Early contractor involvement in framework contracts

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Abstract

Early contractor involvement (ECI) has been used for construction procurement in about 30 countries. The reasons for its adoption include collaboration, integration of design and construction, value for money and utilisation of market capacity. Two models of ECI are previously reported in the literature. A different model of ECI has been used in framework contracts at Wits University in South Africa. The research aim was to analyse how this type of ECI works and its value to the success of projects. Data was collected through ten interviews, documentary analysis and observation of one ECI session. Through framework agreements, an opportunity is created to have ECI. Once concept designs and elemental cost estimates are prepared, the contractor is brought in to assist with value engineering of the design and production drawings. ECI produced 12% cost savings in one project and 32% in another. Team integration and early contractor involvement are supported by framework agreements and NEC contracts. Although contractors receive no remuneration for the involvement in design development, they value the benefits of developing early cost models and production plans. Conditions for successful adoption are intelligent client, framework agreement, collaborative contracts, cost based pricing strategies, professional team's flexibility, committed contractor.

Keywords: construction procurement, early contractor involvement, framework agreement, NEC, South Africa, target cost contract

INTRODUCTION

The use of early contractor involvement (ECI) in construction procurement is growing internationally (see Table 1). This paper examines ongoing applications of the strategy in South Africa and its relationship with other types of ECI practice in the construction management literature. The University of the Witwatersrand (Wits) in South Africa has delivered a capital projects programme exceeding 1.5 billion Rand of expenditure within 6% of the control budget. In other words, the total cost overrun (that is the difference in price between final amount paid to contractor and contract price when the contractor was instructed to execute a contract) in the programme has been less than 6%. One of the contracting strategies and procurement inovations adopted to deliver projects successfully was "early contractor involvement" in the context of framework agreements and NEC target cost contracts. The main innovation here is ECI in the context of design by the employer. As demonstrated in the literature review, this type of ECI has not previously been articulated in the literature. The research aim was to examine and analyse how this type of ECI works and the value of the contracting strategy to the success of projects.

LITERATURE REVIEW

A literature review on early contactor involvement (definition, international applications, benefits, types of ECI and issues in ECI practice) and framework agreements is presented. Both practices are associated with collaborative procurement contracting models.

Early contractor involvement

The practice of "early contractor involvement" is about involvement of the contractor in design development to obtain a benefit of the contractor's expertise as a builder. Many papers have been written on the subject in the past ten years. A search in Scopus reveals 102 documents specifically containing the phrase "early contractor involvement". The practice and acceptability of ECI has developed significantly over the past ten years with a growing portfolio of ECI projects and frequency of publications on the subject – 2003 (1 publication); 2004 (2); 2005 (5); 2006 (3); 2007 (4); 2008 (3); 2009 (5); 2010 (8); 2011 (15); 2012 (17); 2013 (21) and 2014 (18 so far). Examples of projects done in different countries with the ECI procurement strategy are summarized in Table 1.

Three papers refer to ECI as a practice developed by the UK Highways Agency in the early 2000s (see Eadie and Graham, 2014; Eadie *et al*. 2010 and Koncarevic, 2013). ECI is defined as a form of partnering where a contractor is appointed earlier than normal to help in planning and advice on planning (Rahman and Alhassan, 2012). Song *et al*. (2009) defines ECI as relationship between the contractor and the employer or the designer which allows the contractor to be involved in the project from an early stage of design and contribute construction knowledge and experience to a design. In the ECI approach a contractor is engaged in a project before the construction works begin in order to give an input in design (Scheepbouwer and Humphries, 2011). Conway (2009) explains that ECI has been designed so that the contractor's knowledge and experience can be used at the early stages to reduce costs in projects. Contractors are expected to know different products, costs and must be able to advise in case of certain different materials that appear to be of the same quality to ensure that there is cost effectiveness in the work.

Applications of ECI around the world

Table 1: International examples of projects involving Early Contractor Involvement in the design development

Description of project	Geographic location	Benefits of ECI	Reference
Roads projects	UK	Cost savings, supports risk management on larger schemes	Eadie and Graham (2014)
Gibe III Dam / hydro power plant	Ethiopia	Evolution of design features	Asnake *et al.* (2013)
Port of Brisbane Motorway Upgrade	Australia	Buildability issues	Evans and Tran (2013)
Hurricane protection levee and system	United States	Developed a stringent set of specifications in order to ensure quality product was installed	Schmutzler *et al* (2012)
Hurricane protection levees and walls	United States	Minimised construction time through close relationship among the project owner, contractor and designer.	Cali *et al.* (2012)
Public infrastructure projects	Netherlands	Adds value in terms of time gains, improved project control and more innovative solutions	Lenferink *et al.* (2012)
Flood protection system	United States	Optimisation of design based on contractor's experience	Cooling *et al* (2012)
National Partnership Agreement on Remote Indigenous Housing	Australia	Risk management of projects	Martel *et al*. (2012)
Bridge construction	United States	It can avoid waste by the use of prefabricated elements	Chan (2011)
Transportation projects	New Zealand	Improvements in value for money and project delivery time	Scheepbouwer and Humphries (2011)
Industrial construction projects	United states	Improved drawing quality , material supply , information flow , and consequently improved construction schedule performance	Song *et al.* (2009)
Highway projects	UK	Contractor's knowledge and experience at an early stages to ensure cost reduction	Conway (2009)
A3 Hindhead twin bore road tunnel	UK	Optimisation of design	Ireland and Rock (2008)
Tunnel projects and underground facilities in Europe	Europe	Innovative and improved tunnelling technologies, methods and equipment systems for mechanised excavation and ground support	Fulcher *et al* (2006)
Oil, gas and petrochemical projects	Netherlands	Provides an efficient solution and facilitates a cooperative owner –contractor relationship	Berends (2006)
Blackpool's Central Gateway scheme	UK	Optimal buildability in design	Cunningham (2005)
Highway projects	UK	Greater scope for innovation , improved risk management, better planning of resource requirements, minimization of environmental impact, improved consideration of buildability, improved consideration of health and safety factors and reduced programme period from preliminary design to completion of construction	Skanska and Williams (2005)
Tunnel rail, sewage transfer station and New Southern railway	UK, Hong Kong and Australia	Introduces project alliances / contract partnering, common risks and risk sharing on tunnel projects	Caiden *et al.* (2005)
Highway projects	UK	Asset management optimisation	Webster (2005)

The ECI publication sources in Scopus show that ECI is practiced in more than 30 countries. Table 1 presents international examples of projects involving Early Contractor Involvement in the design development and the benefits of ECI in those examples. ECI has been successfully applied in many countries to maximize design efficiency and economy.

An examination of the type of projects in which ECI is used (see Table 1) indicates that there is a preference for ECI in technically challenging and complex projects. Many of such projects may have been procured as design and build engineering solutions in the past. Here, in the context of design by employer, ECI helps to secure the contractor’s skills and expertise.

Benefits of ECI

A range of ECI benefits have been reported (see Table 1). There are several benefits for the client. The ECI process seeks to exploit a contractor's specialist knowledge of construction processes to the benefit of the design process. It is during the early stage of project planning that the greatest influence on capital costs and project outcomes is possible. As ECI allows for buildability issues to be dealt with earlier during the design process, the strategy can produce reduced impacts during the construction process and improve overall efficiency for project delivery (Kuo and Wium, 2014). It also gives an opportunity for better relationships, effectiveness of contractor’s input in to design and better risk management (Rahman and Alhassan, 2012). Of the experts involved in the construction process, contractors are expected to have higher level of construction expertise because of their specialised role and are also expected to know construction materials, methods and local practices than the client or any other consultant in a project. The contractor is thus the ideal expert to advice on issues of buildability and the limitation or availability of certain resources (Song *et al*., 2009).

The ECI strategy also benefits the contractor as it can impact his performance positively which may have a good impact on the costs (see Scheepbouwer and Humphries, 2011). The involvement of the contractor in the early stages also fosters cooperation amongst the participants in the project both during the design and construction stage (Song *et al*., 2009). ECI provides an efficient solution and facilitates a cooperative owner – contractor relationship (Berends, 2006). Skanska and Williams (2005) explained the benefits of ECI as follows: "It allows for innovation, improved risk management, better planning of resources requirements and can minimise environmental impacts. In addition to that it offers an improved consideration of buildability issues, health and safety issues, and a reduced programme time from preliminary design to completion of construction. Working collaboratively also help in solving issues which may arise at any time on site". Lenferink *et al*. (2012) argue that ECI adds value in time gains, improved project control and more innovative solutions. However, as discussed in the next section, bringing the contractor on board earlier can introduce complications relating to design liability, risk allocation, relationships between project team members and reward systems.

Issues in ECI practice

In a book on early contractor involvement in building procurement, Mosey (2009) describes four commercial issues that need to be addressed from the outset in early contractor appointments. First, if the contractor is appointed to work alongside the client and its consultants in developing additional information in these areas and in finalising an acceptable price prior to start on site, then logically there will be insufficient time available for detailed or accurate pricing to be undertaken prior to commencement of such work. It is relevant to consider the implications of this in terms of the criteria for early contractor selection and the means by which preconstruction phase processes involving the contractor can lead the parties to achieve the required level of cost certainty after early conditional contractor appointment, but prior to unconditional contractor appointment. Second, as additional information is built up following an early contractor appointment, it will not be possible for the client to transfer risks that emerge later in the preconstruction phase of the project if the contractor is not willing to accept them. A third issue relates to how the contractor should be remunerated for the activities that it undertakes during the preconstruction phase. A fourth issue is that the parties might bring unequal commitment into a project and due to the sharing of sensitive information it might expose the secrets of a company. A fifth issue mentioned by Rahman and Alhassan (2012) is that the contractor and a consultant can possibly clash over design ideas. ECI require a culture change which may be difficult for some industry professionals to embrace and hence make it harder to implement in practice (Song *et al*., 2009).

Types of ECI practice

Procurement methods like design and build and Turnkey contracts are the traditional solution for clients requiring early contractor involvement in design and construction (see Murdoch and Hughes, 2008). However, one disadvantage is the possibility to lose control over the project. The focus of this study is on ECI in the context of design by the employer.

A paper by Rahman *et al*. (2012) describes one model of ECI practice in Australia. It is a two-stage process where Stage 1 is design development and Stage 2 is design and build. In the first stage, the contractor is engaged (usually on a time basis) to prepare the preliminary design with the principal using the contractor's designers. The contractor completes a preliminary design. This stage may also involve the exploration of innovative design alternatives, value engineering, and constructability issues. The second stage is usually a traditional design and construct model but the principal is not obliged to engage the same contractor in Stage 2 of design and construction. The Department of Transport and Main

Roads in Queensland, Australia employs this form of ECI to achieve value for money and maximise utilisation of market capacity. Their style of ECI is described as a negotiated Design and Construct contract where a two-stage process is used to select the right contractor for a job (see the Department's Manual on Standard Contract provisions (vol. 6): early contractor involvement (ECI) contract).

Wamuziri (2010) explains a type of ECI which has also two phases. In the first stage of the process, the contractor assists with the design development phase and their input is paid for on a cost reimbursement basis. The second phase consists of detailed design and construction. The payments here are done on target cost basis. Thus two models of ECI are articulated in the literature examined. The first is a model where the contractor completes both design and construction (i.e. traditional design and build). The second is a model where the contractor is involved in a preliminary design in the first stage and is (or not) employed in Stage 2 to finalise design and do construction (see explained in a textbook by Mosey, 2009).

Framework agreements

A brief review of the concept of framework agreements in Scopus shows its use has increased in the past 20 years. A framework agreement is an agreement between an employer and one or more contractors, the purpose of which is to establish the terms governing contracts to be awarded during a given period, in particular with regard to price and, where appropriate, the quantity envisaged (ISO 10845-1, 2010). The official journal of the European Union (2004) defines a framework agreement as an "agreement or other arrangement between one or more contracting authorities and one or more economic operators which establishes the terms under which the economic operator will enter into one or more contracts with a contracting authority in the period during which the framework agreement applies". Through framework agreements, construction clients can develop collaborative procurement relationships with their construction partners and supply chains for long term gain (Watermeyer, 2013). The purpose of this section was to simply provide a brief definition of framework agreements as the context within which the ECI examined in this paper occurs.

RESEARCH AIM

The practice on ECI is developing. Two models of the strategy are articulated in the literature. An alternative way of using ECI in the context of design by the employer and collaborative working arrangements like framework agreements and target cost contracts is being practiced in South Africa. Research is needed to develop a systematic understanding of this evolving approach. Therefore, the research aim was to examine how ECI occurs in framework contracts; the value of the contracting strategy to the delivery of projects; and the conditions for its successful adoption and implementation by other organisations.

RESEARCH DESIGN AND METHODS

The aim of the study was to examine the early contractor approach used in framework contracts at Wits University in South Africa. To achieve this aim, the research was designed to be comprehensive, intensive and inductive. It had to be comprehensive to capture the whole ECI process and its context. It had to be intensive to probe deeply into the ECI process. And it had to be inductive to enable a systematic understanding of the ECI process to be developed from the emerging data.

Three research methods were employed to address the research aim. In the first instance, documents relating to the practice of ECI in the capital projects programme were collected and examined to develop a better understanding of the process. The second research method was interviews with the parties involved in the ECI process namely the project manager, designer, cost controller and framework contractor. The interview respondents have significant experience and knowledge of the ECI process as 16 projects in the capital projects programme have involved ECI (see Laryea and Watermeyer, 2014: 224-226). The interviews were semi-structured in nature. The semi structured interviews helped to capture a detailed narrative knowledge from all parties involved on how the ECI process works in practice including their cumulative experiences of the process and the conditions for success. The use of semi-structured interviews also helps to guide the data provided by respondents without limiting them in their answering. All interviews were recorded, transcribed and analysed using thematic analysis.

The third research method was a live observation of an ECI session to obtain a firsthand experience of the process, the content of discussions, nature of the interaction between parties, and how the process creates value. Observations were recorded with the help of a field note book and then .analysed using thematic analysis. Thematic analysis is a qualitative data analysis method for identifying, analysing and reporting patterns (themes) within data (see Guest and MacQueen, 2012; Braun and Clarke, 2006, p.79; and Boyatzis, 1998).

The combination of the three methods provided an opportunity to address the research aim comprehensively, deeply and inductively. The combination of methods also helped to ensure a high degree of validity of the study findings as there was a high degree of ecological validity and reliability in the findings from different data sources.

DATA COLLECTION

Data was collected in 2013 and 2014 using interviews, non-participant observation of an ECI session, and documentary analysis. For the interviews, ten people were interviewed for this study (two project managers, two contractors, two quantity surveyors, two architects, and two members of the client's procurement team). Each interview lasted for more than one hour and where necessary additional interviews were conducted with respondents to obtain additional explanations on ECI and cross-checking of initial information collected. The narrations provided by the interviewees were analysed around three main themes namely (1) the ECI process and its value; and (2) experiences of the parties; and (3) conditions for success.

The non-participant observation of the ECI session was conducted for the duration of the particular session observed. This lasted for one hour and forty five minutes. The project entailed the refurbishment of a major Faculty building on the university campus. The data analysed was the conversations of the parties which were recorded with the help of a field notebook and then analysed around specific research themes.

The documents examined included progress reports on the capital projects programme and previous presentations made by members of the procurement team. Relevant information on ECI was extracted from the documents to form part of the data analysis.

RESULTS

These study results are presented and then discussed.

Findings from interviews

The interviews provided a comprehensive understanding of the ECI process; experiences of the parties involved; and the conditions for success.

ECI process

The interviews revealed that the ECI process here occurs in four stages (see Figure 1). Through framework contracts, an opportunity is created for the client to have early contractor involvement in design and cost development. The contractor participates in the ECI process whilst carrying out the package order (particular contract) they have been instructed to execute within the framework agreement. There is no remuneration for the service.

Once a concept / preliminary design is prepared, an elemental cost estimate is prepared, then the contractor is brought in to assist with the design development and production drawings. The contractor works with the design team to finalise the design and help get the design within the client's budget. The integration between the contractor and professional team and the early contractor involvement processes are supported by the use of framework agreements linked to the NEC target cost contracts.

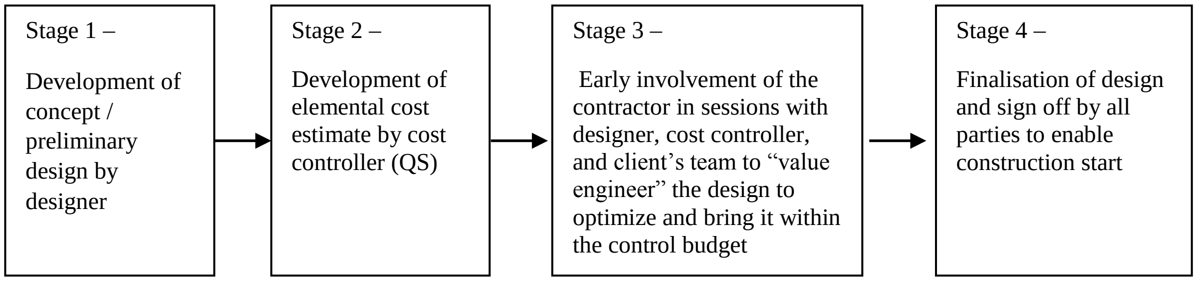

Figure 1: A model of ECI in the framework agreement context

The four stages are summarized in Figure 1are explained as follows.

Stage 1 - Concept drawings are prepared by the designer

Stage 2 – An estimate for the concept design is prepared by the client's cost consultant (quantity surveyor). One respondent said "At this stage the costing is done on the basis of an elemental cost estimate - rates built up for elemental components of your structure". The elemental cost estimate is then compared to the client's control budget which is the approved amount for the project. The elements of a control budget include the construction cost, contingencies for the construction budget, escalation (contract price adjustment for inflation) - contract price adjustment), professional fees, and VAT.

Stage 3 – The contractor is brought on board to work with the professional team and assist with “value engineering” and “cost engineering” of the design. One respondent said “The discussions and interactions in this process is where the contractor’s input proves valuable with suggestions on alternative materials and alternative solutions and perspectives to the designer’s ideas”. Iterations of this process take place to optimise the design and bring cost within the allocated budget. One contractor said: “… they would say this is our budget for the building, then we look at how they can cut things down to fit within the budget. For the first package order, you could look at refining the design after the contractor has won it. Other ones you have the builder involved right from start and you have less changes later”. The interviewees agreed the contractor is an expert in building and is therefore able to make input into design, the cost model and buildability concepts based on his experience and knowledge.

Stage 4 – Production of optimal design solution signed off by the parties including the contractor who is part of getting the sign off for the project. One respondent said “It is a team effort to get the design within the control budget for the project to take off”.

The Project Manager coordinates the early contractor involvement process and organizes for the designer, cost controller, contractor and other relevant parties to meet and carry out the “value engineering” process. As stated by one respondent: “The objective of the process is the parties working together as a team to optimize design and keep it within a control budget”.

The process can takes considerable time in some instances. One respondent said: “For one project we engaged in discussions on design development and how to bring it within budget for almost 2 years”. Several meetings are held to discuss and refine ideas until an acceptable solution is found in terms of an optimized design and acceptable cost of the project.

Client experiences

A summary of quotes from transcripts of interviews with respondents on the client side is presented in Table 2.

Table 2: ECI observations by client representatives

Respondent	ECI observations
R 1	"ECI enables the contractor to manage change during the project. It is used as a strategy to bring teamwork to reduce prices. The success of ECI is dependent on the skills and experience of the contractor. The purpose of ECI is to integrate design and construction and it only works if cost based pricing strategy is used"
R 2	"Value engineering of the design is done efficiently with ECI. It (the process) develops a dialogue opportunity for the contractor, client and the professional team. It considers buildability and affordability issues"
R 3	"The main advantage of ECI is the reduction of costs which works mostly for complex projects. ECI is new to most construction professionals more especially if the designer has egos towards the contractor. ECI works only if you find the right contractor and professional team with a right attitude"
R 4	"ECI enables the optimisation of design to meet the client's requirement and it strengthens the partnership through gain share opportunities"
R 5	"ECI is about adding value for money without decreasing the quality of the design while involving the contractor"
R 6	"ECI needs a flexible designer who is willing to accept opinions from the contractor and also understand how difficult it is to build something "
R 7	"ECI helps the contractor during the implementation of the project. The contractor helps in terms of costs, quality , buildability issues and maintenance issues"

The interviews with client representatives presents the following main points as the primary benefits of ECI – teamwork, cost savings, integration of design and construction, consideration of buildability and affordability issues, and optimisation of design (see Table 2). The conditions for success are flexible designer; cost based pricing strategy; skills and experience of contractor; and selection of the right construction partner (contractor).

Contractor experiences

Table 3: Thematic summary of contractor's experiences

Theme	How value is added	Team interaction
Design	"A contractor will look at something slightly different from an architect – the contractor's input brings additional perspective to the design development" "It is the experience that enables us to add value – whenever we look at something we look at buildability." "An architect will design something that will look as good as possible. That is when the contractor can come in and say this looks good but if I were to do it myself this is what I will do. Things like floor finishes, screeds, etc."	"Everybody wants to defend their turf. So tensions can arise and designers may feel uncomfortable in the initial stages about a contractor making input into design. Traditionally they are not used to this kind of practice. However, in the end, the parties can combine to give the perfect team" "ECI can create tension in the team at the start. Architects may not want to play open cards because the contractor is in the meeting. In one of our early meetings, the consultants handed information to everyone in the team apart from the contractor. The architect does not really like the builder to say the door they have is expensive and you could get something else for half the price. They don't like that. But it disappears very quickly"
Cost / pricing strategy	"It is very difficult for the QS to give savings at the tender stage – they don't have the contacts in the industry. The supply chain people will give us some prices that they might not give to the cost consultants. With us they will do it because they know in future they will get work from us – as a client – but the cost consultant is just someone trying to get an idea of budget." "The QS will ask us can you give us a price for a slab for example. In his initial elemental estimate, he just slots in the figures the industry has been tendering. So we give him more accurate rates. We go to the market to get prices. In one project we had some shuttering slabs – we proposed changes and how much the alternative is going to cost. And then it is up to the design team to decide how the want to proceed. It is more working with the team to try and get those figures" "Exactly what are you trying to help with – the main thing is to keep it in budget. As soon as they begin producing drawings we come in. The QSs do it and we do the same thing." "What you do when you are pricing normal contracts in a competitive tender is to look for flaws in the measure. Then you load that aspect and put that money elsewhere to make money. In this system we are in you cannot do that. You apply your mind to make sure you are doing it correctly rather than finding mistakes in somebody else's work. On this system that is not what you are trying to achieve because it is your own measure."	"If you are in a framework contract you are prepared to put in the effort. If it is a normal tender, you probably don't otherwise you end up overpricing the work and you don't get it. I don't believe we think as much about other jobs we tender on as we do for the framework contracts we do." "The good thing about the process is that in normal bill of quantities you will have things to measure. But here we measure and we have discussions about how are we going to do the work and how are we doing to build the thing."

From the contractor's perspective the following quotes from interview transcripts provide insights on the value of ECI in design and cost development; and some perspective on the nature of team interactions during the process.

The thematic summary from transcripts of contractor interviews shows how value is added to both design and cost of projects through early contractor involvement (see Table 3). More accurate pricing is secured through the interactions between the contractor and cost consultants. The contractor's access to market rates helps with both accuracy of the pricing and cost savings from supply chains. The traditional strategy where contractors exploit flaws in measurement and plan for claims (see Rooke *et al*., 2004) is eliminated here because of the approach is underpinned by teamwork and collaboration. The contractor's input provides benefit to the design development and construction operations from the perspective of buildability reviews and alternative proposals on aspects such as finishes.

Findings from non-participant observation

The ECI observation conducted for one hour and forty five minutes related to the refurbishment of a major Faculty building on the university campus. The parties present at the meeting were three representatives of the framework contractor (a Director, Quantity Surveyor, and Contracts Manager); two representatives from the architectural design firm; and the Project Manager (see Table 4).

Table 4: Observation of ECI session

Nature of project	Duration of ECI session	Parties present	Issues covered in the meeting discussions
Refurbishment project	1 hour and 45 minutes	Project manager, two designers (architects), three contractor representatives	The meeting discussions covered issues of constructability, project organization, scheduling of the works, clarification of the contractor's responsibilities in relation to the design, potential construction risks and sensitive elements to avoid, discussion of specific materials, pricing issues, value engineering of the design to achieve cost savings, interaction with building occupants on how to minimize disruption to their use of the building.

The issues covered in the meeting discussions are presented in Table 4. The interactions are cordial and conducted in a spirit of mutual respect for each party's professional knowledge and skills. Interaction with the ECI team indicated that the number of ECI sessions for projects would generally depend on the size and nature of the project. However, it was not unusual to have at least five ECI sessions for each project. In one case, it was explained that more than 20 ECI sessions had been conducted. Clearly this is extensive.

From a contractor's perspective the level of senior personnel and amount of time invested in the process is significant. However, there is no remuneration for the ECI service because of the contractor's contractual involvement in a framework agreement. While the lack of remuneration may raise concern, the contractors are still happy to participate in the process because of the understanding they build of the project requirements and cost. This enables them to make an early start with construction once the contract is awarded because of their familiarity with the design and cost make-up. The atmosphere of partnership and appreciation of the value they bring to the process is also something of value to the contractors.

Findings from documentary analysis

Documentary analysis was employed to develop a better understanding of the tangible value of early contractor in projects (see Table 5). The paper by Laryea and Watermeyer (2014) showed the use of ECI 16 different projects.

It was found from the documentary analyses that in one project, for example, the original estimate for the project design was R204, 000,527 inclusive of contingencies, cost escalation, professional fees and VAT (see Table 3). This was before the contractor's involvement.

However, the client's approved control budget was R178, 000,000 whereas the final completed cost was approximately R 179 000 000. The framework contractor was brought on board to assist with value engineering of the design to bring it within the control budget. The contractor supplied current market rates, etc. to the cost consultants during the process. This helped to improve the accuracy of the cost estimate and the final cost of construction. Through the contractor's participation and ideas, extensive value engineering took place in various aspects of the design (see Table 5). Participants in the value engineering workshops were the client representatives, professional team and contractor. For Project A in Table 5, early contractor involvement produced a 12% cost savings through the value engineering process.

Table 5: Value of early contractor involvement in projects (two cases)

	Original estimate before contractor's involvement	Client's budget	Early contractor involvement in value engineering of design	Cost savings
Building Project A	The original estimate was R204,000,527 inclusive of contingencies, cost escalation, professional fees and VAT	The approved control budget was R178,000,000	The contractor supplied current market rates, etc. to the cost consultants before the start of construction. Extensive value engineering took place i.e. treatment to treads and risers, omission of mosaic tiling to colonnade concrete balustrade walls, reduction in costs of facades, auditoria seating, acoustic wall panelling, ceilings, drainage channels, etc. The client representatives, professional team and contractor participated in these value engineering workshops	12%
Building Project B	The original estimate was R37,598,000 inclusive of contingencies, cost escalation, professional fees and VAT	The approved control budget was R25,000,000	Extensive value engineering took place i.e. omission of drawing hall, acoustic sliding stacking door, acoustic wall panelling, timber trusses instead of steel, omission of cavity wall insulation, reduction in costs of facades, external works, etc. The client representatives, professional team and contractor participated in these value engineering workshops	32%

In another project (Project B), the value offered by early contractor involvement in projects and the collaborative working approach of the client produced a 32% cost savings. The contractor thus provided a significant amount of value in this contractual arrangement. It is important to note that the contractor's involvement in value engineering of the design continues through the construction phase and cost savings are shared through the use of NEC3 target cost contracts (Option C).

Therefore, the value of early contractor involvement can be quantified in terms of the difference between the budget at the start of the contractor's engagement (i.e. at the end of the concept / preliminary design stage when the contractor was brought on board and worked with the team in value engineering the work prior to the package order being given to proceed, during the works e.g. alternative proposals etc.) and the final budget obtained after value engineering and inputs from the contractor before and during the construction phase. Both cases in Table 5 demonstrate significant benefits of the ECI approach.

DISCUSSION

Four main points are discussed in this section. The first point relates to how ECI occurs in framework contracts and the value of the strategy to project success. Second relates to the conditions for success. Third relates to cost and time savings. Fourth relates to impact on contractor's organisation. Most benefits of ECI summarized in Table 1 are reinforced by the respondents and observation of ECI in this study (see Tables 2-5).

ECI in the context of framework agreements

The first discussion point relates to the type of ECI model in this study. The two models of ECI previously mentioned in the literature are (1) where the contractor completes both design and construction; and (2) where the contractor's input into the design development is paid for on a cost-reimbursable basis (see Rahman *et al.*, 2012 and textbook on Early Contractor Involvement in Building Procurement by Mosey, 2009). Here, the main is ECI in the context of design by employer and framework agreements (see Figure 2).

The process begins with the successful appointment of the contractor onto the employer's framework agreement. The contractor selection is done through the "Restricted competitive negotiations" procedure in the CIDB (2010) Standard for Uniformity in Construction Procurement (page 7) and ISO 10845: 2010. In this procurement procedure, "A call for expressions of interest is advertised and thereafter only those tenderers who have expressed interest, satisfied objective criteria and who are selected to submit tender offers are invited to do so. The employer evaluates the offers and determines who may enter into competitive negotiations". Tenders are evaluated on the basis of price, quality and preference parameters.

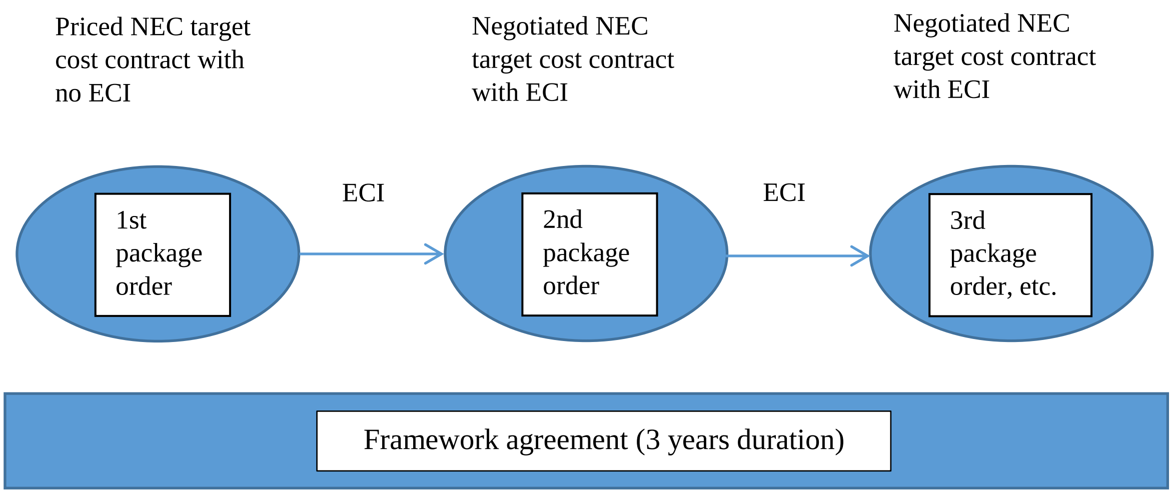

Figure 2: Relationship between framework agreement and ECI

For the first package order (see Figure 2), the contractor is competing with others for the right to win the contract, hence there is little opportunity for input into the design development. The main exception is during the competitive negotiations process (i.e. the second round of the tendering process) when each of the contractors meets with the whole design team to ask for clarification about the design and discuss suitable alternatives which the client may consider to achieve cost savings. However, for subsequent projects after the first package order, the contractor is brought in to assist the professional team with design and cost development. This is where the early contractor involvement occurs. The value relates to both design and cost development (see Tables 3-5). As a result of moving with the same contractor from one project to the next for the duration of the framework agreement, this kind of multiproject partnering helps in establishing a long term relationship with a construction firm in order to develop and capitalise on its improving skills (see paper by Barnes (1999) on "Smeaton to Egan - The Extraordinary History of Civil Engineering Management"). Although contractors receive no remuneration for the involvement in design development, they value the benefits they derive from developing early cost models and production plans.

Conditions for success

The following six conditions of success can be summarized from the data: intelligent client, framework agreement, collaborative contracts, cost based pricing strategies, professional team's flexibility, experienced and committed contractor.

First, ECI requires input from the contractor so naturally its success depends on the experience and skills of the contractor (see studies summarized in Table 1). As indicated by one respondent in Table 2 "The success of ECI is dependent on the skills and experience of the contractor". The contractor must have the capacity and collaborative attitude to contribute to design optimization and value creation.

Second, the opportunity to have ECI was created through framework agreements. This is unlike other ECI models created through design and build or a two-stage process (see literature section on types of ECI practice). Once concept / preliminary designs and elemental cost estimates are prepared, the framework contractor is brought in to assist with value engineering of the design and production drawings (see Table 2-5).

Third, as indicated in Table 2, “ECI needs a flexible designer willing to accept opinions from the contractor”. ECI is new to most construction professionals more especially if the designers had egos towards the contractor. The study by Kuo and Wium (2013) found that designers do not always understand what constitutes a constructible design. This creates constructability problems in projects. Therefore, there is a need for procurement models that enable sufficient collaboration and knowledge sharing between the parties at early stages of design. Close collaboration between designers and contractors may lead to more effective construction processes, economic design solutions and improved safety.

Fourth, the type of ECI described here works better if cost based pricing strategy is used. As explained by Watermeyer (2013: 24-25) it is possible to base framework agreements on either price-based or cost-based pricing strategies contained in NEC3 contracts which are commonly used in framework agreements. However, price-based pricing strategies are best suited to situations where the work is relatively straightforward, is of a repetitive nature, imposes low risks to the parties, does not require sophisticated management techniques to manage and, where necessary, only basic site establishment activities. On the other hand, cost-based strategies are more flexible than price-based strategies and can as such be used where the work is not repetitive and site establishment resources are complex and varied. Cost based strategies make use of target contracts or management contracts.

Fifth, ECI requires collaboration from all parties. It is a relationship-based contracting model (Walker and Lloyd-Walker, 2012). This means the form of contract selected should reflect and encourage a partnering relationship, transparency and shared risk.

Sixth, successful application of the strategy requires an intelligent client. The capability of the client and its relationship with stakeholders has a direct effect on the achievement of efficient and sustainable outcomes (see ICE Group guidance on the “Intelligent Client

Capability Framework”). Intelligent client organisations are capable of specifying the requirements to external participants and managing the delivery outcomes. Fundamental to this is the selection of appropriate private sector participants and the management of those relationships to maximise value. The Intelligent Client Capability Framework outlines client capability in seven key areas that have the potential to support the delivery of major project or programme outcomes. The seven areas associated with the client’s role in procurement and delivery management are: (1) Adequately testing the business case; (2) Providing continuity of investment/funding; (3) Accurately translating and communicating the high level requirements to key stakeholders; (4) Ensuring maximum value is derived from all relationships; (5) Supporting those relationships with responsible and effective governance arrangements and appropriate interface management; and (6) Articulating the nature and shape of the organisation required to deliver. Most traits in the ICE’s Intelligent Client Capability Framework are reflected in the way ECI was used by the client in this study.

Cost and time savings

The study by Koncarevic (2013) and others in Table 1 found that ECI projects experience better performance. The achievement of cost savings is often mentioned as a significant benefit of ECI (see Table 1). However, Scheepbouwer and Humphries (2011) found in their study on ECI that different parties may take a different view on this. Contractors and owners generally shared the view that things go faster which saves time. However, some designers argued that the time savings can sometimes be nullified by the increased collaboration and negotiations between the parties. Scheepbouwer and Humphries (2011) recommended that to implement a successful ECI, objectives in the areas of disagreement should be clarified between the parties while in the transition stage in adopting ECI approach. The initial stages of ECI adoption in the current study involved tensions between designers and contractors (see

Table 3). One respondent said “ECI is new to most design professionals more especially if the designer has egos towards the contractor”. However, this is said to have disappeared quickly and hence did not have much impact on time (see Table 3). Another important point to note is that as this form of ECI occurs within a framework agreement, the contractor makes the input while they are busy with an ongoing project (see Figure 2) so the time is optimized and preparation for the next project is significantly enhanced. In terms of cost, the findings presented in Table 5 shows significant cost savings through value engineering.

Impact on contractor’s organisation

The interviews and observation of the ECI process reveals several benefits of ECI to the contractor (see Table 3). First, ECI improves the contractor’s attitude and ability to do the work. The International Association of Dredging Companies, for example, has argued that involving contractors in design makes them pro-active rather than reactive. Second, the relationship with the team is improved. Third, ECI helps the contractor during the implementation of the project. Fourth, ECI may provide the contractor with an opportunity to discuss issues of constructability and construction methods that they are comfortable with. ECI can allow a contractor to suggest the use of materials that they have got – this may save the client money. Thus, ECI can save money from a type of materials used point of view.

A paper by Kuo and Wium (2014) examined the management of constructability knowledge in the South African building industry. The authors found that constructability problems are common on the construction site due to the lack of construction experience in the design team and the absence of tools to assist designers in addressing constructability. Moreover, designs are predominantly done early in the project in the absence of contractor input. A fundamental misalignment was found between consultants and contractors on what constitutes a constructable design; and the characteristics of optimised vs poor constructability. The communication gap caused by separation of design from construction was an elemental cause of constructability problems. The collaborative procurement approach at Wits and early involvement of the contractor in design development and budget control is a major way of overcoming the constructability problems discussed by Kuo and Wium (2014).

CONCLUSION

The aim of this study was to develop a better understanding of how ECI occurs in framework contracts. The main contribution is the examination of how ECI occurs in the context of design by the employer and the conditions for its successful implementation. Ten people were interviewed and one observation of an ECI session was conducted. The findings reveal ECI practice in 16 projects. These are typically framework contracts based on NEC target cost contracts. ECI is mutually beneficial for the parties. Although the contractor does not receive remuneration for the service, they are satisfied with the practice. Through ECI, they are able to develop early models of cost and production plans for the subsequent package orders in a framework agreement. From the data analysis, six conditions of success discussed relate to the contractor's level of experience and commitment to the arrangement, intelligent client, framework agreement, collaborative contracts, flexibility and openness of the designer to alternative ideas and proposals, and the use of cost based pricing strategies.

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