

## IMPROVING 2-STAGE EARLY CONTRACTOR INVOLVEMENT: LESSONS FROM NEW ZEALAND

### ABSTRACT

This study explores the perceptions of two-stage early-contractor involvement (2S-ECI) as used in New Zealand construction. 2S-ECI provides a procurement process for agreeing a construction-only or novated design and build contract, after the contractor has first been employed before or during design development. Prior research into ECI has struggled to identify the actual procurement system being studied (design and build, management contracting, construction management, or 2S-ECI), skewing findings. Twenty-one semi-structured interviews were conducted with senior construction professionals across New Zealand. Findings focused on advantages, project suitability, challenges and opportunities. 2S-ECI may improve design buildability, construction planning, price transparency, risk equity, and reduce industry tendering costs. 2S-ECI appears best suited to projects involving work to existing building operations where the cost of disruption outweighs any premium incurred for the benefit of contractor logistical planning, where the selection of preferred contractors through open-book negotiation is desirable, where securing resources in heated markets is otherwise difficult through competitive tender, and where designers want contractor input for design solutions. Challenges include lack of clear 2S-ECI definition, unclear expectations and difficulty measuring benefits, incomplete design documentation, and amended standard terms transferring risks to contractors. Opportunities for improvement include education, developing a standard form pre-construction services agreement (PCSA) for New Zealand, better application of design coordination and buildability analysis and value management, and agreeing fixed price construction contracts based on finished quality drawings. Risk transfer is a major issue in New Zealand construction. These findings help inform procurement policies that support transparency and risk equity.

Keywords: Early contractor involvement, New Zealand, pre-construction contracts, procurement, two-stage early contractor involvement

#### Author names and affiliations:

[Author 1 Name]	David Finnie
[Author 1 Affiliation]	Principal Lecturer and Academic Leader Construction, Otago Polytechnic, New Zealand
[Author 2 Name]	Dr. Naseem Ameer Ali
[Author 2 Affiliation]	Postgraduate Director and Senior Lecturer in Quantity Surveying, School of Built Environment, Massey University, Auckland, New Zealand
[Author 3 Name]	Dr. Kenneth Park
[Author 3 Affiliation]	Deputy Head of Engineering, Systems & Management and Undergraduate Construction Programme Director, Senior Lecturer in Construction, School of Engineering & Applied Science, Aston University, Birmingham, UK

## INTRODUCTION

This study explores the perceptions of two-stage early contractor involvement (2S-ECI) in New Zealand commercial construction through 21 semi-structured interviews. The primary focus is on what is working well and opportunities for improvement. Sharing lessons learnt from industry paves the way toward more efficient and equitable procurement practices.

This paper focuses specifically on 2S-ECI. Early contractor involvement (ECI) is used in New Zealand, and other countries such as the UK, USA and Australia, to improve design buildability through involving contractors during design development. Approaches vary across countries (Rahman and Alhassan, 2012) and projects. As a concept ECI includes any procurement systems that involve contractors during pre-construction stages, including design and build, management contracting, construction management, or two-stage traditional, Prior research into ECI has struggled to identify the actual procurement system being studied, skewing findings. For example, Francis and Kiroff (2015)'s conference paper titled: *Attitudes and perceptions towards early contractor involvement procurement*, was based on an initial assertion that design and build is the preferred model of ECI for commercial construction in Auckland New Zealand. An alternative title would have been: *Attitudes and perceptions towards design and build procurement*. Rahman and Alhassan (2012)'s journal article titled: *A contractor's perception on early contractor involvement*, identified lack of collaborative 'win-win' attitudes, and non-inclusion of consultants in pain-share/ gain-share arrangements as potential drawbacks. 2S-ECI construction contracts may be lump sum or target value. Lack of *pain-share/gain-share* would not feature as a drawback in lump sum contracts.

Clients and consultants have little guidance for ECI in New Zealand and generally develop their own bespoke and often informal practices. The New Zealand's Ministry of Business Innovation and Employment (MBIE, 2015) identified procurement as a key focus to improve productivity and released *Planning Construction Procurement: A Guide to developing your procurement strategy*. The guide includes management contracting, construction management, and contractor-led DB. However there is a lack of guidance about how these systems are conducted and no provision for 2S-ECI. The first standard form pre-construction contracts agreements to support 2S-ECI were released in 2011 by the Joint Contracts Tribunal (JCT, 2018) and the Institution of Civil Engineers (ICE) in the UK, which have both been subsequently revised, and are quite different from each other. The JCT *Pre-Construction Services Agreement (General Contractor) (PCSA)*; and *Pre-Construction Services Agreement (Specialist) (PCSA/SP)* support the JCT lump sum building works or design and build contracts. Conversely, the ICE NEC3 supplementary ECI clause (ICE, 2018) supports NEC target value or cost reimbursement contracts, but not lump sum contracts.

The collaborative approach of ECI supports more equitable risk management. Risk transfer is a major issue facing New Zealand construction at present. Standard form contract terms are being amended to shift more risk onto contractors, and contractors are sometimes entering lump sum contracts based on incomplete designs (New Zealand Institute of Builders (NZIOB), 2018). Industry leaders are calling for greater risk equity, on the basis that the current level of risk placed on both consultants and contractors is now 'inequitable' (New Zealand Institute of Quantity Surveyors (NZIQS), 2018). This follows a range of large construction companies existing the commercial market, including Mainzeal, Fletcher Construction, and Ebert Construction (Harris, 2018) and most recently Arrow Construction.

## LITERATURE REVIEW

The following subsections review literature about the definitions, benefits and challenges, and projects types suitable for ECI. Research objectives are then established based on the gaps.

## **ECI Benefits**

### ***Planning and buildability***

Previous studies have identified the following advantages of relational procurement pathways that integrate a contractor with design development: improved planning and buildability (Mosey, 2011; Whitehead, 2009; Farooqui and Ahmed, 2008; Jergeas and Put, 2001), improved team relations and collaborative decision-making (Mosey, 2011; Whitehead 2009; Toolanen, 2008), more open book pricing and reduced risks and contract variations and likelihood of dispute (Mosey 2011; Whitehead, 2009) early material ordering (Gil, Tommelein and Ballard, 2004), and improved innovation, (Whitehead, 2009; Gil, Tommelein and Ballard, 2004) and fast-tracking (Whitehead, 2009; Gil, Tommelein and Ballard, 2004). A key focus is the cooperative and partnering relationships, combining various individuals' competencies into joint-problem-solving (Jorgensen and Emmitt, 2008) and involving specialist contractors in the design process (Gil, et al., 2004, p496).

ECI can provide more time for contractors to plan the onsite construction works, regardless of the potential benefits resulting from better planning and design buildability analysis. For example Gil, Tommelein and Ballard, (2004) found that shop drawings may be produced earlier and faster by reducing the time required for freshly appointed contractors to familiarise themselves with the project. ECI has been compared to Lean Construction principles. Pheng, *et al.* (2015, p831) found ECI may help improve productivity through reducing variability and cycle time, minimizing steps, and increasing output flexibility.

### ***Risk transfer***

Contractors have limited opportunity to manage risks when bidding in a traditional tender. Mbachu and Taylor (2014) found the two most common contractor risk management strategies amongst New Zealand contractors to be excluding or transferring risks to other parties in competitive tender situations. The situation is worsened by amended contract terms transferring risk to contractors.

Early contractor involvement has been found to improve risk management through its more collaborative approach. Rahman and Kumaraswamy (2005, p367) found the majority of 92 industry respondents across 17 countries (including Hong Kong, Europe and the United States) recommended involving consultants and contractors during early project stages to jointly manage risks effectively. They identified (2005, p368) 'equitable and clear allocation of foreseeable and quantifiable risks', 'awareness of risks and rewards' and 'readiness to compromise on unclear issues' within the top ten (of 25) factors influencing relational procurement. Mosey (2011, p15) argues that all parties benefit from ironing out issues early and reduced disputes throughout the project through 2S-ECI. In particular, contractors' buildability input has been linked to improved risk identification and management by a number of researchers (Laryea and Watermeyer, 2016; Pheng, Gao and Lin, 2015; Mosey, 2011; Rahmani, Khalfan and Maqsood, 2014; Song, *et al.*, 2006).

### ***Contractor benefits***

Studies show that contractors may secure long-term client and consultant relationships through providing pre-construction services, and that this contributes to sound profit margins, and improved client satisfaction (Rahman and Alhassan, 2012; Song, *et al.*, 2006). Rahman and Alhassan (2012) found the following advantages from head contractors' perspectives in order of descending importance: increased opportunity for better relationships, enabling collaborative risk management, providing contractor expertise in design buildability, overall improved project delivery, better opportunity for

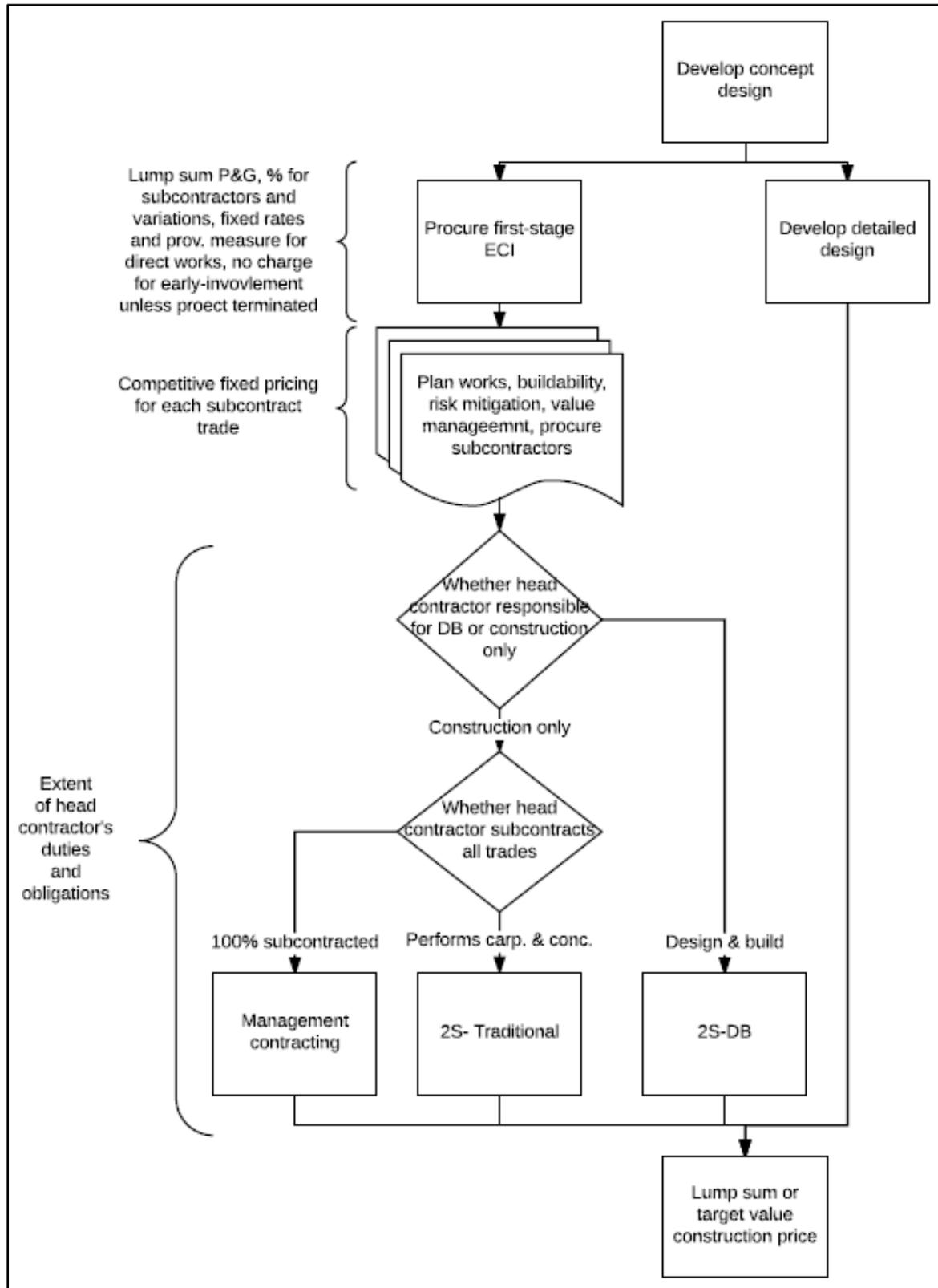
innovation, decreased potential of adversarial relationships, increased customer satisfaction, increased understanding of parties, increased willingness to share risk, reduced cost (budget), flexibility in decision making, reduced risk exposure, reduced over-runs/time/cost/conflict, sound profit margins. Long-term relationships can support continuous improvement through contractors applying lessons learnt to planning projects, who in turn benefit from more certain and consistent workloads and reduced learning curves (Song, et al., 2009) thus reducing business risk. Khalfan and McDermott (2007) describe a UK construction company who successfully launched a new pre-construction department and found local councils using them for either whole project delivery or pre-construction services only.

## **ECI Challenges and considerations**

### ***ECI Definition and contract procedures***

There is some confusion over the meaning of ECI, between the concept of any 'model' that enables contractor involvement during design versus 2S-ECI as a procurement system its own right. Rowlinson and McDermott (1999, p12) described attempts at categorizing procurement into 'models' being referred to as 'virtually meaningless' on the basis that individual pathways may actually be more similar than they are different. This can be demonstrated with 2S-ECI. For example, MC is a 'model' where the head (management) contractor subcontracts all trade packages, enabling them to be employed for a management fee during pre-construction. Similarly, under 2S-ECI, the head contractor may be employed during pre-construction based on a fixed fee for preliminary general (P&G) and ECI services. Therefore whether the head constructor subcontracts all trade packages or uses employees for carpentry and concrete trades, becomes a variable of the 2S-ECI process, not a different procurement 'model.'

Whether the construction contract is construction only, or design and build can also be considered variables within 2S-ECI. The client may procure a concept design and then engage a head contractor to provide design input. Then the construction contract can be either construction only or novated design and build. Figure 1 contextualizes procurement models under the ECI concept as 2S-ECI process variables. This is supported by Rowlinson and McDermott's (1999, p35) call for a set of key variables to define the contract strategy.



**Figure 1:** Procurement 'models' shown as 2S-ECI process variables, adapted from Finnie, Ameer Ali and Park (2018)

Over the past decade a number of researchers have identified the lack of clear measurables and responsibilities of 2S-ECI. Cheng and Li (2004) found the benefits of ECI difficult to measure due to their intangible nature. Whitehead (2009, p24-25) identified potential issues to consider when using

2S-ECI including client incurring tendering costs, project team not working well together, appointing contractors too early, lack of competitive pricing, and new and unfamiliar contracts. Mosey (2011, p2) related problems in defining ECI models and project team member requirements with slowed uptake in the industry. Turner and Riding (2015, p180) highlighted the lack of literature and clear definition of ECI and found badly structured processes that impact on trust and collaboration as a common hindrance to ECI use. Pheng, *et al.* (2015, p831) concluded that ECI requires raising building professionals' awareness of both ECI and Lean in order to improve productivity. However, this is difficult without a clear process framework.

### ***Common goals and buy-in***

A number of studies have highlighted the importance of trust and collaboration, and the barriers to buy-in. Client commitment (King's College London, 2014; Ma and Xin, 2011; Rahman and Kumaraswamy, 2005), and buy-in and commitment across all parties (Laryea and Watermeyer, 2016; Rahman and Alhassan, 2012; Rahman and Kumaraswamy, 2005) have been key influences of ECI success, along with clear pre-construction milestones (King's College London, 2014). Such buy-in logically requires trust and collaboration, something Toolanen (2008, VI) describes as a 'basic pillar' of all procurement, but in particular for relational systems. Ross (2011) found trust a key feature of early collaboration and supply chain integration. Strahorn, Gajendran and Brewer (2015) recommend improving project success through increased trust. 'Trust' and 'open communication' rank as the two top factors for effective relational contracting identified by Rahman and Kumaraswamy (2005, p368). Trust is particularly important for ECI due to the open book approach to pricing and sharing of commercially sensitive information, which according to Rahman and Alhassan (2012, p218) requires 'open and honest communication between client, consultant and contractor'. Moving from the more traditional to a collaborative approach may be a hurdle. Menches and Chen (2012) highlighted the potential barrier of public bodies being statutorily prohibited from entering risk-sharing agreements.

### ***Contractor services and project team composition***

Adding value during pre-construction requires a different skillset to that of traditional builders. Murdoch and Hughes (2008, p74) point out that the skills of construction managers, management contractors and building contractors are all different and warn against contractors using 'the appellation as a marketing tool, rather than as an accurate description of the services offered.' Single-stage procurement typically involves contractor estimators submitting tenders with the lowest price winning the contract (Mbachu and Taylor, 2014). This does not support high-value input. Kashiwagi, *et al.*, (2009) argue that lowest price procurement forces providers to allocate their cheapest staff on projects, because they cannot compete based on value services, whereas ECI enables contractors to add value during design through providing a range of services. Finnie, *et al.*, (2018) identified the following scope of pre-construction services from literature and expanded through conference presentation feedback: design management, planning and programming, buildability advice, risk management, value management, budget advice, subcontractor procurement, stakeholder liaison (including local authorities), and building information modelling (BIM).

Because ECI generally adopts a more open-book approach to pricing, clients may engage independent budget advice. Independent cost negotiation may be particularly beneficial in negotiating contractor rates for preliminary and general and builders' work, and evaluating subcontractor terms. The New Zealand Transport Agency (2018) recommend engaging an independent parallel estimate peer review and possibly design review, and Ma and Xin (2011) describe an independent estimator as a key feature of 2S-ECI for an AU\$100 million Australian infrastructure and construction project.

## **Pricing**

2S-ECI may be based on lump sum or cost reimbursable contracts with or without target values. Prior studies have considered the use of cost reimbursement in relational procurement in terms of scope and market conditions. Cost reimbursement contracts can support negotiated contract formation before detailed design, which may suit a scope that involves high levels of uncertainty, though cost reimbursement provides less price certainty than lump sum contracts and entails more auditing for claim certification (Bajari and Tadelis, 2001). Some studies have found that the transparent pricing of relational procurement may achieve lower project costs (Zuo, *et al.*, 2013) and provide a means of securing resources (Whitehead, 2009) in heated market conditions. However, the situation becomes less clear in recessionary climates when fixed-price competitive tendering may drive prices down, even below cost. On the one hand, Heaphy (2011) found that even where contractors bid below cost during recessions, their final accounts may be higher than target value contract when taking into account aggressive variation claiming. On the other hand, Ross (2011) challenged the assumed benefits of supply chain management during recessionary markets and called for further research in this area, highlighting the lack of empirical evidence.

## **Projects suitable or ECI**

The more open-book approach to pricing in ECI makes it suitable for negotiating contracts, or to obtain buildability design input or both. Kings College London (2014) demonstrate how 2S-ECI may support ongoing relational procurement. Negotiation may also be used to secure resources in heated markets. Zuo, *et al.* (2013) found procurement practices in post-earthquake Christchurch largely u-turned from lowest price conforming bids to more relational procurement strategies. A key driver was demand exceeding supply, meaning competitive pricing would no longer achieve the best value for money. Whitehead (2009) similarly described the introduction of two-stage ECI in Australian infrastructure construction to secure resources in a heated market. Ma and Xin (2011, p83) found ECI best suited to projects with uncertainty (where tender prices would otherwise be high to reflect the uncertainty), but smaller than typical alliance projects, featuring ongoing relationships or pain/gain share pricing. The New Zealand Transport Agency (2018) recommends ECI for projects featuring scope uncertainty, that may benefit, from fast-tracking, constructability input, and engaging work packages during the design stage. According to Rahman and Kumaraswamy (2005, p370) non-traditional procurement systems are beneficial for projects where contractor's input is needed 'for buildability, construction methods and risk management at earlier project stages'.

## **EXISTING KNOWLEDGE GAP**

Prior studies have broadly addressed the main advantages and challenges of ECI as a concept, such as better collaboration, negotiation, and contractor buildability input. However, there is little research on how 2S-ECI operates and the perceptions of its use. This is evident from the main challenges identified being lack of a clear ECI process and measurables and client and consultant buy-in.

## **RESEARCH OBJECTIVES**

The objectives of this New Zealand study are to:

- Identify projects best suited 2S-ECI;
- Explore the effect of 2S-ECI on timing, pricing, project team composition and relationships;
- Explore the scope and quality of pre-construction services currently provided;
- Identify key challenges and opportunities to improve 2S-ECI.

## RESEARCH METHODOLOGY

Twenty-one semi-structured interviews were conducted to collect qualitative primary data. The interviews included a mix of planned and unstructured conversations. This provided flexibility to explore reasons behind answers (Robson, 2002).

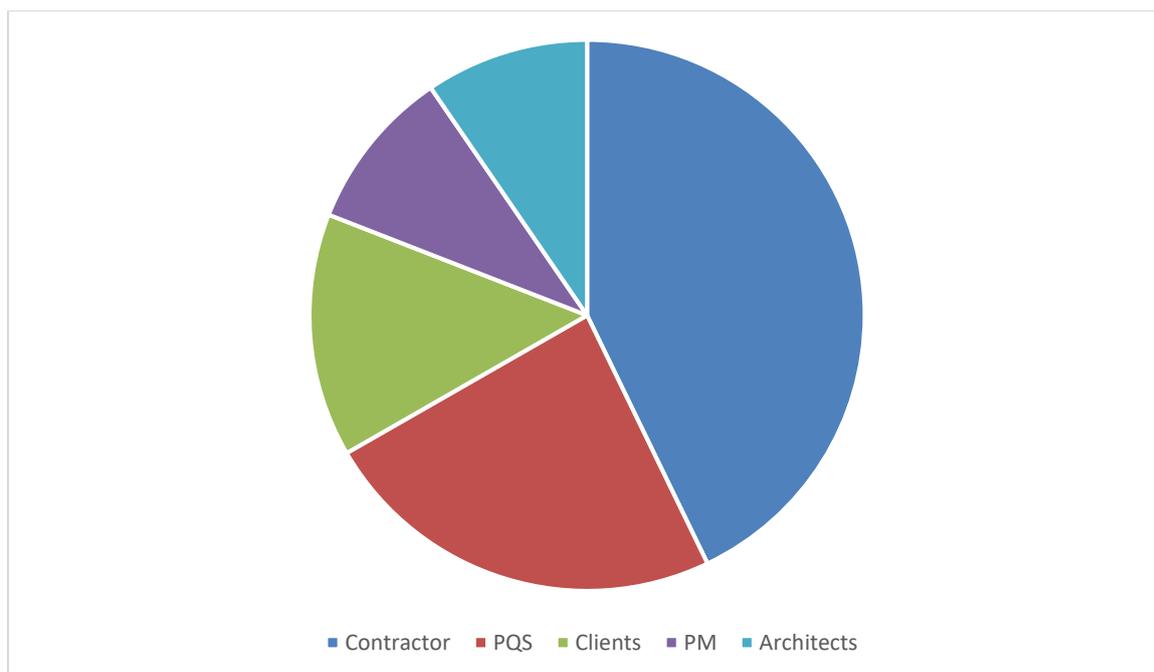
A five-part interview questionnaire, comprising 33 questions, was adapted and modified from a study by Gameson and Sher (2009). Interviews took between approximately one and three hours.

- Section 1: General Questions. Collects general information about the interviewee (name, company, role, years of experience) [4 questions]
- Section 2: Background Information. Collects data about participants' experience with ECI (number of ECI projects, value range, and type) [3 questions]
- Section 3: Case Study Project Information. Collects data relating to a typical facility (facility type, complexity, location, cost, time scale, head contractor or consultant, reason for ECI) [7 questions]
- Section 4: Contractual Issues. Collected data relating to specific contractual parameters (timing of contractor involvement, scope of pre-construction services, services by client's PM, formation of contractor pricing, whether contractor paid for ECI, form of construction contract price, contractual documentation used and key ingredients, risk considerations, lessons learnt) [14 questions]
- Section 5: Perceptions. Collects data about participants' overall perceptions of ECI (effect on pricing, timing, quality, risk clarity, project team composition, project suitability for ECI, and main barriers and opportunities to improve ECI). [5 questions]

Findings were coded based on project suitability, timing, pricing, risk, team relations and composition, scope of pre-construction services, and clarity of the 2S-ECI process, and overall challenges and opportunities for improvement.

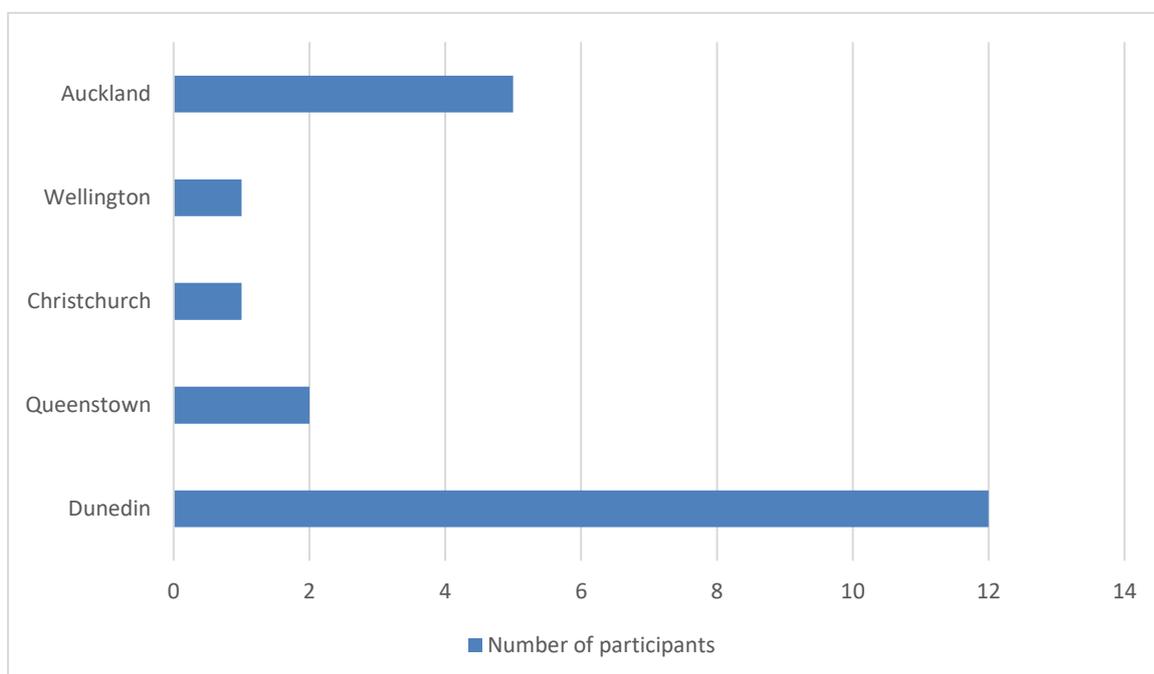
Interview questions were tested by industry (senior QS and senior contractor's PM), to represent both client and contractor sides of the supply chain, and refined before continuing with further interviews.

The sample for this research consisted of 21 participants; three senior staff of large client organisations, five senior PQSs, two consultant PMs including one senior PM and one director, two directors or partners of architect firms, and nine staff in head contractor organizations comprising one senior PM, one managing director, one regional director, one general manager, two regional managers, one senior QS, one commercial manager, one director/ QS (see Figure 1).



**Figure 1:** Sample distribution by organisation

All participants had access to commercially sensitive information making them aware of project successes or otherwise. Most organizations had nationwide coverage, meaning interviewees had communications across divisions. All participants had over 10 years' experience in the construction industry and had experience working on ECI projects. All the ECI projects involved commercial construction. The demographic spread included Dunedin, Queenstown and Auckland (see Figure 2).



**Figure 2:** Sample geographic distribution

## FINDINGS AND DISCUSSION

The collected data explores the perceptions of 2S-ECI in New Zealand construction.

### Project suitability for 2S-ECI

Each interviewee described the features of a typical 2S-ECI project they worked on. Twelve projects involved alterations or extensions to existing buildings, often maintaining client operations. Two projects involved new buildings with substantial site constraints, such as neighbouring historic buildings and complex traffic management. Three involved large complex new buildings. (The total number of projects is less than number of interviewees because some interviewees worked on the same projects.)

Interviewees generally identified four key drivers for 2S-ECI project suitability:

- (i) Projects involving planning logistics around existing operations (all interviewees);
- (ii) 2S-ECI as a means of open-book negotiation to support client/contractor relationships, or to secure resources in heated markets (all clients, PMs, architects and contractors, and 4 PQSs);
- (iii) Complex design solutions benefiting from contractor input (All PMs, architects and clients, 4 PQSs, and 4 contractors), and;
- (iv) Projects requiring fast-tracking (3 contractors, 3 PQSs, and one architect).

These project features can overlap. Clients may employ a preferred contractor who develops knowledge of their operations to support future logistical planning and buildability input, supporting continuous improvement through lessons learnt (Song, *et al*, 2009). Securing the most reliable contractor may mitigate the risk of disruption, which could far outweigh any potential premium paid for early involvement (1 PQS, 1 architect, and 1 contractor). According to one PM:

*ECI can provide a means of negotiating contracts to maintain client and contractor relationships and to retain the knowledge of head contractors and specialist subcontractors, e.g., alterations to an existing hospital.*

A contractor benefit associated with 2S-ECI is securing ongoing client relationships (Rahman and Alhassan, 2012; Song, *et al*, 2006). This is exemplified by the seven contractors who typically do not charge for early involvement. According to one PQS:

*Head contractors have not charged for early involvement in my experience. The Dunedin construction market is largely based more on ongoing relationships. Contractors are incentivized by securing profit through the construction contract, and the prospect of future work with the same client or consultants. Once appointed for ECI, the contractor has a very strong chance of being awarded the construction contract.*

According to two PQSs, the primary driver for 2S-ECI in Auckland is securing resources in the heated construction market, where there would otherwise be a lack of contractor appetite (and therefore high cost) for competitive tendering.

### Timing

While all interviewees identified that 2S-ECI can be used to fast-track projects, this was not seen as a lead driver. One PQS noted that:

*Fast-tracking does not necessarily provide the benefits of ECI. For example, fast-tracking can be used to stage building work without contractor input for logistical planning and value management etc.*

Overall views on timing varied. Some perceived similar timing for 2S-ECI. One client and one contractor warned that design packages should be fully complete before agreeing lump sum construction contracts. For this reason, an architect suggested 2S-ECI provides similar timing to traditional tender. A contractor said that 2S-ECI timing may be similar when the design is finalised before construction, 'though the tendering period may be reduced, because it overlaps with the design stage.' Others perceived 2S-ECI as potentially prolonging the design stage. One client identified the risk of contractors exploring too many options, supporting Whitehead's (2009) identified risk of 'too many chefs in the kitchen.' One contractor said the design stage can be elongated, but 'for the right reasons, i.e., to reduce budget or buildability problems later.' One PQS suggested 2S-ECI procurement can take longer, but that early staging may be used to maintain completion dates. Another PQS said that any 'programming advantages should be weighed up against the potential premium paid for ECI' and that 'tight timeframes also reduce the time available for negotiation.' This supports the need for clear pre-construction milestones (King's College London, 2014).

### **Pricing**

Two stage ECI need not remove all aspects of competitive pricing, and nor can it. Most interviewees described 2S-ECI used toward agreeing lump sum construction contracts (only two described cost reimbursement or target value contracts). The first stage head contract can be competitively tendered based on fixed price P&G and margins for subcontractors. Once appointed, the head contractor can competitively tender the subcontract packages. Subcontractors may be attracted to 2S-ECI over traditional open tenders, when they perceive better odds of securing contracts (as selected tenderers), though this may inflate their prices. It is not possible to eliminate market pressures. For example the only subcontractor offering specialist piling equipment can hold their price regardless of the procurement system. Pricing the P&G consumes less resource than pricing the whole construction works in traditional tenders. In this way, 2S-ECI could reduce industry tendering costs, by eliminating unnecessary duplication (three contractors).

Clients may pay a premium for early involvement due to less competitive tension (seven interviewees, mixed disciplines) with contractors incentivised to submit the highest justifiable rates through negotiation, rather than the lowest possible tender price. The open-book negotiation may require more accurate pricing because 'contractors can't just bury risk within their pricing' (contractor), supporting that 2S-ECI reduces unnecessary pricing assumptions (Mosey, 2011). However, PQSs may incur considerably more work, evaluating head contractor rates and subcontractor terms ('de-tag'). There were mixed views from consultants about whether they increased their fees for 2S-ECI. However according to a PQS working on large projects in the heated Auckland market:

*Our procurement fee is often now 4 to 6 times bigger for ECI and 2 stage (or more) procurement with multiple trade reviews and recommendations. This is regardless of schedules. Even without Schedules, a single trade review, detag and rec could be as much QS time as if we did schedule and then review trade. Depends how good or motivated the Contractors QS is on their review and detag, too often they have inexperienced guys who just throw money at each and every sub tag (& not what the contractor would be doing with subs on a competitive bid!!!) and then we sort it out / push back / reject/ redo – sometimes 10 weeks for a single trade on big jobs.*

Other factors influencing the effect on overall project costs include whether the contractor charges for their early involvement (15 interviewees, mixed disciplines), whether the contractor or PQS measure schedules of quantities (seven interviewees, PQSs and contractors) and how much real value is added by the contractor. The following client statement expresses a commonly held view:

*The theoretical benefits of ECI may not be realized, if the contractor does not provide effective planning, buildability and value management services.*

2S-ECI may help to address the cyclic market pressures of the construction industry, and reduce overall tendering costs. The more open-book approach may discourage contractors from disclosing excessive profit margins during heated markets (three contractors). Equally they should rely on fair margins during downturns. Under 2S-ECI, only one head contractor prices the construction works and selects subcontractors. This avoids unnecessary cost duplication of industry procurement costs compared with traditional tenders. Relying on competitive bidding is considered inefficient for procuring customized products in Lean Construction (Elfving, *et al.*, 2005). Pheng, *et al* (2015) found that ECI can improve Lean efficiency through reducing non-value-adding activities. Reducing wider procurement costs is an example of this. Ma and Xin (2011) highlight the waste associated with multiple contractors investing their own resources on investigation and design analysis in traditional tenders, when they typically have a one-in-three change of winning the bid. The *Project Procurement and Delivery Guidance Using Two Stage Open Book and Supply Chain Collaboration* (King's College London, 2014) also provides that 'the two—stage open book model reduces industry bidding costs.' However, this should be balanced against potentially higher consultant fees, whether the contractor charges for early involvement and the actual added value, something difficult to measure (11 interviewees, mixed disciplines).

Price certainty can be considered at two stages; pre-construction and construction. The general consensus amongst interviewees was that 2S-ECI could improve final price certainty through planning and de-risking, to reduce contract variations, though there may be less price certainty at the pre-construction stage (five interviewees, mixed disciplines). Most interviewees (17 interviewees, mixed disciplines) felt there was at least a moral obligation on contractors to minimise variation claims following early involvement, but none were able to articulate any actual contractual implications.

### **Risk management**

Key factors that affect project outcomes, such as time and price certainty, include the quality of design documentation at the time of agreeing fixed price construction contracts, unclear procurement processes and contract documentation, design obligations transferred to contractors, and the amendment of standard terms transferring contractual risks onto contractors. Eleven interviewees (mixed disciplines) identified declining quality of design documentation over the past five to ten years, as a problem in New Zealand construction, with some specifically relating this to increased variations, and therefore impacting price certainty. One contractor called it crucial to have quality design documentation at the time of entering fixed price contracts. A client described a budget blowout when using 2S-ECI and agreeing a fixed price contract based on incomplete design:

*Contractor agreed a fixed lump sum price before all subcontractors were procured based on an incomplete design. As the design developed, substantial unforeseen circumstances were encountered. This resulted in substantial contract variations. Original estimate \$120 million. Now \$270 – 300 million*

Most interviewees (15, mixed disciplines) felt that 2S-ECI can provide better risk management through front end planning. However the early collaboration of 2S-ECI should support 'equitable and clear

allocation of foreseeable and quantifiable risks’, ‘awareness of risks and rewards’ and ‘readiness to compromise on unclear issues’ as key features of relational procurement (Rahman and Kumaraswamy, 2005, p368) and careful risk allocation and clear communication including of an informal nature (Strahorn, *et al*, 2015). Therefore the contractual transfer of risks onto contractors and declining documentation, summarised in table 1, appear to be key challenges.

**Table 1:** Risk management challenges

Risk factors	Comments
Amending standard contract terms	<p><i>We have observed increasing amendments to standard forms of construction contract by clients’ lawyers over the past five years in divisions across New Zealand. This has become the ‘new norm.’ (Contractor)</i></p> <p><i>Approximately 99% of NZS3910 contracts are now being amended. This appears particularly when a consultant PM is involved. A possible reason is PMs trying to demonstrate their own added value. Conversely, NZIA SCC is not amended by the Architects, and PMs typically use NZS3910. (Contractor)</i></p> <p><i>Clients’ lawyers are often amending standard forms of contract (NZS3910). Often the amended terms are larger than the standard terms. ECI enables parties to discuss and manage risks for collaboratively. (Contractor)</i></p> <p><i>No longer see an un-amended NZS3910, including the standard terms. (Contractor)</i></p>
Design obligations transferred to contractors	<p><i>Large international design consultants appear to be pushing more design risk to contractors over the past few years. (PQS)</i></p> <p><i>Contractors can be a target to push risk onto. There appears to be more transfer of design risk onto contractors over the past 10 years. The government should not be driving this. (Contractor)</i></p>
Variable processes	<p><i>Theoretically, the risk management should be better. Can become ‘blurred if you’re not careful.’ (PM)</i></p> <p><i>That is complicated at the moment, because of a lack of clear ECI documents. Lack of clarity means the contractor may have more flexibility to construct stronger arguments. ECI enabled the contractor to get to know the client and their operations: We were able to build relationships between client and contractor. This helped everyone know what was going to happen. (PQS)</i></p> <p><i>Procedures have been informal. It could be problematic to enforce risk onto the contractor through ECI. Trust and relationships are the most important ingredients. (PQS, Dunedin)</i></p> <p><i>Important to set out clear scope of ECI services so everyone is clear about the expectations. (Contractor)</i></p>
Quality of design documentation	<p><i>A key problem is the quality of design documentation. Theoretically, ECI should improve price certainty, but the benefits are not always realised due to quality of design documentation. Designers need more accountability for design coordination to reduce document inconsistencies and ambiguities. (Client)</i></p> <p><i>Full construction drawings are not full construction drawings! There’s a big gap that needs to be filled between the uncompleted design and the construction. (PM)</i></p> <p><i>In New Zealand, there appears to be a growing problem of completed designs not being fully complete. Possible reasons could be tight timing and competitive consultant fees. A PQS could push back and request further detail when preparing their SOQ, but often there</i></p>

	<p><i>are time pressures. A potential benefit of ECI is that contractors could push for completed designs (subject to timing). (PQS)</i></p> <p><i>The quality of design documentation appears to be declining over recent years. This may be attributable to larger design firms that are profit driven and tighter project timeframes. (Architect)</i></p> <p><i>The quality of design documentation appears to have spiralled downwards. Though this could also be a driver for ECI. Before LBP, drawings for building consents could be brief. Then almost too much detail was required. Now some drawings appear embarrassingly lacking. Designer’s workload could be a contributing factor. There seems to be a disparity between designers and council driving information and compliance. (Contractor)</i></p> <p><i>Most variations generate as a result of design drawings, especially for building services. The quality of design documentation seems to be declining over recent years. Local council seems to be approving poor quality documentation. (Contractor)</i></p> <p><i>Over the past five years, design quality has been suffering. (Contractor)</i></p> <p><i>Over the past 5-10 years. The quality of design documentation has reduced. We’re looking at employing our own architect. (Contractor)</i></p> <p><i>The biggest problem in the industry right now is probably the poor quality of design documentation. If Main Contractor ECI is seen as the complete fix to this, it’s often misguided, most main contractors do not have capable or available design managers. A better fix is often earlier involvement of Key subs such as façade, steel, timber frame or mechanical services in the later design phases. The main-contractor ECI is often the conduit for this but is not always necessary. We have had early sub-ECI input/engagement on at least 12 projects in the last 3 years AHEAD of the main contractor. Piling, Steel, Façade, Mechanical, Bathroom pods and lifts are often key to design, consent and or lead times. (PQS)</i></p>
--	---

No interviewees were aware of standard form pre-construction agreements for 2S-ECI. The comments about unclear or variable 2S-ECI processes were mostly from interviewees in the Otago Region where pre-construction agreements were typically verbal or based on invitation letters. More formal pre-construction agreements were used in the larger Auckland Region.

**Project team composition**

Most interviewees felt that project team composition was generally the same as traditional procurement, except that 2S-ECI typically involves a PQS and larger contractor team.

Six interviewees (across disciplines) described contractors generally providing more leadership through 2S-ECI. Contractors can involve their project managers, site managers and senior staff during design development, compared with estimators pricing tender bids. One contractor explained:

*The expectation is a head contractor appointed through negotiated ECI should provide the top team, top programme, top quality, and top safety. Contractor’s Site Manager can be involved in the design team meetings. This provides better integration between the contractor’s estimating and onsite construction teams. An astute contractor with their Site Manager can work with the design team to determine construction detail requirements.*

The majority of interviewees (14 across disciplines) felt that a PQS was needed to provide independent budget advice and negotiate contractor rates. This aligns with the New Zealand Transport Agency (2018) and Ma and Xin (2011). However three contractors contextualized the need for a PQS as dependent on such factors as trust levels between contractor and client, the PQS fee relative to the likely benefit of negotiation, and the level of design standardization. One contractor described some experienced clients accepting their take-offs without engaging a PQS, being comfortable that the contractor provided their open-book workings.

### **Project team relations**

All interviewees felt that 2S-ECI can improve design decisions through faster round-the-table decision-making. Most identified trust as crucial for successful 2S-ECI, supporting findings that trust is a central ingredient of relational procurement (Rahman and Alhassan; 2012; Ross, 2011; Toolanen, 2008; Rahman and Kumaraswamy, 2005).

Three interviewees specifically felt that 2S-ECI can improve levels of trust, though only one contractor described specific partnering workshops. Five interviewees said that the quality of people were important. According to a PQS trust must operate both ways:

*ECI requires trust. There is no sense being too precious about information. Contractors cannot conceal information, and the PQS may discuss budget information to the head contractor before negotiating the rates. Quality of relationships is paramount to the effectiveness of ECI.*

This supports finding by Rahman and Alhassan (2012, p218) that ECI requires ‘open book accounting, and open and honest communication between client, consultant and contractor, including sharing any sensitive information....’

Another PQS linked relationship-building with better forward planning:

*ECI enabled the contractor to get to know the client and their operations: We were ‘able to build relationships between client and contractor.’ This helped ‘everyone know what was going to happen.’*

It is important for contractors to understand their client and their operations when planning the logistics of construction work around ongoing building operations, a project feature identified as particularly suited to 2S-ECI. One contractor suggested 2S-ECI could be improved through more active client involvement, supporting (Kings College London, 2014; Ma and Xin, 2011; Rahman and Kumaraswamy; 2005).

### **Scope of pre-construction services**

Interviewees identified the following pre-construction services were identified as commonly provided by contractors:

- Construction programme, including logistical planning and project staging;
- Design buildability analysis, including site logistics and temporary works, investigating existing building composition, evaluating interfaces between building elements;
- Subcontractor procurement on an open-book basis;
- Value management input, including exploring alternative systems and materials for structure, envelope and interiors and presenting options for client consultant team;

- Contributing budget information to the PQS;
- Involving specialist subcontractors for design contribution or advice.

Other less commonly provided pre-construction services include:

- Design management,
- Building information modelling (BIM),
- Providing online document control systems, and
- Liaising with third-party stakeholders and managing resource consent applications where the contractor is involved early in the project, though this was typically done by the client's project manager.

The above pre-construction services align with those identified from literature (Finnie, *et al.*, 2018), though buildability evaluation and risk management tend to be integrated. Only two contractors described formal risk management workshops. One contractor described leading the design management process for a large design and build, target value contract in Wellington. A contractor said they sometimes lead design management ahead of construction only contracts. One Client provided a value management facilitator. For projects utilizing building information modelling (BIM), typically the client owned the BIM model with the contractor inputting shop-drawings to perform clash detection.

Interviewees identified the following services typically provided by clients' PMs:

- Procurement strategy;
- Overall project programme;
- Chair design team meetings and record minutes;
- Contract administration by PM or Architect;
- Generally, act as client representative.

The PM's role may be focused at the front-end of the project. Contract administration may then be done by the PM, the architect, or a combination of both. One contractor described how some projects could potentially transition to a more traditional architect or engineer model for the construction stage.

*PM involvement is in the inception and conception stages. Once the construction stage commences, their services may reduce (as the contract effectively becomes a traditional construction contract following early collaborative planning), depending on the scale of the project.*

A PQS described the potential for duplication in administration:

*Contract administration may be by PM or Architect or Engineer. When PM is the contract administrator, the architect becomes a non-contractual administrator, e.g., provides architect directions for approval and issue by the PM (like other consultants). This can add another layer of complexity and timing.*

Some interviewees (one architect and two contractors) described architects project managing and chairing design team meetings, with the PM acting as client representative.

A key advantage of PMs over architects appears to be challenging the design. However, some interviewees raised concerns over PM performance. According to one architect: *‘Some add real value while others tend to “clip the ticket”’*, a contractor said *‘Sometimes PMs can tend to act as letterboxes’*, and a client said they have *‘sometimes struggled with performance of local PMs. More recently we are seeing larger PM consultants from outside local area that perform well coming into the local market.’* The potential variance in PM performance aligns with Gould (2011) who described project management as an emerging discipline, and identified the need for PMs to act persuasively in conducting their central role of client representation, and not merely act as a ‘post box’.

### Quality of pre-construction services

Most interviewees (across disciplines) saw benefits in the early collaboration of 2S-ECI. However, 11 interviewees perceived a lack of pre-construction skills as a barrier to achieving real added value. Fourteen Interviewees (all disciplines) identified upskilling in pre-construction services as a way to improve 2S-ECI. Specific skills identified include value management, design buildability evaluation, and design coordination. Tables 2 and 3 exemplify the comments relating to contractors and then consultants.

**Table 2:** Pre-construction services by contractors

Contractor services	Comments
Lack of ECI maturity	<i>Theoretically 2S-ECI should reduce claims and disputes. However, in practice many contractors don’t understand the ECI process. The lack of contractor maturity with ECI means you don’t get the benefits.</i> (Contractor)
Lack of understanding	<i>In practice, the full benefits may not always be realised. Some contractors may not properly understand the ECI process and the different approach needed.</i> (Contractor)
Real added value added	<i>Theoretically, ECI should reduce administration and disputes, but this can depend on other factors, such as the real value offered by contractors.</i> (PM)
Effective planning, buildability and value management	<i>The contractors ECI advice is often then about how to de-risk it for the contractor and make it easier and simpler to build. Need specialist ECI skills (buildability and genuine value management) – absolutely without them no genuine ECI.</i> (PQS)  <i>The theoretical benefits of ECI may not be realised if the contractor does not provide effective planning, buildability and value management services.</i> (Client)

**Table 3:** Pre-construction services by consultants

Consultant services	Comments
Need more accountability for design coordination	<i>Designers need more accountability for design coordination to reduce document inconsistencies and ambiguities.</i> (Client)
Questionable design coordination capability of designers. ECI could help	<i>Questionable whether designers are able to coordinate design development effectively. Most failings seem to occur here. ECI may help if contractors can provide these skills. People able to coordinate designs well are ‘worth their weight in gold.’</i> (Client)
Need more skilled design managers and experienced Site Managers	<i>Need resource (across all sides of the table), specifically more skilled design managers (many projects don’t have them), more experienced site managers</i>

	<i>giving advice who know how to build (and not fresh faced “paper” PM’s out of school). (PQS)</i>
Lack of design management capacity and design risk transfer	<i>NZ contractors lack the capacity to manage the design of very large projects. There appears to be a growing problem of designers trying to transfer more risk to contractors and contractors wanting more design work provided for them. Transferring excessive risk to contractors can either increase the project cost (as contractor’s price for the risk) or create major problems as the contractor incurs large losses. (PM)</i>  <i>Performance-based specifications are being used to transfer more design risk to contractors. Over the past 5-10 years, the quality of design documentation has reduced. We’re looking at employing our own architect. (Contractor)</i>
Diminishing role of the Architect with introduction of PMs	<i>The architect’s role has been diminished by the introduction of consultant PMs and franchise house builders. (Architect in Dunedin)</i>  <i>There is often no longer a lead architect. This can create more design coordination issues. (Contractor)</i>
Inclusion of subcontractors for design and coordination	<i>Successfully, we are often looking at the bits we need to solve via ECI and then actually doing it without the main builder by engaging with the sub-contracting market (“subbie ECI”). Facades, Steel, Lifts, Piling are some of these. We had a façade contractor in the design team meetings before concept design had even been drawn on one job. The fully coordinated fully shop drawn steel and façade drawings are proving a massive benefit. (PQS)</i>

The move away from architect led designs, and questions around design management support earlier findings that Architects can feel intruded on when design management is performed by another party (Tzortzopoulos and Cooper, 2007; Bresnen, 1991) and that architects can struggle to find their place (Whitehead, 2009).

Some contractors are developing their pre-construction services. One contractor employed a services manager in one division to evaluate building services designs, and a contractor was looking to employ an architect as part of their ECI team to address the declining quality in design documentation. Khalfan and McDermott (2007) described a United Kingdom construction company who developed a pre-construction department for project management, financial and productivity issues at inception phases of projects. There was no evidence of New Zealand contractors being engaged separately for the pre-construction stage, with the construction stage tendered to others. Indeed five interviewees (across disciplines) specifically highlighted the advantage of communicating pre-construction thinking across construction-stage site teams and potential involvement of site managers in the contractor’s ECI team.

### Clarity of 2S-ECI processes

The lack of clear definition of 2S-ECI (or ECI) and associated contractual documentation was an area of concern. In the absence of clear contractual procedures, one architect warned (similarly to Murdoch and Hughes, 2008, p74) that 2S-ECI could simply be a marketing ‘buzz-word’ to describe a process for negotiating construction contracts rather than a genuine process to add value. Seventeen interviewees (across disciplines) felt that 2S-ECI could be improved with clearer pre-construction agreements, in particular to set out the scope of pre-construction services and expected obligations of parties. Ten interviewees specifically recommended developing a NZ standard form pre-construction services agreement (PCSA). For clients and consultants looking to use 2S-ECI for the first

time, there seems no clear avenue for processes or contract documentation, leaving parties to 'feel their way', particularly outside Auckland where practices remain informal.

PQS:

*Lack of clear procedures can mean that client's expectations are not met, and parties' responsibilities are not defined. This can leave everyone to 'feel their way.'*

Contractor:

*No standard ECI documentation. Typical documentation comprises an invitation to treat, offer and acceptance. Sometime invitation can be very brief. Tend to 'feel our way', do what feels right.*

Contractor:

*Lack of clear contractor responsibilities; lack of ECI documentation; everyone is feeling their way.*

PQS:

*No standardised documentation for ECI. Client prepared a complicated ECI contract, and 'no one knew how to handle it.'*

In the absence of clear contract provisions and measurable outcomes, it is perhaps unsurprising that 17 interviewees (across disciplines) perceived client and consultant attitudes towards 2S-ECI as a barrier to its uptake, with some recommending further education in this area. This supports earlier findings (Turner and Riding, 2015; Pheng, *et al.*, 2015; Mosey, 2011; Whitehead, 2009).

## CONCLUSIONS

2S-ECI seems most commonly used as a two-stage process to engage head contractors during design development to provide a range of pre-construction services ahead of agreeing lump sum construction-only contracts.

The main drivers when considering whether to use 2S-ECI include securing resources in markets, maintaining client/contractor relationships, planning the logistics of construction around existing operations, or providing specific design buildability and value management advice. 2S-ECI may be particularly beneficial for projects where the cost of disruption might outweigh any premium paid for the benefit of logistical planning and reliability, such as airport extensions or hospital alterations. Specialist subcontractors may be involved via a head contractor or independently to provide design input for the likes of facades, structural steel, lifts, and piling.

2S-ECI may help to address the cyclic market pressures of the construction industry, and reduce overall tendering costs. The more open-book approach may discourage contractors disclosing excessive profit margins during heated markets. Equally they should be able to rely on fair margins during downturns. However this should be balanced against potentially higher consultant fees, whether the contractor charges for early involvement and the actual added value, something difficult to measure.

Contractors appear to bring greater leadership to the table through 2S-ECI and, regardless of the actual value management and buildability input provided, are able to better plan construction and

integrate early planning with their site teams. This is particularly beneficial given that 2S-ECI was found particularly suited to projects requiring logistical planning of construction to existing client operations.

Key challenges of 2S-ECI include:

- Lack of clear contractual procedures and pre-construction contract documentation, leading to unclear obligations and expectations;
- Reluctance from clients and consultants, perceived lack of competitive tensions, and difficulty measuring added value;
- Lack of genuine quality pre-construction services,
- Increased risk transfer to contractors through amended standard from contract terms and performance-based specifications; and
- Declining quality of design documentation possibly attributable to design coordination capability.

Opportunities to improve 2S-ECI include:

- Standardizing pre-construction contracts with pre-construction milestones, scope of services and obligations and the flexibility to suit client preferences and project types;
- Educating clients and consultants including around expectations and timing of contractor involvement;
- Developing contractual mechanisms for specialist subcontractor early input;
- Contractors developing specialist ECI skills, particularly in value management, design buildability and coordination.

Risk management and buildability analysis appear integrated. Buildability analysis includes logistical planning of construction around existing client operations; analysis of design risk in terms of constructability and resource and systems availability.

Increased risk transfer to contractors through widespread amending of standard terms and increased design obligations, coupled with declining design documentation expressed by interviewees across New Zealand is of real concern. This aligns with calls from industry bodies to address risk allocation practices in New Zealand procurement.

Further research could explore subcontractor perceptions of 2S-ECI in NZ and optimal contractual processes to engage them either through or independent of head contractors.

## REFERENCES

- Bajari, P. and Tadelis, S. (2001) Incentives versus transaction costs: a theory of procurement contracts. *RAND Journal of Economics*, **32(3)**, 387-407. Available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=193121](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=193121) (Accessed 19 June 2019).
- Bresnen, M J. (1991) Construction contracting in theory and practice: A case study, *Construction Management and Economics*, **9(3)**, 247-262. DOI: 10.1080/01446199100000021
- Cheng, E. and Li, H. (2004) Development of a practical model of partnering for construction projects, *Journal of Construction Engineering and Management*, 130(6).
- Elfving, J A., Tommelein, I D. and Ballard, G. (2005) Consequences of competitive bidding in project-based production, *Journal of Purchasing and Supply Management*, **11(4)**, 173-181.
- Farooqui, R. and Ahmed, S. (2008) Assessment of constructability practices among general contractors in Pakistan's construction industry. *CIB Construction in Developing Countries International Symposium "Construction in Developing Countries: Procurement, Ethics and Technology"* 16 – 18 January 2008, Trinidad & Tobago, W.I.
- Finnie D, Ameer Ali, N. and Park, K (2018) Enhancing offsite manufacturing and prefabrication through early contractor involvement (ECI) in New Zealand. *Management Procurement and Law*. DOI: 10.1680/jmapl.17.00029
- Francis, S. and Kiroff, L. (2015) Attitudes and perceptions towards early contractor involvement procurement. RICS Cobra 2015. Available at: <http://unitec.researchbank.ac.nz/bitstream/handle/10652/3179/Attitudes%20and%20Perceptions%20.pdf?sequence=1&isAllowed=y> (Accessed 19 June 2019).
- Gameson, R. and Sher, W. (2009) An investigation into perceptions of client- professional interactions at project inception: an Australian clients' perspective: pilot study results. In: Dainty, A. (Ed) *Procs 25<sup>th</sup> Annual ARCOM Conference*, 7-9 September, Nottingham, UK, Association of Researcher in Construction Management, 187-92. Available at: [http://www.arcom.ac.uk/-docs/proceedings/ar2009-0187-0195\\_Gameson\\_and\\_Sher.pdf](http://www.arcom.ac.uk/-docs/proceedings/ar2009-0187-0195_Gameson_and_Sher.pdf) (Accessed 19 June 2019).
- Gil N, Tommelein, ID. and Ballard, G. (2004) Theoretical comparison of alternative delivery systems for projects in unpredictable environments, *Construction Management and Economics*, **22(5)**, 495-50.
- Gould, N. (2011) *Project management: the liability and standards expected of a project manager*. Available at: <https://www.fenwickelliott.com/research-insight/articles-papers/project-management-liability-and-standards-expected-project-manager> (Accessed 19 June 2019).
- Harris, C. (2018, October 20). Picking up the pieces: The story behind the Ebert Construction collapse, *Stuff*. Available at: <https://www.stuff.co.nz/business/property/106238607/picking-up-the-pieces-the-story-behind-the-ebert-collapse> (Accessed 19 June 2019).
- Hutching, C. (2018, December 10). Collapsed Corbel owes more than \$5m says liquidator, *Stuff*. Available at: <https://www.stuff.co.nz/business/109133826/liquidator-identifies-collapsed-corbels-assets> (Accessed 19 June 2019).

ICE. (2014) *Nec3: early contractor involvement*. Available at: [https://www.neccontract.com/getmedia/9c65871f-bfae-405e-9769-13f7627014c5/NEC\\_ECI\\_Jan2016-Web.pdf.aspx](https://www.neccontract.com/getmedia/9c65871f-bfae-405e-9769-13f7627014c5/NEC_ECI_Jan2016-Web.pdf.aspx) (Accessed 19 September 2019).

JCT. (2018) *Agreements*. Available at: <https://www.jctltd.co.uk/category/agreements> (Accessed 19 June 2019).

Jergeas, G. and Van der Put, J. (2001) Benefits of constructability on construction projects, *Journal of Construction Engineering and Management*, **127(4)**, 281-90.

Jorgensen, B. and Emmitt, S. (2007) Integrating design and construction from a 'lean perspective', *CIB World Congress*, CIB2007-217.

Kashiwagi, D., Kashiwagi, J. and Savicky, J. (2009) Industry structure: misunderstood by industry and researchers. *NED University Journal of Research*, **6(2)**, 59+. Available at: <http://go.galegroup.com/ps/anonymou?id=GALE%7CA297138424&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=10233873&p=AONE&sw=w> (Accessed 19 June 2019).

Khalfan, M. and McDermott, P. (2007) 'Introducing innovative procurement methods for supply chain integration: Implementing the challenge', in Carla de Jager (ed.) *Proceedings of CIB World Building Congress 'Construction for Development' 2007*, Cape Town, South Africa, 14-17 May 2007, pp. 802-813. Available at: <https://www.irbnet.de/daten/iconda/CIB4841.pdf> (Accessed 19 June 2019).

King's College London. (2014) Project procurement and delivery guidance using two stage open book and supply chain collaboration. Available at: [http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Two\\_Stage\\_Open\\_Book\\_Guidance.pdf](http://constructingexcellence.org.uk/wp-content/uploads/2015/12/Two_Stage_Open_Book_Guidance.pdf) (Accessed 19 June 2019).

Laryea, S. and Watermeyer, R. (2016) Early contractor involvement in framework contracts. *Proceedings of the Institution of Civil Engineers – Management, Procurement and Law*, **169(1)**, 4–16. DOI: 10.1680/jmapl.15.00012.

Ma, T. and Xin, H. (2011) Early contractor involvement - South Australian experience. 36th Australasian University Building Educators Association (AUBEA) Conference. Paper 7. Available at: [https://find.library.unisa.edu.au/primo-explore/fulldisplay?docid=UNISA\\_ALMA11143265660001831&vid=ROR&sortby=rank&lang=en\\_US](https://find.library.unisa.edu.au/primo-explore/fulldisplay?docid=UNISA_ALMA11143265660001831&vid=ROR&sortby=rank&lang=en_US) (Accessed 19 June 2019).

Mbachu, J. and Taylor, S. (2014) Contractual risks in the New Zealand construction industry: analysis and mitigation measures. *International Journal of Construction Supply Chain Management*, **4(2)**, 22-33. DOI: 10.14424/ijcscm402014-22-33

Menches, C L. and Chen, J. (2012) Facilitating team decision-making through reimbursable contracting strategies. *Canadian Journal of Civil Engineering*, **39(9)**, 1043-1052. DOI: 10.1139/l2012-052

Mosey, D. (2011) *The strengths of early contractor procurement*. Society of Construction Law UK, 171. Available at: <https://www.scl.org.uk/papers/strengths-early-contractor-procurement> (Accessed 19 June 2019).

Murdoch, J. and Hughes, W. (2008) *Construction contracts law and management*, 4th edn. New York, USA, Taylor & Francis.

NZIOB. (2019) The best of times, the worst of times – by Malcolm Fleming. Available at: <http://www.constructionnews.co.nz/opinion/the-best-of-times-the-worst-of-times-by-malcolm-fleming?A=SearchResult&SearchID=12190984&ObjectID=3565117&ObjectType=35> (Accessed 19 June 2019).

NZIQS. (2018) Enhancing NZ's construction industry: a briefing from the NZ Institute of Quantity Surveyors. Available at: <https://www.nziqs.co.nz/Resources-Tools/News/News-Media-Releases/ID/97/Enhancing-NZs-Construction-Industry-A-briefing-from-the-NZ-Institute-of-Quantity-Surveyors> (Accessed 19 June 2019).

New Zealand Transport Agency. (2018) *Procurement*. Available from: <https://nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/procurement/> (Accessed 19 June 2019).

Pheng, L., Gao, S. and Lin, J. (2015) Converging early contractor involvement (eci) and lean construction practices for productivity enhancement some preliminary findings from Singapore. *International Journal of Productivity and Performance*, **64(6)**, 931-852

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

Rahman, M M. and Kumaraswamy, M M. (2005) Assembling integrated project teams for joint risk management. *Construction Management and Economics*, (May 2005) 23: 365-375. DOI: 10.1080/0144619050004083

Rahmani, F., Khalfan, M. and Maqsood, T. (2014) The use of early contractor involvement in different countries. In Tak Wing Yiu, Vicente Gonzalez (ed.) *Proceedings of the 38th AUBEA Conference*, Auckland, New Zealand, 20-22 November 2013, 1-10.

Robson, C. (2002) *Real world research*. 2nd edn, Oxford, UK, Blackwell Publishing.

Ross, A. (2011) Supply chain management in an uncertain economic climate: a UK perspective, *Construction Innovation*, **11(1)**, 5-13.

Rowlinson, S. and McDermott, P. (1999) *Procurement systems a guide to best practice in construction*. London, UK, Routledge.

Song, L., Mohamed, Y. and AbouRizk, S. (2006) Evaluating contractor's early involvement in design. *2006 AACE International Transactions*.

Strahorn, S., Gajendran, T. and Brewer, G. (2015) The influence of trust in traditional contracting: Investigating the 'lived experience' of stakeholders. *Journal of Construction Economics and Building*, **15(2)**, 81-101.

Toolanen, B. (2008) Lean contracting relational contracting influenced by lean thinking, Unpublished PhD Thesis, Division of Structural Engineering Department of Civil and Environmental Engineering, Lulea University of Technology. Available at: <https://www.diva-portal.org/smash/get/diva2:990225/FULLTEXT01.pdf> (Accessed 19 June 2019)

Turner, N. and Riding, M. (2015) Early contractor involvement in Australia: Learnings from transfield service projects, *Small Enterprise Research*, **22(2-3)**, 173-184. DOI: 10.1080/13215906.2015.1061724

Tzortzopoulos, P. and Cooper, R. (2007). Design management from a contractor's perspective: the need for clarity. *Architectural Engineering and Design Management*, **3(1)**, 17-28.

Walker, D. and Vines, M. (1997) Construction time performance in multi-unit residential construction: insight into the role of procurement methods. In: Stephenson, P (Ed.), 13th Annual ARCOM Conference, 15-17 September 1997, King's College, Cambridge. Association of Researchers in Construction Management, Vol. 1, 93-101. Available at: [https://www.researchgate.net/publication/267262829\\_CONSTRUCTION\\_TIME\\_PERFORMANCE\\_IN\\_MULTI\\_UNIT\\_RESIDENTIAL\\_CONSTRUCTION\\_INSIGHTS\\_INTO\\_THE\\_ROLE\\_OF\\_PROCUREMENT\\_METHODS](https://www.researchgate.net/publication/267262829_CONSTRUCTION_TIME_PERFORMANCE_IN_MULTI_UNIT_RESIDENTIAL_CONSTRUCTION_INSIGHTS_INTO_THE_ROLE_OF_PROCUREMENT_METHODS) (Accessed 19 June 2019).

Whitehead, J. (2009) Early contractor involvement – the Australian experience. *Construction Law International*, 4(1), pp. 20-26.

Zuo, K., Wilkinson, S. and Seadon, J. (2013) A case study of construction productivity after the 2011 Christchurch earthquake in New Zealand, In Prof. S. Kajewski, A/Prof. K Manley and Prof K Hampson (Eds.) *Proceedings of the 19th CIB World Building Congress 2013*, Brisbane, Australia.

Zuo, J. and Zillante, G. (2006) Relationship contracting: the South Australian experience- a case study. *Australasian Journal of Construction Economics and Building*, (6)2, 20-31. Available at: <https://epress.lib.uts.edu.au/journals/index.php/AJCEB/article/view/2981> (Accessed 19 June 2019).