

Early contractor involvement (ECI): ways to do it in public projects

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Abstract

Purpose – Early contractor involvement (ECI) faces many barriers because it differs from traditional business practices. Public owners, especially, face a major challenge because they must comply with international and national legislation. The purpose of this paper is to develop a framework that illustrates the various approaches that public project owners can take to implement ECI.

Design/methodology/approach – In addition to a literature review, three groups of case studies were carried out. The case studies were based on 54 semi-structured in-depth interviews with key personnel from 21 Norwegian public projects and document study.

Findings – In all, 25 approaches to ECI were identified during the research. Twelve of these were used in the cases studied.

Social implications – There are several approaches to ECI that are suitable for public owners. However, the contractor's contribution depends on which approach is implemented and how it is implemented.

Originality/value – As original contribution, this study presents a novel framework that defines options for implementing ECI in public projects. Furthermore, this paper provides insights on how ECI can be implemented in public projects based on Norwegian experiences. Although the empirical data of the study is limited to Norwegian public projects, this study contributes to knowledge about how to implement ECI internationally.

Keywords Public procurement, Public projects, Best value procurement (BVP), Competitive dialogue (CD), Early contractor involvement (ECI)

Paper type Research paper

Introduction

Contractors may be more experienced than the client and the designer when it comes to buildability, construction methods, materials and local practice (Rahman and Alhassan, 2012). The client has to choose a project delivery model. However, traditional project delivery models fail to integrate contractors' experiences in the early phases of projects. The development towards more complex projects demands, however, alternative (evolving) project delivery methods to ensure appropriate project delivery, contract compliance and quality assurance (Molenaar *et al.*, 2007). One of the evolving approaches is early contractor involvement (ECI) (Lahdenperä, 2016; Molenaar *et al.*, 2007; Manley and Chen, 2017). ECI



facilitates implementation of innovative, efficient and value-adding solutions through building trust-based cooperation between clients and contractors (Ozorhon, 2013; Ozorhon *et al.*, 2014; Ozorhon *et al.*, 2015; Wondimu *et al.*, 2018c).

Early phases of projects are typically understood to be the pre-construction phases. The primary purpose of ECI is to bring contractor construction knowledge and experience into pre-construction phases of projects. Of particular interest is the improvement in value for money and project delivery time by comparison with traditional project delivery methods (Scheepbouwer and Humphries, 2011). Research reports that the construction industry has had positive experiences from practicing ECI (Lahdenperä, 2013; Naoum and Egbu, 2016).

ECI refers to the engagement of the contractor in the early stage of project development through a wide range of approaches (Rahmani *et al.*, 2014). Public owners from different countries have developed ECI approaches based on their necessities and circumstances (Rahmani *et al.*, 2013; Wondimu *et al.*, 2018a). Consequently, there is no universal approach to ECI in public projects.

ECI is challenging for European public owners because of European Union public procurement directives. There are few sources that have documented how public owners can implement ECI and which approaches to ECI that exist. The overall motivation of this research is to develop a novel framework through literature review and by studying experiences from the Norwegian context that illustrates the various approaches public owners can use to implement ECI. The study helps public clients to design an appropriate ECI approach that suits their project.

Clients should answer three core questions before involving contractors in an early phase of their projects: When do they want them to become involved? Why do they want them to become involved? How to achieve this involvement? After clients have answered these questions, several ways to implement ECI exist. This paper helps public clients to answer the third question.

The research questions addressed in this paper are:

RQ1. What do public owners do to implement ECI?

RQ2. What options do public owners have when they want to implement ECI?

This study has some limitations: the empirical data is limited to Norwegian public construction projects and the study is limited to the procurement phase. Furthermore, the identified approaches are not studied in depth to understand under which project types they function best. The different approaches are not prioritized based on suitability for different situations, neither.

Early contractor involvement approaches identified in literature

International ECI approaches are presented in this section. The identified approaches are summed up in a table at the end of this section.

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

IPD is a project delivery method that integrates people, systems, business structures and practices by using relational contracts (Gokhale, 2011). Early involvement of all parties is at the core of IPD (Kent and Becerik-Gerber, 2010; Lahdenperä, 2012). In the USA, IPD is used to implement ECI.

Even though ECI does not require the 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). BIM is considered an important tool that facilitates ECI (Rowlinson, 2017). BIM allows for collaboration among owners, designers, contractors, users and other stakeholders throughout the lifecycle of the project with the use of comprehensive 3D models, specifically encouraging ECI (Ferme *et al.*, 2018). Literature indicates that BIM is an important tool that facilitates ECI, but it is not an ECI approach itself.

Partnering is a form of ECI that includes mutual commitment (Walker and Lloyd-Walker, 2012). Partnering is a long-term commitment between the client and contractor for the purpose of achieving specific business objectives. It demands that each participant maximizes the effectiveness of their resources (Chan *et al.*, 2004).

A framework agreement is a relational-based procurement method developed in the UK (Walker and Lloyd-Walker, 2015). It is an agreement between a client and a supplier that establishes the terms for future contracts that are to be awarded during a given period. Depending on the agreement, the client may get the right to or may have to procure from the supplier. It is suitable for establishing ECI (Laryea and Watermeyer, 2016). It shares similarities with partnering and alliance (Walker and Lloyd-Walker, 2015).

An 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. In this approach, the project risks are managed jointly, and the outcome of the project is shared (Lahdenperä, 2012).

Best value procurement (BVP), also called best value approach (BVA), is a procurement model, a risk management model and project management model (Kashiwagi, 2016). The procurement model is a qualifications-based selection approach to procure contractors with the best expertise to complete the task (Hoezen, 2012). In the procurement model, price and other key factors are considered to enhance the long-term performance and value of construction (Perrenoud *et al.*, 2017). BVP has been used as an ECI approach on several projects in the USA and The Netherlands. It has been also used as an ECI approach on some pilot projects in Norway (Storteboom *et al.*, 2017; Wondimu *et al.*, 2018b).

The approaches used to implement ECI in Australia's infrastructure projects can be divided into three activities:

- (1) selection of one contractor on the basis of non-price aspects;
- (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 individual segments are used to implement ECI in a project. Investigation and research are included in the first segment. The second segment includes the preparation of a detailed design, negotiation of commercial terms (fixed price negotiation) and contract duration. In the third segment, completion of the detailed design and physical works based on the DB contract are included (Scheepbouwer and Humphries, 2011). The second segment 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 European Union (EU) procurement regulations ruled out project alliancing. However, that attitude is changing. Project alliances similar in

form to those delivered in Australia are being undertaken in Europe (Laan *et al.*, 2011). Moreover, the emergence of competitive dialogue (CD) has facilitated the use of project alliances in Europe (Walker and Lloyd-Walker, 2015). Alliances can be categorized into pure alliance and competitive alliance (Lahdenperä, 2010).

Pure alliance is based on a 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. However, a pure alliance with the selection of a contractor without considering price as a criterion might conflict 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 pure alliances. In a competitive alliance, the procurement procedure is either a negotiated procedure or a CD. The contract is awarded to the contractor with the most economically advantageous tender (MEAT) (Lahdenperä, 2009). This means price is one of the selection criteria, together with technical qualifications, former experiences etc. Competitive alliance can be carried out either through the competitive single TCC or the multiple/dual TCC.

In the competitive single TCC, the owner selects two contractors based on the MEAT selection criteria that enter the project development phase. 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' capabilities and a comparison of prices constructed from the quotes and the owner's cost estimates. 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 TCC arrangement because it involves two steps to determine the target cost (Lahdenperä, 2010).

In the multiple/dual TCC, the owner selects multiple/dual competing contractors primarily based on experience, capability and attitude. Then, each contractor develops the design, execution strategy and target cost together with the owner. Finally, the owner selects the best tender, based on MEAT criteria with an emphasis placed on the price (Lahdenperä, 2010).

The UK 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 assessment 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 make the contractor design or construct the project on a budget (Molenaar *et al.*, 2007). The open-book target pricing process resembles TCC.

Additionally, in the UK, three procurement methods based on 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 the UK and is comparable to 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 in which two teams 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 TCC.

IPI is a form of insurance that provides single cover 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 that the model is founded on (Cabinet Office, 2014b).

In a 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 contractors compete, with one contractor being chosen based on qualification and price. The qualification criteria include capacity, capability, stability, experience and strength of their supply chain. Price criteria include the contractors profit, fees and overheads and other cost proposals. In the second stage, the winning contractor is appointed to put together 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, the two-stage open book shares similarities with two-stage TCC.

A two-stage procurement process has been advocated for as an ECI approach that maintains the degree of competition for the 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 of the contractor:

- profit margin;
- overheads;
- pre-construction stage fee; and
- approach to risk pricing and any other cost components.

The qualitative criteria typically include:

- the proposed construction method;
- ability to deal with unanticipated problems;
- ability to deliver similar type projects on schedule;
- experience with similar projects (track record); and
- familiarity with local sub-contractors and contractors.

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 form of TCC (Chan *et al.*, 2010a). In the procurement process, the second stage can typically be one of the following:

- traditional construct only contract (DBB);
- design and construct contract (DB);
- novated design and construct contract; or
- construction management at risk (CMR) (Love *et al.*, 2014; Mosey, 2009).

From the above description, the two-stage tender process shares similarities with the competitive alliance based on the two-stage TCC.

DBB, DB and CMR are the three fundamental and traditional project delivery methods (Touran *et al.*, 2009). In a novated design and construct contract, the design team engaged by the client to develop a preliminary design is inherited by the main contractor for detailed design (Doloi, 2008). Each of the three fundamental delivery methods can be procured by low-bid, qualifications-based or best-value procurement methods. There are three possible contracting processes that can be used to get to a final award. The three contracting

processes are one-step, two-step and multiphase, based on how the competitors are asked to submit the required information (Touran *et al.*, 2009). CMR is a delivery method that has been developed in the USA that implements collaborative principles on projects and facilitates ECI. CMR is intended to involve the construction manager in the preconstruction phase of the project to reduce risk and facilitate cost savings (Bilbo *et al.*, 2015; Gransberg Douglas and Shane Jennifer, 2015).

European public owners have six procurement procedures to choose among for projects with cost estimates above the EU threshold (currently 5,548 MEUR). They include:

- open procedure;
- restricted procedure;
- competitive procedure with negotiation;
- CD;
- innovative partnership; and
- use of the negotiated procedure without prior publication (Wondimu *et al.*, 2018c).

In The Netherlands, CD and negotiated procedures are being used to achieve interweaving ECI. Based on their experience using these procurement procedures, it is possible to perform functional specification, conduct a (confidential) dialogue, divide the procurement procedure and provide competition throughout several phases (Lenferink *et al.*, 2012; Van Valkenburg *et al.*, 2008). For simple projects, applying a negotiated procedure is possible (Lenferink *et al.*, 2012; Van Valkenburg *et al.*, 2008; Lædre, 2006). For more complex projects, however, CD can be suitable (Marique, 2013; Wondimu *et al.*, 2018c). 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 implement ECI during the awarding of port contracts (Siemonsma *et al.*, 2012). The Netherlands PPP model is based on design-build-finance-maintain contracts (DBFM). PPP is a design-construct-operate-maintain contract and is similar to build own operate transfer (BOOT) (Walker and Lloyd-Walker, 2012; Jacobsson and Walker, 2013; Rahmani *et al.*, 2014; Martin, 2019).

Riemann and Spang (2014) 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 beginning of the plan approval process. The second option is to allow variant solutions by the bidders during the tendering phase. The third possibility uses the CD procurement procedure. In allowing a variant solutions approach, the client enables 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.

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). Qualifications-based selection can be accomplished using the MEAT awarding criteria (Falagario *et al.*, 2012). Below list summarizes possible approaches to ECI identified in the literature.

- (1) workshops (with the contractors after design phase but before the plan approval process is started);
- (2) framework agreement;

- (3) PPP;
- (4) partnering;
- (5) IPD;
- (6) alliance;
 - pure alliance;
 - based on single TCC; and
 - selection based on non-price aspects/selection based only on qualifications.
 - competitive alliance;
 - based on two-stage TCC/competitive single target-cost approach/a two-stage tender process;
 - based on multiple/dual TCC; and
 - based on negotiation procedure or based on CD procedure.
- (7) selection based on qualifications and price;
 - MEAT; and
 - BVP.
- (8) selection based on only qualifications;
 - company's track record; and
 - non-price aspects.
- (9) CD procedure;
 - together with PPP/BOOT; and
 - based on DBFM.
- (10) negotiated procedure;
- (11) allowing variant solutions by the bidders during the tendering phase;
- (12) multiple (dual) TCC/CLP;
- (13) two-stage TCC/a two-stage tender process/two-stage open book;
- (14) single TCC;
- (15) design-bid-build contract (DBB);
- (16) novated design and construct contract;
- (17) CMR; and
- (18) DB contract.

To summarize, different countries' public owners have developed different ECI approaches based on their 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.

So far, there is no research that systematically categorizes the various ECI approaches to help public clients to design an appropriate ECI model that suits their project situation. This paper fills part of this research gap by developing a framework that illustrates the various ways to involve the contractor in the early phase of public projects.

Method

The empirical data reported in this study is based on a multi-case study. The 18 ECI approaches derived from the literature guided empirical data collection and analysis. The

output from the literature review was used to develop predetermined codes for the analysis. Following the initial literature study, 21 cases were studied through 54 semi-structured interviews with key informants and a document study spanning the cases.

Literature review

The review of the contemporary literature was undertaken using the search engines Google Scholar and Oria. Oria is a Norwegian University library resource that includes academic journal papers, conference papers, reports and dissertations. Search words include ECI, public procurement, EU, public projects and combinations of these terms. Citation chaining according to the principles laid out by Ellis (1993) was also used to identify relevant literature. That includes references from the articles were analyzed to identify potentially pertinent sources of information. More than 130 recent papers were found in the topic during literature search. To filter the relevant literature, abstracts of the articles were read.

During the literature search, the five steps recommended by Blumberg *et al.* (2011) were followed. The five steps are:

- (1) build an information pool;
- (2) apply a filter to reduce pool size;
- (3) conduct a rough assessment of sources to further reduce pool size;
- (4) analyze the literature in the pool; and
- (5) refine filters or stop the search.

Sampling

Three groups of case studies were carried out for this study. A purposeful sampling strategy described by Palinkas *et al.* (2015) was used to select the cases. The cases are selected by using an “emphasis on similarity” strategy. The cases are public projects that have implemented ECI. The unit of analysis is the procurement phase of the case projects.

In the first group of the case study, 11 bridge projects were identified as cases relevant for study. These are Cases 1 to 11 in Table I. Major factors that contributed to the decision to study bridge projects included the first author’s experience in bridge projects as well as the purpose of this research to contribute to effective structuring of future bridge projects. The eleven bridge projects were identified based on recommendations from 20 key-professionals with several years of experience within Norwegian public roads administration (NPRA) and NPRA’s yearly internal project reports from 2001 to 2013. 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 during the early phases of the project.

In the first group of case studies, CD appeared as an appropriate approach to study in further detail because it was used to implement ECI in 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 our decision to proceed with exploring this approach in detail. During this study, six infrastructure projects that have used CD were identified. Those are Cases 12 to 17 in Table I. As far as the authors know, they are the only infrastructure projects where NPRA has used the CD procurement procedure.

During the first group of the case studies, BVP appeared as an appropriate approach to study in further detail because it was a new approach in Norway and it was used to implement ECI. The NPRA’s interest in knowing more about the method, availability of

Table I.
Case descriptions
and informant's
position

	Cases project name/ Client (Project description, Contract Size (MEUR), Start -Finish Year)
1st group of cases (Bridge projects)	Informants
	<ol style="list-style-type: none"> 1. Tresfjordbrua/ NPRA (1 290 m bridge, 58 MEUR, 2012-2015) Project manager, construction manager (2 from the client) 2. Gullibrua/NPRA (740 m bridge, 34 MEUR, 2011-2014) Construction manager (1 from the client), the contractor project manager (1 from contractor) 3. Paradisbrua/NPRA (53 m bridge, N/A, Not started) Project manager, purchasing manager, design manager (3 from client) 4. Sykkylvsbrua/ NPRA (860 m bridge, 14 MEUR, 1997 –2000) Construction manager (1 from the client) 5. Lepøybrua/ NPRA (800 m bridge, N/A, Not started) Project manager, construction manager (2 from the client) 6. E6*E16 Flyplasskrysset/ NPRA (350 m bridge, 14 MEUR, 2015-2016) Construction manager (1 from the client) 7. Smålennebrua/ NPRA (300 m bridge, 17 MEUR, 2008-2010) Design manager (1 from the client) 8. E39 Godstormalenbrua/ NPRA (-bridge, N/A, Planning phase) Assistant project manager (1 from the client) 9. Linesøybrua/ NPRA (315 m bridge, 23 MEUR, 2006-2011) Control engineer (1 from the client) 10. Tjønnøybrua/ NPRA (270 m bridge, 6 MEUR, 2002-2003) Project manager a (1 from the client) 11. Straumsbrua/ NPRA (290 m bridge, 6 MEUR, 2002-2004) Project manager a (1 from the client) 12. E6 Helgeland North/ NPRA (62 km new two-lane road, 180 MEUR, 2015-2019) Construction manager, project manager^b and a representative from NPRA head office (3 from client) and project manager, quality manager^b and geotechnical engineer^c (3 from contractors) 13. E6 Helgeland South/ NPRA (58 km new two-lane road, 205 MEUR, 2016 –2021) Three construction managers, project manager^b and a representative from NPRA head office (5 from client) and quality manager^b, tender manager, project director, tender manager, geotechnical engineer^c and regional tender manager (6 from contractors) 14. E6 Trondheim-Sjørdal/ NPRA (0.6 km new road, 55 MEUR, 2009 –2013) Construction manager, project manager and process manager^d (3 from client) and geotechnical engineer^c (1 from contractor) 15. Fv32 Lilleelvkrysset, Porsgrunn/ NPRA (0.5 km new tunnel, 17 MEUR, 2015 –2018) Construction manager, project manager and process manager^d (3 from client) and geotechnical engineer^c (1 from contractor)
2nd group of cases (CD)	(continued)

Cases project name/ Client (Project description, Contract Size (MEUR), Start -Finish Year)
Informants

16. E39 Sognefjorden/ NPRA (Feasibility study of bridge, N/A, 2012–2012)
Project manager and process manager^d (2 from client)
17. E39 Lavik – Oppedal/ NPRA (Ship building with 10 years operation, 93 MEUR, 2012–2015)
Two procurement leaders from NPRA and process manager^d (3 from client)
18. E18 Rughtvedt-Dordal/ New Roads (16.5 km new four-lane highway, 200 MEUR, 2017-2019)
Project Director, Assistant Project Director, Contract and Procurement Director^e, Construction Manager, Environmental Advisor, and Construction Discipline Leader (6 from the client)
19. E6 Arnkvern – Moelv/ New Roads (24 km new four-lane highway, 204 MEUR, 2017-2020)
Construction Manager, Contract and Procurement Director^e, Contract Advisor, Construction Discipline Leader, and Road Discipline Leader (5 from the client)
20. Metrobuss/ Trondheim Municipality (New bus stops and road, 7 MEUR, 2017-2019)
Tender Manager, Project Manager, Head of the Roads Department, and BVP Interviewer (4 from the client)
21. Flatåshallen/ Flatås Idrettslag (Football field and 3 sport halls, 8.5 MEUR, 2017-2018)
Project manager, Chairman, Member of the core team (3 from the client)

Notes: ^aIn three of the Cases (1, 10 and 11), the project manager was the same person; ^bThe project manager and the quality manager was involved in the dialogue phase of both cases 12 and 13; ^cThe geotechnical engineer was involved in dialogue phase of Case 12, 13, 14 and 15; ^dThe process manager in Cases 14, 15, 16 and 17 was the same person; ^eContract and procurement director was the same person in two of the Cases (18 and 19)

cases in Norway and access to data all contributed to the decision to proceed in exploring this approach in detail. During the third group of cases studied, we reviewed all projects in Norway that had used BVP during that timeframe. We identified four projects that met this criterion. These are Cases 18 to 21 in [Table I](#) and were the only projects that had used BVP in Norway at the time.

To summarize the result of the sampling, we studied the important Norwegian bridge projects regarding ECI, all Norwegian infrastructure projects that have used CD and all Norwegian projects that have implemented BVP.

Data collection

Data was collected based on the four principles of case study data collection described by [Yin \(2014\)](#). These principles are use multiple sources of evidence, create a case study database, maintain a chain of evidence and exercise care when using data from electronic sources. Several interviews and document studies were used to collect multiple sources of evidence. A case study database was created to maintain a chain of evidence from interviews and document studies. Data from reliable sources such as documents provided by the interviewees and government documents were used during using data.

Interviews. Fifty-four in-depth semi-structured interviews with key professionals involved in projects using ECI were carried out using three interview guides (see [Appendix 5](#) for the interview guides). The interview guides were structured based on the two research questions with elaborative interview questions. The interview questions were chosen to assist in exploring the interviewees' experiences on ECI at the general level and case-specific level.

During the first group of study, both the research questions were used. During the second and third groups of study, only the first research question was used to explore the experience with ECI approach in depth. As described by [Corbin and Strauss \(2008\)](#), we reached a point of saturation after literature review and the first group of study. As a result of this saturation, it was not essential to use the second research question during the second and third groups of study. Instead, experiences specific to the ECI approach were collected on CD and experiences specific to the BVP approaches were explored during the second and third groups of study to understand the two approaches in detail.

All the interviews, except one, were carried out face to face and took between one and two hours. All interviews were recorded and transcripts were sent to the interviewees for confirmation. In some of the cases, only one interviewee from a particular participant organization was interviewed. To make sure to get enough insights from a single interviewee about ECI application within the project context, attention was given to the interviewees' positions and professional roles during the interviewee selection.

The professional role of most respondents was manager. The interviewees were selected because they had been actively involved during the procurement phase of the case projects. This way, we benefited from the interviewees' "hands on" experience from the procurement phase. Several of the interviewees were active in the management of the projects during the execution phase. In this way, we were able to include the consequences of choices made during procurement. Because of their roles and positions in the case projects, the interviewees are considered reliable.

Document study. The case study continued via a document study, which was carried out to triangulate the findings from our interviews and literature study. The document study included documents received from interviewees as well as publicly available materials. The document study includes such as contract documents, meeting minutes, tender documents and tender opening protocols. In total, more than 65 different documents are studied. The document study was carried out before the interviews were conducted to gather background information for

understanding the projects and after the interviews to triangulate the findings from the interviews. During and after the interviews, documents restricted from public access were provided for some of the projects. These documents supported opinions and information gathered during the interviews. After the interviews, these documents were scrutinized to validate the information provided in the respective interviewees and to answer the first research question.

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.

Data analysis

After data collection, a data analysis based on the prescriptions of [Creswell \(2013\)](#) was carried out. Data analysis steps described by [Creswell \(2013\)](#):

- 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; and
- interpret the meaning of themes/descriptions.

The data were hand-coded and analyzed by the first author, hand-in-hand with the data collection and the write-up of findings. A combination of emerging and predetermined codes was used. Predetermined codes were developed based on the research questions and literature review. Emerging codes were extracted from the empirical data.

During the coding process, texts with “similar wording on similar ideas” and texts with “different wording on similar ideas” were identified for further analysis. Then texts with “different wording on similar ideas” were grouped together with texts using “similar wording on similar ideas”. Thereafter, the texts were sorted in “described in existing literature” and texts “not described in existing literature”. Through the coding process – that grouping texts with similar wording and ideas – coherent categories were generated. These categories are the different ECI approaches – indirect approaches, information meetings, DB contract, etc. Further, these categories were sorted in groups – basic approaches to ECI, project delivery arrangements and selection method.

Findings

This section describes, based on the case studies, what public owners in Norway do to implement ECI. Because the purpose of this paper is to develop a framework that illustrates the various approaches that project owners can use to implement ECI, we are reporting on the implementation of each ECI approach on an aggregated level. Case-specific detail is presented in previous papers. The first group of studies is presented in detail in the following papers: [Wondimu et al. \(2017, 2016b, 2016a\)](#). The second group of studies is presented in detail in the following papers: [Wondimu et al. \(2018c, 2017, 2018b\)](#) and [Ottemo et al. \(2018\)](#). The third group of studies is presented in detail in the following papers: [Narmo et al. \(2018\)](#); [Högnason et al. \(2018\)](#); [Wondimu et al. \(2018b\)](#) and [Joudi et al. \(2018\)](#). This paper is an aggregated result of the three groups of case studies.

Early contractor involvement implementation

The first research question proposed in the introduction section is addressed in this section. Twelve ECI approaches were identified during interviews 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. The addition of these seven – not described in the literature – enriches the selection possibilities of owners.

Table II presents the 12 ECI approaches identified in the 21 case projects. It lists the approaches in the first columns and the case projects in the first row. The approaches are presented in order from the most frequently implemented approach (A1) to the least (A12). The projects are arranged from the project that used the most approaches to the project that used the fewest in each case study group, respectively. To illustrate which approaches were already identified from the literature review and which approaches are new from the multiple case studies, L/P is used (see the table notes for descriptions).

In the following section, the seven new approaches identified from the case projects (indicated by letter “P” in Table II) are briefly presented and discussed.

Indirect approaches. In indirect approaches we find two approaches. The first one is use of a consultant with construction experiences or a contractor during a development of handbooks and standards. The second one is use of in house construction experience in early phase of a project. 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. Furthermore, the approaches do not involve public procurement complications similar to those of the other approaches identified by this study.

Information meetings. Meetings before selection of a contractor to a project that are open to all contractors who 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.

Front-end partnering process. This approach begins after the contract signing but should be completed before the contractor commences construction. 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.

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.

Direct contact with specialist contractors in the front-end phase of projects. Specialist contractors are sub-contractors that possess special competence and equipment that both owners and major contractors are dependent on to execute the project. 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 because it might be misleading if the contacted specialist contractor does not have enough experience in the area the client is asking about.

Idea competition. 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 because of its use early in the front-end phase. The primary disadvantage of

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

Note: In the second column, L stands for approaches identified in literature and P stands for approaches identified from the case projects

Table II.
Early contractor involvement approaches (A1-A12) identified in the 21 case projects

this approach is that it is a one-time involvement and lacks continuity throughout the whole project life cycle.

Contractors promote their idea to the owner during the early phase. A contractor takes the initiative to promote an idea to the client during the planning and design phase. Obviously, it is not too common for contractors to take this kind of initiative. Typically, they do not 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.

Discussion

Options for public owners to implement early contractor involvement

The analysis derived from case study and literature review is used to answer the second research question proposed in the introduction section. Options to implement ECI are discussed in this section.

Generally, 25 ECI approaches, 18 from literature and seven from the case projects, are identified during this study. The approaches can be categorized as project delivery arrangements, selection methods, procurement procedures, alternative solutions, TCC types, basic approaches and contract structures. Additionally, approaches in the same category have different potentials for integrating contractors' knowledge and experience. Each approach can be graded from less open to more open based on the degree to which it provides contractors the opportunity to suggest new solutions to the project.

ECI approaches identified from the literature and from the 21 Norwegian public projects are presented below in a framework. The approaches are placed into seven major categories based on their similarity.

The first group provides basic approaches to ECI. They are basic approaches that can be used in any type of project. The pain/gain share arrangement in these approaches is low. Low pain/gain share means the contractor does not have share in the project savings or losses based on the implementation of their idea. Therefore, the contractor's contribution in these approaches is limited. These approaches can be combined in a project. Four of these approaches are identified from the first group of case studies from Norwegian bridge projects.

The second group lists project delivery arrangements. Partnering, IPD and alliancing are the three relational-based project delivery arrangements that can be used to implement ECI, which dominates around the globe. PPP, framework agreements and partnering arrangement were developed and frequently practiced in the UK. In PPP, the contractor become responsible for financing of the project in addition to early involvement. IPD is a project delivery arrangement developed and frequently practiced in the USA. Alliance was first developed in Australia. In the Australian alliance model, the selection phase is based on non-price aspects. Therefore, it is called pure alliance. Alliance has been modified in Europe to fit with EU public procurement regulations. Competitive alliancing has been developed and practiced in Finland. In competitive alliancing, the procurement procedure is based on CD procedure and the selection of contractors is based on MEAT.

The third group identifies selection methods. In ECI, selecting contractors based on the lowest price selection method is difficult and not recommended. Instead, the selection of contractors may be based only on qualification or it can be based on qualification and price. In Europe, if the selection is not based on the lowest price, the method is called selection based on the MEAT. In Australia, the selection in alliancing is based only on qualification (with non-price aspects). In the UK, public owners select based only on qualification using the company's track record.

The fourth group provides procurement procedure options. Competitive procedures with negotiation (negotiated procedure), innovative partnership and CD are identified in the EU public procurement directives and can be used for projects that fulfill certain circumstances. These procedures can be used to implement ECI in complex projects. Additionally, they allow a dialogue with prequalified and shortlisted contractors before contract signing.

The fifth group describes alternative solutions. The grouping is based on how the client selects alternative solutions for a project. One of the options is for the client to prepare alternative solutions and ask for an offer for all solutions. The second option is for the client to allow the contractors to suggest alternative solutions. The third alternative is that the client can have a competition in the early phases of the project to get an idea of what kinds of alternatives are available. These three approaches can be combined in a project.

The sixth group lists TCC types. Different types of TCC exist based on how many contractors work to develop the target cost of a project as well as methods for selecting the contractor that develops the target cost. In single TCC, only one contractor gets selected based on non-price criteria, and they develop the target cost of the project, together with the project owner. This approach is used often in Australia, together with alliancing. Using this approach in Europe is difficult because price must be one of the criteria for selecting contractors. This requirement is intended to make the selection transparent. As a solution to fulfill the European public procurement requirement and use alliancing, competitive single TCC has been developed. In this approach, one contractor is selected to develop the project target cost based on MEAT. This is also called two- stages TCC because the selection of the contractor involves two stages. The third approach in this group is multiple/dual TCC. In this approach, more than one contractor (two in dual and more than two in multiple) develops the target cost of a project together with the project owner.

The seventh group identifies contract structures. The two major contract types are DB and DBB. Even though it is possible to implement ECI using either of these contract types, ECI functions better with a DB contract. Between these two ends of the contract spectrum, on a scale from DB to DBB, there are novated design and construct contract and CMR. In novated design and construct contracts, the contractor uses the client's design team during the project execution phase. In CMR, a client hires a construction management company to administrate the procurement and execution phases.

Early contractor involvement approaches – a novel framework. In the ECI approach framework (Figure 1), 25 approaches, 18 from literature and 7 from case studies, are included. As Figure 1 shows, approaches from different groups can be combined to implement ECI, whereas the ECI approaches that are in the same group can be either combined or excluded from one another. Solid lines indicate approaches that exclude one another. Dotted lines indicate approaches that can be combined. A combination of several approaches from the framework can be used in a project to implement ECI. Additionally, when it is possible, the approaches are color graded and arranged from a less open to more open approaches. Less open and more open refer to what extent the approach provides contractors the possibility to suggest new solutions to a project. In the boxes, (L) indicates approaches identified in literature, and (P) indicates approaches identified from the case projects.

The case studies contributed to the development of the framework in several ways. First, they introduced us to seven new ECI approaches. Second, they helped us to conduct the data analysis and categorization of the ECI approaches. Last, they helped us to analyze which approaches can be combined and which cannot be combined in a project, during the framework development.

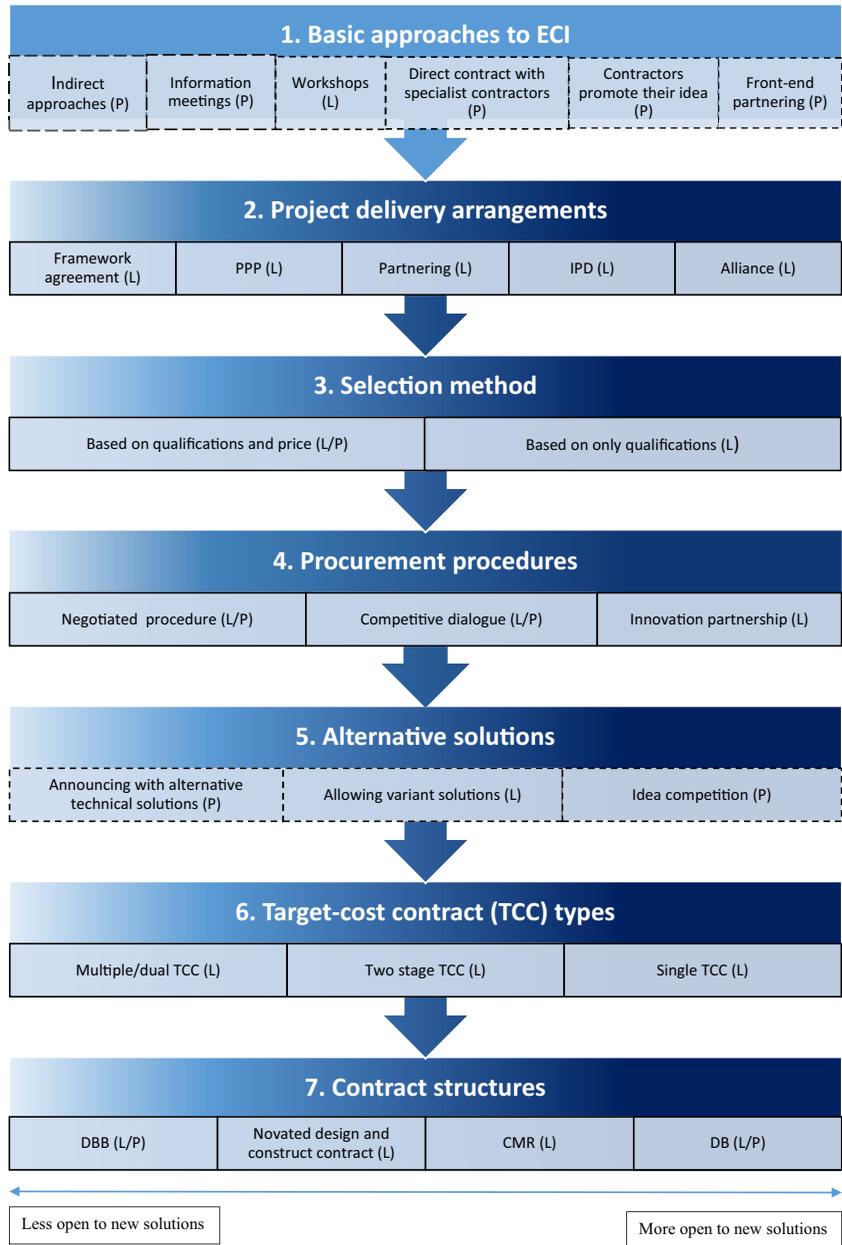


Figure 1. This framework illustrates the options for implementing early contractor involvement in public projects

Conclusions

ECI refers to the engagement of the contractor at the early stage of project development, before construction commences, through a wide range of approaches. This paper set out to present a framework that could assist public owners implementing ECI. To address this, we have explored what public owners do to implement ECI and what options they have. Public owners implement ECI using various approaches. Public owners from different countries have developed different ECI approaches. Consequently, there is no single universal way to implement ECI in public projects. Instead, there are several approaches to implementation. In all, 25 approaches to ECI were identified during this research. Comparing their advantages and limitations to improve understanding of the approaches is a topic for future research.

To address what options public owners have, this paper presents a novel framework that categorizes the various ECI approaches (Figure 1). Approaches categorized in the same group are mutually exclusive, whereas approaches from different groups can be combined. The identified ECI approaches can be tailored to different project types. Some of the ECI approaches let the contractor share pain/gain, whereas others do not. Some of them require much efforts, whereas some easy to implement. The ECI approaches in the framework are identified through both case studies and literature.

All complex projects can benefit from ECI. Although the empirical data of this research is based on Norwegian public projects, the research findings could be useful for most public owners governed by the EU public procurement directive. Furthermore, with some modification most of the ECI approaches should be applicable in other parts of the world.

Although the empirical data of the study is limited to Norwegian public projects, this paper contributes to the knowledge of how to implement ECI internationally. This paper's primary contribution to public procurement literature is the framework that categorizes the various ECI options available for public project owners into seven groups. The framework is a valuable tool for public owners interested in ECI, and who want to combine several ECI approaches in their projects.

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Interview Guide 1

1. Introduction

- Can you tell me about your background?
- Information about the case project (a separate check 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?

(continued)

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 contractors' 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?

Interview Guide 2

Startup questions

Can you tell me about your background / experience?

What is your position in the company and in this project?

What was your previous experience of competitive dialogue (CD) procurement procedure before this project?

Why did the project use competitive dialogue?

What factors meant to use competitive dialogue procurement procedure in this project?

For which projects is competitive dialogue suitable?

2. How was competitive dialogue done (timeline, selection criteria, and participants)?

Prequalification phase

How many showed interest in participating? How many were pre-qualified?

What were the pre-qualification criteria?

(continued)

- How were pre-qualification criteria set?
- What is your opinion about the pre-qualification criteria?

Dialogue phase

- How many dialogues have you had?
- How was the dialogue phase carried out?
- Which persons participated in the dialogue and were they the right person?

- What were the topics in the dialogue meetings?
- To what extent did municipal zoning plan create obstacles in the choice of solutions (was the regulatory plan restrictive in the dialogue)?
- Were there different themes for the various dialogue meetings?

Evaluation phase

- What were the final award criteria?
- How were the award criteria determined?
- Why exactly were these criteria used / why not other criteria?
- To what extent did these criteria work according to the Norwegian Public Roads Administration's expectations?
- 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?

- What are the positive experiences from using competitive dialogue?
- What were the biggest challenges of using competitive dialogue (internally in SVV, between SVV and the contractor)?
- How did you overcome the challenges?
- How was the cooperation between SVV and the contractor?
- How was the collaboration internally with the contractor (between the operation & maintenance contractor, the consultant and the major contractor)?
- How does the competitive dialogue improve quality of the project (both in process and perhaps in product)?
- Should the dialogue phase be longer or shorter? Why?
- What benefit came out of the process (Quality, process and maybe in product)?
- How much additional cost was competitive dialogue compared to a traditional

(continued)

procurement process (in time and money)?

- What ethical challenges did you encounter during the process?
- Did you experience that actors use the process in an ethical way?

4. What could have been done differently?

- What do you think of competitive dialogue procedures in future projects?
- What is your opinion about the award criteria?
- Which award criteria should be changed, removed or added to future projects?
- What should the Norwegian Public Roads Administration do to reinforce the positive

experiences and avoid the challenges in the future use of competitive dialogue?

- What should be done by contractors in order not to meet the same challenges in future

use of competitive dialogue?

- What do you think of compensation for approved offers?
- How much compensation is attractive enough for contractors?

Interview Guide 3

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 Yes/No

about included Best Value items

in the project Elements BVP

Pre-Qualification Phase

Choosing a sponsor1

Selection & educating core team2