

EARLY CONTRACTOR INVOLVEMENT IN THE CONSTRUCTION INDUSTRY: A PRELIMINARY LITERATURE REVIEW

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The Early Contractor Involvement (ECI) concept focuses on increasing efficiency in the construction process by involving the contractor in the design phase and has increased in popularity in recent years. The concept is not new, and the main body of literature applies a relatively unified understanding of the concept. There are, however, differences in the literature on how ECI is applied due to contextual differences. The goal of this paper is to provide a preliminary schematic analysis of current ECI literature and examine the current ECI research. ECI is placed in the wider umbrella framework of relationship contracting, together with alliancing and partnering. The similarities and differences will be briefly touched upon. The literature review is based on a database query in Scopus and Web of Science. A total of 4 648 articles were identified initially, focusing on key words of ‘early contractor involvement’ or ‘ECI’. The search was further refined by adding the key-words ‘construction’ and ‘building’, forming a core list of 332 articles. Further refining by comparing abstracts and key-words, as well as the definition of ‘ECI’ in the text resulted in a curated list of 27 articles. The articles were then compared on type, method, theory, contribution and context/country. The review reveals a rather unified definition of ECI, but contractor involvement early in the design can be found in multiple concepts related to collaborative management models. The focus of the literature is also mainly on the contractual phase and less attention is given to project governance and execution. The literature focuses on the contractual aspects and incentive structures of ECI, while less focus is on how ECI is organized in the project, the division of responsibility and sharing of amongst the partners. Furthermore, there is a difference in how the concept of ECI is applied in different countries. The review also finds that multiple types of methods are applied in ECI studies but that few studies apply a theoretical lens or endeavour to contribute to theory. The article discusses the literature as well as possible future research.

Keywords: ECI, contracting, literature review, procurement, project management

INTRODUCTION

Large and complex infrastructure projects suffer from low productivity levels and adversarial relationships (Rahman and Kumaraswamy 2004, Rahman and Alhassan 2012, Volker *et al.*, 2018) as well as unpredictable outcomes (Chen *et al.*, 2018). As research regarding the construction industry has focused on reducing the aforementioned challenges, a multitude of different project management solutions have developed in both procurement as well as governance. There has recently been a

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heightened awareness of the importance of chosen management and contractual forms and the use of collaboration-based frameworks and tools to develop the relationships between client and contractor has grown (Chen *et al.*, 2018, Bygballe, Jahre and Swärd 2010, Hastie, Sutrisna and Egbu 2017, Mosey 2009). Eadie and Graham (2014) note in this respect that the early involvement of contractors improves project performance. As complex infrastructure projects are major undertakings, both in terms of scope and scale, and the involved parties have different drivers (Rahman and Kumaraswamy 2004), it becomes relevant to help adopting a collaborative perspective in the early design stages: it is in the project's starting phase that the specialist's input has the biggest influence on the project outcomes, such as timetable and cost structure, as well as in improving risk management and the collaboration between client and contractor (Laryea and Watermeyer 2016). This has resulted in a heightened focus on collaborative procurement forms emphasizing this early stage of the process. These approaches to collaboration and co-operation in construction can be gathered under the term of 'relational contracting' or 'relationship contracting' (Rahman and Kumaraswamy 2004). The concepts are applied to both the procurement phase (Chen *et al.*, 2018) as well as execution and governance of the project. The collaborative procurement models are used to stimulate collaboration between stakeholders and can be found in such collaborative models as alliances, partnering, integrated project delivery, and early contractor involvement. The literature focuses increasingly on a combination of collaborative procurement models (e.g., Chen *et al.*, 2018), which seem to overlap to some extent. This article focuses primarily on the involvement of contractors early on in the design process but refers to some extent to other collaborative models as well.

The Early Contractor Involvement (ECI) concept has become more popular in recent years and focuses on increasing efficiency in the construction process by involving the contractor early in the design phase (Eadie and Graham 2014, Laryea and Watermeyer 2016, Mosey 2009, Rahman and Alhassan 2012). The concept is not new, and the main body of literature applies a relatively unified theoretical understanding of the concept. There are however differences in how ECI is applied and organized which may vary by country and local context (Laryea and Watermeyer 2016). In Sweden, a number of major and complex projects related to transport infrastructure and construction are nowadays undertaken with a contractual form based on Early Contractor Involvement (ECI). To better understand the concept of ECI and its applicability for the Swedish context, there is thus a need to look at how ECI is defined and studied in the current literature.

The goal of this paper is to analyze the ECI literature and examine gaps and future research areas in the literature concerning ECI. ECI is placed under the wider umbrella framework of relationship contracting, together with partnering and alliancing. The similarities and differences of the models are briefly touched upon, before a deeper analysis of the literature pertinent to ECI is performed and findings are discussed.

METHOD

This paper is based on findings from what Grant and Booth (2009) call a scoping review. Such a review "provides a preliminary assessment of the potential size and scope of available research literature. It aims to identify the nature and extent of research evidence" (Grant and Booth 2009: 101). One of the objectives of a literature review is to identify methodological concepts commonly used in relevant research

(Hart 2014). This paper performs a preliminary examination of how literature on ECI defines the concept and what methods are commonly used in current research. Below we present the methodology for (a) choosing literature sources and (b) describing and classifying key ideas and concepts, as recommended by Grant and Booth (2009).

A total of 4648 articles were identified in the first search, focusing on all articles containing the key word 'early contractor involvement' or 'ECI' in the Scopus and Web of Science databases. Other formulations, such as 'collaboration models in construction' were considered but were rejected due to the focus on ECI as a distinct concept. There was no time limit set in the search, other than those imposed by the databases. The search was further refined by combining the original query with 'construction' and 'building', forming a core list of 332 articles. This list was curated by limiting the search to first the areas of 'engineering' and 'business' (163 articles) and further by limiting the journals to those pertaining to the construction industry as well as project management and procurement (96). The resulting database was checked for duplicates as well as book reviews, editor's notes, etc., resulting in a list of 93 articles. The list was further refined by examining the articles for the following factors:

- - The abbreviation 'ECI' was used in another context than our definition
- - The words 'construction' or 'building' were used in another context than related to early contractor involvement in the construction industry

This resulted in a curated list of 27 articles to be used as the basis for our literature review. These articles were classified according to publication: (1) peer-reviewed journals, (Scopus/WOS) in construction engineering and management and project management, and (2) conference proceedings, such as proceedings from ARCOM. Adapting the method chosen by Bygballe *et al.*, (2010), the study was based only on the result provided by the chosen search parameters and the refining selection process. We have therefore excluded other definitions and concepts of relational contracting, such as 'partnering' and 'alliances' from the search. The concepts are briefly discussed later on to help frame the main discussion on ECI.

Early Inclusion of Contractors in Construction

The outcomes of infrastructure projects are hard to predict (Chen *et al.*, 2018). Changes in the construction industry and adaptation of new procurement forms is slow. A major reason seems to be the slow decision-making process and client response, but literature also discusses the slow pace of change in the entire industry (Bourn 2007, Eriksson 2008, Jones 2014, MohammadHasanzadeh, Hosseinalipour and Hafezi 2014, Mosey 2009). There is a globally increasing interest regarding collaborative approaches to infrastructure procurement. This is mainly due to their potential to improve project performance in relation to more traditional approaches (Chen *et al.*, 2018), as well as the benefits of long-term relationships between clients, contractors, and consultants which are mainly due to shared experience and knowledge (Naoum 2003). Furthermore, the early inclusion of contractors in construction projects improve the performance of the project, but only if the parties involved commit to the procurement form (Eadie and Graham, 2014). ECI is a subspecies of the field of relationship contracting (Rahman and Kumaraswamy 2004) and will thus be framed with this topic in mind. Below a number of theoretical constructs are discussed except for integrated project delivery (IPD). The reason for not including the IPD model is the lesser extent this model in Europe and the more

integrated collaborative models as discussed in literature are often a combination of the collaborative constructs discussed below (see Chen *et al.*, 2018).

Relationship contracting has been defined as “a process to establish and manage the relationships between the parties that aims to: remove barriers; encourage maximum contribution; and allow all parties to achieve success” (Australian Constructors Association, 1999: 4). This approach can also be defined as relational project delivery arrangements (RPDAs) (Lahdenperä, 2012) The approach is focused on project completion within schedule and budget and is based on strong interpersonal and -organisational relationships. This requires a certain amount of trust as well as open communication and information sharing. The benefits of shared experience and knowledge, born from long-term relationships between clients, contractors, and consultants (Naoum 2003), are a key source of trust.

Trust is the cornerstone of cooperation and collaboration (Jelodar, Yiu and Wilkinson, 2016) and trusting actors in a long-term relationship have the possibility to adapt to each other. Adaptation contributes to improved efficiency and effectiveness in the network created by the actors, enhancing project performance. Relationship contracting also encapsulates the notion that ‘lowest cost’ isn’t the only factor a customer should look at while deciding on which contractor to select for a construction project (Naoum 2003). One of the contractor’s benefits of considering not only the final cost of a project, but also other factors like time, operating costs, impact on environment, and site safety, is that the process helps analyse, define, and prioritize the client’s needs and objectives (Naoum 2003). Two of the most common models in the European RPDAs are project alliancing and partnering. ‘Alliancing’ is traditionally defined as an agreement “to work co-operatively and to share risk and reward, measured against key performance indicators” (Gunn 2002: 3).

An alliance contract involves a mutual view on the risks and rewards in a project, as well as a shared responsibility for the involved partners and an agreed method to solve disagreements (Gunn 2002). Characteristics of an alliance organisation are (1) a common contract, which defines the project organisation; (2) a common organisation, of which all parties of the alliance team are a member; and (3) a common sharing of risks (Lahdenperä 2009). Concerning ‘partnering’, there is no generally accepted concept of ‘partnering’, even though much of the industry refers to and uses the Construction Industry Institute’s definition (Bygballe, Jahre and Swärd 2010). Partnering indicates a commitment on both close collaboration as well as aligning the internal goals of the participating organizations with each other (Aarseth *et al.*, 2012). According to Aarseth *et al.*, (2012) and Naoum (2003), the definition of a partnering relationship is fourfold: (1) the parties have agreed intentions for the cooperation, (2) there is a level of trust between the organizations participating in the partnering arrangement, (3) the parties have agreed on processes to solve problems and disputes, and (4) the cooperation includes a process for continuous improvement. Bygballe *et al.*, (2010) define three key dimensions of partnering relationships, related to the duration of the relationship and its partners, as well as how the relationship develops. The discussion on which effect the concept of partnering has on the construction industry in particular is still ongoing and there is no unified way of defining partnering (Bygballe, Jahre and Swärd 2010). It is difficult to compare these concepts, as well as other RPDAs, as their definitions are fluent and the usage of RPDA is context specific (Lahdenperä, 2012).

Early Contractor Involvement

Early contractor involvement (ECI) is “a partnering approach in which the contractor is appointed at an early stage of project development to assist in planning, assessing buildability and cost estimating” (Nichols 2007: 31). An important part of ECI is the relationship between the contractor and the client or the designer allowing the contractor to be involved in the project from an early stage of design and contribute their construction knowledge and experience to a design (Eadie and Graham 2014, Laryea and Watermeyer 2016, Walker and Lloyd-Walker 2012). There are also some findings indicating that ECI is a more reliable way of achieving the desired outcomes than more traditional methods, such as design and build or public finance partnership/public private partnership (Eadie and Graham 2014). Walker and Lloyd-Walker (2012) state that ECI can take place in all construction phases and can be implemented by a diverse set of procurement forms which can include e.g., partnering and alliancing.

ECI in Literature

The most interesting find was the approach taken on theory building. Almost all analysed articles focus on case studies and the empirical data found therein, while few present a theoretical foundation for their methods or discuss possible contributions to either building or verifying theory.

Most of the articles focused on ECI base their work on empirical studies and qualitative methodologies. Methods identified included case analysis, interviews, document analysis, model comparison, and observation, but also an instance of quantitative method in the case of a questionnaire being utilised. Case analysis was the most frequently used method, employed in 20 out of 27 articles, followed by interviews, which were utilized in almost 50 % of the articles. Document analysis was also quite popular, as 30 % of analysed articles employed some sort of document analysis or review. A more quantitative approach is applied in four papers in the form of surveys or a questionnaire, but only one article stated outright that they used quantitative methods, employing a survey distributed to 100 participants.

The majority of papers were collaborations by two or three authors, which indicates a lack of structured research in the area. A larger number of authors would indicate the existence of research groups, which in turn would indicate a continuous interest in the field. Most authors also only participated in one or two papers in this field, indicating a lack of continuous personal interest. Only five authors worked on more than 3 papers, which means that almost 93 % of authors in the field only contributed to one or two papers.

As literature on ECI is mainly based on case studies and draw from the same source materials and references, the themes found were therefore similar throughout the literature and centred on the prerequisites for and implementation of ECI, although some geographical differences could be noted.

The Approach to ECI

One of the main advantages found in the ECI literature is the benefits it seems to offer in terms of project management. Nichols (2007) defines both benefits and detriments for ECI and many articles refer to Nichols in this respect. On the positive side, ECI enables the contractor to give their input at the most beneficial time; it has the potential to reduce preparation time for projects by 30-40%; provides the client with a better understanding of the project's cost structure; provides greater cost certainty;

increases innovation; and enables a spirit of teamwork (Nichols, 2007). Eadie and Graham (2014) build upon this by further identifying two benefits of ECI in construction procurement: the contracts become less adversarial, and aid in project sustainability. “[T]his is achieved through ensuring design criteria, strategic fit and briefing documentation delivers despite the paucity of information at the early project stages [...] the improvements are the result of innovative solutions, better project control, and savings on time and money” (Eadie and Graham 2014: 662). The authors further show that the decision-making process is a common benefit, and that there is a better awareness and understanding of the project risks with ECI than with traditional methods of contracting and procurement (Eadie and Graham 2014).

Table 1: Methods used in the reviewed literature

Methods applied	No. of articles	%
Case study	20	74
Document analysis	8	29
Interview	13	48
Model comparison	3	18
Observation	1	3
Survey or questionnaire	4	14

The main potential drawbacks related to ECI are mostly tied to the novelty of the approach - as few actors are used to working with ECI, there is a learning curve to take into account; the discrepancy between cultures of the partners which is a hindrance for a successful design and build-process as well as an ECI process; the incentives used haven't fully met the needs of either client or contractor; and the lack of team culture when client and/or contractor haven't committed to the ECI approach (Eadie and Graham 2014, Nichols 2007, Pheng, Gao and Lin 2015). Eadie and Graham (2014) also caution against using ECI as a model for all projects, as projects with a short duration, low complexity, or high specification might need more control and management by the client. In such projects, the ECI model may make matters unnecessarily complex and is thus best suited for projects with high ratios of complexity, value, and risk.

As there is little work done to prove these assumptions through especially quantitative methods, this could be a fruitful avenue for future research.

Contextual and Geographical Differences

The usage of the ECI model is primarily based on gaining the knowledge of the contractor early on in the design in order to improve constructability, but the way how ECI is performed differs per country. Scheepbouwer and Humphries (2011) discuss the differences between US, UK and Australia and New Zealand. In the US the usage of ECI is comparable to a construction management at risk and the client has separate contracts with the design engineering part vis-à-vis the contractor. In the UK there is a single contract with the contractor who can subcontract the design. A number of articles discuss how ECI is applied in their country through case studies (e.g., Lenferink *et al.*, 2012; Volker *et al.*, 2018, Wondimu *et al.*, 2018) and many of these articles also discuss that applying the model of ECI is a learning process in which adaptations are made over time that fit better within the local or geographical context.

As much of the current literature focuses on the local context, an interesting approach for future research would be to compare these and analyse the impact of context-bound differences.

Strong Focus on Procurement Phase and Less on Governance

The majority of existing literature focus on the procurement phase of construction projects and leave the execution and governance phases out of scope. The strong emphasis on procurement is primarily focused on the contract, as well as the cost and incentive structures of the project (e.g., Hastie *et al.*, 2017, Laryea and Watermeyer 2016, Volker *et al.*, 2018). Even though Walker and Lloyd-Walker (2012) view ECI as being applicable in all phases from early design to construction, there has been less focus on the governance of these projects. This is confirmed in Chen *et al.*, (2018) who states that literature on collaborative procurement models can be found in two strands: contractual mechanisms and non-contractual mechanisms like leadership, communication and integration. Furthermore, less attention has been paid to the project relationships between the contracting parties, how the project is organized, and how responsibility and decision making is divided between the involved parties. While ECI literature primarily discusses the contractual relationship between the client and the contractor, the other project parties are not often discussed. Based on literature concerning relationship contracting the relationships between the different actors becomes relevant to study in more detail and especially in ECI projects. (Rahman and Kumaraswamy 2004, Scheepbouwer and Humphries 2011).

In order to gain insight in the different actors participating in an ECI project and how collaboration between different parties can be influenced it becomes relevant to not only study the contractor - client relationship, but also the contractor-client-consultant relationship. In order to study this relationship in an ECI context, as well as follow the literature regarding an increased focus on the relationships within a project as previously mentioned, a theoretical approach based on network theory would be one suitable way of expanding the field.

Lack of a Theoretical Contribution

The literature related to ECI doesn't seem to favour one specific publication outlet, although most of the published journal articles were found in publications related to the field of civil engineering and construction management. Over 40 % of the reviewed research was published as conference proceedings. The existing literature on the construction industry and the different forms of relationship contracting are focused on empirical studies and case studies. Most of the analysed literature was focused more on case studies and finding project-specific factors of success and failure than on contributing to a theoretical framework related to the construction industry. Only a fifth of the reviewed articles discussed their theoretical background or contributions to theory while at the same time giving ample attention to questions related more to applied research, such as how to implement ECI in practice. This practice raises questions regarding the contribution potential of the previous research, as the link to theory is weak at the best and missing at the worst. As Flick (2007: 21) says: “in qualitative research we have to build on existing theories and results from empirical research, unless we want to risk being naïve when starting our research”.

As the lack of a theoretical lens is the most important find in this review, this should be the main area of focus for future research endeavours. As the contribution to theory building is one of the main functions of scientific research and one especially

suited for case research (Eisenhardt, 1989), this is an area not to be neglected in the future.

CONCLUSION

In order to gain insight in research concerning ECI, a literature review was performed to identify the core concepts and usage of the ECI model. The main findings of this review relate to four areas: the approach to ECI, context-based differences, focus on the contractual aspects, and a lack of theoretical contributions.

First, this literature review reveals a unified definition of ECI based on a small number of core references. The review also finds that multiple types of methods are applied in ECI studies, with a major focus on qualitative methods and case studies. The benefits and hindrances of the ECI model are clearly defined and many authors refer to the core references and often confirm especially the benefits of early contractor involvement in infrastructure projects. Furthermore, the involvement of contractors in an early design phase can be found in multiple concepts, such as 'partnering' or 'alliancing'. The identified literature related to ECI is focused on practice and empirical cases, which indicates a gap in the existing research related to the usage of quantitative methods.

Second, the literature identifies differences in how ECI is applied in different contexts based on learnings and adaptations in different projects and countries. A possible angle for future research would be to compare these and analyse the impact of context-bound differences.

Third, the literature focuses on the contractual aspects and incentive structures of ECI, while less focus is on how ECI is organized in the project, the division of responsibility and sharing of information amongst the partners. Furthermore, the relation between contractor - client - and engineering consultancy firms is not often discussed. It thus becomes relevant for future work to focus on the governance and the network of multiple partners collaborating in an ECI project.

Finally, an aspect to consider in further analysis is the lack of theoretical foundation for ECI in the construction industry. A theoretical lens anchors the results from empirical data or case studies can contribute to the development of theory, but this link is currently missing.

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