

EARLY CONTRACTOR INVOLVEMENT IN PUBLIC INFRASTRUCTURE PROJECTS

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ABSTRACT

Advocates of lean construction recommend early contractor involvement (ECI) to further reduce waste. Waste reduction and flow, value generation and sustainability can be improved if some of the companies on a project use lean principles and methods. However, if the contractor is organizationally integrated in the early phases, there is a better chance that the product and process designs are consistent with one another. ECI can ensure better value for money by organizationally integrating contractors' knowledge to early phases of projects. This paper contributes to the knowledge about how to implement ECI in public projects. In addition to a literature study, a document study as well as fourteen semi-structured in-depth interviews with key informants from eleven Norwegian public bridge projects were carried out. The EU public procurement directive represents a challenge for public owners when they consider ECI in their projects. However, the studied bridge projects have used various approaches to implement ECI without violating the EU directive. Thirteen approaches are identified in this study. The conclusion is that there are several approaches to implement ECI in public projects, though the contractors' contribution varies a lot depending on which approaches that are implemented.

KEYWORDS

Lean construction, ECI, Project alliancing, Public procurement, Knowledge integration.

INTRODUCTION

It is widely accepted that contractors have better experience than the owner and the designer when it comes to construction knowledge and experience (Song et al. 2009; Walker and Lloyd-Walker 2012). The traditional project delivery methods with open bidding, unit price contracting and owners' quality control provide transparent checks

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and balances, especially when the award criterion is lowest bid. However, the evolving projects demand alternative (evolving) project delivery methods to ensure appropriate project delivery, contract compliance and quality assurance (Molenaar et al. 2007). When the contractors are more experienced with choosing materials and methods, the traditional project delivery methods should be adjusted to promote early contractor involvement (ECI) in order to eliminate waste (Song and Liang 2011).

Lean is about reducing waste and increasing flow and value generation by optimizing design, supply and assembly with an aim of to improve the whole process and to exceed owners` expectations (Furst 2010; Song and Liang 2011). Construction knowledge and experience is one of the important elements in the lean construction concept (Song et al. 2009). In principle, lean construction requires ECI in the front-end phase of projects (Forbes and Ahmed 2010). Therefore, the contractors should first help the owners to decide in what they want before delivering the project (Ballard 2008).

One of the evolving parts of project delivery methods is ECI (Molenaar et al. 2007). Even if ECI has several advantages, also for the design team(Sødal et al. 2014), it faces many barriers during the implementation (Song et al. 2009). The barriers that hinder ECI are even higher for public owners, since they should treat all tenderers equally, be non-discriminatory and act in a transparent way. Furthermore, public owners should take in to account both price and quality during the early team selection in order to comply with EU public procurement directives (European Parliament 2004; European Parliament 2014; Lahdenperä 2013).

During literature study, the authors of this paper did not find much literature that document what public owners do to implement ECI without violating the EU public procurement directive. This paper addresses this knowledge gap by answering the following research questions:

- How can public owners implement early contractor involvement?
- What do public owners do to implement early contractor involvement?

The first question has been addressed on basis of the literature review, whilst the second one using case studies.

RESEARCH METHOD

An initial literature study concentrated on research databases (Google Scholar, Oria and Emerald), library databases and references in relevant articles was carried out. The objective was to identify relevant research and thereafter describe theoretical background.

The literature study was followed by case studies with an objective of investigating the contemporary phenomenon to answer the second research question. To find appropriate cases to study, 20 key professionals that have several years of work experiences in Norwegian Public Roads Administration (NPRA) were contacted. In addition, NPRA's yearly internal projects reports from 2001 to 2013 were studied. In this way, eleven bridge projects that have used/will use different approaches to involve contractors in the early phase were identified.

These projects are:

- 1) Lepsøybrua,
- 2) Straumsbrua,

- 3) Sykkylvsbrua,
- 4) Tresfjordbrua,
- 5) Paradisbrua,
- 6) Linesøybrua,
- 7) Gullibrua,
- 8) E6*E16 Flyplasskryssetbrua,
- 9) Smålenenebrua,
- 10) E39 Godsterminalenbrua and
- 11) Tjønnøybrua

Fourteen semi-structured in-depth interviews on the eleven identified cases were conducted according to the methodological approach described by Yin (2013). All interviewees, except one, are from owner side of the projects. The interviewees were selected from different management levels in the examined projects. The interviews were recorded and transcribed to increase data collection reliability. The research ended by a study of documents retrieved from the informants and from NPRA's internal database.

This study involves some limitations. The cases range from Norwegian bridge projects completed after 2001, as well as some that are in the design phase in the course of the study. The other limitation of the study is that all interviewees, except one, are from the owner side of the projects.

THEORETICAL BACKGROUND

The main objective of the client when involving the contractor in the early phase of project development is to get assistance from the contractor by working together as a team with owner and consultant (Mosey 2009; Rahman and Alhassan 2012; Scheepbouwer and Humphries 2011). In order to benefit fully from the ECI both direct and early involvement of the contractor in the early stage is necessary. Direct involvement facilitate for better cooperation while early involvement facilitate for better contribution (Song et al. 2009). This shows that ECI goes hand in hand with lean construction concept.

The phenomena here denominated ECI is covered by different terms in different countries. In addition, there are various means that can be used to implement it such as; target pricing and integrated project delivery, early supplier involvement and interweaving (Gokhale 2011). Recently, Walker and Lloyd-Walker (2012) came up with a comprehensive definition of ECI. According to them, ECI can take place in the internal phase, the project definition and design phase and in the project execution phase. Literally, ECI can happen in all these 3 phases. They further divide ECI into five different approaches depending on in which phase of the project the contractors are involved. "ECI 1" can take place in the three phases. "ECI 2, 3 and 4" can be applied in the project definition and design phase. "ECI 5" can be applied both in the project definition and design phase and in the project execution phase.

Previously, public owners thought that the EU procurement directive rules out project alliancing. Nowadays, that attitude is under change and project alliances, similar in forms to those delivered in Australia, are being undertaken in Europe (Laan et al. 2011). Moreover, the emergence of competitive dialog has facilitated the use of project alliances in Europe (Walker and Lloyd-Walker 2015).

The Finnish Transport Agency experience is that pure alliancing without price component as a selection criteria and single target outturn cost (TOC) could be the best alternative to implement ECI. However, it might lead to difficulties with the EU public procurement directive. Two alternatives are alliancing based on the most economically advantageous tender with capability and fee percentage as a price component (capability-and-fee competition based target-cost (TC)) and dual TOC, respectively (Lahdenperä 2013; Lahdenperä 2015; Lahdenperä 2016). The procurement procedure of alliancing is significantly different from other procurement procedures. Recently, the procurement procedures process of alliancing in Australia has evolved from single Target Outturn Cost (TOC) basis to dual TOC, as depicted in figure 1. The dual TOC approach resembles the competitive dialog approach in Europe (Walker and Lloyd-Walker 2015).

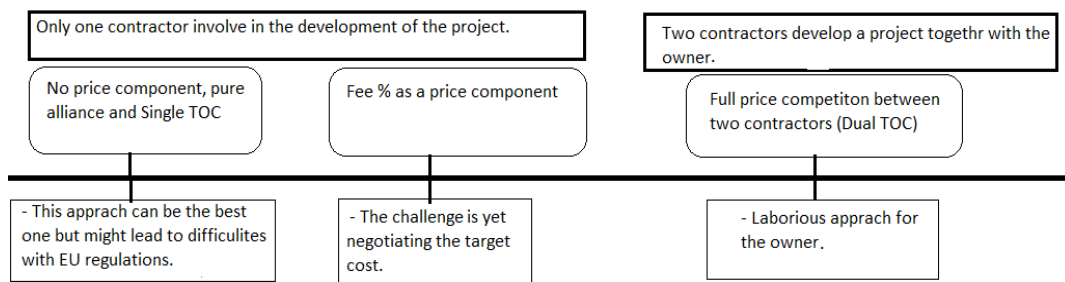


Figure 1. Contractor selection approaches in project alliancing (developed from (Lahdenperä 2013)).

In ECI, the procurement procedure is decisive to achieve integration. The procurement procedure should create a room for creative solutions and for exchange of ideas. Competitive dialogue (CD) and negotiated procedures are the two alternatives owners can use to achieve ECI. By using these procurement procedures, it is possible to use 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, it is possible to apply negotiated procedure (Lenferink et al. 2012; Lædre 2006; Van Valkenburg et al. 2008), whereas for more complex projects, CD can be suitable. In CD, functional specification and technical requirements, staged process bids and competition over several stages, with most economically advantageous tender can be used to develop a project (Lenferink et al. 2012; Van Valkenburg et al. 2008). To summarize the answers to the first research question, there are several models of ECI. Public owners can choose among these ECI approaches based on their needs through the various contract forms and procurement procedures.

FINDINGS AND DISCUSSIONS

In the following, findings for the eleven first ECI approaches are presented and discussed. The findings are based on the interviewees' perceptions and the document studies. The approaches 1 to 9 have been used in the studied projects to a varying degree. Approach 10 and 11 have not been implemented in the studied projects. Instead, interviewees proposed them as potential approaches for the future use. Due to the limitation in number of pages, not all the approaches are discussed extensively in this paper.

1. Indirect approaches

The interviewees have discussed the use of consultant and in-house construction experience as an approach to integrate the construction knowledge in the front-end of a project. Furthermore, inclusion of contractors in the preparation of handbooks, standards and standardizing of bridge parts are also discussed. It can be realised that, even if this is not a direct project activity, the project benefits from involving contractor knowledge in the early phases.

2. Information meetings

In relation to contractor's involvement, the respondents mention that information meetings with the contractors' branch are used in diverse degrees in the studied projects.

It can be realised that the influence of the information meetings depends significantly on in which phase of the project it is held. If it is held in the early phase of the project, then it is easier for the owner to include inputs from the meeting to the front-end phase of a project. However, if it is held in the later phases of the project, like in projects with a tender conference, it is difficult to implement the inputs in the project. This is because most of the works are already done and the important decisions are already taken.

3. A front-end partnering process

According to the interviewees and documents, the main aim of this process is to create an opportunity for the contractor, the owner and the consultant to get to know each other and to set a common goal. A partnering process will start after the contract signing and ends before the contractors commence construction.

In this approach, it is still possible for the contractor to come up with optimization ideas since the execution phase has not started yet. The success of this approach depends on how much the contractor can be prepared to come up with optimization ideas. Furthermore, it depends on how flexible the owner is to accept new ideas at this stage. This approach should be combined with contracts that accommodate flexibility.

4. Announcing the project with alternative technical solutions

As discussed by interviewees, the Norwegian Public Roads Administration (NPRA) tries from time to time to prepare contract documents that have more than one technical alternative. The aim of the announcement with alternative technical solutions is that the contractor can get the possibility to influence the production method and material selection during the project delivery. The alternatives include all necessary detailed designs and respective procurement documents. The primary motive of NPRA when using this approach is to reach a wider supplier market in order to get several bidders for a project and get the cheapest prices. Consequently, it increases competition.

In order to use this approach, it should be technically possible to use alternative technical solutions without compromising with quality. The limitation of this approach is the contractors options are restricted by the owner's options and their involvement is not direct and not early enough.

5. Design build contract (DB) or functional description

DB contract based on open procurement procedure was used as an approach to involve contractors from the design phase of a project. In this approach, the contractor gets the responsibility and the flexibility to design the project. The design must be approved after a quality assurance by NPRA. As discussed by the interviewees, even if a DB

contract is a suitable approach to implement ECI, the downside is that the owner misses control and the possibility to contribute in the design phase of the project.

While using a DB contract the project should not have very high uncertainty and not be very complex in order to get enough bidders as well as to avoid conflicts afterwards. Therefore, the owner should be able to design the project to an optimal level to minimize the uncertainty and clarify the owner's expectations to the contractors. The findings indicate a lack of integration when DB contracts are combined with open procurement where the owners have less influence on the project.

6. Direct contact with specialist contractors in the front-end phase of projects

The interviewees explained that to implement ECI, the focus should not only be on the main contractors but also on specialist contractors. Specialist contractors have special competence and equipment that both owners and major contractors are dependent on to execute a project. The approach is described as effective since it is based on direct contact with the specialist contractors, and not communicating through main contractors.

It can be perceived that the direct involvement may facilitate for the concepts of lean construction, and thereby reduce waste and add effectiveness to the project. Through that, the project participant may achieve a feeling of partnering and working together.

7. Idea competition

Idea competition is one of the ECI approaches used by public owners in the planning phase of projects. The respondents claim that the dilemma of public owners in using this approach is, whether contractors that participate in the idea competition should be excluded from the bid for construction of the project or not. The cause of the dilemma is to be in line with the EU procurement directive.

It can be seen that the primary disadvantage of this approach is that it lacks continuity and involvement integration throughout the whole project life cycle. In order to decrease the probability of occurrence of the above-described dilemma, proper documentation and well-prepared contract document can be used as protective measures. Furthermore, owners should be proactive to evaluate all ideas identified in the competition before selecting one.

8. Contractors sell their idea to the owner in the early phase

In one of the studied case, one contractor took the initiative to promote the idea to NPRA in the front-end phase. The contractor strongly believed that the company had the appropriate knowledge and equipment to solve the project in an optimal way. Then, NPRA has used the idea after detail designing as an alternative technical solution. It is not common that contractors take such initiatives.

9. Negotiated bidding procedure

NPRA is planning to use a negotiated bidding procedure by combining with turnkey contract in one of the studied project. The reason why the project owner is planning to use this approach is due to lack of internal competence about the subject matter from owner side regarding this specific project. Then, NPRA wants to use the contractors' experience in the front-end phase of the project to get help for the decision process. NPRA's challenge in using this approach is lack of experience with this procedure.

10. Opening for alternative tenders

Opening the project for alternative tender, with other technical solutions than those specified by the owner, has been discussed by the interviewees. With this approach, the contractors can submit one or more alternative solutions to the project. However, this approach is not used in the studied eleven bridge projects.

In most cases, the contractors are not allowed by NPRA to submit alternative tenders because of three major reasons. The first reason is that it is difficult to control the quality of the alternative offers in the short period between bid opening and contract awarding. The other one is that it is difficult to compare bidders based on different competition grounds since lowest price is the most used competition base. The last reason is that bridge projects have quite long-lasting control and approval procedures. If the contractor comes up with alternative offers, it will most probably delay the whole project delivery. The finding illustrates the owner may need to be cautious of this approach as the duration and thereby the cost can be influenced by the variety of alternative tenders.

11. Other approaches

The interviewees proposed competitive dialogue and project partnering as potential approaches for implementing ECI. However, none of these approaches was implemented in the studied projects. In addition, project alliancing was identified as an approach through the literature study.

CONCLUSION

The overall conclusion is there are several approaches to implement ECI in public projects. Twelve of the approaches (1-12) have been identified from the case studies. Approach 13 is identified from literature based on the Finnish Transport Agency's experience. Table 1 shows the thirteen possible approaches identified by this study, and which of the eleven projects that have applied them. The table implicitly illustrates to what extent each approaches have been/will be implemented in the target projects. The thirteen approaches are numbered after how often they appear in the eleven target projects.

Table 1: Frequency of the ECI approaches (1-13) in the investigated projects (1-11)

Approaches vs Projects	1	2	3	4	5	6	7	8	9	10	11	Total
1. Indirect approaches	X	X	X	X	X	X	X	X	X	X	X	11
2. Information meetings	X			X	X		X	X	X	X	X	8
3. A front-end partnering process	X			X	X	X	X	X	X	X		8
4. Announcing the project with alternative technical solution	X	X	X	X			X		X	X		7
5. Design build contract (DB) or function description					X	X	X	X			X	5
6. Direct contact with specialist contractor in the front-end phase of projects	X			X								2
7. Idea competition				X								1
8. Contractors sell their idea to the owner in the early phase							X					1
9. Negotiated bidding procedure					X							1
10. Opening for alternative tender												0
11. Competative dialogue												0
12. Project partnering												0
13. Project alliancing												0

It does not seem to be many studies that have documented what public owners do to implement ECI without violating EU public procurement directive. This research is an initial study with a purpose to fill this knowledge gap by using cases study approach. Even though this study is based on NPRA's experience from bridge projects, most of the research findings can be useful for the majority of public owners governed by EU public procurement directive. The logic behind to come to this conclusion is, since they have similar operating framework and NPRA's affirmative experiences throughout implementing the approaches. The findings can also be helpful for project owners that want to know the range of possibilities for ECI. However, the contractors' contribution into the projects varies a lot and depends on which approach that is used.

In the future, experiences from ECI in other project types may need to be collected to reveal new approaches as well as to validate the findings. Furthermore, in future research ECI success factors as well as each of the approaches, which are identified in this study, can be studied in-depth in order to compare them with international experiences. In this way, it will be possible to identify and recommend suitable approaches to implement ECI in future projects. These findings, in combination with future findings, would also be valuable for researchers who want to develop a set of best practice guidelines for ECI.

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