparency throughout the procurement. The **core team** is the group of personnel that delivers the procurement

throughout all phases. **Pre-qualification** is an optional element in the BVP. This step is used to limit the number of applicants. The objective of the **training sessions** is to introduce vendors to the philosophy of BVP. A **core document** is developed for vendors to use when building their proposals. It covers everything the client knows at this stage: objectives, scope, planning, weighting criteria, etc., as far as this is possible and within BVP boundaries. **Open budget with ceiling** means the client informs the vendors what their maximum budget is. It provides the vendors the freedom to give their best expertise to price ratio (Rijt et al., 2016; Kashiwagi, 2016).

2.5.2 Selection phase

Vendors performance varies according to past performance, key personnel project approaches, and related experiences (Nguyen et al., 2018). The purpose of the selection phase is to identify the BV vendor (highest level of expertise for the lowest cost) from the competing vendors. The BV vendor is selected based on the level of expertise. The client uses four filters and five selection criteria in this phase to determine expertise as illustrated in Figure 2. The filters are 1) project capability, 2) interview, 3) prioritization of vendors, and 4) dominance check. The five selection criteria are 1) level of expertise (LE), 2) risk assessment plan (RA), 3) value added (VA), 4) price and 5) interview (Kashiwagi, 2016).

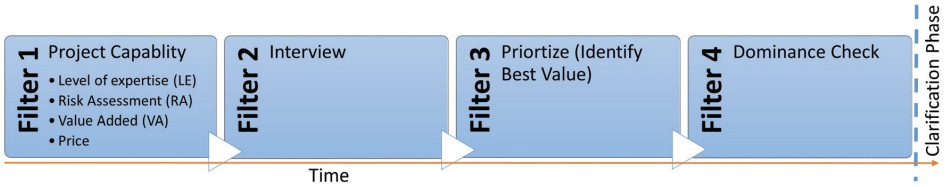


Figure 2: Five selection criteria and four filters of BVP used to rank vendors (developed based on Kashiwagi (2016))

During the selection phase, the vendors compete based on their levels of expertise and their past performance metrics, ability to identify risk and the 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 vendors' abilities to identify risk

as a criterion to select a higher performing vendor, to achieve higher customer satisfaction and for project success. The critical elements in this phase are explained below.

MEAT elements indicate the use of ratings for Project Capability based on **Level of Expertise, Risk Assessment, Value-Added documents, Interviews, and Price**. The **schedule** can also be used in the prioritization of the vendors. In the selection phase, clients can apply**Priortize** as an additional filter to MEAT documents and interviews to limit the number of vendors in the beginning, after the rating, or in the phases that follow. **Interviews with key personnel** are considered the most important filter for identifying the vendor's expertise. The purpose is to determine whether the responsible parties truly understand the project and the claims made in the documents. This step is essential because it allows the vendor to demonstrate accountability, explain the risks, and give clear explanations with dominant information and understanding of the method.

A dominance check at the end of the selection phase can be used to guarantee the best value. The purpose of the dominance check is to ensure the selection process has been performed correctly and accurately and to verify that the performance metrics submitted by the best value vendor are accurate. It ensures prioritization of the best value vendor at the lowest cost. Dominant information is information that stands out without decision-making. It is recommended that clients use two core teams for a parallel rating of the vendors to come to an objective consensus (Rijt et al., 2016; Kashiwagi, 2016).

2.5.3 Clarification phase

When the offer from the Best Value vendor obtains acceptance from the client, the clarification phase starts. During this phase, the vendor that is considered to offer the best value at the lowest cost leads the process and clarifies the proposal (Snippert et al., 2015). BVP is a self-regulating closed-loop system where only one vendor at a time can move into the clarification phase (Pre-award phase). If the vendor manages to clarify their risk management plan (RMP) and weekly risk report (WRR) and meets the client's technical intent for the proposal as specified in the technical specifications, the contract is awarded to the best value vendor (Kashiwagi, 2011). The clarification phase is critical since it is in this phase the significant paradigm shift takes place (Bos, 2012). The critical elements in this phase are explained below.

The **Kick-off meeting** is the start of an important and possibly intense clarification

phase with the winning vendor. The purpose of this meeting is to ensure clarity of the aim of this phase and the responsibilities of both parties, especially the vendor's leading role. The **Risk management plan** builds on the risk assessment document that was considered during the rating in the selection phase. It categorizes in full detail risks that are outside the vendor's sphere of control. The **Scope document** shows the project schedule in full detail, covering what is included and what is not. **Elaboration of the subcontractor** in the clarification phase is to understand the relationship of the vendor with subcontractors. The purpose of the **Reassess the conducted interview** function is to make sure the clients' concerns and needs were covered during the interview. **Key Performance Indicators (KPI)** are the performance metrics used to indicate alignment to the project goal. Presentation of these metrics gives the client an overview of the status of the developments in the project. **A dominance check** in the clarification phase acknowledges a reassessment of the documents of dominant information. The **Risk contingent fund** is money allocated for the risks that are the responsibility of the client. It is set up as a percentage of the budget to absorb unforeseen situations (Rijt et al., 2016; Kashiwagi, 2016).

2.5.4 Execution phase

During the execution phase, after the winning vendor receives the project, his progress is tracked in a Weekly Risk Report (WRR). 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 the performance documentation of the project after completion (Rivera et al., 2016). The critical elements in this phase are explained below.

Weekly reporting is a tool for the vendor to show how they minimize and manage the impact of deviations from the project scope on a weekly basis. It provides the client with an opportunity to perceive the status of the project periodically with dominant information. **Satisfaction/performance measurements** are used to minimize the impact on schedule and scope. It indicates the client's quality satisfaction with the contractor's progress and risk control performance. **Directors reporting** is a collection of weekly reports for the client's management to use as an overview of ongoing projects. This report is convenient for large companies having multiple BVP projects in progress

(Rijt et al., 2016; Kashiwagi, 2016).

3 Methods

The research reported in this study was based on a multiple case study approach, carried out according to the recommendations of Yin (2013). The multiple case study approach was favored in order to understand the topic better by studying similarity and differences between the cases. Furthermore, it was favored to discover the research questions from a wider perspective, to generate strong and reliable evidence and to create a more convincing theory (Gustafsson, 2017). Following the initial literature study, a document study of selected cases, in addition to twenty-eight interviews with key actors from the selected cases, were carried out. A qualitative approach is preferred than quantitative for this study because there are few cases available from Norway and the Netherlands.

3.1 Literature review

A comprehensive literature review –using the search engines Google Scholar and Oria –was carried out to identify similar work within the field of research. The search words used included BVP, PIPS, early contractor involvement, procurement and combinations of these. For determining what literature to review the five steps described by Blumberg et al. (2011) were followed. The steps are 1) building of an information pool, 2) application of a filter to reduce pool size, 3) a rough assessment of sources to further reduce pool size, 4) an analysis of the literature in the pool and 5) the refinement of filters or stop the search. Citation chaining according to the principles laid out by Ellis (1993) was also used to find new literature.

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 in table or concept map format, 3) synthesize the literature prior to writing the review, 4) write the review, and 5) develop a coherent essay.

3.2 Cases selection

After the literature review, 15 cases were selected, 4 from Norway and 11 from the Netherlands. All cases from Norway and more accessible cases from the Netherlands are studied. The cases are selected from Norway and Netherlands because these two countries are the only one that are using BVP in Europe. No failed cases were included in this study. Following the Netherlands, Norway began using BVP. 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. Since the list of Dutch cases identified as having practiced BVP included many projects, only more recent projects were contacted (those started after 2010). We focused only on recent projects because the BVP method has been continuously developing over time and we want to explore the experiences of projects that have used the updated method. The four Norwegian case projects were selected since 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.

3.3 Presentation of the cases and interviewees

Table 1 and Table 2 presents an overview of the case projects that were included in this study and interviewee positions. Cases 1 to 11 are Dutch case projects and cases 12 to 15 are Norwegian case projects. In the Tables No. in the last columns stands for number of informants in each case.

There are three differences between Norwegian cases and the Netherlands cases. First, 11 cases are studied from the Netherlands and 4 from Norway. Second, Norways experiences are fresh, but the Dutch are experienced with the method. Third, most the interviewees from the Netherlands cases were BVP experts whereas the interviewees in the Norwegian cases were public clients. Public clients are likely to be concerned about violating public procurement regulations when they consider using BVP. Alternatively, BVP experts may have an interest in selling the method in addition to having several years of experience on numerous projects.

Table 1: Overview of the 11 Dutch case projects and interviewees

Client/ project name	**Project Description (Budget)**	**start-finish**	**Interviewee position**	**No.**
1)Rijkswaterstaat /Opwaardering Zuid-Willemsvaart Den Dungen - Veghel	Upgrading a canal; deepening, supporting and bridge elevations (27 mill)	2012-2014	Internal BV Expert	1
2)Mitros housing corporation/ Renovation project	Renovation of public buildings (18.5 mill)	2011-2013	Procurement Coordinator	1
3)Rijkswaterstaat /Knooppunt Beekbergen A1/A50	Road construction on a large junction of two highways (22.8 mill.)	2016-2018	Vendor's (Heijmans) Project Manager	1
4)GGZ, the Dutch Association of Mental Health and Addiction Care/ Delivery of meal services across the nation	Professional meal provision including logistics and ICT (2,685 mill./year)	2012-2016	Purchase Manager	1
5)IHC Merwede	Delivery of an HVAC system for 6 vessels (3.5 mill./vessel)	2013-2017	Internal BV Expert	1
6)Municipality Utrecht /Wintermaatregelen haltes SUNIJ-lijn	Procurement tram materials, new stops, gritting and track adjustment (90,000)	2012-2013	External BV Expert	1
7)Boehringer Ingelheim (world-wide pharmaceutical company)/ Hiring temporary medical project specialists	Framework contract to hire temporary medical project specialists (1.5 mill./year for 3 years)	2010-2013	Head of Purchasing and Facilities and BV Expert	1
8)Veiligheidsregio (safety region)/Friesland province	Business intelligence packet to bring all information of the region (160,000)	2016-2020	External BV Consultant	1
9)ProRail/ Meerjarenprogramma Geluidsanering engineering geluidsmaatregelen	180 km of rail tracks sound remediation (5 mill.)	2016-2018	Tender manager	1
10)Municipality Groningen/Relining Groningen	Relining of a sewer system(NA)	2013-2016	External BV Expert	1
11)UMC St Radboud Hospital /Onderhoudsproject I Stoombevochtiging	Replacement of hospital humidification system (160,000)	2015-2015	External BV Expert	1

Table 2: Overview of the 4 Norwegian case projects and interviewees

Client/ project name	Project Description (Budget)	start-finish	Interviewee position	No.
12)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[a], Construction Manager, Environmental Advisor, & Construction Discipline Leader.	6
13)Trondheim Kommune/ Superbuss	New bus stop, new road, and planning of routes (7 mill.)	2017-2019	Tender Manager, Project Manager, Head of the Roads Department, & BVP Interviewer	4
14)Nye veier/ E6 Arnkvern –Moelv (Hamar)	24 km new four-lane highway (204 mill.)	2017-2020	Construction Manager, Contract and Procurement Director[a], Contract Advisor, Construction Discipline Leader, & Road Discipline Leader	5
15)Flats Idrettslag /Flatshallen	Football field and 3 multipurpose halls (8.5 mill.)	2017-2018	Project manager, Chairman, Member of the core team	3

[a] In two of the projects the Contract and Procurement Director was the same person.

3.4 Data collection

3.4.1 Interviews

Twenty-eight in-depth semi-structured interviews with key professionals involved in the BVP were carried out using an interview guide structured after the three research questions. Balanced number of interviewees from both countries were contacted. Each research questions were elaborated with interview questions. The nature of the questions was open-ended with the intention to bring the most out of the respondents own reflection, while the interviewees were encouraged to express their views on the subject without being restrained by the predetermined questions related to the studied cases.

The interviews were held with the clients representatives with one exception. The informants were selected based on their position and role in the projects. Most of the informants have had key role in the projects, such as BV experts, project manager or purchase manager. The informants have first-hand experience with the use of BVP method. More client representatives were interviewed because this study aims to explore BVP from the client perspective. Furthermore, the fact that the client is the party that selects the procurement method supports this selection. The time it took for one interview ranged from 45 to 90 minutes. The interviews were recorded, and field notes were taken. The

transcribed versions were sent to the interviewees for quality assurance.

In the Dutch case projects, the interviews were held with only one interviewee per project. The interviewees were approached individually with a semi-structured focused interview over Skype or telephone. In the Norwegian case projects, all interviews were carried out face-to-face. So far, BVP has only been used in four case projects (case 12, 13, 14 and 15) in Norway. Since the number of available Norwegian case projects were limited, several interviews (a minimum of three in each case) were conducted to explore their experience in detail from the case projects.

3.4.2 Document study

The cases study continued via a document study, which was carried out to supplement the answers from the interviewees to the first research questions and to triangulate the findings from interviews and a literature study. More specifically, the document study was carried out to answer how BVP was implemented in the cases specifically according to phases. See Table 3 for complete rendering of the result. The document study included documents received from interviewees as well as publicly available materials such as tendering document, tender opening protocols, and tender evaluation documents.

3.4.3 Data analysis

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

- organize and prepare raw data (transcripts, field-notes, images, etc.) for analysis
- read through all data
- code the data (by hand or computer)
- use the coding process to generate themes or descriptions
- interrelate themes/descriptions
- interpret the meaning of themes/descriptions.

The data were hand-coded and analyzed by the first author hand-in-hand with data collection and findings write-up. A combination of emerging and predetermined codes

were used. Predetermined codes were developed based on the research questions and the four phases of BVP. The emerging codes represented experiences (answer to research question 2) and measures (answers to research question 3). Through the coding process, themes or categories were generated. These themes are used as subheadings in the findings and discussion sections.

4 Findings and discussion

This section is organized according to (a) findings and (b) discussions and recommendations for each research questions.

4.1 How was BVP implemented?

a) In order to address the first research question, several BVP key elements were selected. The key elements were selected after analyzing the theoretical processes of both Kashiwagi (Kashiwagi, 2016) and the Norwegian BVP book (Rijt et al., 2016). More easily measureable elements than less easily measureable elements were selected for this study. Several elements were left out because of their difficulty in measurability (lack of concreteness) such as create transparency, accountability, less management from the client, less client decision making, less control etc. The output is presented in Table 3, which illustrates the extent that each of the proposed key elements was performed in the case projects.

Table 3: 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**
Pre-Qualification 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 & educating core team	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pre-qualification 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	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
Directors 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

b) The findings indicate that BVP was not implemented in a single standardized way. Some minor deviation during the implementation of the method has been identified. Implementing BVP in slightly different ways might create confusion, especially for vendors. Future projects should follow the standard BVP procedure. Furthermore, the method ought to be more standardized to avoid confusion of vendors when the method is used in different projects. At the same time, it needs be flexible to use it in any kind of project.

4.2 What are the experiences with BVP?

a) In this section, the experiences based on observation from interviewees are summarized in Table 4. Table 5 shows the frequency of experiences in each case and Figure 3 gives an overview of the experiences from the 15 cases. Both positive experiences and challenges were identified during the study. The positive experiences (+) are summarized under the following six sub-topics. They are 3.1) Innovation, 3.2) Better end product, 3.3) Better cooperation, relations, and satisfaction, 4.1) Early project risk identification, better project control, and predictability, 4.2) Meeting the vendors before contract signing, and 4.3) Reduce resource use. The remaining sub-topics are challenges (-) that were identified during these studies. Both the positive experiences and challenges with their explanations are presented below in Table 4. The table is included to give an explanation about positive experiences and challenges each experiences.

Table 4: Major experiences and observations from the interviews

	Experiences	**Observations from the interviews**
0 Preparation	0.1) Vendor skepticism about the method (-)	In some of the cases, the interest from the market was low since 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 open budget with ceiling, it is crucial that the client establishes a realistic budget since vendors that submit an offer above the ceiling budget could be disqualified. However, it was difficult for the clients to determine the ceiling budget of the projects.

Continued on next page

Table 4 – *continued from previous page*

	Experiences	**Observations from the interviews**
1 Selection	1.1) Failure in 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.
	1.2) Challenging to do objective evaluations (-)	In case 9, they tried to have the same core team in every BVP project since it takes a lot of time and other resources to educate a different set of people for each project. 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.
2 Clarification	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 vendor no 2.
3 Execution	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.

Continued on next page

Table 4 – *continued from previous page*

	Experiences	**Observations from the interviews**
	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.
4 Multi-phase	4.1) Early project risk identification, better project control and predictability (+)	Earlier risk identifications and better project time and budget control were raised by the interviewees as a positive experience with the use of BVP method. BVP method facilitates early identification of project risk since 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 of the interviewees, the interactions with the vendors during the interview process and clarification phase gave them an 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 since they were not expected to specify the project in detail. The clients' preparation phase before the procurement start was also shorter since they were not expected to prepare detailed specifications. Furthermore, BVP was considered as effective by most interviewees since only one vendor develops the project together with the client during the clarification phase.
	4.4) Failure in a paradigm shift (-)	Most of the interviewees had the experience of both the client and the vendor falling back to 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 since the outcome is unknown and since the client technicians are used to working with particular risk profiles. It was difficult for the client to find the balance between letting go and involvement in the project.

Continued on next page

Table 4 – *continued from previous page*

	Experiences	**Observations from the interviews**
	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 interviews process and documents as selling 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 of their position in the supply chain was identified as a challenge.

In Table 5, the interviewees' experiences with BVP are presented case by case. The numbering for the experiences from Table 4 is used. In addition, the frequency of these experiences is summarized at the end of the table.

Table 5: Case by case experiences

Cases	**0)Prequalification**	**1)Selection**	**2)Clarification**	**3)Execution**	**4)Multiphase**
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

From the above table it is possible to observe that some of the experiences have high frequency such as 1.1) Failure in SMART in the offer, 3.3) Better cooperation, relations, and satisfaction, 4.3) Reduced resource needs, and 4.6) Misunderstanding the BVP method. Furthermore, the number of experiences increase from the pre-qualification phase to execution phase, except in the clarification phase. In Figure 3, an overview

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

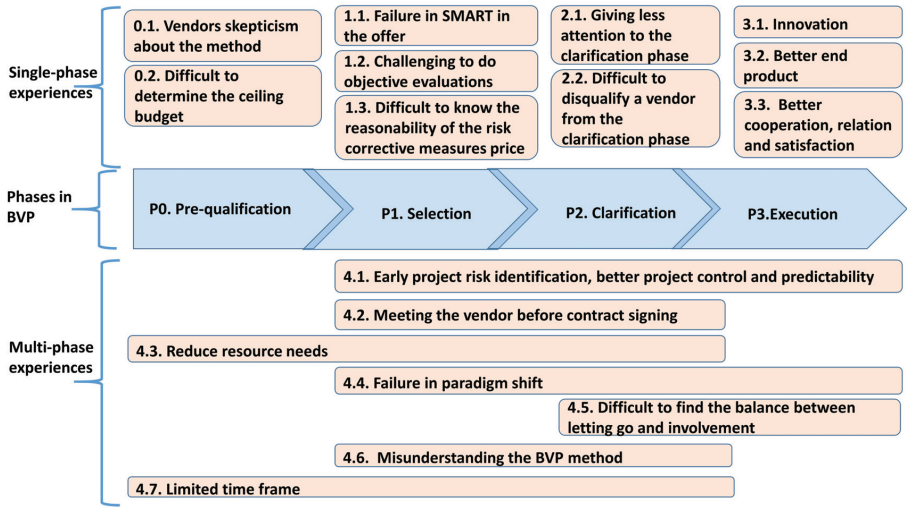


Figure 3: Overview of the experiences with BVP from the 15 cases examined

b) Some of the experiences, one from each phase, are summarized, and discussed below.

In some cases, interest from the market was low since the BVP method was new to the organization. In other cases, client personnel experienced a drop in the number of vendors participating in the tender when the client started to use BVP. During the selection phase, vendors were not good at providing SMART offers and dominant information since they were not used to developing them. This deficiency forced the client to begin decision-making, which is against the fundamental principles of BVP.

The clarification phase was not given enough attention, especially considering the aspect of delivering dominant proof by the vendor to back the claims made in the initial proposals. In some of the cases, the vendors would not take the full lead, and the client continued with that vendor because they did not realize they had any other options at that point.

The value-adding document was an excellent source for innovative ideas in the project. It gave the vendors an opportunity to display their expertise. By dedicating two of the six-page tender document to value-adding suggestions, vendors were encouraged to use the knowledge they had obtained in previous projects. This gave the vendors an opportunity

to present solutions that they had identified earlier but were not able to implement.

4.3 What measures ought to be implemented for the success of future projects using BVP?

To answer how BVP should be implemented in future projects, we 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. In Figure 4, an overview of measures ought to be implemented and pitfalls are divided into the four BVP phases and presented. Single-phase measures and pitfalls are presented above the four phases diagram, and multi-phase measures are provided below it.

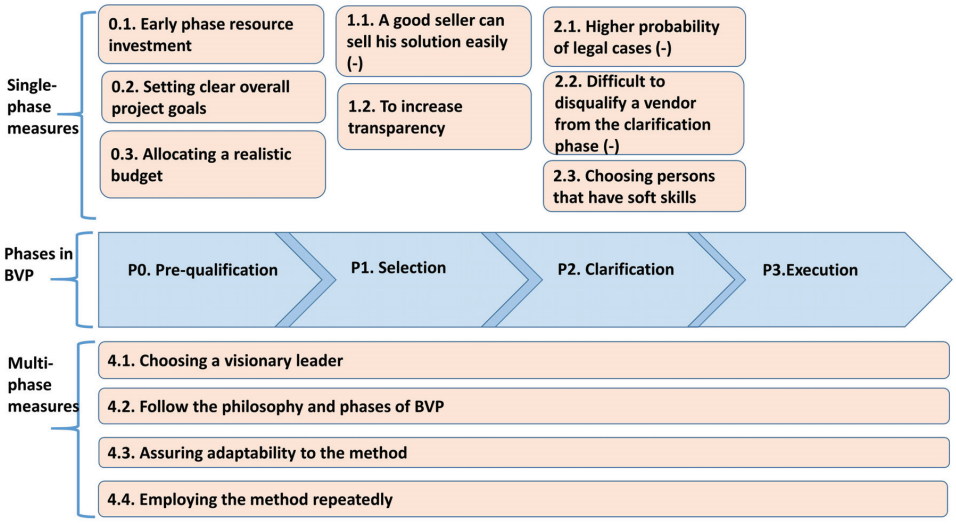


Figure 4: Overview of measures that should be taken for the success of future BVP projects

0) Pre-qualification phase

0.1) Early phase resource investment

a) The success of BVP is dependent in the pre-contractual phase. This is where it is possible to reinforce everyone's role in the procurement and the execution afterward. b) The overall project goals, the selection criteria weight, and clear task divisions need

to defined in the early phase. The client must spend enough time in the early stages to identify effective, clear, and project-specific overall goals.

0.2) Setting clear overall project goals

a) Several interviewees identified the client's ability to set the overall project goals in a clear and precise way as a success factor of the BVP method. b) These goals are vital since they are used both to evaluate the vendors' offers and to evaluate the vendor's performance in the project execution phase. The overall project goals are used throughout the project phases. They are used to select the contractor during the selection phase. During the clarification phase, both the client and the vendor develop KPI (key performance indicators) based on the overall goals; and during the project execution phase, the vendor is evaluated based on these KPI. Therefore, these goals play a central role in the success of the project since they follow the project throughout its life cycle. Furthermore, including a full life-cycle perspective when developing project goals could help clients achieve better results for project outcomes.

0.3) Allocating a realistic budget

a) Having a realistic budget that vendors can work with to propose a solution is another success factor of BVP. b) It is essential for clients to know the market. Otherwise, vendors can never develop realistic proposals, and the procurement will not move forward. The project budget needs to be sufficient for the vendor to have margins and make adjustments, providing more freedom to make choices and create opportunities for better solutions.

1) Selection phase

1.1) A good seller can sell his solution easily

a) According to some interviewees, past performance information/level of expertise selection criteria can be manipulated. If the client is not able to differentiate an expert vendor from a good seller during the evaluation of the level of expertise selection criteria, this element can be a pitfall. A good seller can get a high score under the selection criteria based on how they present dominant information rather than their previous performance. They can also manipulate the selection criteria by collecting and presenting a performance matrix based on their best projects as dominant information while omitting failed projects. Since it is resource demanding to check all projects that the vendor has carried out, the client is dependent on information provided by the vendor.

On the other hand, one of the interviewees in case project 14 explained that it is

sufficient that the vendors prove with one or more previous sample projects that the client's project goals were achieved, and that it is possible to achieve the goals on this project as well.

b) This finding reinforces the importance of project overall goals since the offers from vendors will be evaluated against these goals during the selection phase. These goals must influence how vendors write the level of expertise documents. Furthermore, the client needs be extra careful when evaluating each vendor's offer as it might provide a misleading image. How the vendor really performed needs to be checked not only based on their claims (what they say). Whatever is claimed must be verifiable. In addition, having effective follow-up questions during the interview could help to differentiate sellers from experts.

1.2) To increase transparency

a) The transparency of the client during the evaluation of vendors during the selection phase was identified as a success factor of BVP by case 13 and 11 interviewees. Transparency helps to avoid complaints from unselected vendors as a result of the selection phase. b) To increase transparency in the method, the developer of the BVP method suggests that clients not rate non-expert vendors with a rating below 5 out of 10, but instead to start with 5 and never go lower than that. He recommends assigning experts who deserve it a higher grade and leave the bad' ones at 5. The reasons for assigning a grade lower than 5 must be well documented because otherwise, the affected vendor may sue as a result of the low grade.

2) Clarification phase

2.1) Higher probability of legal cases

a) According to one of the interviewees from case 13, BVP with an open procurement procedure is more vulnerable for receiving complaints from suppliers that are not selected for the clarification phase. When BVP is used with an open procurement procedure, all vendors must be treated equally.

b) When a contractor is selected for the clarification phase, the procurement process is not over. During the clarification phase, the scope of the project neither be negotiated nor changed to keep a fair competition. However, there can be a grey area between scope negotiation and scope clarification. Furthermore, all vendors have the right to obtain access to correspondence –including project scope description –between the client and

the selected vendor during the clarification phase. In addition, they have more time to generate a complaint than with the traditional method since they have the entire clarification phase in addition to the usual ten days quarantine period prescribed by EU regulations. Consequently, there is a higher risk of receiving complaints compared to traditional procurement methods.

This risk increases when BVP is used for more extensive and complex projects since the interest of the vendors to win the project increases and since the grey area involved in defining the scope can be more extensive. Involving lawyers from both the client's and vendor's sides during the clarification phase as members of the BVP core team could help in creating a clearer line between scope negotiation and scope clarification. Thus, the probability of making mistakes and ending up in a lawsuit may be reduced.

2.2) Difficult to disqualify a vendor from the clarification phase

a) One of the interviewees in case project 13 and two from case project 14 explained how difficult it is to disqualify a vendor during the clarification phase. After the selection phase, only one vendor goes to the clarification phase to discuss the scope of the project and present a detailed project plan. If a client decides the scope presented by the first vendor in the clarification phase does not fulfil his requirements, the client can continue with the second vendor. However, it is challenging for a client to disqualify a vendor during the clarification phase since it demands documentation proving that the vendor project scope does not fulfil the client's requirements. Alternatively, another interviewee from case project 14 argued that the four filters of the BVP method prevent an unqualified supplier from making it all the way to the clarification phase.

b) The finding indicates that there is a small probability for the disqualification of an unqualified vendor during the clarification phase. A client probably need support from a lawyer to disqualify a vendor during the clarification phase. Additionally, if a client disqualifies the first vendor and goes to the second, the disqualified vendor has spent a significant resource. As a result, it may be difficult to accept the disqualification. Instead, they might take the case to court, which might delay the project. The fear of project delays might make the client to continue with the first vendor even not fulfilling the client's requirements.

2.3) Choosing persons that have soft skills

a) The effectiveness of the soft skills of the people involved in the process was identified

by interviewees as a success factor of BVP. Even though a project went well concerning transparency and overall BVP aspects, the behavior and group dynamics were not always the best. b) By focusing on the proposed (required) procedures too much, it could be easy to forget the importance of soft skills.

3) Execution phase

During this study, no measures that could be implemented in the execution phase were identified.

4) Multi-phase

4.1) Choosing a visionary leader a) The importance of a visionary leader is emphasized in the literature. Several interviewees also identified this element as a success factor of BVP. Choosing a visionary leader who sees the possibilities in using BVP is absolutely necessary for the success of the method. The leader might not need to be involved in the entire process. The most important role of the visionary leader is to be involved in the core team and intervene when necessary to assure the success of the procurement.

b) The ease with which individuals tend to fall back into traditional roles was identified in this study as one of the challenges of BVP method. Having a visionary leader on the core team likely decreases the probability of parties falling back to their traditional role –or continuing to do so for long. It could also lead to the use of the method on several projects in an organization since the leader may also have a role as promoter of the method.

4.2) Follow the philosophy and phases of BVP

a) Interviewees specified understanding the philosophy behind the BVP method and strictly following its phases as an important success factor. b) 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. Their competence can be developed by taking a course on the method, hiring a BVP expert, conducting research and development, and using the method on several projects.

4.3) Assuring adaptability to the method

a) According to several of the interviewees, both client and vendors have a central role in assuring the success of the method. If the method does not gain acceptance from vendors, it will be difficult to develop a sufficient market for the client. Also, the client

must learn as much as possible about the method to gain the most benefit from it.

b) One step that can lead to the best execution of BVP is following through on the recommendation to have a BV expert on each side. Hiring a BV expert to get assistance throughout the project phases and taking courses about the method can help both the clients and vendors to adhere to 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.

4.4) Employing the method repeatedly

a) In several Norwegian cases, project interviewees identified successful completion of the four first pilot projects as a success factor of BVP in Norway. Currently, six new pilot projects are ready to try the method and successful completion of these projects may motivate more clients to apply the method in future projects.

The supplier market's interest in the method was another point identified by interviewees. Enough interest among suppliers is a precondition for future use of the method.

b) If clients employing the method repeatedly, they will indicate to the market that BVP will be used in the future, which may encourage the market to learn about it. In addition, clients ought to have a strategic plan for which projects they will use the method to create predictability for potential vendor.

5 Conclusions

The study reported on in this paper set out to (1) to explore how BVP has been implemented (2) explore experiences from using the method, and (3) suggest measures that ought to be implemented for the success of future project using BVP.

How was BVP implemented?

The BVP procedure described by the developer of the method is followed with small modification in the case projects. All projects followed the four phases of the method (pre-qualifications, selection, clarification, and execution), but the elements used in case projects varied. Even if 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 strict way.

Several variations were observed within each phase. In some of the cases, the client

representatives claimed that they made conscious deviations based on experience. However, some misunderstandings concerning the method were also observed. One example of this misunderstanding was when case project 11 jumped over the clarification phase, which the developer of the method considers to be a critical phase. All cases used different weighting for the selection criteria. Furthermore, two of the cases (7 and 11) did not use the recommended selection criteria.

Implementing BVP in slightly different ways might create confusion, especially for vendors. Future projects should follow the standard BVP procedure. Furthermore, the method ought to be more standardized to avoid confusion of vendors when the method is used in different projects. At the same time, it needs be flexible to use it in any kind of project.

In future studies, the soft elements (less concrete elements) in each phase should be studied to understand whether the primary consideration of the BVP philosophy remains intact during implementation even when the method is implemented in different ways.

What are the experiences with BVP?

Most of the interviewees had positive experiences with the method. BVP is a promising and an effective procurement method. It is flexible with respect to enabling vendors to have greater influence on the design and scope of projects in comparison with traditional methods. If projects follow the procedure described by the developer of the method, the method works. Therefore, BVP shall be used more often in the future and projects need to follow the procedure.

This study also identified several practical challenges that practitioners are facing while using the method. Most of the challenges were either the result of not fully understanding the method or because of a lack of practical experience of both client and vendor personnel. The differences in the experiences of interviewees from the two countries could be due to the lack of experience with BVP method in Norway.

What measures ought to be implemented for the success of future projects using BVP?

Generally, both the method and its use ought to develop continuously based on the current experiences for the success of future projects using BVP. Sufficient consideration needs to be given to the measures proposed by this study. One of these success factors is to follow the philosophy and phases of the method. This can be achieved through providing

education about the method for both vendor and client personnel. Furthermore, during pre-qualification training sessions for the vendors emphasis and attention must be given to the importance of SMART offers and dominant information and how to use these tools to prove the venders capabilities.

Using BVP experts on both sides along with frequent use of the method can facilitate successful use of the method in the future. According to Dean Kashiwagi, BVP philosophy and method has been developed and completed. However, the founder of the method is expected to continuously develop the method based on current challenges. This paper contributes to construction engineering and management practice to increase the understanding of BVP by suggesting what kind of measures ought to be taken for the success of future projects using the method.

Acknowledgement

The authors wish to acknowledge master's degree student Arnoud Storteboom, who helped to collect data for this paper from the Netherlands.

REFERENCES

ABDELRAHMAN, M., ZAYED, T. & ELYAMANY, A. 2008. Best-value model based on project specific characteristics. *Journal of Construction Engineering and Management,* 134(3), 179-188.

AKINTOYE, A., HARDCASTLE, C., BECK, M., CHINYIO, E. & ASENOVA, D. 2003. Achieving best value in private finance initiative project procurement. *Construction Management and Economics,* 21(5), 461-470.

APOSTOL, R. 2011. Legal Perspective: Is Best Value Procurement achievable within the framework of the ARW 2005? *Journal for the Advancement of Performance Information & Value,* 3(1).

BALLESTEROS-PREZ, P., SKITMORE, M., PELLICER, E. & ZHANG, X. 2016. Scoring rules and competitive behavior in best-value construction auctions. *Journal of Construction Engineering and Management,* 142(9), 04016035.

BEACH, R., WEBSTER, M. & CAMPBELL, K. M. 2005. An evaluation of partnership development in the construction industry. *International Journal of Project Management,* 23(8), 611-621.

BLUMBERG, B., COOPER, D. R. & SCHINDLER, P. S. 2011.*Business Research Methods,* 3rd European Edition. Mcgraw-Hill Education.

BOOIJ, A., HILLEN, M. M. & SANTEMA, S. 2013. Towards the best value tender: The smart assessment tool. *Journal for the Advancement of Performance Information and Value,* 5 (2), 2013.

BOS, A. 2012. Case Study: Implementation at Hanze University of Applied Sciences. *Journal for the Advancement of Performance Information & Value,* 4(2).

BOS, A., KASHIWAGI, D. & KASHIWAGI, I. 2015. Changes Required to Sustain a Best Value Environment. *Journal for the Advancement of Performance Information & Value,* 7(1).

BOSMA, E., VAN DER VEN, M., KERKHOVEN, O. & KASHIWAGI, D. 2015. A Large Dutch Engineering Service Adopts the Best Value Approach.*Journal for the Advancement of Performance Information & Value,* 7(1).

COOKE-DAVIES, T. 2002. The real success factors on projects. *International journal of project management,* 20(3), 185-190.

CRESWELL, J. W. 2013. *Research design: Qualitative, quantitative, and mixed methods approaches,* Sage publications.

DOLOI, H. 2008. Analysing the novated design and construct contract from the client's, design team's and contractor's perspectives. *Construction Management and Economics,* 26(11), 1181-1196.

DUREN, J. V., DORE, A. & VOORDIJK, H. 2015. Perceptions of success in performance-based procurement: Differences between clients and contractors. *Construction innovation,* 15(1), 107-128.

ELYAMANY, A., AND MAGDY ABDELRAHMAN 2010. Contractor performance evaluation for the best value of superpave projects. *Journal of Construction Engineering and Management* 136(5), 606-614.

ERIKSSON, P.-E., ATKIN, B. & NILSSON, T. 2009. Overcoming barriers to partnering through cooperative procurement procedures. *Engineering, Construction and Architectural Management,* 16(6), 598-611

GRANSBERG, D. D. & SHANE, J. S. 2013. Defining best value for construction manager/general contractor projects: The CMGC learning curve.*Journal of Management in Engineering,* 31(4), 04014060.

GUSTAFSSON, J. 2017. Single case studies vs. multiple case studies: A comparative study.

KASHIWAGI, D. 2011. Case study: Best value procurement/performance information procurement system development. *Journal for the Advancement of Performance Information & Value,* 3(1).

KASHIWAGI, D. 2016. *2016 Best Value Approach,* USA, Kashiwagi Solution Model (KSM).

KASHIWAGI, D. & BYFIELD, R. E. 2002. Selecting the best contractor to get performance: On time, on budget, meeting quality expectations.*Journal of Facilities Management,* 1(2), 103-116.

KASHIWAGI, D. & SAVICKY, J. 2003. The cost of best value' construction. *Journal of Facilities Management,* 2(3), 285-297.

KASHIWAGI, J., SULLIVAN, K. & KASHIWAGI, D. T. 2009. Risk management system implemented at the US Army Medical Command. *Journal of Facilities Management,* 7(3), 224-245.

MOLENAAR, K. R., SOBIN, N. & ANTILLN, E. I. 2010. A synthesis of best-value procurement practices for sustainable design-build projects in the public sector. *Journal of Green Building,* 5(4), 148-157.

MOSEY, D. 2009. *Early contractor involvement in building procurement: contracts, partnering and project management,* John Wiley & Sons.

NAOUM, S. G. & EGBU, C. 2016. Modern selection criteria for procurement methods in construction: A state-of-the-art literature review and a survey. *International Journal of Managing Projects in Business,* 9(2), 309-336.

NGUYEN, P. H., LINES, B. C. & TRAN, D. Q. 2018. Best-Value Procurement in Design-Bid-Build Construction Projects: Empirical Analysis of Selection Outcomes. *Journal of Construction Engineering and Management,* 144(10), 04018093.

OYEGOKE, A. 2011. The constructive research approach in project management research. *International Journal of Managing Projects in Business,* 4(4), 573-595.

PALANEESWARAN, E., KUMARASWAMY, M. & NG, T. 2003. Targeting optimum value in public sector projects through best value-focused contractor selection. *Engineering, Construction and Architectural Management,* 10(6), 418-431.

PANAHI, B., MOEZZI, E., PREECE, C. N. & WAN ZAKARIA, W. N. 2017. Value conflicts and organizational commitment of internal construction stakeholders. *Engineering, Construction and Architectural Management,* 24(4), 554-574.

PARK, J., OJIAKO, U., WILLIAMS, T., CHIPULU, M. & MARSHALL, A. 2014. Practical Tool for Assessing Best Value at the Procurement Stage of Public Building Projects in Korea. *Journal of Management in Engineering,* 31(5), 1-6.

PERRENOUD, A., LINES, B. C., SAVICKY, J. & SULLIVAN, K. T. 2017. Using Best-Value Procurement to Measure the Impact of Initial Risk-Management Capability on Qualitative Construction Performance. *Journal of Management in Engineering,* 33(5), 1-8.

RAHMANI, F., KHALFAN, M. & MAQSOOD, T. The application of Early Contractor Involvement (ECI) in different delivery systems in Australia. International Conference on Construction in a Changing World, 2014. University of Salford, 1-12.

RIJT, J. V. D., SANTEMA, S. C. & SOILAMMI, A. 2016. *Best Value Procurement/prestasjonsinnkkøp,* RIF, Oslo.

RIJT, J. V. D. & WITTEVEEN, W. Contractor selection using BVP in the construction industry Case studies at the Dutch Ministry of Infrastructure. Ipsera Conference Proceedings Maastricht, 2011. 1398-1404.

RIJT, J. V. D., WITTEVEEN, W., VIS, C. & SANTEMA, S. 2011. Best Value at the Directorate-General for Public Works and Water Management in The Netherlands: A Case Study of the Procurement of Infrastructure Projects Worth $1,200 M. *Journal for the Advancement of Performance Information & Value,* 3(1).

RIVERA, A., KASHIWAGI, J. & KASHIWAGI, D. 2016. Improving the Management of Environmental Engineering Projects through the Best Value Project Management Model for a State Agency. *Journal for the Advancement of Performance Information & Value,* 8(1).

SANTEMA, S., VAN DE RIJT, J. & WITTEVEEN, W. Best value procurement: Lessons learned in The Netherlands. Proceedings of the 27th IMP Conference, Glasgow, UK, 1-3-September 2011, 2011.

SCHÖTTLE, A. & ARROYO, P. 2017. Comparison of weighting-rating-calculating, best value, and choosing by advantages for bidder selection. *Journal of Construction Engineering and Management,* 143(8), 05017015.

SEBASTIAN, R., CLAESON-JONSSON, C. & DI GIULIO, R. 2013. Performance-based procurement for low-disturbance bridge construction projects. *Construction Innovation,* 13(4), 394-409.

SINGH, D. & TIONG, R. L. 2005. A fuzzy decision framework for contractor selection.

Journal of Construction Engineering and Management, 131(1), 62-70.

SNIPPERT, T., WITTEVEEN, W., BOES, H. & VOORDIJK, H. 2015. Barriers to realizing a stewardship relation between client and vendor: the Best Value approach. *Construction management and economics,* 33(7), 569-586.

SONG, L., MOHAMED, Y. & ABOURIZK, S. M. 2009. Early contractor involvement in design and its impact on construction schedule performance. *Journal of Management in Engineering,* 25(1), 12-20.

SULLIVAN, K. T. 2010. Quality management programs in the construction industry: Best value compared with other methodologies. *Journal of Management in Engineering,* 27(4), 210-219.

TRAN, D. Q., MOLENAAR, K. R. & KOLLI, B. 2017. Implementation of best-value procurement for highway design and construction in the United States.*Engineering, Construction and Architectural Management,* 24(5), 774-787.

UTTAM, K. & LE LANN ROOS, C. 2014. Competitive dialogue procedure for sustainable public procurement. *Journal of Cleaner Production,* 403-4016.

TURNER, N. & RIDING, M. 2015. Early contractor involvement in Australia: Learnings from Transfield Services projects.*Small Enterprise Research,* 22(2/3), 173-184.

WANG, W.-C., YU, W.-D., YANG, I.-T., LIN, C.-C., LEE, M.-T. & CHENG, Y.-Y. 2013. Applying the AHP to support the best-value contractor selection–lessons learned from two case studies in Taiwan. *Journal of Civil Engineering and Management,* 19(1), 24-36.

WITTEVEEN, W. & VAN DE RIJT, J. 2013. Possible Barriers to a Successful Further Diffusion of the Best Value Approach in the Netherlands: Observations of Major Misunderstandings on the Concept and Theory. *Journal for the Advancement of Performance Information & Value,* 5(2).

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.

A APPENDIX: INTERVIEW GUIDE

1. Introduction
    - Interviewees name and position:
2. General about the project
    - What was the size and complexity of the project?
    - How would you describe the project?
    - Why was it chosen to use Best Value on this project?
    - Do you have any own general documents about Best Value?
3. Contract Strategy
    - Which type of contract was used (DB or DBB)?

- Which procurement procedure was used (open competition, limited competition with pre-qualification, competition with negotiation, competitive dialogue)?
- What type of compensation form was used (fixed price, fixed price, unit prices, etc.)?
- What type of description was used in the project (function or quantity descriptions)?
- Will incentives be used in this project? If so, what kind of incentives will be used?
- Have you chosen to comply with a legal standard for the contract (NS 8406, NS 8407, NS 3430, etc.) or do you use a custom contract? Why did you choose this?

4. How was BVP performed? General yes / no questions about included Best Value items in the project

Follow-up questions

(a) If Yes, what was the sponsor's position?

(b) What was the role of the core team?

(c) In case answered YES, how much was the expert involved. In case answered NO, what made you not hire them?

(d) What were the pre-qualification criteria used?

(e) If Yes, what qualification criteria were used?

(f) If Yes, how was the reception of BVP?

(g) If Yes, what made you use it?

(h) Have other selection criteria been used other than the ones listed below? (If so,) What have been the weighting criteria?

(i) Was the price of the added value included in the total price?

(j) Did all vendors go for the interview? Did the vendors present the plans, costs and risks SMART?

(k) If Yes;

o What weighting factors have been used?

o Has this been done to ensure prioritization of the best value vendor at the lowest cost?

o Was the information dominant (unquestionable, verifiable, accurate, and measurable with numbers)? Was this verified?

(l) What was the length of this period?

(m) Are the interviews assessed by the vendors to make sure the client's concerns are taken care?

(n) Which parts of the contract are expected that the supplier will be responsible for? Would you say that the vendor has a high or low degree of participation in the formulation of the contract?

Elements BVP	**Yes/No**
Pre-Qualification Phase	
Choosing a sponsor (a)	
Selection & educating core team (b)	
Involvement of an external BV expert (c)	
Pre-qualification of vendors (d)(e)	
Training sessions for the vendors (f)	
Core document /Request for Proposal	
Open budget	
Use of all four phases	
Selection Phase	
Time-plan as a prioritization assessment (g)	
Award criteria in prioritization assessment (h):	
o Past performance information / Level of expertise	o
o Risk assessment documents	o
o Value-added documents (i)	o
o Interviews	o
o Price	o
o (Time-plan, in case answered Yes)	o
Short listing	
Interviews with key personnel (j)	
Prioritization/dominance check (k)	
Interview highest weighting criteria	
Multiple grading groups	
Clarification Phase (l)	
Kick-off meeting	
Risk management plan	
Detailed plan / Scope document	
Elaboration of involvement subcontractors	
Reassessment of interviews (m)	
Usage Performance Indicators (KPI)	
Dominance check	
Vendor involved in the framing of contract (n)(o)	
Owner financially responsible for all uncontrollable risks (p)	
Risk contingency fund (q)	
Execution Phase	
Weekly reporting	
Satisfaction measurements / Performance evaluation	
Directors reporting	

(o) Have you chosen to follow standard conditions for the contract or did you use a custom contract? Why?

(p) If no, what kind of risks were excluded in the financial responsibility? Why were these risks within the responsibility of the supplier?

(q) What were the incentives for the fund?

Are there any items not mentioned here that you think are special and important in Best Value projects?

4. What are the experiences of using BVP?

   - What positive experiences do you have with the use of BVP?
   - What negative experiences (challenge) do you have from the use of BVP?
   - How was the receipt of BVP with you?
   - How was the receipt of BVP with the supplier?
   - Are there any legal challenges with the use of BVP (interviews and performance data under supplier selection in Norway)?
   - How have you experienced BVP and its use in Norway so far?

5. How should BVP be implemented in future projects?

   - What are considered to be the success factors of BVP?
   - What are the pitfalls of BVP, if any?
   - What do you think of using BVP in future projects?
   - What could you do differently in this project?
   - Is there something you are planning to do different in the future/ what have you been doing differently since?
   - Is there something others should do different in the future?

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

Paulos Abebe Wondimu[1], Ole Jonny Klakegg[2], Ola Lædre[3], and Glenn Ballard[4]

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

1 PhD Candidate, Department of Civil and Environmental Engineering (DCEE) , Norwegian University of Science and Technology (NTNU), Trondheim, Norway/Senior Engineer, Norwegian Public Roads Administration, Norway, +47 901 11 814, paulos.wondimu@ntnu.no / paulos.wondimu@vegvesen.no
2 Professor, DCEE, NTNU, ole.jonny.klakegg@ntnu.no
3 Associate Professor, DCEE, NTNU, ola.ladre@ntnu.no
4 Professor, DCEE, NTNU/Professor DCEE, University of California Berkeley glenn.ballard@ntnu.no / ballard@ce.berkeley.edu

(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.

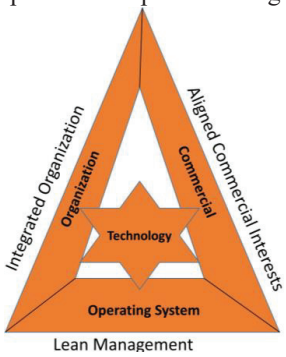


Figure 1: LCI Triangle (Ballard 2012)(driven from Thomsen et al. (2009))

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.

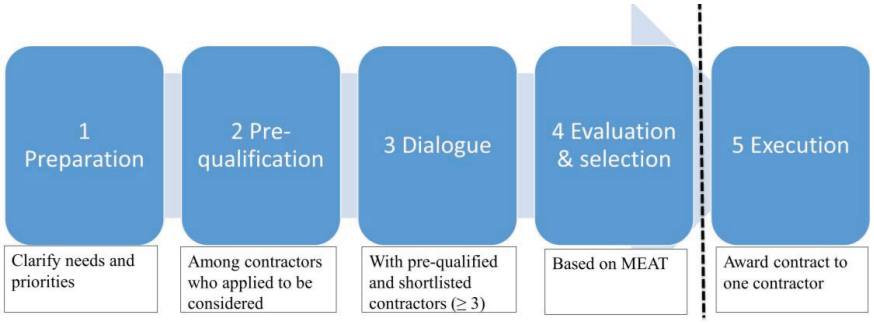


Figure 2: CD phases and major client activities

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.

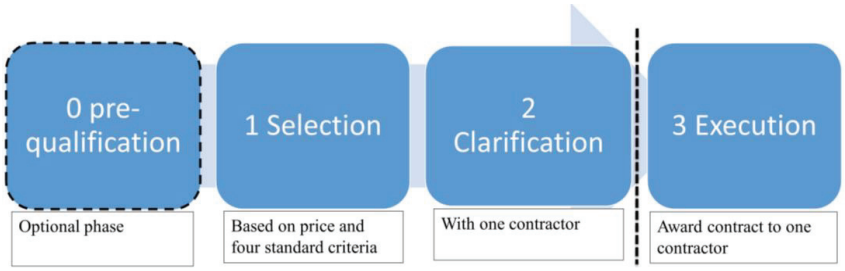


Figure 3: BVP phases and major client activities (developed based on Kashiwagi (2016))

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.

REFERENCES

Arrowsmith, S., and Treumer, S. (2012). *Competitive dialogue in EU procurement*, Cambridge University Press.

Ballard, G. "Should Project budgets be based on worth or cost." *Proc., International conference of the international group for lean construction*.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*, Sage publications.

Duren, J. V., Dorée, A., and Voordijk, H. (2015). "Perceptions of success in performance-based procurement: Differences between clients and contractors." *Construction innovation*, 15(1), 107-128.

Ellis, D. (1993). "Modeling the information-seeking patterns of academic researchers: A grounded theory approach." *The Library Quarterly*, 63(4), 469-486.

Elyamany, A., and Magdy Abdelrahman (2010). "Contractor performance evaluation for the best value of superpave projects." *Journal of Construction Engineering and Management* 136(5), 606-614.

European Commission, P. P. P. (2006). "Explanatory Note-Competitive Dialogue-Classic Directive." *Directorate General Internal Market and Services*.

European Parliament, C. o. t. E. U. (2014). "Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC Text with EEA relevance." *Official journal of the European Union*.

Hoezen, M., and Dorée, A. "First Dutch competitive dialogue projects: a procurement route caught between competition and collaboration." *Proc., In 24th Annual ARCOM Conference*, Association of Researchers in Construction Management, 535-543.

Kashiwagi, D. (2016). *2016 Best Value Approach*, Kashiwagi Solution Model (KSM), USA.

Lenferink, S., Arts, J., Tillema, T., vanValkenburg, M., and Nijsten, R. (2012). "Early Contractor Involvement in Dutch Infrastructure Development: Initial Experiences with Parallel Procedures for Planning and Procurement." *Journal of Public Procurement*, 12(1), 1-42.

Mosey, D. (2009). *Early contractor involvement in building procurement: contracts, partnering and project management*, John Wiley & Sons.

Perrenoud, A., Lines, B. C., Savicky, J., and Sullivan, K. T. (2017). "Using Best-Value Procurement to Measure the Impact of Initial Risk-Management Capability on Qualitative Construction Performance." *Journal of Management in Engineering*, 33(5), 04017019.

Schiele, J. J., and McCue, C. P. (2011). "Lean thinking and its implications for public procurement: Moving forward with assessment and implementation." *Journal of Public Procurement*, 11(2), 206.

Snippert, T., Witteveen, W., Boes, H., and Voordijk, H. (2015). "Barriers to realizing a stewardship relation between client and vendor: the Best Value approach." *Construction management and economics*, 33(7), 569-586.

Song, L., Mohamed, Y., and Abourizk, S. M. (2009). "Early Contractor Involvement in Design and Its Impact on Construction Schedule Performance." *J. Manage. Eng.*, 25(1), 12.

Storteboom, A., Wondimu, P., Lohne, J., and Lædre, O. (2017). "Best Value Procurement - The Practical Approach In The Netherlands." *Procedia Computer Science*, 121, 398-406.

Thomsen, C., Darrington, J., Dunne, D., and Lichtig, W. (2009). "Managing integrated project delivery." *Construction Management Association of America (CMAA), McLean, VA*, 105.

Uttam, K., and Le Lann Roos, C. (2014). "Competitive dialogue procedure for sustainable public procurement." *Journal of Cleaner Production*, 403-4016.

Walker, D. H., and Lloyd-Walker, B. M. (2015). *Collaborative project procurement arrangements*, PMI.

Wondimu, P. A., Hailemichael, E., Hosseini, A., Lohne, J., Torp, O., and Lædre, O. (2016). "Success factors for early contractor involvement (ECI) in public infrastructure projects." *SEB16 Build Green and Renovate Deep*, Elsevier`s Energy Procedia, Tallinn and Helsinki.

Wondimu, P. A., Lohne, J., and Lædre, O. (2017). "Motives for the Use of Competitive Dialogue." *25th Annual Conference of the International Group for Lean Construction*Heraklion, Greece, 53-60.

Yin, R. K. (2014). *Case study research: Design and methods*, Sage publications.