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TRADITIONAL TENDER VERSUS EARLY CONTRACTOR INVOLVEMENT (ECI): A COMPARATIVE ANALYSIS OF WORK HOURS

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ABSTRACT

The strategy of Early Contractor Involvement (ECI), wherein contractors participate in a project's design and planning stages, is seen as an effective approach to address inefficiencies and complex interpersonal dynamics of construction projects. These challenges arise from contracting and procurement systems that do not promote collaboration, leading to delays and increased costs. Tendering, marked by competition and unpredictability, mirrors the industry's fragmentation and waste. Contractors face issues such as scope ambiguity, flawed documentation, market volatility, strict deadlines, and probity. This paper conducts a comparative analysis of two infrastructure projects in Australia, involving a tier 1 Contractor. Each project underwent both a traditional tender and ECI, facilitating comparisons. The results indicate that ECI tends to extend the time and resources utilized by contractors, with Project 1 and Project 2 experiencing increases of 12 weeks and 10 weeks, respectively, along with additional work hours and personnel. Despite ECI increasing time and resources, it improves the tendering process by enhancing certainty, focus, and communication.

KEYWORDS

Collaboration, Tender, Workhours, Collaborative Project Delivery.

INTRODUCTION

Current practices in contracting and procurement contribute to financial waste and hinder collaborative initiatives (Farrell & Sunindijo, 2022). Projects, especially those that are intricate and dynamic, exhibit low productivity, delays, and frequently surpass budgetary limits (Kim et al., 2016). Within project, tendering is a specific stage in the construction industry burdened with inefficiencies, uncertainties, and challenges related to resource allocation. Primary contractors wrestle with the task of securing projects through competitive pricing while avoiding potential cost overruns (Urquhart & Whyte, 2020). Addressing these inefficiencies not only promises clients and contractors increased certainty in tender outcomes but also facilitates smoother handovers to site teams and empowers contractors to trim business expenses or bid for additional work.

The incorporation of the lean philosophy into construction management seeks to maximize value while minimizing waste. A key aspect of this philosophy is the collaborative nature with anticipated engagement of relevant stakeholders. This includes Early Contractor Involvement

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(ECI), which entails the early introduction of the contractor into a project's lifecycle. Typically, ECI involves the contractor providing design, pricing, and scheduling inputs before the primary contract is awarded (Rahman & Alhassan, 2012). This practice generally fosters improved relationships between clients and contractors, enhances constructability, and promotes shared risk. Indeed, innovative project delivery approach (e.g. Integrated Project Delivery, Strategic Partnerships, etc) have been shown to improve overall projects performance (e.g. Paulsen et al. 2023, Hanna et al 2023, Mavik et 2021).

ECI is perceived as valuable for contractors, enhancing productivity during construction (Pheng et al. 2015, Rahman and Alhassan 2012). However, the impact of ECI on the internal operations of contractors remains unexplored, specifically at the tendering stage. Furthermore, there is a lack of consensus in the limited literature concerning its influence on resourcing. While Gransberg (2013) and Pheng et al. (2015) argue that contractor design inputs and concurrent planning can expedite the preparation phase, reducing it by 30-40% according to Mosey (2009), Malvik et al. (2021) present case study evidence suggesting that ECI may extend procurement timelines. Differently, Sødal et al. (2014) observed an increase in time and resources during the design and preparation phases. Additionally, Greenhalgh (2013) emphasised a heightened presence of senior staff during the early stages due to ECI.

This research aims to investigate the effects of ECI on the tendering process and assess the value it may offer. Specifically, it seeks address the following question: (i) What effects does ECI have on the length and resource use (staff numbers, hours, and disciplines) for contractors compared to Traditional tender? This paper is based on the final year undergraduate thesis developed by the first author of this manuscript.

COLLABORATIVE PROJECT DELIVERY MODELS

Non-traditional or collaborative project delivery models (e.g. Integrated Project Delivery - IPD, Strategic Partnerships, etc) are believed to increase the quality of constructing products, while lowering overall costs, and expediting completion times. Indeed, a number of studies set out to assess the performance such models and/or compare these against their traditional counterparts, notably Design-Build (DB) or Design-Bid-Build (DBB) (e.g. Suttie 2013, Assainar and El Asmar 2014, Ibrahim and Hanna 2019, Kulkarni et al. 2012). Kulkarni et al. (2012) examined two proxies for IPD and DBB, respectively, CM-at-Risk (CMR) and Competitive Sealed Proposal (CSP). It was found that the overall cost is more reliable for CMR projects and that reducible changes for error, omissions and design modifications is also lower. Ibrahim and Hanna (2019) examined a data set of 109 projects delivered using DB, DBB, CMR, or IPD and found statistically significant differences among these models in five performance areas (cost, schedule, quality, communication, and change management). The pairwise of comparison of the models also showed that DBB performs noticeably worse than the others, in particular IPD. Assainar and El Asmar (2014) examined the two non-traditional collaborative approaches: (i) Contractor and Subcontractor's involvement in the design phase, and (2) Architect or Engineer (A/E)'s involvement in the construction phase. Statistical tests using performance scores for 30 construction projects complete in the US show that non-traditional approaches are significantly linked to improvement in project quality.

Such studies attest the benefits attained with the integration and collaboration of all stakeholders in early stages of a project. This includes ECI, however, thus new model does alter Contractor's traditional ways of working, particularly during the early non-construction stage. Indeed, the impact of Early Contractor Involvement (ECI) on tendering and its effect in the contractor resourcing is less explored. According to Pheng et al. (2015), ECI typically involves a "two-stage tendering" approach, where, in the initial contract, contractors provide design advice, address key risks, and work towards a target price before the main construction contract is awarded (Pheng et al. 2015). By adopting this initial appointment approach, contractors can differentiate themselves based on experience and capability, moving away from a sole reliance on price (Love et al., 2014). Love et al. (2014) further contend that, even if not all contractors are proficient in ECI, it could still be applied in situations where competitive tendering is limited. Malvik et al. (2021) explored projects with extended procurement phases involving collaboration and negotiation with multiple contractors to establish competitive pricing. For ECIs where contractors contribute to design, this involvement leads to an increase in time and resources during the project's early stages (Sødal et al. 2014). On the other hand, the simultaneous development of project aspects can reduce preparation time (Pheng et al. 2015), a notion supported by Mosey (2009), who quantifies time savings of up to 30-40%.

Gransberg (2013) suggests that procurement times can be reduced through contracting procedures and aggressive deadlines rather than relying on ECI alone. However, contractors' inputs can expedite the design process (Gransberg 2013). Both contractors and clients commonly allocate senior staff to play more substantial and prolonged roles in the early stages of a project, characterized by potential reimbursement of costs but relatively low profit margins (Greenhalgh 2013). Furthermore, project teams, including seasoned project engineers, may be extensively engaged for tasks such as estimating, scheduling, and procurement, as emphasized by Migliaccio and Holm (2018). Long-term benefits in tender resourcing are also recognized by various researchers, such as the reduction of arbitrary tendering highlighted by Love et al. (2014) and the generation of more consistent work streams suggested by Song et al. (2009). Mosey (2009) contends that, even in cases where upfront costs do not necessarily decrease, the initial investment is anticipated to yield enduring advantages.

RESEARCH METHOD

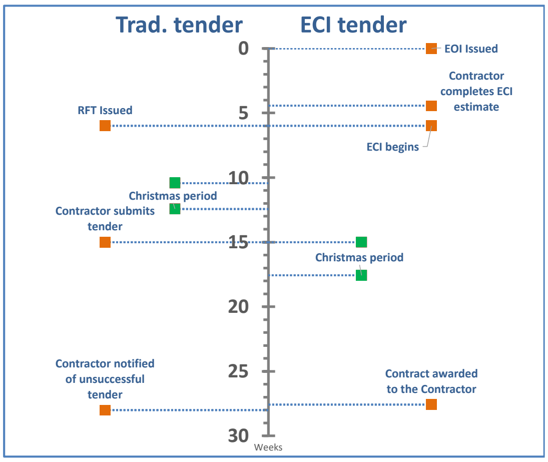
This study focuses on the Tender Process, encompassing the development and submission of pricing, programs, and necessary documentation to compete for project awards, along with associated negotiations and planning, prior to contract execution. Traditional Tendering is operationally defined as the contractor's unpaid development of a tender submission in response to a Request for Tender (RFT) to vie for a project. Early Contractor Involvement (ECI) is conceptualized as a process wherein a contractor is engaged by a client, typically for a fee, at an earlier project stage, offering various services involving design inputs, scope definition, and budget pricing. The tender process, involving pricing development and persuading clients to award contracts, is inherently integrated into this ECI phase. Notably, both examined projects were tendered under both traditional and ECI models.

PROJECTS 1 AND 2

'Project 1' entailed remediation of control systems and valves for a state-owned corporation, denoted as 'Principal 1' (Figure 1a). Having unsuccessfully bid for a Design and Construct (D&C) contract in late 2019 (referred to as 'Traditional'), the Contractor was later appointed as one of two delivery partners in 2021 by Principal 1. The project underwent partial completion, and in 2023, following an Expression of Interest (EOI) directed at the two delivery partners, the Contractor was chosen to enter an Early Contractor Involvement (ECI) stage to evaluate and formulate a scope, subcontracts, pricing, and a program (referred to as 'ECI'). Subsequently, the Contractor secured the Construct-Only contract for the remaining works. 'Project 2' entailed a D&C contract for enhancements and additional filtration facilities at a major water treatment plant for a council, designated as 'Principal 2' (Figure 1b). After being shortlisted following an Expression of Interest, the Contractor submitted a tender proposal in 2021 ('Traditional'). The project experienced a 12-month hiatus before the Contractor was exclusively engaged to undergo an ECI process in 2023 ('ECI'), ultimately securing and executing the contract.

DATA COLLECTION AND ANALYSIS

The data collection involved quantitative data, namely, timesheets for the two projects examined for the traditional and the ECI tender periods, with a further analysis of workhours per discipline for Project 2 (data which is not available for Project 1). Qualitative data was also gathered in the form of six semi-structured interviews involving key pre-contracts and delivery personnel, including a general manager, construction manager, planning manager, and several estimators. A thematic analysis of interviews (Braun and Clarke 2006) method was carried out, in which the transcripts were coded through manual annotation and note-taking, then grouped by theme. This enable uncover distinctive perspectives on the contextual nuances of each project, discern staff perceptions regarding the impact of Early Contractor Involvement (ECI) on tendering, and factors beyond ECI that might have impacted tendering efficiency to be uncovered.



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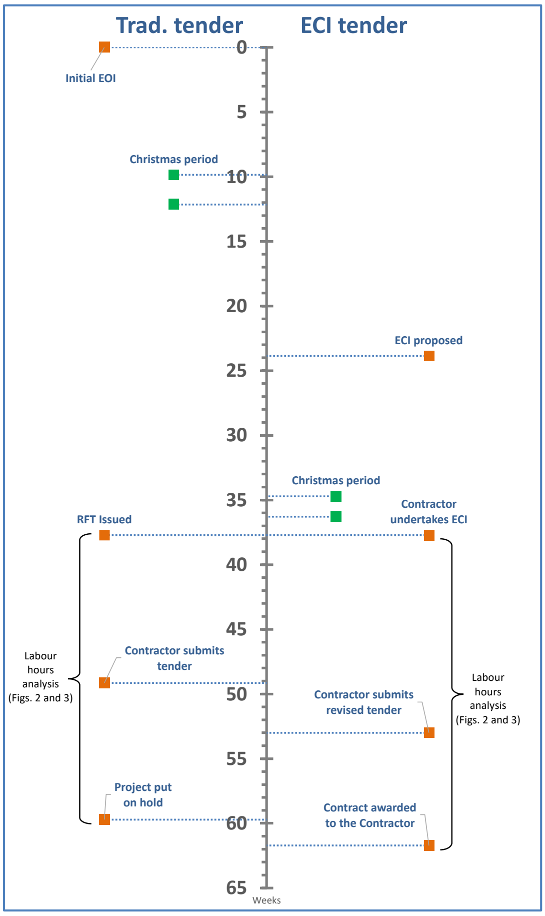


(b)

Figure 1: Timelines for Project 1 (a) and Project (2)

RESULTS

PROJECT 1

Length of the Tender Process

The Request for Tender (RFT) for the Traditional stage was released in Week 6 and concluded on Week 15, spanning a total of 9 weeks, as illustrated in Figure 2. Although the plan aimed for contract award in Week 20, the Contractor received notification of their unsuccessful submission only in Week 28, a delay of 22 weeks post-RFT release. Accounting for a two-week

Christmas shutdown period between weeks 11 and 13, the entire process of developing and submitting the tender extended over 7 weeks, with an additional 13 weeks dedicated to awaiting a response, as depicted in Figure 2. This timeline aligns with insights from an interviewee who highlighted the historical duration of tenders, ranging from 4 to 8 weeks, with some recent instances extending up to 16 weeks.

Preceding the ECI stage, an Expression of Interest (EOI) was initiated in Week 0, with the Contractor submitting their proposal in Week 1, as depicted in Figure 2. One interviewee argued that the EOI could be perceived as a business development activity, similar to the efforts of business development staff in ensuring the Contractor's shortlisting for other tenders. Consequently, the time span between the release of the Request for Tender (RFT) and contract award (Weeks 6 to 28) remained consistent for the ECI, mirroring the timeline observed in the Traditional tender, although the duration of active involvement was notably lengthier. Initial discussions and the preparation of an ECI estimate occurred during Week 5, followed by the commencement of the ECI in the subsequent week. While the contract award was initially slated for Week 13, an interviewee pointed out that the allocated timeframe "*was never going to be enough.*" After several months of additional meetings, presentations, and negotiations, the contract was eventually awarded in Week 28.

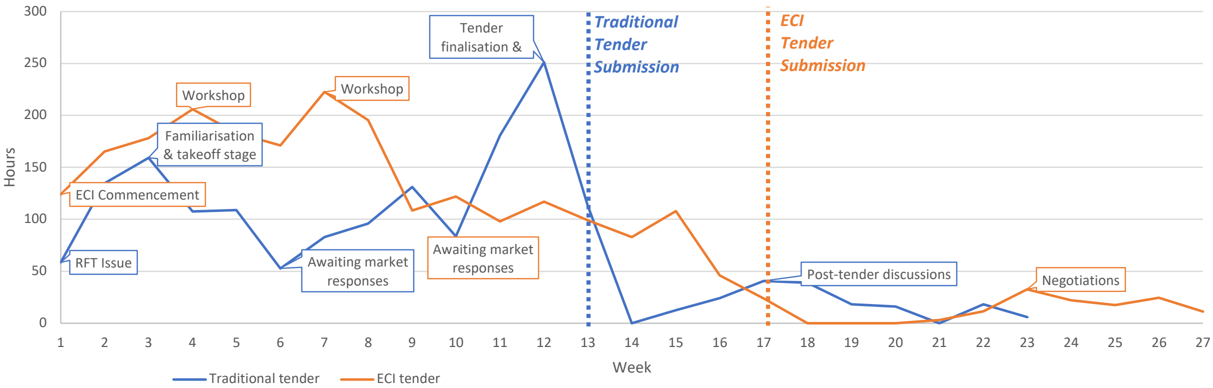


Figure 2: Work Hours Per Week (Project 2)

Views on ECI Impact on Tender Length

Respondents exhibited divergent perspectives on the impact of Early Contractor Involvement (ECI) on tendering duration, reflecting inconsistencies in the existing literature, as observed in the contrast between studies by Sødal et al. (2014) and Pheng et al. (2015). One interviewee asserted an unequivocal extension of the process, with acknowledgment that ECI could have been even lengthier if not for leveraging groundwork from the Traditional tender during the ECI. In contrast, another interviewee emphasized ECI's potential to streamline efforts, allowing the Contractor to approach the market sooner, obtain real-time responses, and expedite the tender process. Project 1 exemplified ECI's capacity to foster collaboration and establish common objectives.

The ECI model was identified as a crucial factor in enhancing efficiency, aligning with insights from Gransberg (2013) on the influence of contracting procedures. Another interviewee concurred, noting that the ECI was approximately four weeks shorter than a typical tender, facilitated by a deeper understanding of subcontractor capabilities and contacts through access to client personnel. Initial concerns about tight timeframes imposed by Principal 1 were addressed, with discussions highlighting scheduled shutdowns and contractual negotiations imposing a hard deadline for the ECI process. Despite varied perspectives on the ECI period's definition, one interviewee revealed a prolonged ECI process marked by extensive project reviews over three months before final pricing, underscoring the lack of consensus in defining the ECI duration.

Overall Resource Usage

One interviewee highlighted the predominant involvement of a single estimator during the Traditional tender, with additional support from undergraduates and site supervisors. In contrast, the ECI witnessed increased participation, encompassing a site team concurrently engaged in another project. Several participants disclosed heightened engagement of construction personnel during the ECI enabling more thorough scrutiny of provided information, provision of advice to estimators, and participation in workshops with Principal 1. The dynamic nature of resourcing during Early Contractor Involvement (ECI) was emphasized, characterized by an initial intensity that could be subsequently increased or reduced based on encountered challenges. The significance of client-funded staffing for the Contractor was underscored, enabling access to vital resources that would otherwise be financially prohibitive. However, the complexity of maintaining the right personnel available for tenders (when projects constitute the primary income source for the Contractor) was highlighted as challenge. Conversely, another interviewee perceived the ECI as a streamlined process primarily orchestrated by management staff—a perspective in alignment with Greenhalgh's (2013) view that such staff plays a more substantial role in ECI tenders compared to traditional ones. Despite the potential similarity in total work hours with the Traditional tender, this interviewee emphasized a more concentrated effort during the ECI, contributing to its perceived brevity.

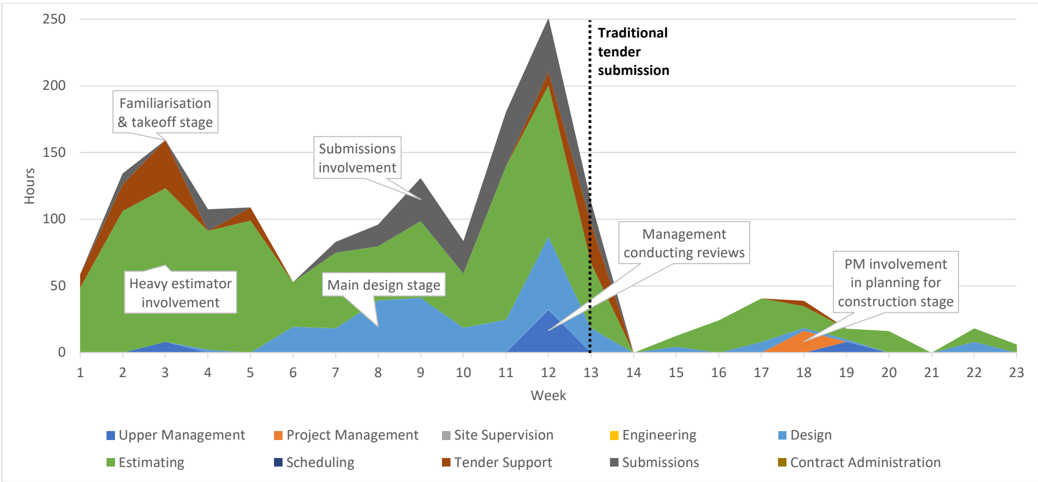
PROJECT 2

Length of the Tender Process

The Traditional tender, characterized as "normal" and akin to typical tenders, extended over 23 weeks, as depicted in Figure 1. The Request for Tender (RFT) process spanned 13 weeks, initiated in Week 38 and concluding in Week 50, aligning with a conventional 16-week Design and Construct (D&C) tender timeframe noted by an interviewee. Figure 1 illustrates an ensuing 10-week period of discussions and negotiations concluding on Week 60. In contrast, consistent with Sødal et al.'s (2014) emphasis on contractor involvement in design, the ECI tender unfolded over 38 weeks, commencing preliminary Early Contractor Involvement (ECI) discussions in October 2022 (Week 24) and culminating in the final contract review on Week 62 (Figure 2). Participants cited increased design inputs and the identification of unforeseen issues as contributors to the extended tender period, enhancing pricing certainty but lengthening the process. Accounting for a two-week Christmas break and a three-week lull post-ECI, a total of 33 working weeks transpired. The ECI stage itself spanned 16 weeks, with the Contractor submitting the revised tender in Week 53. One interviewee highlighted the advanced starting point for the ECI after a two- or three-month traditional tender but suggested minimal impact on the overall process duration. Challenges in obtaining pricing from the supply chain extended the timeline, with one interviewee noting a month spent acquiring competitive market pricing: *"That five months was extended due to some... issues. Responses from the supply chain (were) probably the main issue... (we spent) up to a month getting decent pricing back from the market"*. Additionally, extended pricing negotiations ensued due to hyper-escalation, as observed by a second and third interviewee.

Overall Resource Usage

Figure 2 illustrates the weekly work hours for the Traditional and ECI tenders over time. In the Traditional stage, the total work hours amounted to 1735, distributed among 16 staff members, averaging 108.4 hours per person and 4.7 hours per week. During the RFT stage (weeks 1 to 13), 1560 hours were expended, averaging 5.4 hours per person weekly. Notably, a peak exceeding 150 hours in week 3 (familiarization & take-off stage) was clarified by interviewees as a period involving meetings, document familiarization, and preparation of tender packages for subcontractors and suppliers (Figure 3a). Subsequently, a trough (weeks 5 to 10) occurred while awaiting market responses, succeeded by a peak of 251 hours in week 12 (tender finalization & review) just before tender submission. This peak was succeeded by a substantial decline in work hours, coinciding with post-tender discussions between the Contractor and Principal 2, as noted by one interviewee (Figure 3a).



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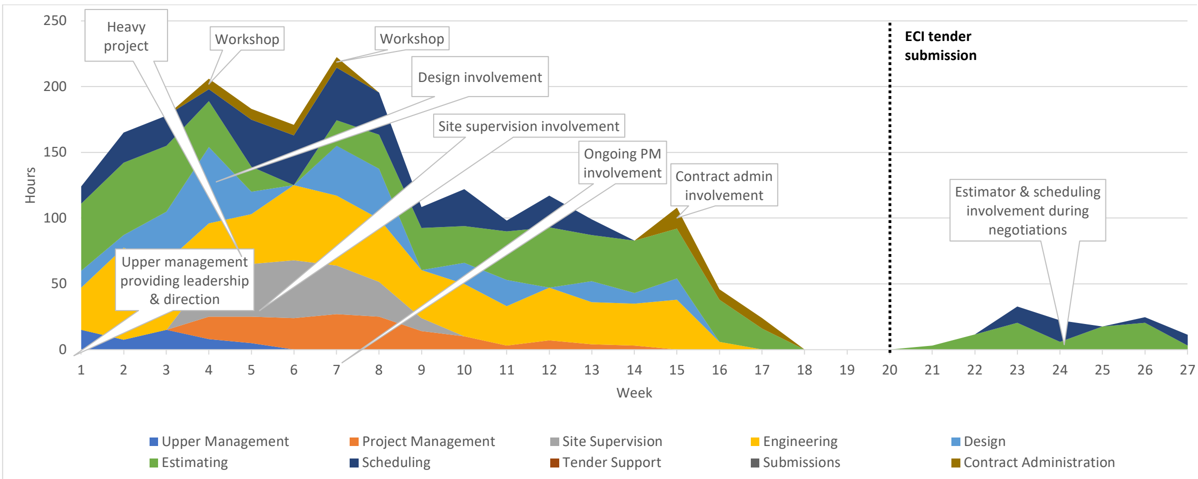

(b)

Figure 3: Work Hours Per Discipline in Project 2: Traditional (a) and ECI (b) tenders

In the ECI, a total of 2880 work hours were expended by 19 individuals, including 4 or 5 full-time staff according to one interviewee. The average total hours per person were 151.6, with a weekly average of 4.6 hours. Work hours prior to ECI tender submission reached 2251, with staff averaging 12.8 hours per week each. The initial 8 weeks were particularly labour-intensive, peaking over 200 hours per week twice. Notably, the ECI involved extensive discussions in the first four weeks regarding the possibility and details of ECI, requiring approximately 100 hours per week from staff before tapering off before the Christmas period. This contrasted starkly with the traditional tender, where discussions on the tender process were unnecessary, and the RFT was issued to shortlisted tenderers. The ECI phase included an average of three client meetings per week, unlike the two key meetings in the Traditional tender – a briefing and a site visit. Peaks during this period, such as those in Weeks 4 and 7 in Figure 3b, can be attributed to key workshops. After the ECI submission, several weeks were dedicated to commercial and contractual negotiations, requiring significantly less time from the Contractor's tendering team.

Interdisciplinary & Interdepartmental Resource Distribution

The timesheet data reveals a significant increase in delivery personnel involvement in the ECI compared to the Traditional stage, including five site supervision staff and two project engineers, while none from either discipline were engaged in the Traditional tender. This observation aligns with insights from multiple interviewees emphasizing the intensive participation of delivery personnel in ECI, often in full-time roles, deviating from the traditional approach of assisting with tenders while concurrently working on-site on other projects. This supports Migliaccio and Holm's (2018) perspective that project teams are more likely to be extensively involved in ECI. Additionally, one interviewee highlighted a related phenomenon: in traditional tenders, on-site staff often work on tenders in their spare time, potentially on weekends, leading to their working hours being predominantly allocated to the concurrent on-site project, which might not be considered a cost of the tender by the business. While it is evident that the implementation of ECI resulted in a substantial increase in the number of hours project staff dedicated to Project 2, the data also underscores a second effect of ECI: more accurate logging of staff hours, partly driven by the requirement to submit payment claims to the client based on staff timesheets.

In the traditional tender process, interviewees highlighted the necessity of a submissions coordinator responsible for organizing site meetings, managing client correspondence, compiling non-price criteria, and creating a polished final submission. In contrast, the ECI process did not require a submissions team, likely attributed to the iterative nature of ECI rather than a single submission event. Additionally, the ECI process involved a contract administrator to handle cost-reimbursable aspects, a role not necessary in the Traditional stage. The discipline with the highest involvement in the Traditional tender was estimating, accumulating a total of 1085 work hours with an average of 270 hours per person, followed by the design and submissions teams with totals of 262 and 203 hours, respectively. Estimators and undergraduates exhibited heavy initial involvement, combining for 534 hours in the first 5 weeks, peaking in week 3 (familiarization & takeoff stage). This aligns with activities such as document review, quantity take-offs, and distribution of tender packages. Design team involvement grew subsequently as the Contractor’s design consultants-initiated work on a tender design. The peak involvement per person for design staff (averaging 40.25 hours per person per week) occurred between Weeks 8 and 9, presumed to be the primary design stage before the final pricing review and submission. Steady involvement from the submissions team paralleled the work of design personnel.

The paid nature of the ECI, a feature not guaranteed in all cases, significantly influenced increased participation from construction personnel and consultants. An interviewee emphasized that the involvement of design consultants in the ECI process would not have been possible without payment from the Principal, aligning with the concerns expressed by Malvik et al. (2021) and Mosey (2009) regarding contractors' reluctance to engage in unpaid ECI work. Estimating remained the most engaged discipline in the ECI, mirroring the total hours in the Traditional tender (1081 hours), while project engineers assumed a more substantial role during the ECI process. This supports Migliaccio and Holm’s (2018) assertions regarding the utilization of experienced project engineers for ECI tenders. The peak during initial discussions (between weeks 2 and 4 in Figure 6) involved extensive estimating efforts (439 hours), 4 hours of senior management input, 8 hours of scheduling contributions to formulate an ECI program, and 56 hours of engineering support.

DISCUSSION

Several interviewees stated that ECI is most suited to complex projects where there is significant uncertainty, such as operational treatment plants like the one in Project 2. Scope definition was one challenge identified, with ECI providing better awareness and understanding of the scope. ECI also reportedly allows the contractor to work with the client to resolve issues due to poor documentation. According to one interviewee, "*the main challenge is (that) we're trying to get the right price*", which is predicated on having the correct information from the client and site. As identified by Tower & Bacarini (2012), this is a fundamentally inexact process. Risks and unknown elements are typically reflected in added risk pricing or tender qualifications. Multiple participants noted that the increased transparency between client and contractor and the additional time spent exploring issues during ECI allow risks to be identified, allocated appropriately, and priced accordingly. One asserted that "*the less uncertainty we have, the more certain we can be on the pricing and the more comfort we can give our senior management that we understand the project*", highlighting the means by which ECI can facilitate more astute business decision-making. For example, in Project 1, past operational issues were identified by the client.

In Project 2, the Contractor owned the design, and interacted with Principal 2 to address them. One interviewee also stated that commercial risks can be better understood, permitting less aggressive contracting. They also argued that the success of an ECI lies in the right resourcing, which provides comfort to all parties that they are receiving the correct information. One participant also remarked that the increase in price typically associated with greater knowledge of risks can be detrimental to a contractor's competitiveness if the tender goes to open market post-ECI. Multiple responses also acknowledged the major challenge of securing engagement from the market – subcontractors and suppliers – to provide pricing, particularly since COVID. However, it was noted that through ECI, the Contractor was able to go to the market with a better understanding of market capabilities, greater confidence they would be awarded the project, and with the ability – and willingness – to be transparent with subcontractors, improving the likelihood of market interest. Subcontractors were reportedly brought to site and into discussions with the client, providing an additional layer of confidence and further mitigating subcontractor-related risks.

Interviewees also clearly identified understanding client expectations and market price escalation as challenges of tendering. One participant stated that the ECI process is reflective of increasingly collaborative construction contracting, with the ability to tap into an engaged client through open forums. Rahman and Alhassan's (2012) study, which revealed the prominence of relationship-related benefits of ECI, confirms this view. Another interview revealed that during the ECI tender Project 2, operators of the treatment plant could be brought in to verify information and identify potential solutions. Yet another interview exposed similar advantages with the ECI tender for Project 1, where the Contractor was able to utilise Principal 1's knowledge of existing issues and risks. That same interviewee noted that same transparency allowed risks associated with escalation pricing during Project 2 to be addressed by the client. An issue that became apparent as interviewees discussed the effects of ECI on the efficiency of tendering was probity, which acts as a barrier to information flow and problem-solving. In a traditional RFT process, the client must provide their answer to one tenderer's question to all tenderers. Interviewees noted that this is typically a lengthy process, with answers often lacking detail. By contrast, they revealed that greater access to the client and the involvement of only one tenderer "does streamline the whole question and answers elements", allowing the contractor to raise ideas, receive feedback, and address potential difficulties without a prolonged request for information (RFI) process.

CONCLUSIONS

This paper examined the impact of ECI during tender on a Contractor's resourcing, and more specifically on staff workhours. Projects 1 and 2, which had both traditional and ECI tender processes (for stages A and B, respectively) were examined in terms of quantitative and qualitative data (respectively, time sheets and semi-structured interviews). The comparative analysis of traditional and ECI tenders suggest that the latter streamlines certain aspects but tends to result in a more prolonged and resource-intensive procedure. ECI in Project 2 did not merely extend the work involved in the tender process across a longer period, resulting in a substantially greater total number of hours spent on the pre-construction phase. Also, the weekly average hours per person more than doubled during the actual tendering period. Tenders involving ECI also showed increased engagement from delivery personnel, including site supervisors, project and site engineers, and project managers, attributed in part to the Contractor being reimbursed for their time in ECI tenders. Despite the extended and more involved tendering process associated with ECI, the qualitative data demonstrated that it offers significant value by addressing challenges like unclear scope, poor documentation, probity, lack of market responses, tight timeframes, and price escalation through enhanced certainty, focus, and communication.

This investigation provides a different angle to existing studies (e.g Suttie 2013, Assainar and El Asmar 2014, Ibrahim and Hanna 2019, Kulkarni et al. 2012) by uncovering the changes in the staff workload in pre-construction phases. Prior research suggests that such additional effort and workhours upfront are paid off by enhancements in the overall project performance. It is nonetheless key to map and outline these changes as done here so stakeholders (e.g. Contractor) can be prepared and plan accordingly. Lastly, it is also important to acknowledge the limitations of this study. It is clear from the qualitative results that factors such as project complexity, client relationships, internal resource capabilities, and the contractual model likely limited the generalization of results. Due to availability of staff, the qualitative data provided by the Contractor only consisted of six interviews with management and estimating personnel. Furthermore, conclusions from the Project 1 were hindered by incomplete timesheet data (i.e. no discipline breakdowns). Also, this paper has only examined the impact of ECI on specific projects and has not given consideration to whether bidding decision-making or tender success is affected by ECI, so the impact of ECI on the total resources used by the organisation for tendering has not been addressed. Furthermore, further to the literary consensus that ECI's primary advantages are attained during delivery, one interviewee suggested that the success of a project would be an indicator of tender success, however this factor could not be examined here due to time limitations.

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