ECI Impacts on Reducing the Causes of Disputes in Construction Projects

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science
in
Construction Engineering and Management

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Abstract

This study investigates the complexity and the context of the construction industry and conditions where causes of disputes arise. The construction project life cycle needs management approaches that help to reduce conflicts in the first place, reduce risk and improve performance. According to lean, disagreements and disputes are waste; if eliminated, costs would be reduced, performance improved, and the health of the working environment would be sustained. Emerging collaborative project delivery methods involve key participants very early in the project, frequently even before the design phase. It is characterized with a multiparty contractual agreement that allow risk and rewards sharing among the stakeholders to mitigate them collaboratively. Although partnering may be a helpful solution to improve the situation by getting people to work together; however, it does not analyze the underlying issues that make the conditions difficult and contribute to uncertainty and disputes. Taking inspiration from lean and collaborative delivery methods, ECI is a project delivery method that can fill the partnering deficit gap. It would specify the time of contractor involvement to improve the design, increase productivity, reduce risk, improve performance, and sustain a healthy environment through constructability reviews, design assistance, or even taking over the design process. This study contributes to filling that missing gap by evaluating the impact of ECI that, if brought to the construction projects, would reduce the cause of disputes occurrence, and improve performance and relationships. According to the research findings, there are several pathways for ECI implementation, which indicates that there is no one strict rule, neither for its procurement evaluation nor for its contractual design. This means that ECI can be used in two stages for the same contractor,

or it can use different contractors for each stage. It could also be done in different ways, such as with traditional DBB, DB, management contracting, project partnering, or alliancing. This study offers research opportunities and agendas to help academics and construction practitioners gain better knowledge that can help them design an appropriate ECI pathway that can improve the project's performance and reduce surprises that might lead to conflicts and disputes. ECI has been shown to reduce various types of claims such as design, time extension, scope, liability, and termination claims. The results were confirmed with actual data from a case study in Canada, "170 Street over YHT—Bridge Rehabilitation". Moreover, the study analyzes the ECI influence on the contractual risks through a comparison of two ECI contracts: CCGC contract form as adopted by the City of Edmonton in Canada and JCT (MC) as adopted in UK.

Acknowledgments

I want to thank Dr. Farook Hamzeh, my excellent supervisor, for his crucial supervision, support, and direction throughout my MSc degree. I am also grateful to the representatives of the City of Edmonton: Sam El Mohtar, the project director at the City of Edmonton, and Ryan Teplitsky, Supervisor, Transportation Infrastructure Delivery at Integrated Infrastructure Services for providing the knowledge and information which helped me to explore the relevant project delivery method that is being applied by the City of Edmonton.

I want to thank the Faculty of Construction Management and Engineering for allowing me to pursue my studies at the University of Alberta's Department of Civil and Environmental Engineering. Finally, I'd like to thank my family, including my parents, brother, and wife. With their outstanding support and understanding throughout the previous few years, I could have finished my study.

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List of Abbreviation

Abbreviation	Explanation
ECI	Early contractor involvement
ADR	Dispute prevention and resolution
IPD	Integrated project delivery
PDS	Project delivery system
ICT	Information and communication technology
DBB	Design bid build
CM	Construction management
DB	Design build
CMAR	Construction manager at risk
PMI	Project Management Institute
MGI	McKinsey Global Institute
CPM	Critical path method
ABS	Australian Bureau of Statistics
PERT	Project evaluation and reviewing technique
PPC	Percentage of plan completed
LPS	Last planner system
PSA	Pre-construction services agreement
MEP	Mechanical electrical plumbing
LDM	Lean Design Management
RFI	Request for information
RFP	Request for proposal
TPS	Toyota production system
BVP	Best value procurement
CD	Competitive dialogue

MC	Management contracting
CM	Construction management
PPP	Public Private Partnership
BIM	Building information modeling
PMIS	Project management information system
Novated DB	Form of DB procurement where the client employs designers to develop
D&C	Design and construct
RAP	Risk adjusted price. The price of construction work developed during
DBH	Department of Building and Housing (now the Ministry of Building
MGI	McKinsey Global Institute
CII	Construction Industry Institute
NPWC	National Public Works Conference
NBCC	National Building and Construction Council
AIA	The American Institute of Architects
TCC	Target-cost contract
CRE	Constructability Review and Engineering
TOC	Target Outturn Price
CCGC	Construction Consultant/General Contractor Delivery Method
CC	Contractor hired as Construction Consultant
WBS	work breakdown structure (WBS)
P&G	Preliminary & General costs not directly related to the construction

1. Chapter 1 – Introduction

1.1. Background and Problem Statement

The construction industry is characterized by a dynamic nature that increases project uncertainty and risks. Therefore, all construction parties tend to shed their risks or transfer them to other parties. This may result in an unfair allocation of risks. If a party endures an unfavorable situation of risk allocation, he might ask for compensation in return, which may lead to a negative relationship. With such context, trust is diminished, and conflicts erupt that might lead to disputes. Many researchers studied the causes of conflicts to arrive at the root causes and make improvements that reduce the occurrence of disputes. According to Sakal (2004), improvements have been made to three main categories, which are called "Tripartite": contract reform (i.e., IPD), the philosophy of management (i.e., lean construction), and dispute prevention (i.e., partnering), and resolution (i.e., ADR). Integrated Project Delivery (IPD) makes contract reforms to establish commercial terms promoting collaborative behavior. It is implemented through building consensus among the participants about risk sharing. Thus, any gain or pain shares are experienced by all participants as one entity. Secondly, Lean focuses on eliminating project waste, eventually improving performance and productivity. Thus, schedule and procurement coordination are closely implemented with reliable promises and the total commitment of team members (Ballard, 2004). Lastly, collaborative partnering establishes a process that fosters a collaborative project culture by gathering the team members to closely set project goals and accountability, identify issues or conflicts and set procedures for dispute resolution, and identify areas to improve project outcomes. From a lean perspective, partnering and ADR need to address the heart of the problem- how the actual work is done- and their development is further evidence of the fundamental flaws of traditional project management. Improvements have been independently applied to one category, while others may lack improvements. For example, a perfect contract would only be sufficient to solve inherent problems in the industry with

synchronizing enhancements to the different categories that lead to the optimization of the whole system. In other words, innovations and improvements for all categories must be merged into a comprehensive management approach.

In response to the rising interest in reducing causes of disputes in the construction industry, early contractor involvement has been introduced as a project delivery method that involves a contractual and procurement route where the general contractor is brought into the design phase early. This early involvement would allow for feedback from the contractor about the design and prevent non-adding value activities presented at the duplication of efforts as the design is continuously updated collaboratively before construction. This early contractor involvement can bridge the segregation between design and construction processes, which can be one of the significant root causes of a change order. Such a change order might be issued to resolve design errors, poor planning, or inadequate allocation of risks that might hinder the project's performance; This change order might lead to cost and time overruns, which might add tension to the relationships and project's environment. When a change order is not settled, denied, or leads to unsatisfactory results, conflicts may erupt, evolving into a claim that, if not settled or leading to satisfactory results, might evolve into disputes and arbitration. In such a context, ECI might gain significance to mitigate such circumstances.

Studies have shown that savings of around 10% in construction phase time and 7% in cost are achievable using ECI (Gransberg, D.D., 2020). Therefore, value engineering is well promoted in ECI contracts rather than traditional contracts fostering lean management philosophy. Although ECI involves less competition than conventional open tenders since the contractor is selected early, this diminishes the adverse and competitiveness relationships. According to a study by Diekmann and Girard (1995), they analyzed an extensive database of construction projects to study the likelihood of disputes based on various variables. These variables were classified into people, project, and process criteria. They concluded that while

all these criteria are essential in determining the likelihood of dispute occurrence, they still have more significant impacts on people. Therefore, the involvement of different vital stakeholders would impact the construction disputes and claim entitlement affecting the project performance.

1.2. Research Objectives

Since any conflict or dispute may jeopardize the reputation of any contractor or client whose priority is to achieve project success, all stakeholders should be willing to avoid any dispute in the first place. From previous researchers, some universal causes of conflicts are present in the construction industry anywhere in the world. This might map out the areas that hinder improvements and current matters which are to be used for managerial purposes to avoid conflicts. This study aims to seek and establish knowledge about the ECI impacts on the context that might reduce the causes of disputes. The study reviews the literature on the grounds of arguments, the benefits derived from ECI, and their interrelationships, which might impose further improvement and information for construction practitioners by expanding knowledge about how ECI can improve project performance in terms of dispute occurrence. The findings of this study expand understanding of the role of early involvement of contractors and subcontractors on projects' dispute performance. As there is no universal approach to ECI implementation, the study helps construction practitioners to design an appropriate ECI approach that suits their needs by recognizing the ECI implementation procedure and approaches. The study presents several ECI approaches to illustrate ECI is possible in public project procurement.

ECI derives its importance from that fact that the cost of changes at the early stages is lower than at the later stages; therefore, influence at the early design phase could have a more significant impact on disputes and conflicts. Thus, involving contractors at earlier stages would affect the cost and functionality of the design. So far, no universal approach for ECI

might help design an appropriate ECI model that suits their project situation. This research discusses the various ways to involve the contractor in the early phase of projects, the causes of potential claims in ECI, potential claims which ECI can mitigate, claim entitlement which ECI might have limitations to mitigate, and the ECI influence on contractual risks. Concisely the research objectives would be:

- Investigate the causes of disputes in construction.
- Examine the impacts of ECI on reducing potential claims & disputes and their causes.
- Verify the ECI influence on the potential causes of claims and disputes.

1.3. Research Questions

The research tends to study and try to answer the following questions:

RQ1: What are the causes of disputes?

RQ2: What are the potential claims and their causes in ECI?

RQ3: How does ECI influence the potential claim entitlement?

RQ4: How does ECI influence contractual risks?

1.4. Expected Contributions

Most dispute occurrences are always happening at later stages, creating adverse relationships leading to lower productivity and quality. The literature indicates that the segregation between design and construction is one of the main reasons for the emergence of various new delivery models. These models aim to integrate design and construction knowledge to overcome the drawbacks of the traditional barriers between design and construction by bringing together participants with various knowledge and skills. The goal is to use the knowledge of all participants by getting all the key participants together in the early stages of design and planning to better understand the project. Sanvido and Konchar's (1999) research

indicates that assembling a multidisciplinary team with experience and chemistry, especially before 25% of the project design is complete, is one of the key success determinants of a construction project. Such early collaboration helps the designer make accurate decisions. At the same time, the contractor develops ownership of the design (Thomsen et al., 2009, as cited by Sødahl et al., Andreas et al. & Lædre et al., Ola et al. & Svalestuen et al., Fredrik et al. & Lohne et al., Jardar et al., 2014). According to Westgaard et al., Arge et al., and Moe et al. (2010), adding contractor knowledge to the design phase usually necessitates more time and money paid upfront, however, the expected value in return is more valued. Given all the benefits of ECI that might promote the context within which construction practitioners are performing, which would avoid the occurrence of the dispute which would enhance the relationships among stakeholders, constructability and affordability which eventually lead to more stable processes and increased productivity. Thus, the causes of disputes would be studied to understand the interdependencies of conflict, claims, contract, and disputes which would help in identifying the mainstream of disputes occurring in the industry which can bridge us to the ECI application as a solution to reduce the likelihood of dispute occurrence. Thus, ECI pathways would be studied to understand more approaches that can be used to implement ECI and assess the ECI capability to reduce conflicts and disputes.

1.4.1. Academic contributions:

- Investigate the context of the causes of disputes in construction.
- Discuss the limitations of ECI on potential causes of claims and disputes.
- Identify the benefits, challenges, and opportunities to improve ECI.

1.4.2. Industrial contributions:

- Identify ECI pathways for public project procurement.
- Address ECI influence and limitations in mitigating the potential types of claims, their causes.

- Discuss ECI influence on the contractual risks to consider for standard ECI contract that might mitigate claims and dispute.

1.5. Research Methodology

Research is classified into qualitative and quantitative based on methods and type of data being studied. Moreover, research is organized into pure and applied based on the goals of the research. Pure research is conducted without a specific purpose, while applied research is conducted to solve a problem. Therefore, it tends to be descriptive. It frequently uses empirical approaches since it deals with actual problems and their solutions. Because existing knowledge is used to create a new product or method, applied research is also reliant on the findings of the pure study. To sum up, pure research focuses on understanding basic properties and methods, while applied research focuses on using information to create functional materials.

Qualitative methods tend to collect data using conversational methods, and the results are not numerical. Therefore, primarily open-ended questions are used. This method facilitates the researcher's comprehension of the participants' thoughts and the underlying reasons for their diverse opinions. Focus groups, text analysis, one to one interviews, ethnographic studies, and case studies are examples of qualitative methods (Creswell, 1994).

Quantitative methods use a systematic way of investigating data to collect measurable results. Relationships with measurable variables are used to explain, predict, or control a phenomenon. Quantitative research methods include survey, descriptive, and correlational studies (Creswell, 1994).

This study intends to increase knowledge and solve practical problems and, thus, can be classified as applied research. Results of previous research would be utilized that involve case studies and questionnaires that are being adopted in structured interviews with project

participants. To review the context of disputes and the performance of project delivery systems, a systematic literature review was conducted to examine all relevant literature on the causes of conflicts.

1.5.1. Systematic Literature Review

A systematic review is a meticulously organized and structured evaluation of all completed research on a certain subject. It is defined as "a review of the evidence on a clearly specified subject that employs systematic and explicit methods to find, select, and critically appraise relevant primary research, as well as to collect and analyze data from the included studies" (Ungvarsky, J., 2023). Specifying the inclusion and exclusion criteria); searching and screening; ‘scoping' or ‘mapping' the research; extracting data from the included studies and assessing their quality; synthesizing the studies in a narrative, and sometimes conducting a meta-analysis; and writing and disseminating the report are all components of a systematic review (Torgerson et al., 2003). Figure 1 illustrates the search methodology for this study.

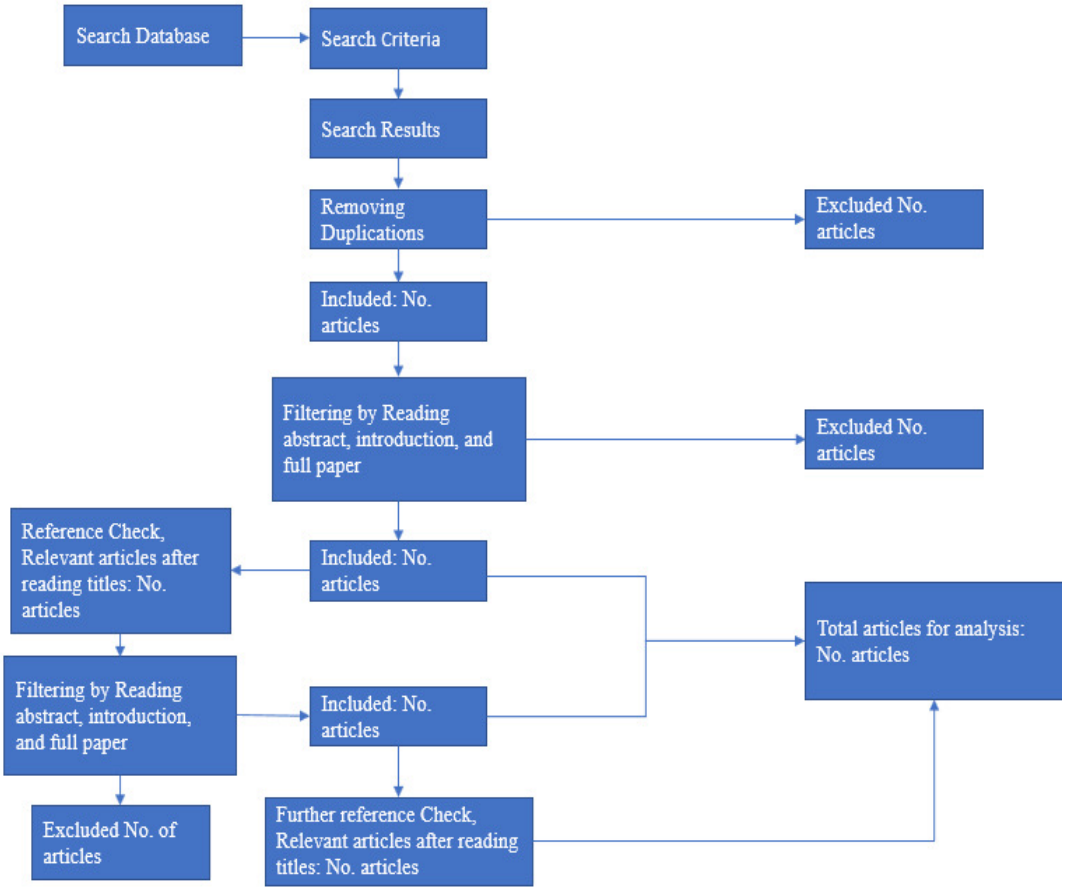

Figure 1: Adopted Search Methodology

Relevant papers were found using various resources (Compendex, Web of Science - All Databases, Scopus, ASCE Research library, TRID (Transportation Research International Documentation), SpringerLink, ScienceDirect, Engineering Village, ProQuest Dissertations & Theses Global, EBSCO Open Dissertations, AccessEngineering). As shown in Figure 1, all selected databases were searched with the phrases "Conflicts", "Dispute", "Integrated Project Delivery", "Traditional Delivery Systems", "Performance of Project Delivery Systems", "Causes of construction disputes", and "construction disputes causation". Articles and papers that address the performance of project delivery systems and IPD were included and analyzed to build up the relationship between the performance of PDS in terms of cost,

time, etc., with the causes of disputes. The research was limited to literature from 2021 and 2022 and limited to "Engineering" as a subject area. The search resulted in a total of 755 research papers from all databases. The irrelevant results were then eliminated. In the first phase, 180 duplicated papers were excluded. In the second step, by reviewing titles, abstracts, this process resulted in 160 distinct papers that incorporated all the search keywords found in the body content. In the end, the whole procedure resulted in a total of 72 unique papers for further evaluation. Figure 1 depicts the structure for this systematic review paper's analytical method.

1.5.2. Narrative Literature Review

Narrative literature reviews, also known as traditional literature reviews, are an in-depth, critical, and objective evaluation of the present level of knowledge on a specific topic. They help put the study in theoretical perspective and provide a point of concentration or background information. A literature review helps you find patterns and trends in the literature, allowing you to detect knowledge gaps or discrepancies. This should lead you to a sufficiently focused research issue that justifies your investigation (Onwuegbuzie and Frels, pp 24-25, 2016). Thus, a narrative literature review was used to explore the ECI procedures and the relevant approaches which are used for such early involvement of the contractor.

1.5.3. Case Study Analysis

A case study should be considered when the research intends to reveal the contextual conditions which is not alleviated, it would be difficult to evaluate the concerning phenomenon under study (Yin, 2003, as cited by Baxter, P., and Jack, S., 2008). Thus, CCGC project delivery method and relevant contract form as case study was chosen. Such context would make it easier to investigate the potential causes of disputes and claims in ECI, as well as the effects of ECI on contractual risks, without which an accurate picture would be impossible to obtain.

1.5.4. Semi-structured Interviews

In this research, qualitative methods are used to collect facts. The same is true for the literature search and the questionnaire data. Surveys and interviews are used to gather comprehensive data that can be analyzed to successfully improve the business. Conclusions are drawn from these sets of facts and data. There is a lot of quantitative data on disputes and conflicts in construction, and this research is partly based on that. The framework of this research is set by utilizing qualitative methods in the form of semi-structured interviews.

Appropriate strategies and techniques must be selected to answer the research questions. The descriptive type is used in this research to identify a process or phenomenon using surveys and interviews (McCombes, 2019). Thus, a semi-structured interview was chosen for data collection to allow for dialog to develop ideas extracted from the interviews. As disputes may affect or harm the reputation of any construction entity, confidentiality is a crucial factor when conducting such research, which is the selection of interview techniques in data collection.

To verify the results, semi-structured interviews would be conducted with construction practitioners to study the ECI capability to mitigate disputes. The semi-structured interviews are conducted with participants who have responsibility or are aware of project procurement routes. The number of interviewees were limited due to the limited number of projects employing ECI as a project delivery method. Moreover, there were little knowledge about ECI among construction practitioners. Therefore, the interviews were conducted with experts who can add to the study. The participants were selected based on their experience with more than 10 years of experience with previous involvement in ECI project. Moreover, interviewees who are not familiar with ECI were excluded from the interviews since we are looking for experts who can really add value to the study. The findings cover the results from the semi-structured interviews conducted to deeply understand ECI and its impacts on claims and disputes. Interviews were conducted to learn how ECI is implemented in Canada,

investigate user opinions of how the various process elements affect project performance through ECI, and assess the overall impact on risk, cost, benefits, difficulties, and improvement potential. This contributed to addressing study questions 3 through 4 regarding ideal contract aspects, the impact of ECI on market pricing, and the overall advantages, difficulties, and prospects for ECI improvement.

The interviews acted as a pilot study for the writers to practice interviewing and trying out the questions. This led to more timely and adaptable interviews and better-structured interview guides for the main study. The participants were picked based on their experience and line of work. They were either recommended by the supervisor or proposed by business professionals. By doing this, we ensured the interviewees could contribute to our research and were knowledgeable. Only quick notes were taken throughout these interviews because they were all transcribed, allowing us to pay close attention to the participants' responses. Since all participants were interviewed by one individual, specialized software was unnecessary. The main themes in these interviews were the benefits and difficulties of ECI, preconstruction services, procurement and tender, reimbursement schemes, lead times, and contractor claim entitlement. The order of the questions was frequently modified based on the interviewee's initial responses, though. This improved the flow and allowed the interviewee to emphasize their points without the authors' influence. The choice of using semi-structured interviews was based on a desire to give flexibility to the interviewees and to identify new ways of seeing and understanding the topic. The nature of the questions was open-ended, intending to bring the most out of the respondent's reflection. The interview sample included three interviewees representing public clients, two of them are representing City of Edmonton and three interviewees representing design consultant from Canada. The designations of all interviewees are listed in the below table.

Table 1: Participants in the interviews

Client interviewees	**Organization**	**Department**
Project Director	City of Edmonton	Civil
Project Manager	City of Edmonton	Civil
Planning Manager	Musanda (UAE)	Civil
Consultant interviewees	**Organization**	**Department**
Principal	RJC Engineers	Civil
Associate	RJC Engineers	Civil
Project Engineer	RJC Engineers	Civil

All the people interviewed were managers or higher-ups in their companies, so they knew how well or poorly projects bought through ECI did. They had worked in construction for more than ten years and on ECI projects before. The sample distribution by role is shown in the below figure.

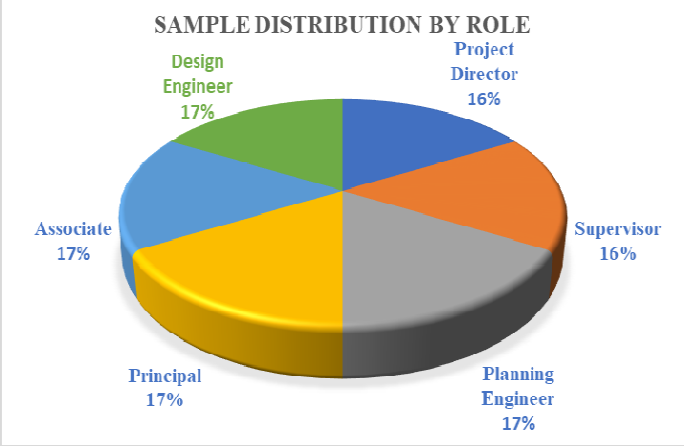

Figure 2: Sample Distribution by role

The following sections make up the interview framework:

Section 1: gathers fundamental data on the interviewee (name, company, role, years of experience).

Section 2: data gathering on users' ECI experience (number of ECI projects, value range, and type).

Section 3: Case Study: gathers information on a typical facility (facility type, complexity, location, cost, time scale, general contractor or consultant, reason for ECI).

Section 4: Contractual Issues: the timing of the contractor's involvement, the extent of the preconstruction services, the client's PM's services, the creation of the contractor pricing, whether the contractor paid for ECI, the type of construction contract price, the key components of the contract documentation, risk considerations, and lessons learned.

Section 5: Gathers information on participants' general perceptions of ECI, including its impact on costs, schedules, quality, risk clarity, team makeup, project qualities that lend themselves to ECI, and possibilities for improvement.

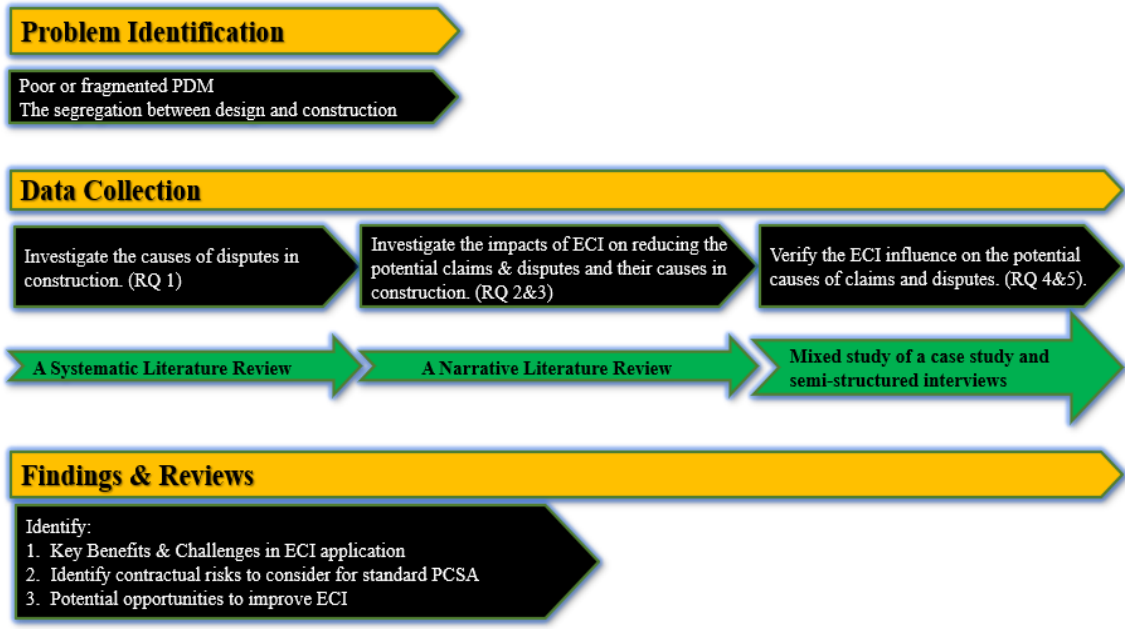

Figure 3: Research framework

To sum up, the research is laid out as follows. The systematic literature review section maps out and discusses the causes of disputes (research question 1). A narrative literature review to describe and appraise the ECI pathways, and potential of claims in ECI that might lead to disputes and their causes. The literature was reviewed to learn about past and present studies on procurement processes involving contractors at the design stage. This helped in exploring the different pathways of ECI, the characteristics of ECI, and approaches that could be used to implement ECI (research question 2). Moreover, the limitations of ECI influence on the claim mitigation were discussed. Thus, a flowchart was created to identify the situations where a claim entitlement might occur in ECI (research question 3). Additional, ECI influence on the contractual risks were addressed through the comparison of contractual clauses of two preconstruction services agreement (PCSA) as employed in Canada and UK (research question4). Such comparison can identify and illustrate the effect of contractual components at the preconstruction stage that could be considered for standard

form of PCSA, such as timing, obligations, and liabilities which could contribute to improving ECI in practice to reduce disputes. This might assist in determining what was already understood about ECI in terms of risk, concerning difficulties in employing ECI and areas for improvement.

1.6. Organization of Thesis

This thesis consists of 6 chapters: Chapter 1 includes an introduction, background, problem statement, research objective, expected contribution, and methodology. The literature review spans chapters 2, 3, and 4. Chapter 2 reviews the causes of disputes to answer research question No. 1, chapter 3 discusses the early contractor involvement including project suitability, pricing provisions, contractor reimbursement, and preconstruction services during the design phase as a new emerging delivery method that would help in the reduction and mitigation of construction disputes. Moreover, it describes the different approaches of ECI. Chapter 4 studies and identifies the potential claims in ECI and their causes. It analyzes the ECI influence on claim entitlement and limitations of ECI in mitigation the causes of claims through studying a case study, semi-structured interviews. Chapter 5 analyzes the ECI influence on contractual risks through the comparison of ECI preconstruction services agreements from UK with the CCGC contract form that is being used in Canada. This chapter aims to analyze and discuss the contractual risks to consider at the pre-construction stage, such as scope of services, timing, obligations, and liabilities which impact dispute mitigation. Finally, Chapter 6 includes a conclusion, thesis summary, recommendations, opportunities of potential improvements, and highlights topics for future research.

Table 2: Organization of Thesis

Goal	Research Objectives	Research Questions	Methodology	Chapter No.
ECI is a project delivery method that can mitigate causes of disputes and potential claim entitlement.	Investigate the causes of disputes in construction	RQ1: What are the causes of disputes?	Systematic Literature Review.	2
	Examine the impacts of ECI on reducing the potential claims & disputes and their causes in	RQ2: What are the potential claims and their causes in ECI?	A Narrative Literature Review.	3
	Verify the ECI influence on the potential causes of claims and disputes.	RQ3: How does ECI influence on the potential claim entitlement?	Mixed use of a case study and semi-structured interviews with open-ended questions. Comparison of contracts forms used at preconstruction stage (PCSA) in Canada & UK.	4
		RQ4: How does ECI influence contractual risks?		5

Research Questions	Chapter No.	Scope
RQ1: What are the causes of disputes?	2	Identify the context of the disputes and their classification to arrive at the most significant root cause of disputes.
RQ2: What are the potential claims and their causes in ECI?	3	It identifies the different project delivery methods to differentiate the differences between traditional approaches with the ECI. It discusses the early contractor involvement as a new emerging procurement route that would help in the reduction and mitigation of construction disputes. It covers the different ECI pathways as applied globally and describes the approaches that can be used to implement ECI.
RQ3: How does ECI influence on the potential claim entitlement?	4	It identifies and verifies the potential causes of claims and the claims which can be mitigated by ECI. It describes and verifies the impact of ECI on claims, disputes, and claim entitlement in the ECI procurement process.
RQ4: How does ECI influence contractual risks?	5	It verifies the influence of ECI on contractual risks through the comparison of two contracts used for preconstruction stage as adopted in Canada and UK. It assisted in determining what was already understood about ECI in terms of risk and market pricing, as well as concerning difficulties in employing ECI and areas for improvement.

1.7. Limitations

Each project has unique conditions or circumstances, which dictates that no one universal study of disputes can prevail in all projects. Moreover, several perceptions and classifications of the causes of disputes indicate that it is intractable to build up one model that can prevail for the industry. For example, a study surveyed by Semple, Hartman, and Jergeas (1994) mentioned that the most common causes of disputes were due to scope changes, weather, and limited access to the works. Another study by Cheung and Suen (2002) suggests that the relationship between the client and contractor is the most crucial source of disputes, which may result in overspending the budget, increasing the cost of payments, untimely or late payments by the client, changes in the number of project days, the settlement of debts, design changes, etc. Additionally, building a comprehensive model that can consider different cultures, rules, regulations, local practices, and codes of conduct takes time to achieve. Therefore, one of the limitations of this study is that it should have addressed the aspects mentioned above.

Moreover, this study's case study was from Canada for a public project. Therefore, the results are limited to public projects and the ECI approach implemented in Edmonton, Alberta, Canada, by the City of Edmonton. Finally, the number of ECI projects (case studies) is limited; therefore, there is a need to study more projects to draw authentic conclusions about ECI influence and mitigate claims and disputes.

2. Chapter 2 – Literature Review

2.1. Introduction

This chapter discusses the significance of studying the causes of disputes in the industry to assess the problem's effects on productivity and project performance. Also, some terms are defined: conflicts, claims, and disputes, which construction professionals use interchangeably, to clear up any confusion about how they are used in the study. Moreover, one clear definition for each term might help identify and assess the root causes of any argument occurring among construction professionals. Such a study would help in understanding the several perceptions of causes of disputes and assessing their context, which might lead to a solution.

Disputes in construction have been researched by many authors, such as Diekmann and Girard (1995), Fenn et al. (1997), Kumaraswamy (1997), Semple *et al.* (1994), Reid & Ellis (2007), and Willmot and Hocker (1998). All researchers mentioned that conflicts and disputes detrimentally affect the project's success. Improvements have been adopted to increase the industry's efficiency, as indicated by Peansupap and Walker (2005), who suggested that the use of emerging information and communication technology (ICT) can enhance the construction process at all project phases. Although communication technology is being gradually adopted, such as digital boards, the contextual problem still needs to be solved. Therefore, more than technology adoption to improve the information flow might be required to reduce disputes in the industry (Love et al., Davis et al., London et al., Jasper et al., 2008).

Another improvement is relational contracting, such as partnering, alliancing, public-private partnership (PPP), and joint venture, which can lead to huge potential savings in the industry (P.C. Chan et al., W.M. Chan et al., F. Y. Yeung et al., 2009). However, the industry still suffers from conflicts and disputes frequent occurrence. As being unconsciously

practiced daily, these conditions become inherent as part of the processes in the industry. According to (Busby & Hughes, 2004), there are dormant conditions the project's stakeholders need to be aware of that only become active when a dispute arises. Hence, work processes and procedures need improvements that reduce the incidence or occurrence of conflicts.

A client's main objective is to achieve a successful project that has been adequately designed, planned, and constructed according to the contract documentation. Therefore, any deviations from such spectrum may disrupt the work. Efforts have been undertaken to close gaps that cause incidents that lead to disruption; however, the construction industry is still plagued with claims and disputes. When no settlement is reached, conflicts can lead to disputes. When a claim is made, and the contractor is found responsible for not performing the work as promised, the contractor puts his reputation at risk when a client files a claim. A successful claim implies that the contractor still needs to perform the work to the contract's required standards. This poor performance indicates either drawbacks in the quality standards as set in specification or schedule and cost overruns.

Moreover, some clients may ask about the claim history before hiring a contractor, which may affect the contractor's ability to get new assignments. Although a claim could result from many reasons the contractor may not be blamed for, the problem still exists as a claim has already been raised in the first place. As the claim may imply the inability or inflexibility of the concerned parties, it may be considered an adverse relationship that may affect clients' decisions in the future when working again with that contractor. Such an issue may also affect the decision of surety agencies as they are always looking for manageable bonds. Thus, a contractor with a various claim history may need help to obtain a fair new bond which hinders the contractor's ability to obtain a fair new bond in the future which may affect the contractor's license resulting in a legal inability to get new assignments. Therefore, it would

be very beneficial for construction professionals and practitioners to avoid such conflicts and disputes in the first place.

Blake Waldron and Dawson (2006) state that time and cost overruns are the two most significant causes of disputes in construction and infrastructure projects. According to their research, these overruns are connected to skills, coping, and risks: more specifically, they are derived from a lack of up-front planning, incomplete design, incorrect or uncoordinated documentation, Poor project management, changes to scope, and authority approvals. Therefore, the context of the construction environment must be further studied to land on the underlying causes of disputes in the industry.

The context is vital to understand the underlying factors contributing to disruptions leading to disputes. Such context is necessary to identify issues by considering the relational impeded issues among the construction processes. For example, if John asks David to inform Richard that he needs the loader at spot No. 1 to load some trucks. David conveys the message; however, the context is missed, which may affect Richard's ability to determine the best reaction. Therefore, Richard may assume that sending that equipment may affect its maintenance schedule or other tasks being handled; consequently, he may be reluctant, which can cause disputes. Although David is in emergent need of the loader; otherwise, a delay may occur, Richard is unaware of such status.

The construction industry still needs to achieve superior untroubled performance. According to Thomsen et al. 2010, only 45% of construction projects have not suffered any delays. Changali et al. (2015) mentioned that 80% of mega-construction projects suffer from cost overruns and 20-month schedule overruns. According to Barbosa et al. (2017), productivity in construction has remained the same, while an increase of 1500% has occurred in manufacturing, retail, and agriculture since 1945. A lot of efforts have been expressed by researchers on the factors that might lead to spending time on non-adding value activities,

such as change orders (Ibbs, 2012), poor scheduling practices (Nepal et al., 2006), a lack of construction insight during the design (Raviv et al., 2012), inadequate client involvement and engineering support during construction (Anderson et al., 2004), poor coordination between trades (Riley et al. 2005a), a poor project definition (Song & AbouRizk, 2005), out of sequence work (Abotaleb et al., 2020), a lack of construction readiness (Hanna et al., 2018), and rework (Ji & AbouRizk, 2018), poor communication and collaboration among different project parties and stakeholders (Cheung et al., 2013) which affects 50% of the project costs (Dalcher, 2018).

Poor or fragmented project delivery systems may contribute to inefficient rough collaboration and handoffs among project parties (Yates & Battersby, 2003). According to Thomsen et al. (2010), this fragmentation has led to the increased use of transactional contracts focusing more on individual performance metrics rather than the project. Moreover, with such fragmentation, the project stakeholders would rely on arbitration to transfer, avoid, alleviate risks, and secure compensation (Iwanski, 2013). Such fragmentation has led to the evolution of project delivery systems such as design-bid-build (DBB), construction management (CM), design-build (DB), and integrated project delivery (IPD) that would define the involvement of all project participants.

The construction industry has been continuously exposed to disagreements and conflicts throughout the project life cycle. Conflicts and disputes are resolved with the help of an attorney; however, this comes at a higher cost, time, and effort. Such arguments may be determined by applying discounts or adding extra work. According to (Stipanowich, 2004), almost 95% of disputes are resolved in-between the construction parties without resolving to arbitration or courts. Therefore, avoiding conflicts in the first place is a priority through which productivity increases, cost, and rework are reduced.

Previous research stated that the most significant contributors to disputes are the client changes after the formulation and signage of the contract, differing site conditions, and

inefficiency or unfulfilling of duties by the engineer (Onyango, 1993). Another research conducted by Blake Dawson Waldron (2006) shows that the fundamental causes of disputes are variations in scope, extension of time claims, site conditions, site access, contract interpretation, obtaining approvals, design quality, late, incomplete, or sub-standing information, and availability of resources.

Some of the attempts and studies to identify the drivers of disputes in the industry are categorized into three main categories. As follows: project uncertainty, contractual problem, and opportunistic behavior (Mitropoulos & Howell, 2001). Moreover, other studies listed some other causes: delay in delivery, increased project cost, reduced productivity, loss of profit, or damaged professional or business relationships (Love et al., Davis et al., London et al., & Jasper et al., 2008). Other studies mentioned more specific causes, as suggested by Chan and Kumaraswamy (1997), such as client contract changes, different site conditions, poor site management, and slow-paced decision-making.

2.2. Conflict, Claim, and dispute

The industry does not seem to have a solid or definite definition or description of "conflict, claim, and dispute.". These definitions are occasionally used interchangeably. A dispute is a disagreement or argument between two or more parties (Diekmann & Girard, 1995), whereas Semple et al. (1994) defined a claim as a party's request for compensation for damages. According to Diekmann and Girard (1995), a dispute is "any contract concern or controversy that must be resolved by a party other than the project site management, whereas a conflict is "a struggle that is articulated between at least two independent parties who see things differently, scare resources, and interference from others in achieving those goals" (Willmot & Hocker, 1998). Moreover, according to Reid & Ellis (2007), defining dispute is a subjective matter where there is one definite meaning or definition. They mentioned that a dispute exists only when a claim is filed. However, other researchers consider conflict to exist due to underlying conditions

inherent in the construction processes (Kumaraswamy, 1997). Therefore, literature provides diverse definitions for these terms, indicating that a common language for the organization does not exist.

Figure 4: Conflict, Claim and dispute

Fenn et al. (1997) suggested that conflicts occur when interests are incompatible. Adequate mechanisms for avoidance can prevent conflict from maturing into dispute. However, Yale and Hardcastel (2003) define a claim as a declaration for money, property, or a remedy, and a dispute is simply an unresolved claim. The figure 5 below demonstrates the conflict spectrum against time.

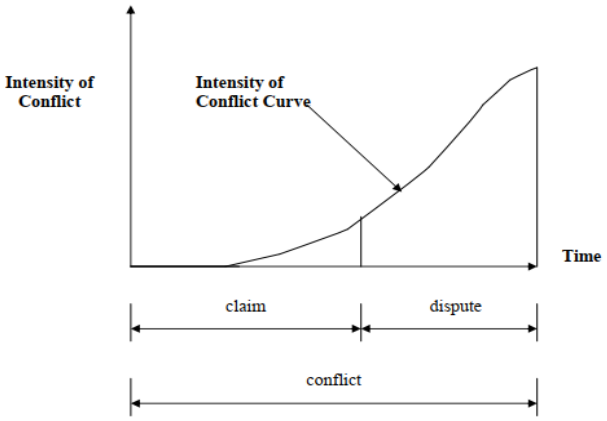

Figure 5: The Spectrum of Conflict as adopted by Aref Charehzehi, saar chang chai, Aminah Md Yusof, Heap-Yih Chong, Siaw-Chuing Loo (2017)

The above curve demonstrates that conflict occurs at the same time when a note of claim is initiated. A conflict usually occurs after the denial of a claim or acceptable terms; however, it might also appear before the claim initiation. Conflict exists until the claim or dispute is resolved. Moreover, the intensity of conflict increases the strength of feeling among parties as the conflict progress through the various stages of a claim until it is entirely resolved. It should be noted that not all conflicts necessarily lead to claims, and not all claims result in disputes (Yale & Hardcastel, 2003).

Regardless of the first to occur either a claim or a conflict, it might be claimed that a change order is one of the significant causes of such a conflict. Such a change order might be issued to resolve design errors, poor planning, or inadequate allocation of risks that might hinder the project performance; however, this change order might lead to cost and time overruns which might add tension to the relationships and project's environment. However, if parties do not agree with the nature of such a change order and its associated rising risks, the performance might be disturbed. Thus, conflicts may erupt evolving to a claim which if not settled or led to satisfactory results, might evolve to disputes and arbitration. In such context, ECI might gain its significance as a proposal to mitigate such circumstances.

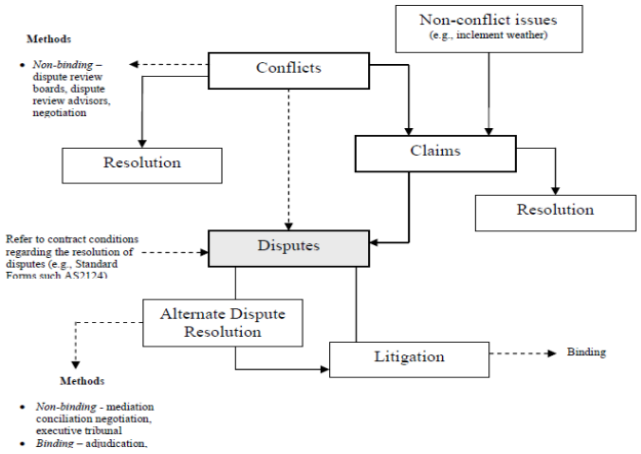

Figure 6: Conflict, disputes, and claims (Adapted from Kumaraswamy, 1997)

2.3. Causes of Disputes

According to Kumaraswamy (1997), disputes have causes that can be categorized into three main groups. These classifications sorted the cause of disputes into three main categories: root causes, causes generated by themselves or through interactions, and proximate causes. These causes would form a chain by which a trace could be drawn back to the root causes of the dispute. He defined proximate causes as immediately apparent and are closest factors responsible for causing despite. Moreover, he defined causes generated by themselves as resulting from the context of the environment within the project team interacts. Finally, he defined common root causes as the primary to cause conflicts. For example, a change order from the client may result from a lack of information on the client's side. He defined this as a root cause that may lead the client to inappropriate decisions. He mentioned that these causes could be controlled and removed from the process by eliminating the conditions that initiate their occurrence. Once these causes are eliminated, the process would gain a degree of stability (Deming, 1986), reducing disputes to the minimum.

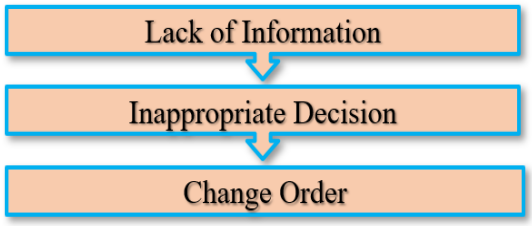

Figure 7: Chain of Causes: Example 1

Another example is when the client doesn't plan well, the designer might agree to unrealistic deadlines, which hurts the quality of the design documentation that needs to be finished or made more evident. Thus, the change order is only a proximate cause in that case, while the lack of information is the common root cause of the dispute. Another example is

that a tight schedule might force the contractor to claim a time extension lately. The contractor may be forced to compress the schedule by adding more resources, which might lead to profit loss and divert him from closer safety and quality supervision. Thus, less supervision of the contractor is a proximate cause, while the root cause is poor planning on the client's side, which is the exact cause for the incomplete or ambiguous design.

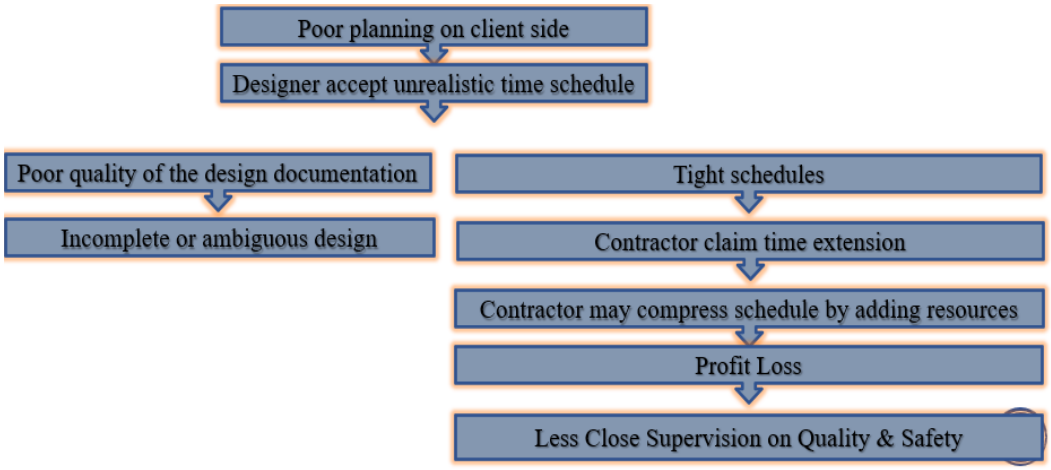

Figure 8: Chain of Causes: Example 2

There are dormant conditions that become relatively stable phenomena before the error occurs. These conditions, as identified by (Busby & Hughes, 2004), fall into one of the categories: task which arises from the nature of task being done, tool which arises from the technical characteristic of the tool, circumstances which arises from the environment within which the project is operating, practice arises from people's behaviors, industry which arises from the structural characteristics of the industry and organization which arises from organizational structure. These dormant conditions are interrelated, and it is difficult to identify underlying conditions that contribute to disputes; however, identifying such conditions could help us identify process changes that have not been considered dispute contributors. Such process changes, if eliminated, may provide the process or the system with stability. One of the most important underlying conditions that may lead to disputes, as

proposed by Cole (2002), is when a contractor goes into a contract with a client; he would know the risks he is taking in return and the prices of such risks. However, some other risks may not be anticipated due to the degree of uncertainty for the different parties at the time of contract signage. For example, the degree of accuracy or error in the contract documents could be an underlying condition contributing to a dispute (Mitropoulos & Howell, 2001).

2.3.1. Project Management

A Project Life Cycle consists of different phases that divide a project to meet identified control needs. This division results in an easily manageable project. At the same time, a project management approach is used to achieve the project's objective. This framework is based on a set of principles that give advantages and limitations to all participants or stakeholders. However, some project life cycles may be prone to disputes more than others. According to PMI, the project life cycle can range from predictive or plan-driven to adaptive or change-driven approaches. A predictive life cycle is a detailed plan that describes the scope of work in detail and entitles careful management to any change to quality, scope, or delivery times. Such a high level of detail makes it intractable for a change unless authorized, which would entitle a cost increase due to a change order (PMI, 2017). The late authorization results in more costly changes. Therefore, this approach may be prone to disputes when the plan is not executed as promised.

Conversely, the deliverables are being developed and delivered in the adaptive life cycle through an ongoing process where the project starts with a less defined plan. Details are being developed during the life cycle of the project. Consequently, the scope of each phase is defined through iterations which allow for the development of the scope along the way to deliver optimal value to the client. Likewise, in the technology industry, products or deliverables are developed in "sprints". Each component is developed through a burst of effort and completed over a short-time period (PMI, 2017). This might dictate less vulnerability to changes that lead to less variability.

Lean construction is a production management approach that eliminates underlying issues that lead to workflow variability (Howell, 1999). The facility and its delivery process are designed to reveal and support client goals. Positive iteration within the process is encouraged, while negative iteration is discouraged. Work is structured throughout the process to maximize value and minimize waste at the project delivery level. Since it is more significant than lowering costs or speeding up individual activity, efforts to control and improve performance are focused on improving overall project performance. Making things happen is redefined as "control" instead of "monitoring results". The planning and control systems' performance was measured and improved. The consistent release of work between specialists in design, supply, and assembly ensures that value is delivered to the client while reducing waste. Lean construction is advantageous in complex, uncertain, and time-sensitive projects. It calls into question the notion that there must always be a trade-off between time, cost, and quality.

Even if technology is used in planning, the method still needs to handle the increasing number of delays and disagreements. Traditional planning could be one of the contributing causes of the project's failure. This motivates the planners to consider other factors besides their reliance on the software. According to the lean philosophy, designing and manufacturing projects should be completed through connected phases. Ballard introduced LPDS: Lean Project Delivery System in 2000. This system includes tools and procedures that may be applied from the start of a project until the handover of a facility. It consists of work structuring and production control that breaks down products and processes into work chunks that foster the short cycle processes to dimension production units and organize handoffs between groups. This assists in continuously measuring and tracking schedule adherence and identifying problems before they can endanger the project's on-time completion. The consistency of monitoring each process cycle's schedule adherence is crucial. Moreover, Hamzeh et al., Ezzeddine et al., Shehab et al., Khalife et al., Ghali et al., El-Samad et al., and

Emdanat et al. (2020) indicates that visualization of all information can provide professionals and planners with early warnings for enhanced schedule and plan communications.

According to Afshari (2010), an unqualified management team leads to poor decision-making, which was noticed at the client organization at most. This lack of inexperience and understating of roles and duties caused delays in the approval of critical decisions and documents. Moreover, such a lack of efficient decision-making exists not only in the client but also at designing. Thus, poor inexperienced teams are not able to challenge the clients' comments and requirements, which may lead to unresolved problems or even be poorly tackled (Ahsan & Gunawan, 2010). Moreover, lacking effective management may lead to the inefficient or inadequate selection of team members where all stakeholders are expected to bring up their qualified teams to finish the project correctly and according to the expectations and requirements. Therefore, time, cost, quality, and safety issues may arise, affecting the deliverables of the project (Doloi et al., 2012). Hamzah et al. (2011) identified that a qualified team should be able to maintain the schedule by providing the engineering documents as required at the right time to reduce any risks that might arise in execution. This right time is translated into providing immediate reflex that could compensate for any delay or poor performance through making fast and proper decisions to compensate, reduce, or avoid any drainage to the resources (Kumaraswamy & Chan, 1998). Therefore, poor project management is one of the key factors which might lead to conflict and even disputes if not counteracted by experienced, qualified teams that can provide excellent reflexes at the proper time. This effective decision-making must be extended from design to the close-out phase to avoid any bottlenecks that might drain any good performance that has occurred before.

2.3.2. Scope

An unclear scope definition may lead to frequent changes in any construction phase. When the project objectives are not well defined, frequent changes affect the design (Chanmeka et al., 2012). Moreover, if such a change occurred in the execution, this change might cause

schedule and cost overruns (Dr. Patrick. X.W. Zou1, 2006). This eventually might lead to conflict or even dispute later (Ramanathan et al., 2012).

The reduction of scope changes is very important to mitigate disputes. The likelihood of scope changes can be decreased by initially concentrating on attaining scope certainty and allowing enough time to plan and prepare the contract paperwork. Clients and stakeholders should be integrated into the design process. Design is an iterative process. The client should be required to sign off after each developmental phase to acknowledge that their requirements are being met and translated into a workable solution as the design evolves and materializes. However, the signage-off may impose tension on the clients, which can create adversarial relationships between parties since the value is dynamic and changing over time (Charrett, 2019); therefore, clients are reluctant to do so since no going back is allowed. Even if we find a way to let the client have a going back path if his requirements change, this may become a punishment for the client for his signage. Allowing clients, the freedom to change requirements may impose turbulence on the workflow and value. Most of the literature mentioned that change of scope is a critical factor for disputes; however, clients would need to be willing to pay additional costs to foster resilience. The problem exists in the in-resilience that the contractor shows when a scope change happens, even with additional payment being processed. Therefore, the mentality must change to see that any change of scope that add value is very welcomed, and even we could argue that it is also recommended. Typically, the scope is not finalized at the beginning of any project life cycle, which most of the construction industry suffers as most of the construction projects suffer a change of scope, variations due to change of scope, and even total actual construction cost always differ from engineer's estimate or the tendered price.

Construction parties consider scope change as a critical factor for cost increases. When a change of scope is being undertaken in the execution phase, then a change order is required. The designer issues the change orders during construction upon the request of a construction

party. This change order may come in the form of design documentation (Serag et al., 2010). However, such a change order may lead to rework that might disturb the sequence of work and the utilization of the resources; therefore, the cost may increase, and delays may occur (Zhang, 2010). As an attitude that construction practitioners mainly adopt, construction contractors tend to bid at low prices. After the award of the contract, they look after any change orders to claim compensation. They think the more change orders are being requested, the more compensation could be claimed (Pishdad-Bozorgi & de la Garza, 2012). This tends to create adversarial relationships among parties as the clients constantly reject any cost increases while some cases are valid for cost increases. Such adverse relationships diminish trust, which eventually ruins collaboration. In that sense, most contractors may not reveal information to avoid change orders that might occur before construction.

2.3.3. Change Orders & Incentives Sharing

When changes occur in the execution, this change might cause schedule and cost overruns (Dr. Patrick. X.W. Zou1, 2006). According to Jiankun Ma et al., Zhiliang Ma et al., and Jiulin Li et al. (2016), most construction projects in China suffer from cost overruns mainly because of excessive change orders during the construction phase. Although authors think IPD as a new emerging project delivery method may solve significant problems such as change orders through the optimization of the design and cost savings shared among the construction parties, for such cost savings to occur, the construction parties must be motivated through a compensation mechanism that establishes coherent and well-defined incentives.

According to Jiankun Ma et al., Zhiliang Ma et al., and Jiulin Li et al., (2016), there are three main compensation methods for contractors: fixed gross price compensation, variable unit price compensation, and fixed unit price compensation. In the first method, the contractor is compensated at a fixed gross price regardless of the number of change orders. In the second method, the contractor informs the designer about the potential change orders that

the project may develop with the current design. Accordingly, the designer reviews and applies any modifications if approved. Accordingly, the contractor would be compensated for any cost savings from his review. Finally, in the last method, fixed unit price compensation would be determined for each potential change order announced by the contractor and approved by the designer, who would implement any design changes accordingly. For the first method, the contractor may not report any potential change orders due to being compensated fixed gross price compensation; moreover, he would be compensated regardless of the number of change orders. For the second method, the variable unit price compensation, which the client determines, may need to be increased, which would not motivate the contractor to actively report any potential change orders. For the last method, the contractor would only report any potential change order when his profits from that order are higher than the fixed unit proof compensation, which is announced for each change order accordingly. According to the author, the last method is suitable primarily with predetermined higher fixed unit price compensation compared with contractors' anticipated profit of change orders since it would motivate the contractors to be involved and actively report any potential change orders. Thus, the clients must establish high price compensation to avoid any losses that might be incurred from the contractor's de-motivation to note any possible change orders even if the client would incur high costs due to many numbers of small change orders while leaving the larger change orders to the designer to review and approve.

Designers must also be compensated for any potential change order that would avoid losses. The first method is the unit price compensation which is paid to the designer for any likely change orders that he might discover that might have caused a loss more significant than a defined value. The second method is fixed gross price compensation, which is paid after the project completion as a guarantee under an additional condition. For example, this fee is to be paid only when no change orders have occurred that caused a loss greater than a defined value. These compensation methods should promote design quality. However, if the designer successfully provided a design that would not suffer any potential change orders, the

designer would lose potential profits, which he may have obtained if he discovered likely change orders. Therefore, the quality of the design may be affected, and even the designers may not reveal all information about any potential change orders to reserve profits to be incurred at a later stage. However, when the second method is used, the designer would not obtain fixed gross price compensation if he did not successfully eliminate any potential change orders. Like in the contractor case, the author states that clients must appropriately determine a defined value for losses caused by change orders and fixed gross price compensation to be given to the designers that would be equivalent to the profits that the designer may have obtained from any potential change orders. Thus, as in the case of the contractor, fixed gross price compensation is more appropriate for designers. In other words, the incentive mechanism may lead to adverse relationships in which the collaborative agreements convert the incentive mechanism from an independent tool where each party plays isolated to incentives sharing mechanism where all stakeholders gain or lose collaboratively.

2.3.4. Traditional Planning

In 2017, the McKinsey Global Institute (MGI) indicated that the construction industry requires productivity improvement by 50 to 60 percent and delivers $1.6 trillion a year in incremental global value. The manufacturing industry utilizes the concept of conversion and flow of activities while planning approaches in the construction industry are "activity-based" strategies. In construction, the project is split into discrete packages of work linked with logical links where predecessors and successors are well respected. This may promote the silos position, which can reach up to 49.6% of operating time, as McKinsey indicates. This linkage of relationships needs to include the flow aspect in the construction planning and elimination of not-adding value activities. This notion was first implemented in the Empire State Building in 1930, the tallest building in the world at that time. As the site was in congested downtown Manhattan, elaborate planning was needed to schedule the material

delivery to its instant use or installation since no lay-down areas existed. Such a tight, precise schedule was performed without the use of the CPM programme. Completion time has been a very crucial factor in all construction projects' success. However, the industry suffers from delays which results in further capital investment, more management effort, and reduced client satisfaction. The Australian Bureau of Statistics (ABS) (2008) reported that house buyers had to wait 35% longer in 2008 compared with the situation in 2000. Furthermore, Western Australia experienced a 70% increase during the same time period. The two most common planning approaches are activity-based planning and workflow planning (Sawhney et al., 2009).

A study has been conducted by Gharaie (2010) to explain the increase in the Australian average house completion time. They used the two planning approaches to analyze the correlation between the production rate and time of completion. The authors concluded that the increasing trend of completion time has happened when the production rate has been constant, which dictates that the increase has not been affected by the loss in production rate as activity-based planning approaches suggest. Moreover, the project's scope was the other parameter to be used. The impact of that parameter was studied on the completion time. The study has shown that the increase in the project's scope does not affect the average house completion time. Thus, the activity-based approach could have been more successful in explaining the trend where the focus is on the scope of work and the production rate of resources. This might imply the need for more use of such other planning approaches to reflect the project status.

According to Orangi (2011), poor planning on the client side makes the designers accept unrealistic time schedules, which affects the quality of the design documentation, which ends up incomplete or ambiguous. This may result in poor or incomplete design (Faridi & El-Sayegh, 2006; Ramanathan et al., 2012). This tight schedule forces the contractor to claim time extension lately; moreover, the contractor would look for any opportunity to claim so

(Chanmeka et al., 2012). Therefore, the contractor may compress the schedule by adding more resources, which might even affect the profitability and divert him to pay less close supervision on safety and quality (Chanmeka et al., 2012).

Activities are created and linked with software to create a path. However, such a path may contain flawed logic, which might be done unintentionally. Occasionally, the contractor uses the programme to show flawed or unreal progress to maintain early cash inflow. On the contrary, the client may delay payments intentionally to counteract such flawed logic, which is becoming standard practice. However, clients might delay payments unintentionally due to the slow process of payment authorizations. The payments must go through a lengthy bureaucratic process to review at some client organizations.

Moreover, constraints may interrupt the calculation of float and the critical path that affect the project completion. Such deviation of the project status leads to misrepresentation of project progress updates. When deviations from the original baseline or as-planned programme occur, the critical path differs, which commonly happens in the industry. Therefore, the critical path rarely remains unchanged. Therefore, the project completion changes accordingly. This may add or divert activities from being non-critical to critical activities. Moreover, the durations of the activities in a CPM programme are based on guesses which might be unrealistically short or excessively long. Therefore, critical, and near-critical activities should be supported with calculations of their durations.

Commonly, using the programme as only a representation that does not show actual progress to the client makes the programme ineffective with no tracking tool. Therefore, the programme is a list of activities with actual dates, which makes the programme only a checklist. This might need to be corrected to the critical path, which derives the project completion date. When projects are delayed while the completion date is still unchanged, this requires the schedule to be compressed to maintain the same completion date. Such compression comes at a cost; therefore, the project suffers not only from time overruns but

also cost overruns. However, to maintain the exact completion date, the planner and scheduler have to manipulate that schedule to show the client that the project is doing well; then, the contractor work to show that such delay is out of his control, and he may be entitled to an extension of time and compensation. Also, teams should get rid of logic and shorten times to reduce risk. Crashing the schedule month after month is a bad habit that results in an infeasible, unusable schedule that silently and unconsciously costs all stakeholders more money. Therefore, the schedule becomes a tool to show unreal progress or status, and the truth eventually presents itself too late. Thus, CPM scheduling technology requires collaboration and reality.

The programme is used to determine any extension of time for a delay and any quantification for compensation, if applicable. Therefore, if applicable, it works as a model to simulate the project performance and any delays. Therefore, the programme should be used to predict future events and mitigate the impact of events. A delay analysis is conducted, which may entitle the contractor to an extension of time, or additional payment as compensation for the delay, disruption, or acceleration. On the other hand, the clients may deduct liquidated damages for the contractor's failure to complete the works on time, or the client may terminate the contractor for failing to comply with the obligation to progress the works. A contractor's claim may be inappropriately relevant when the critical path is not carefully represented.

Moreover, if the client has the right to deduct liquidated damages, it is paramount to make sure that the contractor is not entitled to EOT; otherwise, a contractor who feels entitled to, but was denied, a time extension throughout the project may make a constructive acceleration claim against the client. Moreover, suppose the contractor fails to progress the work as promised. In that case, the actual progress must be measured and analyzed in both time and resources to be compared against the standard of progress specified in the contract.

Any missing logic links must be identified for the activities with many floats, which might have been ignored in the progress updates. Milestones that are attached to the project payment may lack logic links. All unclear milestones, which all parties cannot afford to e unclear, can lead to disputes. Therefore, information must be collected and inserted to analyze the output and assess the impact on all construction activities and the project's stakeholders. Therefore, without careful interpretation and consistency, the programme becomes useless and exposes the process to frequent disputes.

Many construction projects track progress through monthly schedule updates that compare various activities to the baseline schedule. A delay claim, on the other hand, can only be proven once the work is completed because behind-schedule activities can always catch up before the project's completion. The workforce could be added, or work could be re-sequenced. This waiting time may require a contractor to endure months, or even years, of behind-schedule work, hindering the in-cash flow.

The productivity of the workforce should be tracked at the activity level in every part of every trade of the project rather than tracking the workforce for accounting purposes only. Capturing this data requires a continuous persistent process to collect it daily for all works. This aids in controlling the schedule and cost of the project. Moreover, a better estimate of labor productivity would lead to accurate cost estimates, avoiding cost overruns (Alaghbari et al., 2007). Assaf and Al-Hejji also mentioned that contractors miscalculate labor productivity estimates or need to be more familiar with labor laws which end up in time and cost claims (Assaf & Al-Hejji, 2006). Therefore, any inaccurate estimate of labor productivity forces the contractor to increase laborers and crews, eroding their profit margins (Chanmeka et al., 2012).

2.3.5. Workflow Planning

The workflow variability should be managed and structured to control variability throughout the system. The negligence of such management and the pressure imposed by clients increase risk (Howell, 1999). As a result, clients may tend to assign unfair risks to third parties. Howell stated that current practices emphasize teamwork, communication, and commercial contracts while ignoring the underlying physics of production, supply and assembly chain variation, and the effects of dependence. One of the inherent problems in traditional planning tools such as CPM is that it needs to model non-value-adding activities, such as waiting time (Koskela, 1992). When CPM is used for repetitive projects, floats related to these repetitive activities may demonstrate waste and unforced idleness. Therefore, a pull system makes activities start so that any unforced idleness is eliminated. In other words, the pull system pulls upstream material and offsite work to match progress on site, eliminating any waiting, overproduction, or over-processing.

This planning approach has introduced production planning to the construction industry. It considers variables such as cycle time, work in process, and throughput to be interrelated (Koskela, 1999). Houses are the products of the construction industry. The cycle time of these products represents the time it takes to complete a house and the time it takes to build a house. With these definitions, it is observed that the number of houses under construction impacts the completion time (E. Gharaie et al., R. Wakefield et al., and N. Blismas et al., 2010).

The authors started by expressing concern about the recent increase in house completion times in Australia. According to the research, the main reason for this increase is an increase in the number of houses under construction, which has been adopted as another parameter. The workflow planning approach as an influential factor on completion time proposes this parameter. According to the trend study of this parameter, the average house completion time and this statistic have a tangible link. Observations indicate that the number of houses under construction and the average house completion time are positively correlated (E. Gharaie et

al., R. Wakefield et al., and N. Blismas et al., 2010). Whenever the number of houses under construction increases, the completion time increases, and whenever it decreases, the completion time decreases. This study also demonstrated that the workflow planning approach can explain the house-building industry's completion time behavior. As a result, we propose that policymakers and practitioners in the industry use this approach to better understand the dynamics of the housing construction process. Based on this suggestion, the loss of production rate lengthens the activities and the project's duration. Thus, a decrease in production rate could be to blame for the average house completion time increase.

The Last planner, as developed by Ballard, fosters the short schedule and assignments. It links the high-level project schedule and the actual execution schedule daily. This link provides the information required to execute, manage, and control the upfront work to facilitate work coordination. The bottom line of such coordination is to reveal any unforeseen, hidden, or neglected issues that might affect the workflow. Such disruption of the workflow may affect the system variability. Thus, a lack of consistent coordination may lead to opaqueness that hinders information flow leading to low productivity, cost and time overruns, conflicts, and disputes (Sakal, 2004).

One of the primary issues in traditional planning is the fragmentation between the project master schedule and the execution plans derived from the master schedule. Traditional planning might lack the linkage between the master schedule, which represents the project's overall schedule, and the tasks being performed on-site by trades. Therefore, LPS introduced the look-ahead or short-interval schedule, providing a more detailed plan to connect the master schedule or close the gaps between the project master schedule and the activities being performed on-site. This look-ahead schedule uses several different formats, such as calendar schedules, checks list, etc., rather than the traditional graphical Bart chart format, which is more general and does not provide details and information. Such representation of

look-ahead scheduling emphasizes repetitive construction operations and interactions among different disciplines regarding time, space, resources, and work continuity.

This linkage between the master schedule and tasks performed on-site is created by two types of look-ahead schedule presentations. In contrast, activities and locations are marked manually on a site layout in the second look-ahead schedule daily for three to five weeks. This provides much additional information about activities mainly done to significant activities since its manual preparation of updates and charts may be time-consuming.

Rather than the traditional planning where every work is being planned early even with circumstances that are still ambiguous, lean facilitates planning and assignments of milestones through the utilization of pull schedules which are produced by last planners, who build up their executable tasks and can be able to identify the upcoming or current constraints that may hinder the work. The use of buffer and float is discussed in a collaborative task so a compromise could step in. this collaboration is a critical factor that supports the continuous workflow with the aid of location-based scheduling techniques such as line of balance, flowline, and takt-time planning, which is supposed to reduce the idle times rather than the activity-based critical path method (CPM) and program evaluation and review technique (PERT) which lacks this concept.

As mentioned earlier, the work is performed in small chunks, which makes it easier to identify the root cause or the impacted part, activities, location Etc., if something does not follow the plan. Such a concept improves productivity and raises commitment awareness. This commitment is planned with pull techniques that make the workflow evident for the trades or crews. This makes the clients and workers visualize the effect of their productivity and hands-off on the other crews or trades, rather than having a programme that might be used only as a way of representation.

More importantly, constraints are being analyzed before adding those tasks to the look-ahead schedule as the tasks are made ready before their execution which PPC monitors percent plan completed. This is a crucial measurement key factor as it may hit 100% if all tasks are ready to be executed, which entitles the reveal of constraints. Therefore, with the regular, consistent implementation of such a concept, disputes should be reduced and avoided if all the crews, teams, and trades maintain the same level of collaboration.

When planning is performed heavily for construction methods and physical resources while ignoring the review of technical engineering review during look-ahead scheduling, this may incur a delay. When a design issue occurs on site, delays eventually occur even if the design issue has been resolved. Such an event may affect the relationships and workflow among the different subcontractors, leading to disputes. According to Javkhedkar, (2006), good technical engineering review on work in the upcoming weeks must draw more attention. Moreover, the look-ahead schedule does not provide details about the productivity of crews, time and space constraints, or activities of trades that might have conflicts with concurrent activities. Therefore, subcontractors should be actively involved in the look-ahead scheduling process so their responsibility and wiliness to buy into the schedule are clear; otherwise, misunderstanding or uncertainty might occur that lead to disruption and performance issues.

2.3.6. Design

Design in the construction industry is a crucial factor in reducing waste if carried out correctly. A faulty design can result in change orders, rework, reduced constructability, cost overruns, and delays, leading to disputes. The design workflow can impede unnecessary design errors, which reduces the design reliability. Therefore, design processes require a smooth flow of information that provides feedback from all team members and builds a culture of continuous improvement.

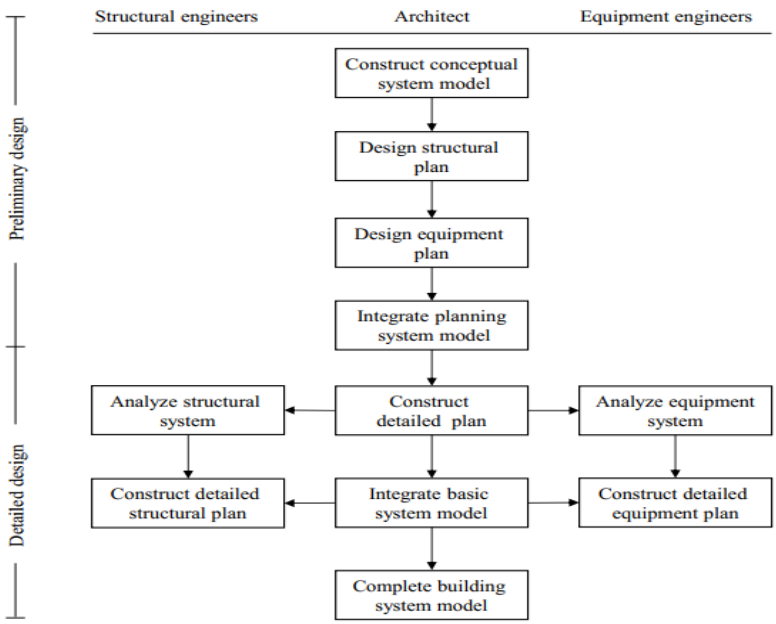

Figure 9: Current Design Workflow as adopted by Ko and Chung, (2014)

In construction, the Designer completes the design in two stages: preliminary and detailed designs. The design stage starts with preliminary designs to determine the winning design, which authorizes the start of detailed design, which is reviewed against the client's requirements. Afterward, structural engineers work on the shop drawings for all the disciplines, which are approved and signed after checking for errors. After the finish of the design of all other disciplines, the designer then integrates the prints obtained from these processes. Figure 9 shows the current design and planning workflow, which dictates that the designer is responsible for the design plan at every stage except for structural and equipment designs (Ko & Chung, 2014).

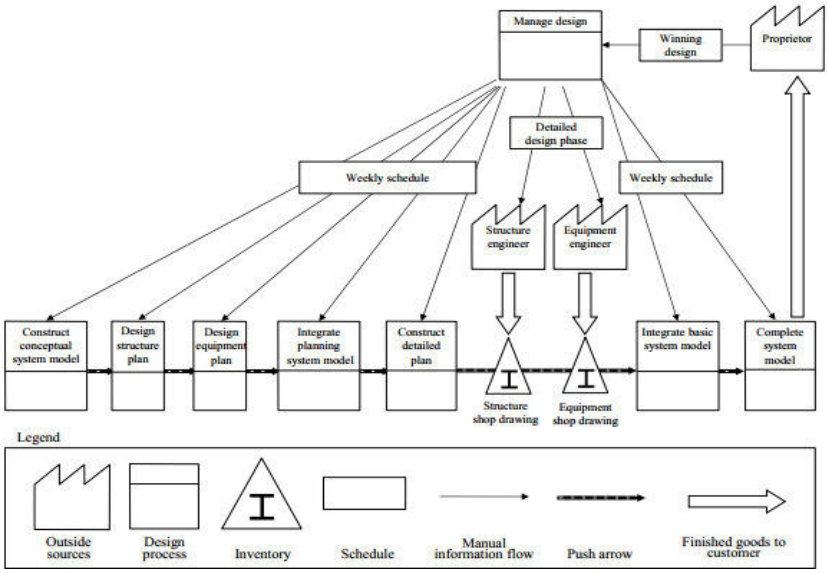

Figure 10: Current-state value steam mapping of design processes as adopted Chien-Ho Ko and Neng-Fu Chung (2014)

According to the current-state value steam mapping of design processes demonstrated in Figure 10, the client first tasks the project design to the designer, who would then independently complete each part of the design plan. Structural and equipment engineers analyze and inspect the design after the completion of the design work being done by other disciplines. Afterwards, the design is being handed over to the contractor for construction. The completed building is then turned over to the client. If work is obstructed by design errors or construction issues, the design is returned to the designer for corrections.

The design in the construction industry is complex since it includes several disciplines and participants that no single comprehensive expertise can entirely hold. This impedes concealed problems that affect the construction phase (Abdelsalam et al., 2010). This may lead to a change order, resulting in a conflict if schedule and cost overruns occur (Josephson et al., 2002). Such a change order may require plan or design modification, which is considered a waste, particularly for a plan-driven approach life cycle that is mostly adopted by the industry. Moreover, if the design becomes unfeasible, it is returned for revision.

According to Chang et al. (2007), as cited by Chien-Ho Ko and Neng-Fu Chung (2014), 40% of design changes are due to errors and problems occurring in the design phase, which add to conflicts and disputes in the industry.

Design is complex as it involves the enormous exchange of information that a competent design team may fail to process or provide the required information at the right time with adequate quality. The design should have two provisions: the first is to be accurate, fully coordinated, and complete information, and the second is the timely provision of the information (Saad, 2011). As a result, the three involved parties must deliberate on some principles and basic techniques of planning, monitoring, and control appropriate for dealing with the specific requirements of the design process during the design and execution. Agreement at this stage is an excellent strategy for limiting future causes of delay, which can lead to conflicts or even disputes.

The outcome is only perceived in design after the designer utilizes his capabilities to create a design alternative. Each activity would be based on an approved drawing based on conceptual design. To gain the support of the managers, they must be aware of methods and techniques used to develop that design alternative. Thus, all parties must be engaged sufficiently with technical issues to select the appropriate procurement method adequately.

With traditional project management, design variations might occur, which causes delays and claims (Ahsan & Gunawan, 2010). This makes the contractor incur higher costs resulting from operating and indirect costs. Therefore, frequent design changes or variations may reduce the project's success. According to Bennett, design variations may be performed due to the client's instructions to cut costs (Bennett, 1981). Some clients allocate inadequate, insufficient budgets, which might occur unintentionally out of the client's ignorance of the construction costs and methods.

Another cause of conflicts that might lead to disputes is the need for more knowledge by the designers. Most of the design organizations are structured so that the experienced designers would provide only a schematic design and let the young designers with little experience in material handling and installation take over the drawings. Along with the pressure the client imposes on the designer to finish the design, documents, and specifications, more time is needed to evaluate every detail fully. Thus, inefficient details may lead to time waste that might be experienced by the contractor, which can turn into a loss. Moreover, when the design firms prepare the bid documents, they would not spend time reviewing the specifications' requirements. They would instead use template specifications. Consistent design documents and specifications may result in consistency in the cost estimate, which that a project may become overpriced and suffer from unnecessary costs. Therefore, value engineering may be required to provide ideas to bring the cost down without compromising the quality. However, by the time spent on such activities could have been avoided in the first place, which implies time, effort, and cost waste. When such inconsistency exists in the bidding documents, it creates additional waste due to rework by designers and RFI issuance by the contractor. Therefore, the designer would be required to eliminate those errors from the drawings, which is a very time-consuming process; therefore, most designers would only provide a table for beam sizes, for instance, and provide general information on the subsequent drawings to avoid much rework for the designers and to avoid many RFI that may be presented by the contractor who is trying to understand the inconsistent drawings.

2.3.7. Lean Design Management

The last Planner System is a social system with a technical component (Seppänen et al.'s, 2010). As suggested by Seppänen et al., the system is considered purely technical if it can be applied without requiring any social interaction with the team members. In contrast, the system is considered social when the technical system requires social interaction to be

effective. Moreover, LPS includes social methods for conducting weekly meetings and calculating performance metrics (Ballard, 2000a). These methods are used to gain the commitment of all participants, "Last Planners" such as "Big Room". The technical part improves information flow by collecting information in a more systematic approach to facilitate sharing of knowledge to advance the design work (Seppänen et al., 2010). The percentage of plan completed (PPC) and other LPS metrics are part of the technical system.

Disputes result in the absence of trust among the construction participants. The industry's dynamic nature deepens the uncertainty, making the parties transfer, avoid, or at least mitigate risks. Therefore, the need for lawyers emerged. They draft contracts that would protect their clients' interests regardless of the other parties' interests rather than drafting contracts to facilitate the smooth operation of construction projects, appropriately placing risk, and minimizing the incidence of disputes. Thus, imbalanced contracts lead to mistrust and reduced project performance and teamwork. This environment hinders the possibility of creating a collaborative environment where decisions are made in the project's best interest.

Trust is a critical factor for collaboration (Coleman, 1988). It is defined on three levels, as Lewicki and Bunker (1996) suggested. At the first level, called calculus-based trust, people weigh the benefits or costs. The second level is knowledge-based trust, in which people are likely to predict people's behavior based on their previous doings and interaction. The last level is identification-based trust, at which both parties are confident of each other, and they are likely to protect each other interests. As mentioned by the author, trust almost stabilizes at the first level at work and rarely goes beyond that level. Moving to the construction industry, a study conducted by Cerić (2015), at the beginning of the project, interactions are based on inter-firm relationships; afterward, they switch to inter-personal relationships and then back to inter-firm relationships after the project completion.

Trust is required to solve complex design management problems as the construction parties become empowered, enhancing loyalty and creativity. Lean design management (LDM) can develop trust from a calculus-based level to a more advanced level, where people become more willing to participate in creative problem-solving through trial and error. Moreover, trust blurs the organizational boundaries between actors. It supports the solving of problems in a collaborative way which is required for the effective implementation of the social domain of the LDM concept. Thus, buffers could decrease, and resources could be better utilized for the project's best interests rather than ensuring their benefits. Trust and collaboration can facilitate the adoption of the LDM concept. Therefore, an initial level of trust is required to effectively use the social domain of LDM, which improves information flow through the technical domain of LDM tools and methods and helps to solve design management problems (Kpamma et al., 2017).

2.3.8. Logistics

The ineffective collaboration between procurement and engineering during the planning stage may lead to disputes. The procurement organization should engage with engineers to identify material and equipment needs throughout the project's critical path, gather technical information from suppliers, and design the subcontracting strategy based on the capabilities and costs of suppliers (Roland Haslehner, Santiago Castagnino, Armin Lohr, Pascal Engel, and Ailke Heidemann, 2015). Lean distribution can be defined as minimizing waste in the upstream supply chain while making the right product available to trades at the right time and location, in accordance with lean principles that maximize value by reducing waste and cost (Holweg, 2007). To ensure a consistent flow of materials to the site, they should be drawn into the process at the appropriate place and time. This strategy reduces the amount of material storage required on the job site while avoiding delays and bottlenecks that may occur if materials are in short supply. To meet these objectives, contractors should determine the scheduling requirements, including lead times and frozen zones, for the entire supply

chain—from the job site to the supplier. So, contractors should set up quality gates all along the supply chain and look for potential problems long before they need materials at the job site. Lean distribution should be discussed along with lean production; otherwise, any distinct discussion to lean production away from lean distribution would be misleading. Without an implementation that does not span the processes streamline would cause bottlenecks, and disputes may arise.

Delay in procurement and mobilization of resources is widespread, which the industry suffers from. The contractor's delay in procuring the material and resources required occurs in most projects, which eventually leads to delay (Afshari et al., 2010; Ahsan & Gunawan, 2010; Alaghbari et al., 2007). According to Asmar, the late delivery of material might be due to the need for smooth coordination between the client and contractor, which dictates late approval of purchase orders (El Asmar et al., 2013). Consequently, this disturbs the supply chain between the contractor and subcontractors, imposing more pressure leading to delayed installation and jeopardizing the project performance (Doloi et al., 2012). Moreover, some contractors think that purchasing very late may get them to benefit from low prices as they are using this strategy to pressure the seller or the subcontractor; however, this fosters adversarial relationships. Therefore, some sellers or subcontractors compensate for the quality as counteract (Frimpong et al., 2003).

2.3.9. Contract

Contract type may be one of the causes that may cause the degree of uncertainty. Most clients tend to select lump sum contracts to determine a fixed price for the project, and practically, it is rare that projects undergoing these contracts would be completed at the same price. Moreover, the contractor would seek different ways to ask for variation orders or quantity changes in some items that would add to the tendered price. Therefore, some contractors may exploit the incompleteness of the drawings, inefficient competencies of the

engineer to review shop drawings that the contractor creates and poorly issued IFC drawings. This implies that the cost certainty is just a fallacy under this specific type of contract. This may imply that some procurement methods are critical factors in avoiding or reducing disputes. According to Cheung and Yiu (2006), some procurement methods are prone to disputes rather than others because of their different risk allocation. Such risk allocation could add differing interpretations as each party thinks of his entitlement to compensation.

In lump sum contracts, the contractor asks for a higher price since he bears all risks to account for any unforeseen risks. Meanwhile, the contractor must ask for a fair price; otherwise, he is not the lowest bidder resulting in the loss of the contract. Clients use this type of contract to determine the budget and schedule, which is almost impossible. Therefore, this type of contract makes it intractable for any modifications to occur. If any flawed risk identification process occurs, a dispute occurs. Moreover, the contractor usually recognizes that imperfect information might occur, such as design or drawings errors which eventually affect the actual construction cost reducing his profit. Such reduction might lead the contractor to cut corners in a way that might affect the quality. If ambiguities of drawings persist, then the client may issue a change order or variations in response to a contractor’s claim to additional costs. This entitles the contractor to receive additional payments which should be amended in the contract; otherwise, a dispute may erupt.

Unfair pricing of contracts is one of the most sources of disputes in the industry. Most clients think the contractor's estimate should be very close to the engineer's estimate. This is not always true in the making, like conditions that must be fulfilled. This mindset forces the contractors to accept a low-priced task, which might force the contractor to cut costs to compensate for his loss, which would eventually reduce the project quality. Thus, the contractor may revert to raising claims and variations to release some resources to compensate for some of his losses (Le-Hoai et al., 2008).

Moreover, some clients exploit the market conditions, mainly when the market is low, which again forces the contractor to take on low-priced jobs. This forces the contractor to always look for variations and manipulations to improve his profit. Thus, improving the contract provisions and clauses is vital to avoid disputes. Occasionally the construction parties need to understand their rights and responsibilities fully. This occurs because the contracting parties need to read the contract carefully, which may lead them to assume without referring to the contract provision and clauses. For example, there might be a dispute concerning who owns the float. The contractor assumes that the float is dedicated to the construction team to utilize in a way that levels their resources or manage their cash out.

Additionally, each party has interests that must be aligned with others. For example, the contractor would seek to finish the project with maximum allowable profit; therefore, he would pursue every claim and variation order to claim as much profit as possible and avoid any liquidated damages due to any delay, while the client seeks to finish the project with the lowest possible allowable price at the highest quality standards. Therefore, clients tend to decline variations and claims through imposing privilege clauses and provisions, and consequently, disputes erupt. Moreover, when clients delay the payments, the contractor who has not been paid would not be able to pay the subcontractor. This makes the latter is not being able to pay his suppliers. Due to the presence of contracts chain in the industry, this prevails, and any payments delays cause disputes. Sometimes, the contractor is paid; however, he may use the payments on something outside the project boundaries or unrelated to the project interests, which eventually may cause a shortage of supplies and resources on the project. Thus, this may lead to disputes if cash is not monitored and has been spent on the execution of the project.

The procurement strategy and the selection of construction parties require attention. Identification, allocation, and proactive risk management are critical components of dispute resolution. Standard contract forms should be used because both parties are generally aware

of the obligations that each party accepts. Competitive tendering frequently results in the lowest price, which only occasionally results in the best value for money. The contractor who submitted the lowest bid usually had the smallest profit margin. If this margin is depleted, they may resort to opportunistic practices to recoup any losses. Using negotiated or selective tendering with a policy that requires contractors to openly present their margins and how they priced the project could potentially break down any perceived "them and us" barrier. Also, sharing knowledge through inter-organizational communities of practice would help people work together to solve problems and might make it less likely that people fight with each other.

2.3.10. Tendering

In this phase, contractors should prioritize projects with the highest potential value. According to Sambasivan and Soon (2007), contractors should only take on jobs with sufficient skills. The dimensions to consider when evaluating a project include:

- The likelihood of its being realized,
- The probability of winning the bid,
- The capacity of the organization,
- The risks of the project, and
- The qualifications and backgrounds of the prospective project team.

Contractors should only bid on projects they can do profitably or have a good chance of winning. If they don't, they usually waste time and money on projects they can't do profitably or have no chance of winning. The contractor would recoup the costs of failed bids in the one he won. Therefore, it is paramount for the contractor to evaluate the projects he is bidding for precisely. On the other hand, when a contractor decides to go into a bidding process, there

are some factors that may constitute a waste possibility that reduces the efficiency of the tendering process.

According to Odeh & Battaineh (2002), bidding duration is a crucial factor in avoiding conflicts and disputes if well-designed and adequately provided. Most clients do not allow for sufficient bidding duration; therefore, it is seldom that the bidders have enough time to study the scope adequately, which forces the contractor to overlook or even skip some items without rigorous study (Odeh & Battaineh, 2002). On the contrary, clients tend to award the project late. Contractors provide their bids based on the available resources; therefore, with such a late award, the contractor may assign or lose such resources since he may be engaged in other projects (Ahsan & Gunawan, 2010). With such a late award, any change in schedule, availability, or even costs of the resources may affect the profitability and the project's success. Moreover, if there are scarce resources, the contractor may divide these resources between both projects, which might affect the performance and cause delays (Salama, Hamid & Keogh, 2008).

Most bids are chosen based on the lowest price. With this tendering method, the contractor competes to win the project by making the bidding process a competition (Falqi, 2004). As a result, choosing the lowest bidder may also mean choosing the least qualified contractor. By choosing a contractor based solely on pricing, the client might not consider the contractor's qualifications, workforce capabilities, and resource availability. As a result, this could lower the quality or increase delays. Afshari also mentioned that choosing an unqualified contractor ensures a timely process (Afshari et al., 2010). The lack of social comprehension and knowledge of local laws may be to blame for this; thus, the contractor ought to have focused more on resolving the issues with approvals and labor (Doloi et al., 2012). Hence, the bidding technique would impact the resources, project quality, time, and selection of unqualified contractors.

Moreover, Fallahnejad (2013) noted that there are better ideas than rewarding the lowest technically accepted commercial. Fayek further underlined that this might be the case because most bidders need to pay more attention to the specifications due to client pressure to shorten the bidding period. As a result, clients and contractors suffer when they later claim losses (Fayek et al., 2006).

For comparing the bids, relying merely on the lowest price is insufficient or even invalid. According to Robert B. Pattison (2004), there are alternative ways to safeguard the integrity of the bidding process besides requiring a bidder whose bid price is incorrectly too low to honor it. The implied provision that a client would not base its decision on factors that are neither openly stated nor implausible from the Call for tenders should be the more accurate definition of the client's responsibility of "fairness" in bidding and tendering. So, the client should have a selection procedure that can assess offers fairly and exclude any that are not compliant. For example, a prequalified list of bidders can contribute to disqualifying any contractors whose qualifications do not comply with the project's standards. Therefore, the criteria employed in creating such a list should be further studied. Would be a new contractor adopting technology better or more qualified than an old contractor with a history while behind in adopting new technologies?

The Supreme Court of Canada recognized the formulation of a construction contract in two steps: Contract A and B. When a contractor responds to a bid by submitting a complaint bid, then Contract A is formed. Moreover, when the client accepts a particular compliant bid, then contract B is formed. However, this scenario has two primary sources of disputes: Privilege Clauses and compliance issues. When a contractor decides to withdraw after submitting a complaint bid as a response to the client's Call for tenders, according to the Supreme Court of Canada, contract A is formed instantly after the submission; however, Contract B would be formed after the selection is being performed and the contractor signs officially the contract. Here come the issues of compliance; the contractor may claim the

withdrawal due to the incompliance of his bid. Even though sometimes, the bid may be incompliant as the contractor may have performed a mistake in the estimation process, which happened before in the case of *Ron engineering*, some contractors may also claim the withdrawal due to compliance as they may find another opportunity; therefore, they prefer to withdraw from here to go there which constitute a waste of time and efforts particularly for the client and the engineer as well. Another is the privilege clause, which gives the client the authority to disqualify the lowest bidder, eventually leading to a dispute between the lowest bidder and the client. In that case, contract A has been formed while the client breaches contract B. In that case, should the contractor be compensated, or the client disqualifies the contract due to compliance or just rely on the privilege clauses to qualify or disqualify any bids (Robert B. Pattison, 2004).

As discussed above, when a contractor submits a non-complaint bid to the criteria that are being set by the Call for tenders, the client could disqualify the bid; however, if the client selected one of the non-compliant bids, then the client may expose himself to be suited by the unsuccessful not selected bidders. Contract A is not formed when all contractors submit non-compliant bids, and the client can call for another call for tenders. The submission of a complaint bid is paramount to avoid bidding disputes in construction. In addition, if all bids are compliant, the contract is awarded to the lowest bidders. This award must be done relatively; otherwise, the client may breach its obligations to the other unsuccessful compliant bidders. Therefore, this may entitle the unsuccessful complaint contractor to the amount of profit the bidder may have earned if his bid was successful and accepted (Robert B. Pattison, 2004).

To reduce or avoid tendering disputes is to submit a compliant bid which implies that all required information is received ahead of time from all subcontractors. Therefore, all aspects required for bid submission should be prepared before the deadline. Sometimes, to meet the deadline, the submitted bids need all the required information. Therefore, when there are

privilege clauses that allow the client to accept incomplete bids, this may lead to accepting non-compliant bids. Consequently, this may result in other unsuccessful bidders claiming the client's breach of his obligations towards them (Robert B. Pattison, 2004).

Suppose a bidder submits the second-lowest bid on a project, and the client awards the contract to a non-compliant bidder. The award may then be challenged as a breach of the client's contract A obligations to the unsuccessful bidder. This challenge must be resolved quickly for practical reasons if the challenger wants the client to reconsider its bid. This may be accomplished by an application to the court for a declaration that the successful bid was non-compliant. Alternatively, a challenger may bring an action in court for damages in the amount of the profits it would have realized if it had been awarded the contract.

As previously stated, if a bid is accepted and the bidder discovers an error in the bid, the bidder may apply for a declaration that its bid is non-compliant. By the same token, a client may file an application for a declaration that an incorrect bid is compliant, forcing the bidder to enter Contract B.

Potential tendering process flaws are frequently discovered after the contract has been awarded. If the contract is awarded to a non-compliant bidder, an unsuccessful bidder may sue for breach of Contract A, claiming damages for the profit it would have realized if the contract had been awarded to it (Robert B. Pattison, 2004). Similarly, if the contract was awarded to a compliant bidder and an unsuccessful bidder believes it was treated unfairly during the bidding process, the unsuccessful bidder may sue for lost profit damages. In either case, the losing bidder must demonstrate that it would have been chosen if the client had not breached its obligations.

This option may appeal to unsuccessful bidders because it allows them to profit. They would have realized if they had been awarded the contract without having to invest the time and risk in carrying out the contractual obligations. Unsuccessful bidders in this position

should consider the risk and expense of litigation, as well as the potentially negative business consequences if the client is a regular source of work (Robert B. Pattison, 2004).

2.3.11. Documentation and Specifications

When there is insufficient specification or drawing, stoppage occurs, leading to project delay. Falqi summarizes that might lead to stoppage of construction as ambiguities, mistakes, and inconsistencies in the specifications and drawings. Moreover, when the specifications or drawings are not accurate, the client's expectations may be distracted from what is expected on site, which may result in adversarial disputes and changing orders (Falqi, 2004). Therefore, specifications and bidding documents, in general, must be accurate and signed off for complete understanding by all parties; otherwise, the contractor may work to reduce costs to increase his profits while the client tries to overload the work. This attitude may lead to conflicting objectives and disagreement (Al-Hammad, 2000).

Some clients possess bureaucratic review and approval processes that result in delays that badly affect project performance. This lousy performance or productivity by the client affects the completion of the design documents (Afshari et al., 2010). Therefore, due to the pressure being imposed on the contractor, he would have either two options, either to proceed and the possibility of rework would exist or wait till the client's approval and raise a claim to defend his situation, asking for an extension of time. However, with such waiting time, the contractor may be liable for operating costs and resource mobilization, affecting his profitability. The tendency is that the client would provide any cost compensations. Doloi (2012) mentioned that this is prominent in manufacturing since they must wait until they receive the official document approval before starting production to avoid any potential rework; therefore, the production is constantly being affected by the client awaiting the time of approval (Doloi et al., 2012).

2.3.12. Risk Allocation

Scoping is determining the contractual expression of a client's project requirements. "Front-end loading" refers to the period in which the scope and execution detail of a project is defined before a final investment decision is made (Charrett, 2019). He mentioned that this period costs 3 – 5 % of project cost; however, it drives the cost of schedule predictability and minimizes operational problems. Therefore, the negligence of that period may cause insufficient time to develop the design, documentation, planning, etc. which might impose the risk of unnecessary costs.

A significant portion of the wastage in the construction industry is attributed to inappropriate risk allocation in contracts. Therefore, the risk is a crucial factor that can affect the final cost of a project. Although of the severity of that issue, the allocation of risks has not changed. The process of risk allocation dictates that risks must be identified and managed closely. Such allocation can significantly impact all stakeholders' behaviors, eventually impacting project performance. This implies the importance of mutual agreements on the risk allocation process, reducing disputes. Risk management addresses project uncertainty, whereas lean addresses waste through flow optimization. Therefore, a risk "threat" driven by project uncertainty is a waste from a lean perspective. Therefore, lean strives to reduce wastage driven by project uncertainty. Preventing and limiting the risk of disputes or "threats" is always better than resolving them.

Project uncertainty due to risk allocation is a critical underlying factor that leads to disputes (Cole, 2003). When a contractor enters a contract with a client, they are aware of the risks and price of these risks accordingly. However, there may be a degree of uncertainty for parties when a contract is signed, which can later contribute to a claim and dispute (Mitropoulos & Howell, 2001). For example, such uncertainties should arise with the use of a traditional lump sum contract since the client is being provided with a fixed price, which in practice is a fallacy as most projects rarely end up with the tendered price, nor the project

starts with complete contract documentation. Therefore, some types of contracts are more prone to disputes than others.

Clients commonly select the contract type that would transfer the risk to mainly the contractor. Therefore, they consider the contract as a tool for risk allocation. Although the clients should favor the fair risk allocation that reduces disputes and improves performance, not all contracts allocate the authority to manage the risk equitably. The client aims to allocate the contractor as many risks as possible (Gransberg et al., 1997). Risk sometimes needs to be allocated to the best party able to manage it. Risks should never be assigned to a single party. Instead, parties must seek an equitable sharing of risk and allocate risks most appropriately, considering each project's specific circumstances and reducing potential disputes.

Clients use disclaimer clauses as an attempt to transfer risks to contractors. These clauses are intended to exclude a client's liability in the contract and often in tort for the cost incurred by a contractor. Using one of the five disclaimer clauses, including uncertainty of work, conditions, delaying events, indemnification, liquidated damages, and sufficiency of contract documents becomes a general industry practice. When the contractor endures a risk that he does not control, the contractor must either ensure against it or add a contingency to the bid price (Jergeas et al., 1994). Two recent studies indicate that using disclaimer clauses in Canadian contracts carries a premium of between 8% and 20%, depending on whether business conditions are favorable or adverse (Hartman & Zaghloul, 2003). Using these disclaimer clauses implies several concealed impacts, such as restricted bid competition, increased potential for claims and disputes, and, above all, more adversarial client-contractor relationships.

Clients' and contractors' risk allocation contracting practice is mainly a function of their trust (or mistrust) relationship. If the client-contractor contract is based on a solid trust

relationship, the amount of the premiums associated with disclaimer clauses is very low. Even better, the disclaimer clauses would not exist in the contract from the outset. Other than the problem of risk premiums associated with disclaimer clauses, there is one more significant problem. The existence of disclaimer clauses in contracts may destroy yellow and/or red trust (integrity and intuition). Disclaimer clauses can clearly communicate how much one-party trusts or values the other party or the contracting relationship itself. As a result, the contractor would be very creative in finding ways to get as much money as possible from the client. This can be done in different ways, such as risk premiums, change orders, overheads, inflated estimates, and other ways. In general, the process of risk allocation via disclaimer clauses discourages creative ways of doing business between contracting parties and destroys their trust. Above all, a disclaimer clause in any contract would harm the relationship by forcing both contracting parties to focus on different sets of personal goals rather than common ones.

Davenport has suggested that it is misleading to mention that the contract allocates risks; however, it allocates obligations. For example, the extreme weather conditions risk is not allocated by the contract to either party; neither party controls the risk in the sense of having any responsibility for the risk event happening, namely the extreme weather conditions different from those expected by both parties. However, equipment that not be able to construct the facility is under the contractor's control, which must provide appropriate equipment to construct the facility. The obligations occur from the risk event happening the contract allocates that. These neutral risks must be identified because they must be managed by a party that can affect at least one of the following: the likelihood that the risk event occurs, the nature of the risk event, and the consequences. Hence, addressing the difference between obligations and risks is necessary to decrease disagreements.

2.3.13. Human Behavior

Firms must make deliberate decisions about who they hire to complete their projects. Because of the nature of the client and the team they are working with, different personality types are required for specific projects. Firms must hire people with emotional intelligence to deal with the challenges they face. As a result, businesses must have a solid understanding of their employees' personality types, emotional intelligence, and ability to deal with the pressures associated with their role in the specific project. As part of the hiring process, people should be given personality tests to see how well they fit into the emotional context of the organisation and the projects they are working on. For complex projects, for example, it's important to think about the personalities of the people on the project team and how they might work together to solve problems. As the project goes on, building an emotionally intelligent team that can spark creativity and find solutions to problems that come up during design and construction makes it easier for the team to deal with conflicts and negotiate solutions.

According to (Cheung & Yiu, 2006), human behavior is one of the sources of disputes which might be derived from poor negotiation skills, which may occur when parties need to prepare for negotiations, or many issues are discussed simultaneously. Other studies suggest that disputes occur due to the inefficiency of the cooperation between the client and the contractor (Fadhlullah Ng, Ismail, & Hashim, 2019), which is represented when the client is not satisfied with the contractor progress; thus, he may not be willing to pay additional costs. Also, Diekman et al. (1994) suggested that people are one of the critical factors influencing claims and disputes. When a contractor withholds a piece of information from the client or the engineer, which may be due to ignorance or inefficiency of the engineer, he gains interest over the other parties. For example, suppose a design error occurs in a storm pond that the contractor might know is inapplicable or in-constructability. In that case, the contractor thinks that such an error result in a notice of delay by which he gain an extension of time.

Moreover, the contractor intentionally does not notify the engineer to have privilege in the eyes of the client against the engineer. This kind of opportunistic behavior is called "adverse selection," and it usually happens before the contract because measurement isn't perfect. Also, Love et al. (2008) found that many mistakes are made because people do things in a certain way when they are trying to solve a problem. For example, reusing design details, specifications, and other contract documents to save time and money without thinking about the purpose and nature of the projects being made. People sometimes do the same things over and over, like taking short cuts and not doing things the right way. When a practice gives a result that a person finds satisfactory, that practice is used on other projects, even if it wasn't right for that project. For example, designers may decide to skip audits, checks, verifications, and reviews before releasing documentation for pricing or construction. Even though these things are important, they are often done this way because clients put financial and time pressures on design firms (Love et al., 2008).

2.3.14. Culture

Due to the industry or company's expansion, clients and companies may assign foreign project managers over local ones. They tend to assign project managers who are familiar with company policies and procedures. Differences in backgrounds and experience may result in different ways of thinking and attitudes. The project manager is a role that involves 90% for communication according to PMI; therefore, the project manager must understand the different cultures, gestures, or body language, which may be different from one culture to another. Therefore, it is a big challenge for the project manager and team members to understand the environments they are acting within to interact effectively with all participants.

The culture of the construction industry is a shared understanding of what all parties are expected to do. To avoid disagreements between the parties involved, the cultural objectives must be clear. In this context, culture is defined as the ideology, belief system, norms or

behaviors, and social order that comprise society and traditions, and which may be reflected in the behavior of project stakeholders. To control the cultural aspects that can confuse project design and construction, the Project Manager and team members must clearly understand the following points:

- It may be crucial to consider the religious factors as, in some conflicts; the project manager may not act due to the religious factors, and this can affect their career or future in the organization.
- When various nationalities exist in a project, this may imply a lot of traditions, rules, and habits linked directly to the religion, such as regular holidays and festivals for different traditions of others in the workforce.
- Most construction parties prefer to use their language.
- They may not prefer to employ interpreters whose translation or conveyance of information is inaccurate or ineffective compared with people using the same contract language.

2.3.15. Expectations

A conflict arises when construction parties have different expectations regarding outcomes, impacts, changes, etc. For example, the contractors expect that all design disciplines are fully coordinated during the design stage to allow smooth construction; however, uncoordinated design may result in clashes that become a dispute. This clash issue may result in other dormant issues such as delays, additional work, cost, etc. Therefore, any ambiguity must be identified and managed closely. Contractors may tend to avoid discussion with clients about expectations, problems, etc., as they think that they should not reveal all their information or they think that the client may not be pleased when the contractor discusses negative issues, such as delays, variation, etc. therefore, they do not prefer or suggest discussion in an

industry which is already full of disruptions. Research by Powell (2001) found that the communications problems between designers and manufacturers are due to differing values held on the supply and demand sides of the supply chain. Similarly, integrating design and construction is not a matter of incorporating process tools to streamline the processes; however, it is about the efficacy of relationships between individuals within such organizations (Emmitt & Gorse, 2003). Therefore, integration is about understanding the processes to create a built artifact to budget and programme, surpassing the client's expectations.

When expectations are not defined, misunderstanding may lead to disputes. Mane and Pimplikar (2012) define a dispute as a misunderstanding that may take time to resolve, leading to late payments. Consequently, the contractor might need more cash flow affecting the project performance. Moreover, if expectations are not well defined, the client may expect excessive work that the contractor does not expect to implement. Even such successive work may imply change orders and add more pressure on the contractor. Therefore, collaboration and transparency should be built into the process.

2.3.16. Inexperience and Adequacy

Mortaheb mentioned that the client's participation in the design is beneficial and can assist in the alignment of expectations; however, the frequent interference of the client may result in distraction to the designers and other stakeholders (Mortaheb et al., 2013). This distraction diminishes the performance and increases the occurrence of conflicts. However, the author mentioned that the client's reluctance to participate in significant reviews resulted in the inefficient design, which would need frequent change orders and modifications which entitles rework.

Moreover, the complexity of projects requires qualified and competent stakeholders. The inadequacy may result in delays, leading to conflicts and disputes eruption (Ogunlana et al.,

1996). This inadequacy may result from a lack of engineering apparent roles/goals factor and lead to delays and claims (Alaghbari et al., 2007). When engineering roles are evident for all stakeholders, then the responsibilities and duties are set to clear, and expectations are established; therefore, no one is supposed to do something else, and even no one expects that someone does something which alleviates his responsibility. Therefore, the coordination and management must establish the connections between all engineering roles for their integration. However, if such roles are unclear, the deliverables may suffer from poor quality, affecting the performance, cost estimate, and delays entitling rework and losses (Chanmeka et al., 2012).

Some clients understand that their involvement should come at a later stage since the consultant is taking the role of designing, reviewing, and inspecting. Even some clients tend to reject participating in activities such as team building as they think it is irrelevant to their roles or out of their responsibilities. For example, the client's inspection team usually needs to be involved early enough to ensure that material and equipment arrive at the site in competent status, free of errors or defects and that systems are performing according to the specifications and standards (Odeh & Battaineh, 2002). This lack of involvement sometimes is traced to the organizational structure. Thus, the organization should be structured to bring it to full involvement in the design phase, at which lessons learned and maintenance problems could be analyzed and tackled rather than waiting till the commissioning and close-out phase (Ramanathan et al., 2012).

Team building activities are a critical factor that establishes competent, qualified, skillful team members whose performance is fostered through collaboration. However, if such a building process is performed adequately, the project could maintain performance and be protected from conflicts and disputes. According to Mashayekhi Ali N. & Mazaheri Tahmasb, team building could foster a healthy environment since team members from the client and designers would be involved in technical discussions, which would alleviate any

misconceptions and break any tension among them, resulting in effective communications and trust that would foster collaboration (Mashayekhi Ali N. & Mazaheri Tahmasb, 2010).

2.3.17. Establishing Values and Value Parameters

The establishment of shared values is vital to reduce conflict in the industry. Value parameters should be established among the construction parties to establish the value, which might be the key to improved productivity and client satisfaction. According to Christoffersen (2003a), the perception of value is individual, personal, and subjective. Indeed, agreement on a group's objective best value differs from individuals' perceptions of value. Moreover, he stated that value is dynamic and changes over time. Therefore, such value establishment is intractable and crucial to reducing disputes. Therefore, one of the sources of disputes is the inconsistency of value management implementation. Kelly et al. (2003) argues that value management as a tool to aid the briefing process should be integrated as part of professional design management. This integration should be established through interpersonal communications among the project participants. Kelly and Male (1993) suggested that "value opportunities" are best applied early in the design process when strategic decisions are being taken that affect subsequent work. However, Maister (1993, 2000) mentioned that professional service firms do not share values within the organization and fail to discuss values with clients early in the appointment process adequately. The implication here is that the sharing of values is a challenge for individual organizations and individual and temporary project groupings. Moreover, the need for clarity for the value engineering term in the industry can lead to disputes as the saving is to be shared between the contractor and the client. It might be easy to figure out and agree on how to save money on the supply and installation of the material or product in question. But these are only a few of the benchmarks, and a good value engineering approach needs to consider all the costs of a change over its whole life.

2.3.18. Innovation

Innovation can play a paramount role in creating and facilitating value delivery. Innovation contributed to the development of new products and materials, which has influenced the quality and performance of the industry; however, still, process innovation has not shown great success in managing the development of new organizational structures and management methods that can improve business processes and competitiveness.

Tendering and procurement methods are essential factors influencing the competition, which might be derived from marketing campaigns, new products, etc. (Charrett, 2019). According to Craig (1997a), the tendering process is designed to maintain the bidding process's integrity rather than encourage innovation. He thinks that tendering aims to treat all bidders equally through creating transparent award criteria in advance that lead to price competition. The tenders can increase profits through bid shopping or organizing work; however, bidders are not asked to demonstrate their design suggestions as there are no criteria for the evaluation of novel proposals, and bidders cannot be treated equally if one is preferred on an alternative bid, which is non-conforming in terms of the original invitation. The point is that using the bid process to evaluate design, capability, time, and cost competitively takes work, and the integrity of the process must be safeguarded. Craig concludes that the conventional tendering process does not promote the bidders to innovate in design (Charrett, 2019).

Clients may also significantly hinder innovation since they are unwilling to take the risks that come with it. They care more about the budget and running expenses than they do about encouraging innovation, which they may believe would be less beneficial. The T5 project was used by Charrett (2019) as an illustration of how actively implemented forms of innovation are. BAA, as the project's client, accepted the risk of innovation. It featured advances in products, technologies, processes, and management, such as an off-site

manufactured roof structure, tunneling technology, two logistics centers, insurance coverage, and financial incentives.

2.3.19. Technology Scarcity

Technology needs to be implemented to its full potential in the industry. In terms of the Digitization Index, the sector ranks second to last in the United States and Europe (Zeiss, G, 2017). The use of technology is specialized and time-consuming, requiring training to be added to the full schedule of different stakeholders and parties. BIM is one tool that should be used to span the project life cycle integrating the design with construction by incorporating elements of product, process, and organization. The goal is to provide a foundation for collaborative design by allowing cross-disciplinary sharing of ideas and design adjustments rather than producing rigid and singular design outcomes. BIM implementation, however, is still limited to the feasibility and design phases. The feasibility stage focuses primarily on conducting preliminary estimates to determine the potential construction cost. It is used during the design phase to plan and control costs alongside the design in accordance with the client's budget. This means that less emphasis is placed on digitalizing the construction, operation, and decommissioning phases of a project through conflict analysis, 3D/4D coordination, maintenance schedules, and so on. Accordingly, this insufficient implementation is not successful in reducing or avoiding disputes during the construction phase and onwards (Zeiss, G, 2017).

The lack of integration of collaboration tools may affect the efficiency of the process of resisting conflicts and disputes. BIM and PMIS are collaboration tools whose proper integration would create the tendency and stable process against conflicts and disputes. BIM is a parametric object-oriented digital model that integrates geometry, building attributes, schedule, cost, operation, and maintenance information. This integration creates a single repository that includes all information about the project. Thus, if any change occurs, then the change is applied universally in only one place (Cyon Research Corporation, 2003, as

cited by Pishdad-Bozorgi, 2012). This mechanism of applying the change enables the project team to avoid rework and reduce any effort waste allocated to productive tasks. Therefore, performance is improved, and the tendency of conflict occurrence is diminished. PMIS is a web-based shared database that might include documents such as contracts, permits, approvals, and commitments. In other words, PMIS provides all participants with information about the project status from concept to execution; therefore, the management team and decision-makers may use it for planning future projects. Therefore, their integration would reduce communication errors and problems associated with multiple models and databases (Thomsen et al., 2010).

The lack of a mechanism for capturing lessons learned is a prevailing cause of disputes and fragmentized improvements. The industry lacks a mechanism for recording and analyzing lessons learned. Afshari mentioned that most construction organizations need such a mechanism that can provide them with continuous improvement. Therefore, mistakes are repeated (Afshari et al., 2010). Although some organizations possess a mechanism for archiving such lessons, there is no mechanism to retrieve them back to be used in other projects (Merrow, 2012, as cited by Al Subaih, 2016).

Moreover, clients need to possess the tools that would make them be able to monitor their progress; therefore, clients become unaware of any slow progress that might lead to delay (Assaf & Al-Hejji, 2006). Such a client's ignorance of slow progress and potential delays would defer the client's ability to take prompt actions to correct the situation (Fallahnejad, 2013). Thus, parties may blame each other for poor performance, leading to adversarial relationships that might cause conflicts and disputes.

2.3.20. Coordination and Communication

Proper coordination and communication should be conducted through all the stakeholders, and even they should be held responsible for that. However, the contractor has the most significant responsibility since he is involved in planning and communications with subcontractors and suppliers (Falqi, 2004). When the contractor does not communicate properly with the stakeholders, the client becomes unaware of technical issues; therefore, he may transfer any liability derived from this negligence to the consultants, which affects the client's ability to decide to correct the situation (Al-Kharashi & Skitmore, 2009).

The industry expects a lack of communication between the engineers and other stakeholders. According to Afshari, this poor communication occurs in the design, leading to delays in the completion of the design drawings and documents (Afshari et al., 2010). Moreover, this lack of communication affects the relationships between the client and the end-user, which cause many problems during the handover operation of the project (Doloi et al., 2012). Clients are responsible for selecting an appropriate project delivery method that would affect the stakeholders' integration in a format that would influence the entire design consultant team (Asmar et al., 2013). He concluded that most delays are due to the lack of early communication between the required stakeholders. This led to unclear engineering design, eventually leading to poor performance, adding more change orders, cost, and time overruns. Asmar et al. added that other significant delays are caused by a lack of communication among the contractual parties. Some examples of big delays are starting construction before all the engineering is done, taking land without paying for it, not having enough paperwork, not following standards, cultural issues, bad cost estimates, not getting enough data and taking too long to mobilise, material delays, bad management, a lack of technical experience, change orders, coordination problems, bad planning, choosing the wrong contractor, and client interference (Asmar et al., 2013).

2.4. Summary

As discussed in the literature review, the table below in the appendix summarizes all causes of disputes in the construction industry. These factors have been classified. The first classification consists of three categories: People, Process, and Product (Diekman et al., 1994); the second classification consists of the following categories: technical, legal, and managerial disputes (Totterdill, 1991), and lastly, project contractual issues, uncertainty, and opportunistic behavior (Mitropoulos & Howell, 2001). A thorough conceptual model should be created to characterize the context of conflict causes due to the diversity of the causes. The incorporation of the contract is the primary source of construction conflicts since, as the literature emphasizes, disagreements always have a contractual relationship.

Furthermore, a confrontation results in a dispute. Such a dispute could arise from the denial of a claim or the displeasure of a construction party (Cheung & Yiu, 2006). As a result, the claim is one of the fundamental reasons for construction disputes arising from one of the factors indicated in Table 3 earlier. In conclusion, the disputes mainly stem from two sources: contractual clauses and inclusions and claims or conflicts brought about by one or more of the causes stated in the preceding table. All parties to a construction project must refer to the contract during a conflict. If the contract specifies the issue in detail, then all parties to the project must abide by it. Otherwise, negotiations are only helpful if some lateral conditions play a role in the relationships between the construction parties, in which case a consensus may exist.

Nevertheless, a dispute would be valid and may become more severe if the contract is ambiguous or not specified. As a result, the contract is a crucial factor that may contribute to the emergence of a conflict (Cheung & Yan Pang, 2013). As shown in the following table, Cakmak and Pinar (2014) proposed a different classification containing 28 common causes

of disagreement adopted from Kumaraswamy's (1997) list and divided into seven groups related to the party responsible in table 5.

The literature review shows several perceptions of the causation and their classification; however, these causes can be categorized into three categories: common root causes, causes generated by themselves or through interactions, and proximate causes. The first category is the common root causes that primarily cause conflicts. The second category is the causes generated by themselves or through interactions that result from the context of the environment within which the project team interacts. The third category is common proximate causes, which are the things that can cause conflict. For example, incomplete bid documents that do not spell out the payment terms when a change order is involved are an example of a common proximate cause. The last category is the claim, a proposal for remedy; however, if it is denied or yields dissatisfaction among parties, it may also cause conflicts.

3. Chapter 3 - Early Contractor Involvement

3.1. Introduction

This chapter discusses the significance of ECI as a project delivery method involving relational contracts versus the traditional method. Therefore, ECI pathways and approaches are illustrated to arrive at the implications of the different implementations of ECI approaches. The objective is to determine the significance of ECI as a proposed solution for improving the project's performance. Such approaches are classified into two main groups: during the preparation and procurement periods. Additionally, ECI application along the project life cycle with the possibility of contractor involvement along the project life cycle is discussed to assess such timing of involvement in the design stage process. This timing of involvement is also illustrated for ECI and other project delivery methods to establish the differences among such methods and their implications. Finally, ECI aspects are discussed: ECI-Reimbursement of Contractor, Preconstruction Services, and Tender Evaluation Criteria, by which ECI benefits and challenges are identified.

3.2. ECI Significance as a Project Delivery Method

Selecting approaches and delivery systems is mandatory to maintain a healthy environment that fosters productivity and performance. The selection of delivery systems is based on the project type and clients' needs. Due to the adverse relationships which might lead to disputes and performance disruption, several approaches have been developed to overcome such issues as dispute occurrence.

Traditional project delivery methods are based on assigning risk to a party that can handle such risk technically and financially to control and manage it. Such an approach would minimize the risk severity, reducing the cost of such risk. However, practically clients tend to shift risk to mitigate risk allocating it to the party with the least power (Thomsen et al.,

2010). This tendency of shifting risk assumes that risk is the responsibility of one party, only creating silos of work that might affect the response and management of such risk.

Contracts must be created to control the variability, complexity, and uncertainty that lead to cost and timeline overruns because construction projects are dynamic. Relational contracts have been developed to address this scenario because traditional contracts are not well suited. A formal contract is required to manage and control such variability because change results from such a dynamic nature. Sakal (2004) noted that a successful contract could handle any unforeseen circumstances in the future. According to Macneil, as cited by Wang, 1998, traditional contracting approaches such as DBB drive project participants to focus on discrete pieces (Koskela & Vrijhoef, 2000), and self–interest only eventually results in poor overall project performance (Macneil 1978 and 1987). Additionally, he claimed that relationship agreements encourage the social activity of collaboration. This cooperation would become a self-dispute resolution strategy rather than following procedures for such resolution in traditional contracts (Macneil, 1980, as cited by Harper, 2014).

Another area for improvement with traditional contracts is their propensity to prioritize local optimization, which harms overall performance due to a lack of collaboration and team problem-solving skills that, in contrast, are cultivated by relational contracts that focus on project optimization (Sakal, 2004). Finally, some contracts are more likely to result in a dispute than others. Collaborative project delivery aims to combine people, systems, business structures, and practices in a collaborative environment to reduce waste across the project life cycle (The American Institute of Architects, AIA). Key participants are gathered early in the planning phase to promote open communication and early involvement. Due to the complexity of the construction business and the interdependence of its numerous parties and players, only one area of competence could function independently with the assistance of another area of expertise. The planning process is left to the designers and engineers in traditional project delivery. However, this is insufficient because some designers, especially

young ones in charge of the design, may need to be more familiar with material requirements and installation. To facilitate relevant concerns, tradesmen or subcontractors should be encouraged to engage in the design process alongside designers and engineers (Cook et al., 2007). In this way, collaborative agreements can involve all parties and enable them to impact the design, directly impacting several other factors, including a budget, constructability, schedule, etc. As a result, such participation would encourage general contractors' and subcontractors' capacity to offer insightful value engineering suggestions that would improve the project's performance. Instead of having incentives for each partner separately through a contract, this collaboration depicts the sharing of risk and rewarding system, which entitles the participants to make more profit if the projects become under budget or ahead of time.

Risk sharing is one of the critical pillars of collaborative agreements, which motivates the client to adopt such agreements (Duke et al., 2010). This sharing should help align interests and promote collaboration toward the project's objectives. Collaboration would make each party reveals any problems which might be unforeseen by other parties. In traditional project delivery, identifying and mitigating risks is the other's role, which implies that parties are trying to hold off or keep away from risks. Unlike the traditional contracts where the responsibilities and duties of all parties are identified to the client, the responsibilities and duties are identified of each party to another through the signage of a multi-party contract by each member of the core team, including the client (Thomsen et al., 2010). Identifying responsibilities and duties define the interrelationships among the parties and their crossings. Thus, performance is improved, and disputes are avoided utmost.

According to El-adaway et al. (2017), traditional delivery contracts only address the symptoms rather than the roots of the industry's problems. He further explained that the traditional methods involve hierarchical levels of contracting that lead to more fragmentation, which is no longer suitable for complex construction projects. However, collaborative

agreements involving multi-party partnering contracts address interrelated managerial aspects: project management, project environment, partnering, advisor, design process, partnering, and project schedules (El-adaway et al. (2017).

Tools such as Partnering have been developed to improve relationships in a construction industry filled with mistrust. While partnering is focused on adjusting the adversarial attitudes of the people, Lean Construction focuses on improving the reliability of the actual work being done. The first goal of lean construction, according to Greg Howell, must be to fully understand the underlying physics of production, the effects of dependence and variation along supply and assembly chains. These physical issues are ignored in current practice, focusing on teamwork, communication, and commercial contracts." Howell continues to state, "Partnering makes great sense from an activity perspective. However, few realize Partnering is a solution to the failure of central control to manage production in conditions of high uncertainty and complexity" (Howell, 1999). In other words, while partnering effectively gets people to work together in difficult situations, it needs to address the issues that make them difficult. Therefore, several approaches for procurement have emerged to overcome such deficits, one of which is early contractor involvement. The below table summarizes the main differences of traditional and ECI contracting approaches:

Table 3: Comparison of traditional and ECI contracting

Phase	Traditional	ECI
Design	Design must be complete before construction begins	Preconstruction services to be provided by the contractor while the design is in progress (15 – 30%)
Construction	Construction begins only when design is complete after award of contract	Construction can begin after the major design decision are complete and before the final completion of design.
Contractor Involvement	Contractor is only involved after the	Contractor can be involved any time throughout the project life

	design completion	cycles, most preferably, during design phase such as concept, preliminary stages
Contract type	Lump sum price/Fixed price contract	Firm fixed price for pre-construction services. Firm price incentive for construction contract (Other pathways may also exist) As the design matures, the firm price incentive contract may involve successive targets
Scope	Scope must be clear to have a fixed price pricing that would be core criteria for the evaluation of any claim for additional cost	The contract documentations are prepared through coordination among all participants which makes the contractor acquainted with the project requirement, duration, and scope
Evaluation Criteria	May be solely based on price	Qualifications and price
RFP	Include: SOW for project as full design is complete, bidding process and contract terms	Include: SOW for preconstruction services, concept engineering solution, ceiling price, evaluation criteria

National Public Works Conference (NPWC) and National Building and Construction Council (NBCC) Joint Working Party suggest that the Australian construction industry must move to more cooperative approaches as they have yet to benefit from the claims and disputes. However, new contractual and procurement approaches would need careful evaluation to satisfy stakeholders' needs. Early Contractor Involvement (ECI) is an emerging approach with origins in the UK that aims to reduce adverse relationships that might lead to disruptions and disputes.

Poor choice of procurement strategy is one of the main reasons for disputes in the industry (Rowlinson & McDermott, 1999). According to Laedre et al. (2006), improper procurement method selection may lead to time and cost overruns and quality deficits. Research conducted by Conlin et al. (1996) has concluded that specific procurement systems might lead to conflicts of performance, quality, cost, and time when delays occur. Relational project delivery methods are gaining importance because communications can occur repeatedly or continuously at specific times. This implies that timing of involvement can happen at an early stage of the project: at the design phase, the preparation for the procurement phase, or at the procurement phase.

Early contractor involvement, as a type of relational contracting, is a method to mitigate risks by exploiting the contractor experience, specifically on constructability. According to Hosseini et al. (2017), it is suggested that team-building activities should be completed before the completion of 25% of the project design to ensure the early involvement of the contractor. According to Thomsen et al. (2009), this early involvement would build a sense of ownership. When ECI is implemented, design and construction processes would be integrated rather than segregated, as in the case of traditional routes. According to Lopez & Love (2012), this segregation is caused by the uncertainty that occurs due to design errors, mainly due to lack and poor coordination of information flow during the design phase.

Regardless of the project delivery method, early contractor involvement (ECI) is an approach that aims to increase certainty through the integration of design and construction phases to create a construction-centric process. With this integration, the contractor can have ongoing access to the design, allowing for the contractor's input to the project's design and continuous modifications for cost estimates which correspond to the evolving design. Thus, accurate cost estimates are achieved, which would help the designer revise the design relative to the project budget. Such frequent revisions would accelerate the design process and help the client make informed decisions about the design, as cost estimates are frequently

produced along with the drawing's packages. Additionally, such continuous processes would help the designer to develop the design without pending approval by the client. With a good design process based on technical construction expertise being applied by the contractor as early as possible, consequently schedule and cost control measures by the contractor are ongoing processes throughout the design process, which would promote the reliability of the schedule, cost, and design.

According to the literature, there is not one definite rule for the procurement evaluation model nor contractual design. According to Mosey (2009), ECI is a procurement and contractual route with open books. The aim behind the model, as identified by the British Highways Agency, is to prevent the attitude of "bid low, claim later," where the contractor bid very low just to get the job. He would look for every opportunity to claim cost and time (Mosey, 2009). Such an attitude is the reason for most disputes in the industry. ECI can be considered a two-stage procurement model (Whitehead, 2009) where the designer assists the client in identifying the project's needs and objectives, which would set the boundaries for the designer to develop the preliminary design. As the main characteristic of ECI is the early involvement of the contractor during planning and design phases to contribute to constructability, value engineering, environmental impact assessment, etc., such involvement may be embedded in other project delivery systems; thus, ECI could be considered as a concept which applies to every project delivery system that involves the contractor early in the process. For example, alliancing involves one contract which gathers all the participants, including the contractor, from the start of the design; therefore, alliancing has an ECI element approach. According to Rahmani (2016), ECI could be considered a variation of the alliancing type of contract where the client and the contractor work jointly to complete the planning and design of the project.

Consequently, the client may revert to a traditional method in a Design and Construct (D&C) phase. Thus, it may be perceived as a two-stage route where a collaborative method is

adopted in the first stage, and then a traditional method is adopted in the second stage. ECI is defined by Song et al. (2009) as contractor involvement in the design phase of a project, implemented through a DB contract rather than a DBB. At DB agreement, the contractor would assist in preliminary and concept design and take over the detailed design and construction responsibility. Finnie (2021) defines an ECI contract as a pre-construction service agreement where the contractor is involved accordingly to provide services in design decisions prior to the construction. This agreement would describe in detail the services to be provided by the contractor. Another description of ECI is the one provided by Nicholas (2007), who stated that ECI is a form of partnering with the contractor who is brought early to assist in planning, constructability and develop a pain/gain share formula into the contract based on the Target Price. Under this model, the client and contractor may agree on a target price, unlike the traditional methods (Nichols, 2007). This description described the payment and incentives mechanism which might be used by ECI, which eventually may open the door to other mechanisms that might be tailored into the process, leaving us with the flexibility to build up a model that best suits the project needs and objectives.

3.3. Background

According to Murdoch and Hughes (2008), procurement was implemented directly between the client and trade contractors in a series of contracts. With the evolution of construction technology during the Industrial Revolution, trade contractors started to develop, adding more complexity that would require a definition of responsibilities and obligations. Construction companies tended to hand over the full responsibility of the design and let the contractors focus on construction only, leading to the evolution of traditional contracting. Other procurement processes have also emerged to bring the contractor early, such as management contracting, where the general contractor assumes full responsibility for construction works and construction management: the client employs the sub/trade contractors directly along with a consultant to manage them.

Due to the defragmentation of the design and construction phases, new models emerged in the UK inspired by the lean philosophy derived from TPS (Toyota Production System), which aims to integrate design and production through the elimination of waste. According to Jorgensen and Emmitt (2007), lean can be effectively integrated by establishing an appropriate project delivery framework which has been defined by Jorgensen and Emmitt (2007) to process such as the incentives, agreements, resources, and contracts which support the integration of design and construction and an overall lean approach. According to Pheng, Gao, and Lin (2015), ECI has benefits inspired by lean principles as reducing the non-adding activities since only one contractor is involved, preventing the duplication of multiple contractors' bidding. As counterparts of ECI being introduced in the UK, Construction Management at Risk and Integrated Project Delivery have been developed in the US (Kadefors & Eriksson, 2015), while Project Alliances have become common in Australia (Walker & Lloyd-Walker, 2015).

Early contractor involvement became a notion in the 1990s as constructability gained popularity among academics and practitioners, notably the US-based Construction Industry Institute (CII) and its Australian counterpart (CIIA) (Walker & Lloyd-Walker, 2014). The UK Highway Agency originally applied it for its infrastructure projects in 2001 after being introduced by the engineering and construction contract published by the British Institution of Civil Engineering in 1998. (Rahmani, Khalfan, & Maqsood, 2013). This strategy, which the US Army Corps of Engineers developed, was also employed in the Hurricane Katrina rehabilitation operation in the US (USACE). In Australia, Queensland Mains Roads implemented the ECI contract for the first time in 2005. The ECI consists of two phases, with a separate contract for each phase. About 70% of the design process is covered by the first phase, which also involves moving from an idea to a preliminary design. The second phase, which involves finishing the detailed design and construction, uses a standard design and build contract (Swainston, 2006). The European Union maintains two distinct ECI models. The first method, "Competitive Procedure with Negotiation," is settling on a best and final

bid after discussing scope and pricing with two or more contractors. The second form is called "Competitive Dialogue," in which competing contractors present their own scope proposals before the field is narrowed down to the two best proposers, who then submit tender offers for the specified scope, with the lowest cost offer being chosen. In contrast to US model, Australia and New Zealand models recruits the contractor onto the team before the design consultant and is frequently actively involved in the environmental permitting process. (Scheepbouwer, E., and A. B. Humphries, 2011 as cited by Gransberg et al., 2016).

3.4. Approaches of ECI

There is no one universal approach for ECI implementation. According to (Finnie, 2021; Mosey 2009; Whitehead, 2009), ECI consists of a two-stage procurement model. In the first stage, both the client and the designer identify the project's needs and objectives, which are used to develop the preliminary design. This design development deliverable can vary from a sketch drawing to a detailed design, depending on the project objectives (Hastie et al., 2017). The client then releases an Expression of Interest (EOI) or prequalification criteria, followed by a Request for Proposal (RFP) from shortlisted contractors.

During the early stages, contractors might take the initiative to promote their idea to the client. This type of initiative is common among contractors. The contractor's responsibilities during the ECI phase typically revolve around design coordination, cost planning (including value engineering), and site investigations. The contractor may be required to place orders for long-lead-time items or to identify the need for orders to be placed and help coordinate the placement of those orders on behalf of the designer. If an outcome is not defined, then it should be a subject of a workshop to identify the risk, allocate the risk, measure the risk, and accept the price. One of the reasons that ECI projects have performed better than traditional projects is the increased awareness and understanding of the risk (Bundgaard et al., 2011). At the end of the ECI phase, the contractor often has to make a formal offer to the client to finish the project for a fixed lump sum. The client is not required to take that offer, and they

usually have the right to call for bids from other contractors if they are not sure they want to work with the ECI contractor to finish the project. The following contractor submissions are included in the price-based criteria: profit margin, overheads, pre-construction stage fee, approach to risk pricing, and any other cost components. Typical qualitative criteria include:

- The construction method,
- The ability to deal with unexpected problems,
- The ability to complete similar types of projects on time,
- Knowledge of local subcontractors and contractors,
- Previous experience with similar projects.

The contractor is then hired on a temporary basis to help with the delivery process. After being hired, the contractor may provide a maximum guaranteed price (GMP) for project delivery in the second stage (Love et al., 2014; Mosey, 2009). The second stage of the procurement process is typically one of the following: traditional construct-only contract (DBB), design and construct contract (DB), novated design and construct contract, or construction management at risk (CMR) (Mosey, 2009).

3.4.1. Approaches to ECI during preparation phase:

The approaches to early contractor involvement and selection process can be divided into three approaches: the preparation phase, procurement phase, and execution phase. The third category is not relevant to the early contractor involvement, thus, the first two are discussed. According to Wondimu, P.A. et al., Klakegg, O.J. et al. and Lædre, O. et al., (2020), the contractor could be involved through the use of one or more of the following approaches:

3.4.1.1. Indirect Approaches:

This approach aims to integrate construction knowledge into the front end of projects. The client invites contractors into a project's price estimation process and to update handbooks and standards workshops.

3.4.1.2. Information meetings:

This approach is used to obtain feedback from the contractors on the contract strategy plans of the project through a meeting to be held during the very early phase. This was separate from public procurement regulations as the client invited the entire contractors' branch to this meeting, and the same information was provided to all contractors. However, in most cases, information meetings were held later in the project's life cycle, either before or after the tender announcement at the tender conference. When such a meeting is held in the later stages, the client's intentions are to attract contractors to the project, explain the project, and answer any questions that may arise, but not to obtain input from the contractors.

Contractors usually contribute little to these meetings. Fear of revealing the company's strategies is a main reason for the lack of contractor participation in these meetings. Moreover, such meetings are held publicly while all the contractors are gathered in one meeting room. To get the most out of such meetings, should be held as early as possible. It is not easy for public clients to have a closed meeting with contractors in the front-end phase of a project.

The influence of an information meeting significantly depends on which phase of a project it is held. If it were held early, then the client would find it easier to incorporate meeting inputs into the front-end phase of a project. However, if it is held later in the project's life cycle, such as during a tender conference, it is difficult to incorporate the inputs. This is because the majority of the critical work has already been completed, and the fundamental decisions have already been made during a project's tender conference.

3.4.1.3. A front-end partnering process:

This approach overcomes the legal barriers as this phase starts after the contract signing. This phase should be completed before the construction works begins. The length of this phase can vary depending on project needs. The main objective of this process is to create an opportunity for the project team to get to know each other and set common goals. This event can become one of the internal regulations to be set in the process. However, as the contractor has yet to start with the execution phase of the project, during the front-end partnering process phase, the contractor can still come up with optimization ideas. The success of this approach is determined by the contractor's optimization ideas and the client's willingness to accept new ideas from the contractors during this phase. The common challenges are the contractors' limited time to come up with new ideas and the fact that this meeting is mostly attended by those at the management level, rather than technical people, so technical details may not be discussed thoroughly. To address the second issue, clients may schedule two parallel meetings during the front-end partnering process phase. The first meeting is to discuss the general conditions while the second meeting is to discuss technical details in order to find optimal solutions. This approach should be combined with a more open contract document, proper compensation, and flexibility of the client to accept changes during this phase to succeed with this approach. For example, conditions can be decided after contract signing to earn the most benefit.

3.4.1.4. Announcing the project with alternative technical solutions:

Clients can prepare contract documents that include a variety of technical alternatives, allowing contractors to influence construction and material selection. The goal is to reach a larger supplier market and obtain multiple bidders for a project to increase competition and obtain the lowest price to build the project.

The planning cost can be higher as all the alternatives should be planned reasonably before the tender announcement. However, the benefit in the latter phase is relatively high. This approach could be used in the project's concept development and pre-engineering phases. Clients can announce projects with several alternatives, or if the design is more mature, then only construction methods, such as the foundation type, could be announced with several optional technical solutions.

This approach limits the contractors to the client's options which entails that the contractor involvement needs to be more direct and early enough. Moreover, the contractors should evaluate all presented alternatives to calculate the cheapest option. Thus, the contractors should be eager to evaluate alternatives equally, which can increase their probability of winning the bid; however, they are paid directly for this work.

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

Specialist contractors have specialized equipment and expertise that project clients and general contractors rely on to complete a project. This method could be applied during the concept development and pre-engineering stages. The method was described as a practical ECI method based on direct contact rather than indirect contact through the main contractors. Furthermore, discussing a specific challenge with highly experienced and specialized contractors can be beneficial to the project. However, revealing specific project information may create legal barriers for public projects. Others argue that because such specialized contractors are not directly involved in the bid, this would not cause any issues. As a result, with care that such contractors do not reveal any specific information about the project, this approach could be successfully implemented.

This approach would require that the contractors be competent enough to understand the challenge with limited information being exposed to the client. This would eventually require

proper competence from the client to avoid exposing the project's specific information but the competence to prepare procurement procedures.

3.4.1.6. Idea competition:

This approach could be used in the planning phase to implement ECI. In the front-end phase of a project, the client gathers initial ideas about how to solve a problem through a bidding process. The challenge for public clients in using this approach is whether contractors involved in the idea competition should or should not be disqualified from the bid for the construction of the same project. The cause of the dilemma is how to treat all contractors equally while using this approach, i.e., not to give project-specific information to some contractors that could give a competitive edge to a contractor at the expense of others.

Three undesirable scenarios could make the competition imbalanced in the bid for construction. The first one is that bidders not involved in the idea competition may have different information than those involved. The second possibility is that patent and compensation issues arises. Finally, contractors who participate in the idea competition may develop ideas that are suitable for themselves but require an optimal solution for the project. A design competition could be an option, with the winner receiving the award for detailed design, procurement, and construction. Benefits relative to cost of competing alternatives could be weighed. The main disadvantage of this approach is that it requires more continuity and interweaving throughout the project life cycle. Proper documentation during the idea competition process could be used as a preventative measure to reduce the likelihood of the above-mentioned undesirable scenarios occurring.

3.4.1.7. Contractors sell their idea to the client in the early phase:

A contractor can take the initiative to promote an idea to the client, who can use this idea after detailed design as an alternative technical solution to avoid legal issues. A contractor

who takes such an initiative believes that he has the necessary knowledge and equipment and that he is the only competitor capable of carrying out his idea. However, contractors exposing their information, knowledge, and expertise is a rare approach.

3.4.1.8. Negotiated bidding procedure:

Clients can use this approach when there is a need for more internal competence in the subject matter regarding this specific project. Thus, the client seeks the use of contractors' experience in the pre-engineering phase of the project to obtain help for the decision process. It allows achieving both direct and early involvement of contractors. However, the client's lack of experience might be a challenge to implement such an approach; therefore, transferring experience from one project to another should be carried out to accumulate experience and expertise.

3.4.1.9. Opening for alternative tenders:

The contractors can submit bids for alternative solutions to a project. However, it is not permitted to submit alternative offers as it is complicated to control the features of the offers in the short period between the bid opening and the awarding of the contract. This might result in more extended control and approval process. Moreover, comparing bidders based on different competition grounds is difficult, as the lowest price is most used as the competition base. When the contractors present alternative tenders based on a new solution, this might delay the whole project delivery impacting cost the duration.

3.4.1.10. Project partnering

It is a contract that lasts for a long time and requires both the client and the contractor to commit to certain business goals. (Wondimu, P.A. et al., Klakegg, O.J. et al., and Lædre, O. et al., 2020). It focuses on cooperation between parties but is based on traditional

frameworks, like D&B contracts (Lahdenperä, 2012), however, the parties are more independent.

3.4.2. Approaches to ECI during procurement phase:

The contractor is chosen using non-price factors. The contract is given for stage one, during which the client, designer, and contractor collaborate to value engineering, constructability, and cost control. (Mosey, 2009; Rahman and Alhassan, 2012) (Hastie et al., 2017). In Australia, the contractor is chosen based on a non-price criterion at the first stage of ECI (Ma and Xin, 2011). At the conclusion of stage one, the contractor offers risk-adjusted pricing, which is a fixed price for the design and construction work. The contractor and the client collaborate to establish a target price and a pain-and-gain-sharing arrangement for excess expenses or cost reductions (Hastie et al., 2017). ECI does not have a mechanism for sharing pain and gain, although one could be added (Finnie, 2021). Following the submission of the pricing, the client can move through with stage two of the contract with the contractor or reject the offer and return to the market. If the client declines the proposal, the client owns the design's intellectual property and be free to market the project under a design-and-build agreement. In this instance, the client's choice of delivery method for stage two pursues a more conventional strategy, with the parties entering a construct alone or designing and constructing a contract (Whitehead, 2009).

According to Abu Dief (2020), contractors must undergo a prequalification criterion to be allowed to enter the first stage of ECI with the signage of confidentiality to avoid exposing any of their related work and solution, which might affect other contractors' proposals. Some of the criteria of the prequalification process are common, and others are specific for certain projects; those may include financial Strength, resources & capabilities, relevant experience, and current contractor workload, claims/litigation history, social values commitment, and sustainable procurement commitment. As with any prequalification procedures, specific

criteria must be followed, some of which are standard for all projects and others unique to projects. These criteria may include the following:

- Financial strength,
- Resources,
- Relevant experience,
- Current workload,
- A history of claims/litigation,
- A commitment to social values,
- A commitment to sustainable procurement.

The contractor selection process can be divided into three approaches: the preparation phase, procurement phase, and execution phase; during the preparation phase involves information meetings used by clients to inform all interested contractors in an open arena about the project and to get feedback on their project plan. However, contractors might need to be more willing to share their ideas to keep their companies competitive (Wondimu et al., 2020). Secondly, during the procurement phase, through either of the following three approaches as stated by Wondimu, P.A. et al., Klakegg, O.J. et al., and Lædre, O. et al., (2020):

- **Best Value Procurement (BVP):** allows for short interviews after prequalification and shortlisting the best-qualified contractors. This category involves a clarification phase that would be used to convince the client that the shortlisted contractors are the most qualified.
- **Competitive Dialogue (CD):** The European Parliament first proposed it in 2004 for exceptionally complicated projects. Competing contractors submit their scope proposals, and after an elimination process, the field is narrowed down to the top two or three. These

proposers then submit bids for the proposed scope, and the lowest-priced offer is chosen. During prequalification and shortlisting, but before the contractors submit their offers, it enables parallel and closed talks with at least three contractors to establish the project plan jointly. This conversational step would clear any unspoken or worrying concerns from all parties (Ottemo et al., 2018). It allows for parallel and closed dialogues with at least three contractors to develop the project plan together after prequalification, and shortlisting but before the contractors offer. This dialogue phase would reveal all stakeholders concealed or concerning questions (Ottemo et al., 2018).

- **Competitive Procedure with Negotiation (CPN):** it involves the negotiation phase after the prequalification, shortlisting, and first offer from the contractors. The client would negotiate with three contractors on all sides of their first offer to optimize the offers during the negotiation phase. These contractors must have passed the prequalification, shortlisting filters, and submitted a valid first offer.

Table 4: Procurement models with ECI pathways

Basic Approaches to ECI	Indirect approach, Information meetings, workshops, Direct contract with specialist contractors, contractors promote their ideas, Front-end partnering, Idea Competition, announcing with alternative technical solutions, Opening for alternative tenders
Selection Method	Based on qualification only, Based on qualification and price
Procurement procedures	Negotiated Procedure, Competitive dialogue, BVP

3.5. Criteria for contractors to consider when pursuing an ECI project

The available team: Because the evaluation is primarily based on non-price criteria, contractors must be prepared with the appropriate personnel; no design or cost estimates are required. Instead, the tender should include explanatory responses to the tender document's non-price criteria and descriptions that necessitate skills that are not typically required for tender processes.

Procurement design: The contractor is not required to perform a cost estimate, which reduces tendering costs. Contractors are compensated for these expenses as cost estimates are transferred to Phase 1. The removal of project cost estimates from tender documents helps to increase construction industry efficiency by reducing the amount of double work performed by contractors during the tendering process.

Contractual design: the length of phase 1 during which the contractor is required to bind valuable resources in the project without profit-generating production activities. Clients of large projects with a lengthy Phase 1 should consider beginning time-sensitive work before the target price is met or dividing Phase 1 and Phase 2 into sub-phases with separate target pricing for each sub-phase. Even though clients' opportunities to use the go/no go exit diminish as the project progresses, and a sub-division reduces the possibility of taking advantage of pain/gain share. A subdivision allows both parties to learn from previous phases and improve for the next one. In addition, it inhibits contractors from engaging in opportunistic conduct, such as purposely increasing the Phase 1 target price.

Finally, an adequate reimbursement arrangement can allow contractors to support clients' objectives without worrying about their pay. As a result, before beginning the main activities in Phase 1, the client should prepare this model in consultation with the selected contractor. Despite limited revenues and profit potential in Phase 1, it can reduce contractors' overheads

because Phase 1 can be viewed as a partially paid tender, and Phase 2 generates predictable and stable cash flow.

3.6. Timing of involvement

Some argue that contractors should be involved early to maximize value after preparing a business case (Ma & Xin, 2011), while others argue that the contractor should be better involved after a concept design. The reason behind this is that too early involvement may imply that the contractor has nothing to add or even waste resources for clients who still do not have any idea about what they want (Francis & Kiroff, 2015), which may demotivate the contractor from actively involved in the design that leads to a loss of design creativity (Whitehead, 2009). Such early involvement would only induce unnecessary costs. Additionally, consultants tend to be unwilling to involve the contractor early as they prefer to work solely with their client to develop concept design (Francis & Kiroff, 2015).

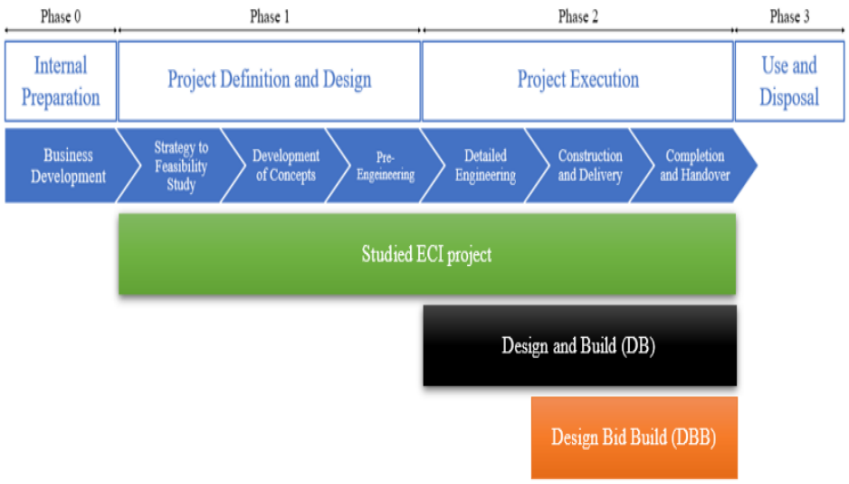

Figure 11: Illustration of timing of contractor involved as adapted from Walker & Liod-Walker, 2012)

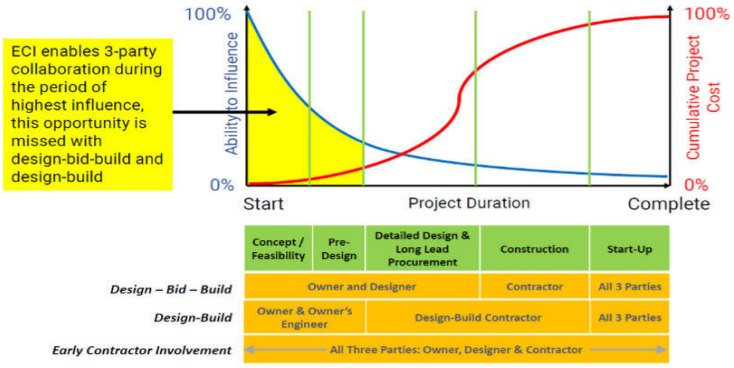

Figure 12: ECI Project delivery methods throughout project phases as adopted by David Bowcott (December 20, 2021)

At its most basic, early contractor involvement means that, regardless of the contractual project delivery method, the contractor who is responsible for the project's construction can contribute significantly to the project's final design. The project delivery method determines the timing and amount of that input. Figure 12 depicts the spectrum of contractor involvement in each primary project delivery method. Figure 12 shows how P3, IPD, and ECI-A bring the contractor on board during the planning phase, giving the contractor the opportunity to influence the environmental permitting process and other early design decisions that ultimately define the final scope of work. Contractor involvement in DB, CMR, and alliancing is typically initiated at some point during the design process. Including alternative technical concepts (ATC) in the DBB procurement phase gives construction contractors a "last bite at the apple" opportunity to propose personal changes to the baseline design during bidding and build their approved ATCs if the contract is awarded. While this approach is not widely used, it has proven to be effective in transportation departments in Alabama, Michigan, and Missouri. The Federal Highway Administration in the United States has approved its use nationwide. ECI has been successfully used throughout the entire project

delivery life cycle, from selecting the construction contractor at project inception in Australia to the last-minute opportunity to gain enhanced constructability through the encouragement of confidential ATCs during DBB procurement.

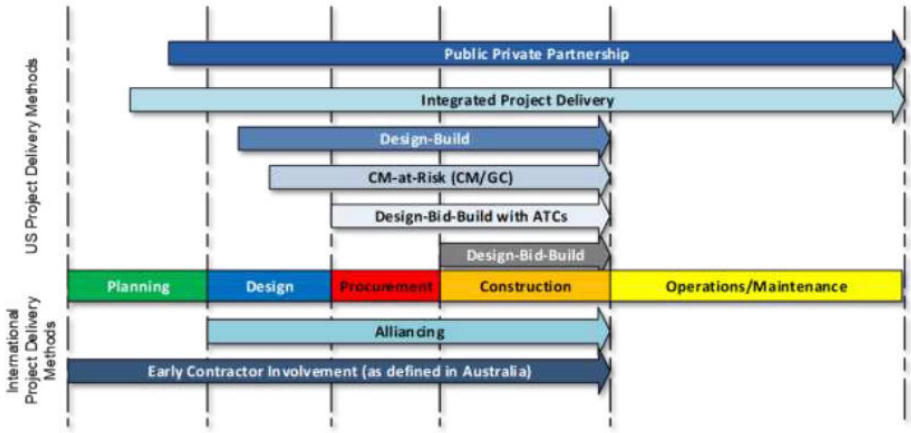

Figure 13: Spectrum of Project Delivery Method Coverage of Project Development and Delivery Process as adopted by Gransberg, D.D., as cited in NAC Executive Insights, National Academy of Construction, EI 1.7, (November 2020).

3.7. ECI in Project Phases

As described by Klakegg (2010) in his PhD thesis, figure 14 demonstrates the ECI implementation onto three of the identified four project lifecycle phases. This model consists of four phases and five stages described below.

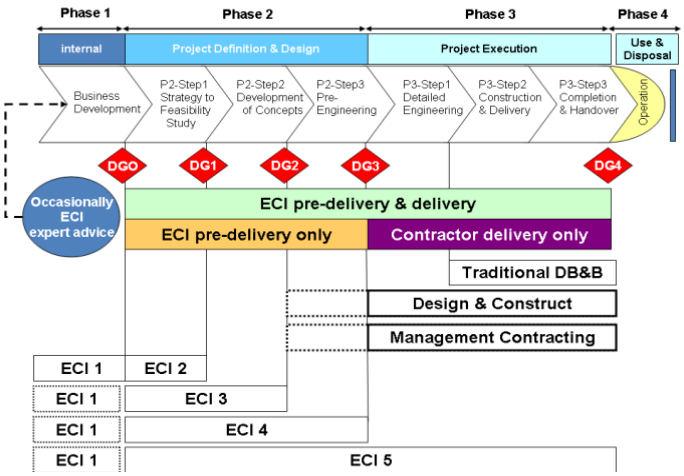

Figure 14 – Project Life CyclePhases: (Adapted from Klakegg et al. 2010, p38-39)

Phase 1 is the conception of a strategic plan for a revised project course. At this point, a possible project is identified and deemed worthy of future investigation (DG0). Project definition and design are tasks for phase two. This phase consists of three stages with decision gates (DG1, DG2, and DG3). Phase 2's first step involves creating a proposal and determining whether it has the right to exist. The range of possible solutions is narrowed down to a single generic solution, and the viability of that form (idea) is confirmed and validated. The general form at DG1 may either develop further or be abandoned. If it progresses to Step 2, the logical generic form (idea) is further specified and examined for viability and eligibility to exist at DG2. A sufficiently well-developed embryo enters Stage 3 of Phase 2 when it is pre-engineered to be ready.

Three more developmental phases are undergone in the third phase. The form at stage 1 is precisely engineered. In stage 2, construction and delivery reveal a functional entity prepared to fulfill its preprogrammed purpose. The finished mature output is authenticated as a mature and valid product (DG4) in Stage 3, and it is then "given over" to carry out the task for which it was created and programmed. Finally, at Phase 4, the output is operational which typically has little to do with the contractors.

Phases 1 to 3 can all, or any, of ECI1, occur. In Phase 1, the contractor may have valuable professional advice that can be accessed for a price. The contractor's tacit knowledge could be crucial for carrying out feasibility studies at DG1 in Phase 2 Step 1.

ECI2 and ECI3 happen more frequently at steps 1 and 2, respectively, during Phase 2. There may be significant technical input, like that previously discussed with the ECI1, but where the contractor at DG1 and/or DG2 offers guidance about the idea's viability and development to the concept. This engagement might take several different forms. ECI4 would involve guidance until the decision to tender (DG3) on various procurement forms, such as DB&B, D&C, or MC. ECI3 would be involvement and collaboration up to the point when a concept solution is tested. At DG3, the contractor may be hired (ECI5) on an MC or fee-based service basis. The degree of cooperation, the framework for sharing risk and uncertainty management, the type of incentives used, and the relationship contract arrangements differ in the ECI5 form from the MC approach. These range from full-integrated collaborations to partnerships requiring less commitment and integration. Moreover, clients may decide not to use ECI and perform all tasks either internally or through external consultants and go for project execution using DBB, DB, novated D&D or MC (Walker and Lloyd-Walker, 2012).

Walker and Lloyd-Walker, (2012) as cited by Rahmani, (2016) has summarized the application of ECI along the project phases as follows:

- ECI1 is appropriate for clients who need special delivery of subject matter knowledge while creating project concepts and can occur during any or all of Phases 1 to 3.

- Clients that need to assess a project's viability through precise benchmarking and impartial guidance during the project concept and designs - phase 1 - use ECI2.

- Clients who want to keep convergent decision-making on concept alternatives open and separate from the ECI entity adopt ECI3.

- When pre-engineering input, value engineering, value analysis, and constructability guidance are necessary, ECI4 would involve the contractor. Concerning a variety of procurement forms, the contractor offers the client advice.

3.8. Project Types Suitable for ECI

Non-traditional procurement systems are usually used when the contractor's expertise is needed on constructability during design to minimize risks and increase certainty (Rahman & Kumaraswamy, 2005). According to Finnie (2021), ECI is recommended for projects with scope uncertainty that may benefit from fast-tracking and constructability input during the design stage, which would avoid the process of arising claims and disputes in the first place.

ECI involves open-book negotiation between the client and contractor. This strategy leads to open-book pricing, which would help secure resources in unstable situations such as inflation markets. Thus, the contractor would not tend to bid high or increase contingency. Moreover, this would encourage the contractor to avoid the no-bid decision.

The market condition is one factor that affects the selection of the appropriate procurement process. When the demand exceeds the supply, as many projects are available with insufficiently qualified contractors, competitive tendering based on the lowest price might not be applicable; therefore, relational negotiated procurement systems might be more applicable. Relational and open-book procurement may lower prices during boom markets (Whitehead, 2009).

As traditional procurement is suitable for non-complex specific projects, ECI and alliances are still more suitable for complex projects with no standard design. Therefore, the project might need early contractor involvement to benefit from his expertise in

constructability and inputs during the design phase. These inputs and early involvement reveal many hidden unique aspects, such as the challenging site that might affect the performance and completion of the project. However, unlike alliances, ECI does not feature the pain/gain share pricing (Finnie, 2021). In design-build (DB), the contractor owns and controls the design as they comply with the client's brief. However, in ECI, the contractor would be involved early to design input. Afterward, the contractor may be granted the construction contract, which might be construction only or "novated design-build," where the design is novated to the contractor to become a design and construction contract.

A two-stage ECI process is suitable for public projects since it involves public money, which must demonstrate value for money (Finnie, 2021). Therefore, involving only one contractor at an early stage would not provide competitiveness which is required by legislation and acts. Stage one is an open, "no blame" collaboration between all project participants to resolve issues. In contrast, stage two is a design and construct model with a lump sum guaranteed price, allowing for the traditional risk transfer. ECI model maintains the best of both strategies by bringing the contractor's expertise early while maintaining competitiveness at the second stage through the open tender if the client decides not to proceed with the contractor from the first stage (Love et al., 2014).

3.9. Contract and tendering

It is possible to agree on a cost-plus contract strategy with the contractor, CM, or MC during the early design stage, which is limited to achieving a certain level of design progress. While the design development is progressing, the agreed-upon level of design development is reached. It is preferable to complete the entire design with a high level of detail in accordance with the required BIM model and contract documents. Contracting under the Lump-sum contract and entering the contract closeout process becomes more practical. In the

private sector, this approach is more successful because it may involve contractors for free with the promise of being awarded the construction phase.

Enough project details should be included in the first stage of tender documents to allow bidders to submit a tender response that includes: programme, construction methodology, health and safety, approach to the project including sub-contractor management, identification of initial risks and opportunities for design and construction, a response on how realistic the client's budget ceiling is and initial thoughts on achieving this, proposals for working with the designer, and proposals for working with the designer. details of the proposed project team, both for the second stage tender process and during construction, fixed preliminary (site running costs) and fixed margin (covering off-site overheads and profit), schedule of rates for common building elements (where sufficient information is available), preconstruction services fee.

A preconstruction services agreement (PSA) describing the services the contractor must offer during the second stage of the bidding process, such as constructability, value engineering, supply chain guidance, and contribution to the design and tendering services, should also be included in the paperwork. In most cases, the PSA states that the contract's award is contingent upon the contractor's satisfactory performance during the second stage of the tender, the contractor's provision of complete cost transparency to the client via an open-book approach, and the agreement of a contract sum that is acceptable to the client (in terms of public value), is below the specified cost ceiling, and is unqualified. The client would brief the bidders to enable a common platform of project understanding and identify what response the contractors expect. Therefore, the client would issue the concept design with requirements to the contractor along with responses to the RFI and amended to the contract document. If the client is uncertain of his requirements, he might ask for RFP, which should include the following:

- Statement of work for preconstruction services.

- Concept engineering solution.
- Ceiling price.
- Evaluation criteria based on qualifications and price.

The PSA generally gives the client the right to reopen the market for tender if the predetermined conditions are not met. This guarantees that there is competition throughout the tendering process. To avoid potential intellectual property conflicts, if the contractor is not given the contract, it still paid for its services per the PSA. After evaluating the first-stage tender offers, a preferred contractor is chosen through the PSA execution to move on to the second-stage tender procedure.

The contractor collaborates with the design team throughout the second stage of the tender process to provide design inputs and develop its tender price on an open-book basis per the PSA. When the client advises the contractor that it is not granted a contract because some PSA requirements still need to be completed, the second stage tender ends. According to Abu Dief (2020), the technical proposal would include a presentation from the contractor to show the technical proposal without price, project understanding, design requirements, contractor's capabilities and experience, alternative solutions, and initiatives, and planning and quality proposal.

3.10. Tender Evaluation Criteria

The design of tender documentation aims to match with the right partner. Non-price criteria should be given more weight than price criteria because the goal is to find the most competent and collaborative partner. The most frequently mentioned non-price criteria were organization, work methods, competence, and previous experience. The price criterion is weighted at a maximum of 20 - 30% (Lahdenperä, 2010). If these weightings are surpassed, there is a risk that price becomes an overriding criterion in identifying the most economically

advantageous bid, and the procurement and contractual arrangement loses much of its intended value. Others suggested that the fee be represented in the tender evaluation, while others suggested that the client decide on a fixed price fee in the tender documents instead. It is difficult to set an accurate fee for a project that is too complex. In one of the interviews conducted as part of a study conducted by Al-Saadi, J., and Yas Khudhair, M. (2021), they interviewed a project director who suggested that a reasonable percentage fee that the contractor should charge be between 7 and 10%, with 7% receiving the most points and 10% receiving the least. The project director mentioned that the contractor still had a pain/gain share agreement in the contract, which allowed for a higher profit if the project's targets were met.

Tender submission costs differ from fixed-price contracts because ECI tenders typically do not require work from design engineers or cost estimates. ECI, on the other hand, necessitates a different type of work. In the same study conducted by Al-Saadi, J. & Yas Khudhair, M. (2021), they interviewed a Commercial manager who estimated the tender costs for fixed-price contracts to vary between 0.5 – 1 % of the project cost. For ECI, the tender cost could be reduced by up to 50 % of a fixed-price tender. Setting a reasonable range for the fee in the tendering process is essential. If the lower part of the range is set at a reasonable level, it further prevents the "bid low, claim later" approach.

3.11. Pricing Provisions

Clients prefer lump sum contracts to gain certainty about the price before beginning construction. The client thinks this would limit the tendency of the contractor to claim additional costs or time. In reimbursable cost contacts, the contractor is reimbursed for actual time and materials incurred; however, the contractor may need to spend more on increasing his fees which would require more extensive auditing. Although a reimbursable cost contract may incur more risks to the client, the client may receive more information and cooperation

from the contractor (Menches & Chen, 2012). This transparency would assume open-book pricing.

For preliminary and general works, lump sum price can be calculated if a good concept design identifies management, supervision, insurance, and temporary works requirements (Ma & Xin, 2011). General contractors announce profit and overhead margins that can be applied to subcontractors and modifications, together with a lump sum construction price for first-stage work designed or fixed rates for carpentry and concrete works against a provisional bill of quantities. Once the design is complete, provisional quantities are re-measured to create a bill of quantities using the original tender rates (Pheng, Gao, and Lin, 2015) and arrive at a lump sum construction price. Ma and Xin (2011) discovered that hiring an independent estimator was a critical component of the contractor providing a realistic price.

3.12. ECI-Reimbursement of Contractor

The ECI agreement would identify the amount to be paid to the contractor, including how and when this amount is to be paid. At the same time, most ECI agreements entail paying the contractor a fixed lump sum fee ECI fees may be based on rates. When a fixed lump sum is used, variations only are allowed if the contract becomes frustrated or there is an authorized change of scope. As the ECI agreement involved open book negotiations, the contractor is entitled to reveal the preliminaries and margin rates that the contractor intends to apply. Furthermore, the ECI agreement would specify the timeframes or dates for completion of the ECI services. Consequently, the contractor's lump sum offer is delivered to the client.

The amount due to the contractor for rendering the ECI services and when and how it is to be paid are all specified in the ECI agreement. Nevertheless, this is only sometimes the case. Most ECI agreements call for the contractor to be paid a specific flat payment for the ECI services. ECI fees occasionally depend on rates. When a set lump payment is employed,

adjustments are often only accepted if the project's scope changes significantly and visibly. When tendering for an ECI engagement, contractors are often asked to identify the preliminaries and margin rates they intend to apply during construction. At the end of the ECI phase, the contractor must use these rates to calculate their lump sum offer. Typically, the ECI agreement specifies the timeframes or dates by which the ECI services must be completed. Sometimes, and mostly on larger projects, the time mechanism is extended. The most important date is usually when the contractor's lump sum offer is to be delivered to the principal. A contracting strategy called early contractor engagement (ECI) can support the conventional and novated design and build delivery models. With ECI, a contractor can provide early guidance and engagement in the constructability and optimization of designs.

The opinions on whether the contractor should be reimbursed for participating in Phase 1 differ in the literature (Mosey, 2009). Contractor contributions at no cost in Phase 1 can result in insufficient resource allocations by the contractor and move the focus from the intended aims with Phase 1 to quickly reaching Phase 2, whatever the cost to the client. On the other hand, getting reimbursed as a consultant at an hourly rate can incentivize the contractor to increase the scope of the project. Mosey (2009) argued that the best way to secure value for the clients is to reward contractors appropriately for their contributions to the project instead of basing their rewards for Phase 1 on achieving Phase 2.

3.13. Preconstruction Services

El-Sayegh (2009) conducted an extensive literature review to identify selection factors when evaluating firms for construction management at-risk (CMAR) (the US equivalent of management contracting or ECI) then construction professionals ranked the factors. He concluded that the essential preconstruction services from a general contractor are time planning, developing construction methodologies, procuring subcontractors, and providing technical solutions. Thus, such services would include analyzing design alternatives and proposing alternative solutions.

Contractors present services under ECI before the construction contract. According to Finnie, as adopted from (El-Sayegh, 2009), table 5 presents a list of preconstruction services are presented in the literature review.

Table 5: Pre-construction services (adopted from El-Sayegh, 2009)

Pre-construction services	**Sources**
Design management	Tzortzopoulos and Cooper (2007); Sidwell (1983)
Plan and co-ordinate design	Tzortzopoulos and Cooper (2007)
Stakeholder management and communications	Tzortzopoulos and Cooper (2007); Mosey (2009); Education (2016); Berends (2006)
Develop design brief	Tzortzopoulos and Cooper (2007); Education.govt.nz (2017)
Construction planning	
Planning and sequencing construction activities	El-sayegh (2009); Mosey (2009); Kashiwagi, Kashiwagi and Savicky (2009); Sidwell (1983)
Constructability evaluation	Laryea and Watermeyer, (2016); Pheng, Gao and Lin (2015); Rahman and Alhassan (2012); Mosey, (2011); Rahmani et al., Khalfan et al. and Maqsood et al. (2014); Whitehead (2009); Song, et al. (2006); Jergeas and Put
Financial	

Budget advice	Kirkham (2007); Laryea (2010); Sidwell (1983)
Value management	Mosey (2011); Kirkham (2007); Whitehead (2009); Jergeas and Put (2001); Kashiwagi, Kashiwagi and Savicky (2009)
Risk management	Rahman and Alhassan (2012); Mosey (2009); Education.govt.nz (2017); Jergeas and Put (2001); Kashiwagi, Kashiwagi and Savicky (2009)
Supply chain	
Subcontractor and supplier procurement	El-sayegh (2009); Whitehead (2009); Mosey (2009) ; Sidwell (1983)

3.14. Summary

ECI as a procurement route may consist of two stages. In the first stage, the client invites several qualified contractors to submit a proposal based on preliminary design and complete client requirements. If the client decides to proceed, the client selects and negotiates with the selected contractor for his service during the design phase and a construction contract. The contractor provides a descriptive lump-sum or target value-priced proposal and sufficient illustrative design in the first stage, allowing the client to make an informed decision based on their project perspective and needs; this stage is referred to as early contractor involvement. The first stage agreement is primarily compensated on a cost-plus basis. Following technical and commercial negotiations, the client may decide to enter into a second stage agreement. Hence, the contractor would help with the detailed design, construction drawings, and BIM model. The first-stage pricing of ECI commonly comprises

the following: a lump sum price for the preconstruction services, a lump sum price for the construction of any first stage for which design is already developed. If the selected contractor would hold the responsibility of the design, then a design-build contractor is formed; however, if not, then a construct-only contract would be awarded, either management contracting in case of the contractor subcontracts all trades or traditional contracting in case of the contractor performs some of trades work and subcontracts others.

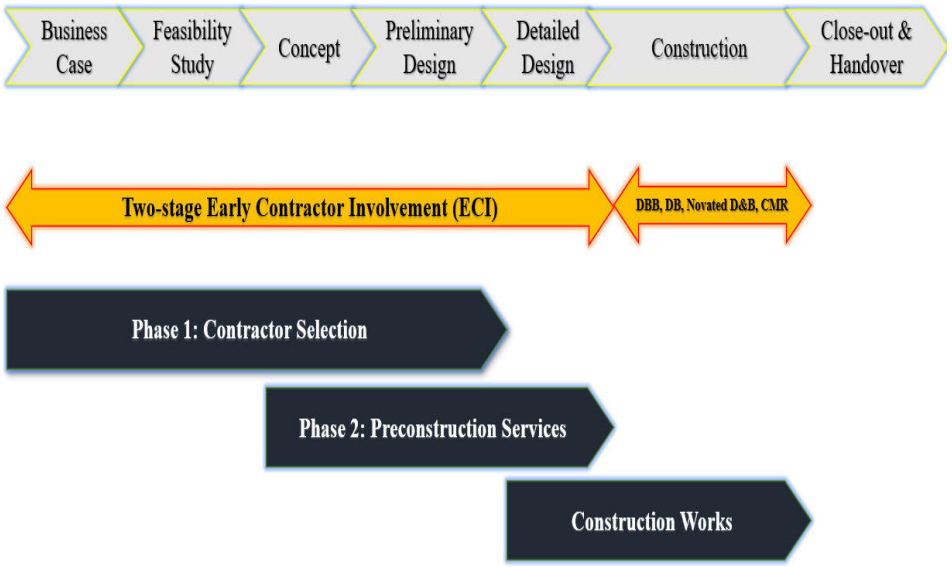

Figure 15 – Two-stage ECI Process

Finally, there are several ECI implementation approaches that must be modified and adapted according to the necessities and needs of involved stakeholders. In other words, no universal approach for ECI implementation can differ according to each project situation.

In the following table, a summary of ECI models as implemented globally in different countries with detailed description as in the appendix:

Table 6: ECI models implemented in different countries

ECI (as defined in Australia)	**ECI (as defined in UK)**	**ECI (as defined in US)**
A hybrid between the more traditional model and the UK model (Rahmani et al., 2013)	It is a two-stage procurement and contractual model that intends to prohibit the attitude of "Bid Low, Claim Later".	It is a two-step award process where contractors' qualifications and past performance are first evaluated on a Go/No Go basis against a set of evaluation criteria.
Prior to phase 1: a business case is prepared by the client as well as little work on preliminary planning and detailed design report. The first phase includes the design progress from a concept to a preliminary design embracing approximately 70% of the entire design process.	The contractor develops the design. The contractor is paid his actual cost plus a fee percentage. The fee percentage is fixed at 7.5%. Phase 2 - Construction Phase.	Once the shortlist is formed, "Ceiling Price" is announced and provides the technical documentation used by the Corps to reach that estimated cost. The competing contractors actually bid an "Initial Target Price" that consists of an "Initial Target Cost" (ITC) and an "Initial Target Profit" (ITP). These are compared to the "Ceiling Price" and the contract is awarded to the contractor that meets all the qualification requirements and has the lowest

The second phase includes the completion of the detailed design and construction and employs a typical traditional design and build (construct) contract (Swainston 2006).		ITP.
The specified moment of a 70% completed design between the phases.	The Highways Agency tenders the project with only feasibility plans.	USACE seeks to award the ECI contract at approximately 10% to 15% design completion.

4. Chapter 4 - ECI Influence on Claim Entitlement

4.1. Introduction

This chapter discusses the potential types of claims in ECI, their causes, and the ECI's influence on mitigating those types of claims. However, there are still some gaps and limitations in ECI, which can impose situations that might incur a claim entitlement. Claim entitlement in ECI would be discussed to identify the circumstances of ECI's ineffectiveness in mitigating claims and their causes for further improvements. This chapter summarizes the responses from the experts who were interviewed. These interviews were conducted along with the study of a case study from Canada for a public project implemented by the City of Edmonton to analyze and verify the influence of ECI on claim entitlement and contractual risks. The case study included a bridge rehabilitation that employed a construction consultant/general contractor (CCGC) as a delivery method, another term for ECI as implemented in Canada. The case study and the expert interviews assisted in determining what was already understood about ECI in terms of risk, difficulties in employing ECI, and areas for improvement. Additionally, the CCGC contract form was compared with another contractor from the UK (JCT) released in 2011 to implement the ECI phase in the UK.

As construction stakeholders are assumed to work collaboratively to reduce claims and conflicts, they are also assumed to share the responsibility for the emergence of claims and conflicts. All key participants share the responsibility to prevent claims during the design phase, with most of the responsibility coming at the designer's expense; however, the contractor is required to work with the designer to assist in claim prevention. This role extends in tendering phase with the assistance of available quality contracts. It might be desirable to integrate through the overlapping of design and tendering phases to include the expert knowledge of the contractor in the design phase. Thus, it might be desirable to implement tendering during conceptual, preliminary, or even detailed design stages. The main aim is to constitute a mutual responsibility for claim and conflict prevention among all

key participants that would lead to internal protection or, at least, to prescribe a dispute resolution procedure that would lead to an earlier settlement of disputes. With shared responsibility and balanced agreements, the system, or the model within which all the participants work, would lead to dispute resolution. Therefore, an early solution to conflicts or disputes would be essential to preserve the quality of relationships.

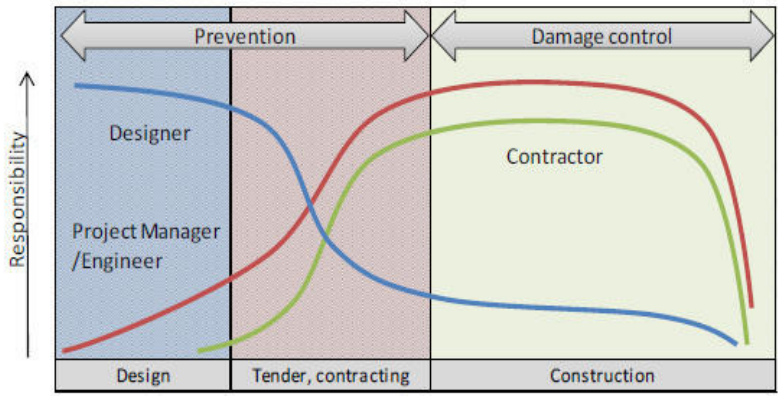

Figure 16: Responsibility of claim prevention throughout the project as adopted by Stojadinović, Z.1, (2018).

Considering all innovative and technical quality criteria during the design phase is essential. This quality could be best described as the combination of design solutions resulting in the best compromise in technical, technological, economic, aesthetic, or any other sense. This would maximize the cost-benefit/value ratios. According to Stojadinovic (2018), it is necessary to refrain from contracting the main design required for the construction permit as soon as possible. Instead, it would be better to study several design options at the level of conceptual solutions and optimize the selected option at the preliminary design level. This optimization could be performed through constructability reviews, value management, and risk management implemented with the contractor's expertise. Moreover, the technical quality of the main design is essential for the success of

the following stages: tendering, construction, and close-out phases. The technical quality of the design is greatly affected by the design briefs and the quality of the design input data.

To ensure the success of project delivery value, the optimal contracting model or strategy must be selected first. This strategy would set each stakeholder's responsibilities, the timing of involvement, and risk sharing. The client should understand that transferring risks to the contractor would lead to higher contingencies, prices, and the likelihood of disputes. For example, using unit prices and measured quantities contracting would lead to problems during construction which have been temporarily concealed through payment certificates, variations, and claims (Stojadinovic, 2018). Choosing a contract strategy and tendering procedures would be crucial for the project's success.

4.2. Impacts of ECI on Potential Claims & their Causes

Due to the need for a consistent or universal definition of a project's success, there are no universal performance metrics. Profitability may be a contractor's most critical success factor, while quality may be of greater importance to the client. Therefore, such variations may lead to differing interests and poor performance. Moreover, if expectations need to be aligned and well communicated, disputes may arise that might lead to unresolved claims, which consequently affect the cost finalization of the project.

Love et al. (2014) studied the different benefits of ECI and barriers to the implementation of ECI in Western Australian projects. The study outlined the impact of ECI on project performance. The authors ranked the performance metrics in the order of high to low influence from the implementation of ECI. These metrics are in order of significance as follows: disputes, variation claims, time, cost, client satisfaction, project quality, and site safety. Moreover, the author ranked the benefits of ECI as follows: improved constructability, risk identification, and risk management. Another study conducted by Diekmann and Girard (1995) used dispute frequency and severity as two components to

assess a dispute. Dispute frequency refers to several dispute occurrences, and severity refers to time and cost-related overruns. They analyzed an extensive database of construction projects to study the likelihood of disputes based on various variables. These variables were categorized into people, project, and process criteria. Their study revealed that while all these criteria are critical in determining the likelihood of dispute occurrence, still impacts on people are more significant. Thus, early contractor involvement could have a considerable effect on dispute occurrence.

ECI agreements, like all construction contracts, are subject to the risk of potential construction claims, which require active management and control. The ECI can proactively mitigate construction claims by addressing the root cause of the claim through early contractor involvement. The ECI approach can be tailored to the needs of the project and integrated with standard forms of contracts such as the FIDIC forms of contracts, the Yellow Book for plant and design-built contracts, and the X22 NEC4 contracts (Abu Dief & Elsayed, 2020). The ECI contract can be used in two stages with one contractor or with different contractors for each stage. The ECI approach can increase project success certainty while mitigating the majority of potential construction claims. ECI has been shown to reduce various types of claims such as design claims, time extension claims, scope claims, liability claims, and termination claims (Abu Dief & Elsayed, 2020).

According to Kumaraswamy (1997), there are top 10 causes of claims in Hong Kong, as determined by data gathering and questionnaires. As the causes of disputes are assumed to be universal, such causes would be applicable to other environment and cultures. Therefore, they are applicable to elsewhere. Moreover, these causes still exist the industry although they are from back 1997, however, still the causes of disputes prevail. These causes are as follows, in descending order of significance:

- Inaccurate design information

- Inadequate design information
- Inadequate site investigations
- Slow client responses
- Poor communications
- Unrealistic time targets
- Inadequate contract administration
- Uncontrollable external events
- Incomplete tender information
- Unclear risk allocation

Early planning, design constructability feedback, more collaborative decision-making, and risk management may help lessen these claims' sources. This would make it possible for the following to happen before construction begins:

- Collaborative design review and development allow the principal contractor and its experts to provide alternate solutions and comment on the project's constructability and economics (causes 1 and 2).
- Second-stage supply chain bidding to encourage the primary contractor to price or re-price work packages through supplier or subcontractor tenders following first-stage selection, working jointly with the client to iron out faults or omissions in brief and ensure accuracy in the flow-down of risk (cause 9).
- Collaborative risk management, wherein the prime contractor can suggest early risk reduction initiatives instead of only submitting risk contingency bids (causes 3, 8, and 10).
- A schedule for the building phase that outlines the contractual deadlines for crucial client, consultant, and contractor activities (causes 4 and 6).

- The development and application of a communication strategy during the planning phase, with clearly defined authority, early warning systems, and advanced knowledge of the cost of variances (cause 5).
- More client involvement in the project team, beginning in the planning stages and participating in crucial meetings to ensure information is accessible other than through the contract administrator (cause 7).

4.2.1. Faulty Designs

Designers and contractors may have different perspectives when it comes to design. Designers aim to create high-quality designs without taking much into consideration schedules, resources, and costs as constraints (Thomas, 2006 as cited by Andreas Heier Sødal, Ola Lædre, Fredrik Svalestuen and Jardar Lohne, 2014). Most designers lack the constructability and production expertise which should be compensated for through the early involvement of the contractor. This lack of production expertise might lead to variations affecting the project completion date, costs, and even the quality of relationships among the participants. In traditional design bid build, the client has the power to influence the design and can protect the designers from the contractor's influence to select a lower or easy-to-implement or functional design at the expense of quality since it prevents the contractor from strong-arming the designers into choosing the minimum level of quality (Erikson & Westerberg, 2011). In the ECI contract, the contractor would not have a justification to enclose a claim of incomplete or improper design since he has been involved early in the process. If so, it might be perceived as a shortcoming of the contractor doing his responsibilities. According to Finnie (2021), an insurance company would carry the liability insurance for the public and the professional indemnity when claims of design fault or professional indemnity arise.

4.2.2. Adverse physical conditions

Soil condition is one of the primary sources of claims which have raised controversy among construction participants. Assessing the soil conditions determines the adequate equipment and production rates, affecting costs. Some contracts would give the contractor the right to claim for additional time and cost when adverse physical conditions arise which are not reasonably foreseeable by an experienced contractor: a term commonly used in FIDIC. This condition always has controversial interpretations. The contractor performs boreholes and sometimes through a geotechnical consultant to detect the soil variations, which might impose significant risks and associated cost uncertainty. However, some soil conditions are unforeseen and unforeseeable, adding to cost and dispute significance and potential liabilities. When ECI is employed, the client and the contractor work closely. They would identify all conditions and circumstances together at a stage where they can prepare a mitigation plan collaboratively rather than transferring risks to a party at the expense of another. Thus, a risk registers and risk response plans are prepared collaboratively. Such atmosphere should promote the quality of relationships and develop a sense of ownership. This atmosphere would develop a no-blame culture which is one of the client's responsibilities in the first place. When such a culture exists, lost efforts which were devoted to protecting self-interests and advocating blame and accusations are avoided; the challenge would be only finding solutions and mitigation actions for the project's interests. Thus, designing a procurement model and contracting strategy is essential to create an attractive atmosphere that would address all parties' needs, where financial viability and profitability are present. However, avoiding disputes is to everyone's benefit.

Under ECI, any potential geotechnical-related risks would be assessed, investigated, and discussed before the construction contract award. Therefore, there would be a no-surprise culture which would give all parties a transparent image of the current situation. Therefore, employing a specialized geotechnical consultant to give reliable reports is crucial to creating

a reliable and transparent atmosphere before the contract is awarded. Although this might increase the associated cost paid upfront, the significant impacts would be higher as the resort to dispute resolution would be minimal or even avoided.

4.2.3. Scope

The contract documentation is prepared in ECI through coordination among all participants. Moreover, early involvement makes the contractor acquainted with the project requirement, duration, and scope, leading to high certainty of project completion. This is one of the ECI advantages as to mitigate against claims evolving from the project's improper duration. Thus, any claims for incomplete or improper scope would become invalid, or at least not every day.

4.2.4. Termination

Since all parties are working collaboratively from the design phase through the contracting and tendering phase, implementing the termination clause in the ECI contract is seldom implemented. This enables parties to avoid such practice in a disputed situation due to the consistent relationship between the parties. The termination clause is present and may be the last choice for termination for convenience, not for default by a party (Abu Dief & Elsayed, 2020).

4.3. Claim Entitlement

In ECI, constructability is imposed as a contractual commitment. ECI's benefit is to de-risk the design and generally improve project planning and reduce claims and disputes through the contractor's constructability inputs (Mosey, 2011). However, sometimes contractors might need help to build what has been designed. Traditionally, further detailed drawings are provided by the client's design team, as the contractor is not involved early during the design phase. When the contractor is involved in the design in ECI, the situation of a contractor

being unable to construct what has been designed becomes a more complex legal issue. The contractor has already been involved early, and the work and contracting have been implemented collaboratively, which leaves the contractor with no excuse. This also would add pressure on the designer or engineer since he is supposed to direct, resolve, and make sound decisions in something that may need to gain knowledgeable expertise. The designer or consultant would make a sound decision on the contractor's entitlement to additional time and cost. Thus, it might result from a flawless implementation of ECI or the non-existence of a transparent atmosphere.

As discussed earlier, ECI needs a unified procurement route allowing the contracting parties to tailor their route. In the United Kingdom, ECI is commonly regarded as a form of partnering (Rahman & Alhassan, 2012; Mosey, 2011), whereas in Australia, ECI has been associated with hybrid models developed for infrastructure projects in which the first stage is a form of partnering and the second stage is frequently a design and build contract (Whitehead, 2009). As mentioned by Finnie (2021), there is no one standard preconstruction agreement in New Zealand that would establish the required services which the contractor has to offer before the award of the construction award. Consequently, the contractual provisions and obligations for ECI are not constant and may change the contractual effect of early involvement on the contractor's claim entitlement accordingly during the construction stage. When the parties agree on a fixed price contract, this might lead to variations since the price is based on preliminary designs if a contractor is involved in the preliminary or concept design stage. Thus, the contract might be amended, creating inconsistency, and opening the door for transferring greater risk onto the contractor. The non-existence of a unified preconstruction agreement led to the launch of some contracts that address this situation: JCT Preconstruction Services Agreement (PCSA) in 2011; however, still, some remaining gaps exist which the parties must decide on them (Finnie, 2021). Finnie listed some of these variables: the scope of preconstruction services, timing of involvement, reimbursement models for the contractor contribution at phase 1, which contacts to be adopted for phase

either DB or construction only contract, whether the general contractor executes all the work by his own personnel or subcontracts all trade packages.

Mosey (2011) argues that the contractor bidding competitively would look for opportunities to claim variations; however, with the aid of ECI benefits through constructability review, value management, and risk management, many of the causes that might lead to claims and variations would diminish. The author continues that such early involvement would incur joint design review and development during preconstruction. This review would enable the contractor to input and comment on the function-ability and constructability of such design, along with the associated costs. This may derive innovation, creating other alternative solutions. Joint risk management is involved for the alternative solutions that allow the contractor to make proposals that reduce risks rather than applying risk contingencies. Thus, mutual agreement on a construction programme and contractual deadlines for client, consultant, and contractor activities would be established. The author also mentioned that the client is involved closely with the project team attending critical meetings during the preconstruction phase rather than only a contract administrator. Mosey claimed that a preconstruction services "conditional" contract would provide an alternative to "a letter of intent" for a project whose full documentation has not yet been completed. This preconstruction service agreement can specify the scope of preconstruction services, parties' obligations, and pricing provisions.

4.3.1. Constructability liability

The common law in the UK holds the contractors strictly liable for design constructability which entitles the contractor to full responsibility for the design even if not specified on the drawings. This is the "inclusive price" principle which considers the drawings to be within the inclusive price of the contractor; therefore, the contractor may be instructed as a variation without the entitlement of additional cost and time (Dennys & Clay, 2015) (as cited by

Finnie, 2021). Finnie discussed a case study for Tarmacadam Co Ltd v. Hannaby (CA) (1995), in which the contractor demanded extra amounts because he ran into hard rock. Despite the contract having a compensation clause, his claim was denied. Finnie also brought up the Wilkins and Davies Construction Co Ltd v. Geraldine Borough (1958) case, in which the contractor was held responsible for redesigning a concrete tank chamber whose original design had been abandoned during construction. The contractor said that once ground conditions were discovered that prevented excavation, sinking a sewage tank ceased to be an option. As a result, the contractor asserted that the work could not be done as intended. However, the High Court in Wellington came to the contrary conclusion that the work could have been completed using different construction techniques and that the contract was not frustrated because performance remained feasible, holding the contractor accountable for his obligations under the terms of the agreement. Since there is no legal definition of design constructability that can be used to establish guidelines for determining whether a contractor has fulfilled the premise, they are still held accountable for their obligations regardless of how challenging their work may be. Rosenberg (2012) states that the contractor is responsible of including all necessary cost to complete the work.

4.3.2. Extent of Inclusive Fixed Price

ECI contracting can provide flexibility in pricing terms. The contractor is employed to provide preconstruction services concurrent with design efforts. The contractor can offer a fixed price for the preconstruction services and subsequent target price adjustments for the project as the design matures, then a fixed price incentive contract can be established for the construction phase. Clients always prefer such types of contracts to have certainty before or through project phases. Therefore, claim entitlement for the additional cost may only be allowed in specific situations. Finnie stated three situations when the contract administrator might consider the extent of the contractor's inclusive fixed price:

- When there is no entitlement for instructions sufficiently, this could be considered as a contractor requesting further details.
- Instructions are sufficiently different to enable variation claims such as extra work, like the contract work. This could be considered as a contractor requesting further details.
- Instructions outside the contract itself could be refused or performed for rates outside the contract. This could be considered as instructed scope changes by the client.

Absolute responsibility is fundamentally not applicable when unforeseen developments render performance impossible or materially modify the conditions of the original contract. The agreement is thus void, relieving the parties of their obligations. Although contractors may suffer significant losses due to unforeseen circumstances such as ground conditions, the frustration threshold is usually high (Burrows et al., 2012). Suppose an instruction was deemed necessary to avoid circumstances that would otherwise frustrate the contract. In that case, the contractor may be permitted to claim expenses for the work beyond the contract rates under the theory of restitution based on unjust enrichment. However, restitution claims are only admissible in cases where there is no other remedy available through contract or tort law and where it would be unfair for one party to enrich itself at the expense of the other (Davenport & Harris, 1997).

The author gives two instances when claims might be subject to restitution. The first occurs when the designer rejects a modification order to get around a problem, such as a flaw in the design or a latent site condition, like running into subsoil conditions that are inappropriate for the kind and design of footings and necessitate changing the design (Davenport & Durham, 2013). The second instance is when the specification requires a contractor to complete a work that cannot be completed without first completing another subordinate task. According to the author, the contractor must fix specific rotten beams before it is safe to lay new tiles because the specification calls for replacing the tiles on an

existing structure. The client declined to request a variation since the contractor must do this additional activity before continuing his work. However, the contractor assumed it was not part of his obligations. Hence, the contractor must either do dangerous work or abandon the project (Davenport & Durham, 2013). The authors claim that this task is not a variation and must be completed by the contractor. This suggests that restitution only takes effect when the contract is frustrated.

4.3.3. Responsibility to Warn

Contractors are required by common law to warn of design flaws that are reasonably foreseeable to them as soon as they are discovered. Because the contractor has been allowed to participate in the design, early contractor involvement may extend what is reasonably foreseeable by the contractor; as a result, the contractor administrator may adopt a stricter approach towards contractors who request changes to the requested details.

4.3.4. Contract Document Ambiguity

If the detail is issued to settle ambiguities in the original documents, the contractor may be eligible to claim for the associated costs. Ambiguities in contract documentation work against the document's provider. Contractors may be able to recover the cost difference between contradictory information on multiple designs. Assume, for example, that the contractor installs materials based on ambiguous drawings. If it is determined that they should have been notified in advance, they may be entitled to the difference in cost between materials but not the cost of removing what has already been installed. If the contractor was involved in design development via ECI, the reasonably foreseeable threshold may be raised. When negotiating through open-book pricing rather than competitive tender, the contractor's bargaining power may be greater.

4.3.5. Designer Constructability Negligence

According to Dennys and Clay (2015), as cited by Finnie (2021), designs should rely on something other than exceptional levels of craft, which may entitle the design to need more constructability. Moreover, the documentation quality should be sufficiently detailed and legible to enable construction without further clarification. A case study mentioned by Finnie (2021) clarifies that a designer in New Zealand was found negligent for their design lacking constructability. However, under the scheme, which came into effect in 2007, designers and residential building practitioners must be licensed; therefore, the license of that designer was canceled, and the board ordered—the designer to pay costs for incompetence after the designer failed to carry out adequate site investigations. The board stated that the designer's plans should be self-contained, should not require clarification, and should document how the building work is completed to meet code requirements.

4.4. Summary

Contractors are liable for the costs of design solutions when they enter a fixed-price contract. Separately, licensed designers may be held accountable and possibly ordered to pay costs if their design is found to be negligent due to flaws such as preliminary investigations or illegible and inadequately detailed drawings. Courts may also hold designers liable if their designs rely on exceptional levels of craftsmanship to meet building code requirements, as mandated by the Building Amendment Act 2013 for residential building contracts (Finnie, 2021). This demonstrates two primary bases for claims:

5. Instructed details are sufficiently different from the original scope provided that the contractor has already fulfilled his duty to warn of any foreseen conditions.

- Instructions different from the original scope of the contract which if not applied, the contract is considered as frustrated as unforeseen events makes it possible to perform according to the original scope of work.

Even while designers may ensure that their plans are sufficiently detailed to meet the building code when constructed utilizing good workmanship, the commercial duties that contractors face when signing fixed-price construction contracts may remain the same. When instructed after contract signing, the following were found to be crucial considerations for determining whether directed detailed drawings call for a variation:

- Whether the specifics are within what the contractor should have included in their set price to cover any missing features, including temporary and permanent works (inclusive price principle).
- Whether the task described in the instruction is sufficiently different to count as a contract variation or outside the original scope to be viewed as outside the contract itself.
- Whether the contractor asked for the drawing to accommodate their construction method, constructability is typically guaranteed by contractors when giving fixed-price contracts for client-supplied designs. The contractor may provide such instructions as revisions without added expense or delay.
- Whether the instruction corrects problems the contractor could have prevented if they had been informed previously, where the contractor was legally compelled to issue warnings, the warnings would serve as the basis for assessing any ensuing deviation.
- Whether the instruction clears up any ambiguity in the drawing, the contractor can be compensated for the price difference between two products per the contra proferentem concept. The foreseeability requirement is higher when the contractor participates in design creation through ECI.

• **Claim Entitlement Flowchart**

To summarize previously, below is a flowchart to demonstrate the situations and circumstances where potential claims might occur and relevant claim entitlement:

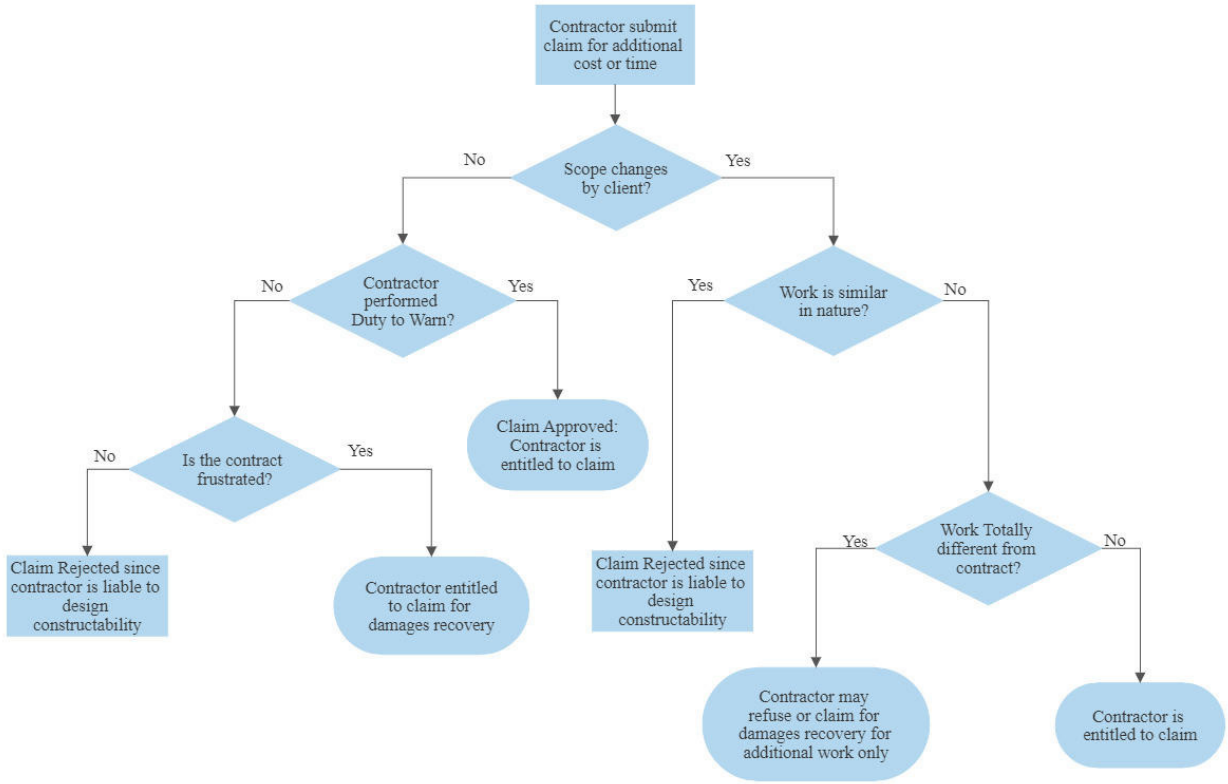

Figure 17: Flowchart for claim entitlement in ECI

4.5 Findings Implications and Reviews

4.5.1 Semi-structured Interviews

4.5.1.1 Project Suitability

Interviewees widely noted four main factors that affect the suitability of an ECI project:

- Projects involving the planning of logistics around ongoing operations.
- Employing ECI as an open-book negotiation technique, if applied, to protect cutthroat market resources and fortify client/contractor ties.
- Complicated design solutions that benefit from contractors' knowledge.
- Tasks that require accelerated progress.

These project components might overlap. Clients may work with a preferred contractor who becomes familiar with their processes to facilitate future logistical planning and constructability input and promote continual improvement through lessons learned (Song et al., 2009). Hiring the most reliable contractor may lower the risk of disruption, which may outweigh any potential premium paid for early involvement.

4.5.1.2 Pricing and Payment models

ECI cannot and is not compelled to do away with competitive pricing. After being chosen, the general contractor may submit competitive bids for the subcontractor packages. Increased possibilities of landing contracts may entice subcontractors to ECI, but this could raise their costs. The forces of the market cannot be eliminated. For instance, the single subcontractor with specialist piling equipment might keep their price notwithstanding the procurement process. ECI could reduce industry tendering costs where several contractors must prepare and submit bids by eliminating wasteful redundancy.

The openness of ECI pricing may partially alleviate the construction industry's cyclical market pressures. By using ECI open book pricing rather than a competitive tender, contractors are more likely to keep their profits in competitive marketplaces. In contrast, open-book pricing results in more equitable margins during a downturn. Because contractors cannot just bury risk within their pricing, confirming the claim that ECI lowers unwarranted pricing assumptions, the open-book negotiation may necessitate more accurate pricing (Mosey, 2011). A contractor's perspective of best practice ECI is provided by Turner and Riding 2015, p. 181, as cited in Finnie (2021), when only one contractor is involved, he would receive financial recognition regardless of his solution acceptance. The contractor is selected upon qualifications. Before arriving at a target cost verified by an outside estimate, the service provider passes through a series of specified staged gates as the design evolves.

Using stage 1 contractors may help reduce overall industry procurement costs because only the selected contractor determines the pricing for the building activity (two contractors). Competitive bidding is disregarded in lean construction as useless for obtaining custom products. Pheng et al. (2015) found that ECI can improve Lean efficiency by reducing non-value-adding tasks. The reduction of overall procurement costs is one illustration of this. Ma and Xin (2011) highlight the waste that occurs because of numerous contractors using their funds for research and design analysis in traditional tenders, even though this practice is optional, where they typically have a one-in-three chance of winning. Thus, the two-stage open book strategy lowers industry tendering costs.

According to interviewees, the first-stage pricing of ECI commonly comprises the following:

- A lump sum cost for the preliminary work for the entire project where construction is staged.
- A lump sum cost for building any initial stage for which a design has already been produced.

- Negotiated rates for direct construction works (for instance, carpentry and concrete) based on conceptual design.
- Non-price qualities like a base construction programme, technique, and history of similar previous projects are examples of non-price attributes.

Interviewees concurred that it was challenging to establish a target price in Phase 1. They said that the complexity and size of the projects create uncertainty and several contingencies that make it challenging to estimate expenses. Risk management is one of the difficulties faced by construction professionals, which plays a significant role in goal price development. One of the interviewees noted that the client's job might be easily underestimated, which suggests that the client should present, convey, and allocate the risks to the party who can impact them, then let that party price them. He said that the client may be unwilling to participate deeply, however, at least the client should be involved sufficiently in developing specifications.

Another aspect mentioned in the interview is the compensation arrangement in an ECI agreement. Costs to be included in such an agreement are crucial to all interviewees. The supervisor said the problem with ECI is the costs we do not get compensated for. Moreover, he further explained that the target price should be set in collaboration with the contractor with a predefined fee in mind. This fee should be lower or higher depending on the tolerance of the target price. This entitles a lower fee, which a more generous target price could accompany to account for reasonable compensation to the contractor, which builds up a sense of ownership of the project.

Interviewees from the City of Edmonton recognized that the target price must be fair and with a corresponding fee; otherwise, the contractor might try to look for all possible means to maximize his budget. A project director from the City of Edmonton mentioned that EI could only be successful if the price target and fair compensation for the contractor were pretty set.

The project director further explained that using a target price with pain/gain share may benefit the contractor by increasing the target price in Phase 1 to increase his profit. Such an attitude can diminish trust and jeopardize cooperation and innovation, which are necessary for successful ECI implementation.

Some interviewees argue that the contractor would only be willing to present innovative ideas in phase 1 that might reduce the cost and their compensation if reimbursed with the target price and pain/gain share. However, others think a target price at the beginning of Phase 1 would allow the contractor to expose any innovative ideas that might lead to cost reductions later in Phase 1. Setting a target price at a very early stage in phase 1 is challenging, specifically for large and complex projects. However, one of the motives for selecting ECI is to reduce uncertainty through early contractor involvement to develop accurate cost estimates before tendering. The project director further explained that "*this could be mitigated through considering any cost reduction due to innovation or any solutions by contractor generating savings at phase 1 would be considered as if such reductions have been carried out in phase 2, so the cost savings are added to the target price which has been developed at phase 1*". This implies that innovation that generated any cost savings would be perceived as if it was achieved in Phase 2 and got an impact on the pain/gain share incentive. Some interviewees argue that innovation is most likely to reduce time rather than cost; therefore, they suggested using incentives as bonuses connected to time targets rather than cost savings. However, the pain/gain share incentive still relieves the client since it connects the profits with the contractor's performance, continuously motivating the contractor to keep costs down and controlled.

Some interviewees argue that such incentive mechanisms may need to be revised to eliminate self-interest. The project director with more experience from ECI said that "*eliminating such self-interest could be achieved with such kind of incentive*". He thinks all this could be avoided by offering the proper initial compensation. However, a contractor

reimbursed as cost-plus without any incentives such as bonuses might leave too much freedom for the contractor as he may try to increase the length of the project to maintain a cash flow. Reimbursement without including risk contingencies might result on the long term in lower costs.

Although some interviewees preferred a target price with pain/gain share and incentives, others think this model may result in opportunism which jeopardizes the success of ECI. One of the interviewees stated that "*having other criteria such as schedule initiatives may be more effective than a target* price". He added that a cost forecast can works as a guide for public projects; however, the profit should not be based only a target cost. This implies that target pricing should not be the basis of the evaluation or reward of the contractors. Thus, a cost-plus fixed fee might be a better reimbursement model, provided the fee was reasonable. Such a model may prevent opportunistic behavior by focusing on quality rather than financial aspects. With a fixed fee agreement, the contractor would not let the project elapse for an extended period, reducing the profit. One of the interviewees mentioned that "*a fixed-fee model would force the contractor to be concise the project duration not to elapse for a long time; otherwise, the profit margin dilutes*". The project director further explained that since the client would consider costing a priority rather than a schedule, a cost-plus fixed fee might open the door for the contractors to increase the fee through additions or change orders. Therefore, a client with a prioritized cost criterion may need improvement. Thus, the project director stated that a fixed fee might be used with pre-condition as "*The forecasted cost is to be expected at a certain amount, so the target cost should allow for a margin of tolerance either up or down that target cost which would not affect the fee which the contractor is entitled to get. Moreover, the contractor can still be entitled to bonuses if achieving certain targets related to cost or time schedules".* A fixed fee and bonuses might prevent opportunistic behavior better than pain/gain share connected to the target price.

The interviewees further explained that applying a target price and a specified percentage fee might not interest the big contractors who are eventually suited for ECI projects characterized by complexity and large size. Therefore, the payment mechanism must include pain/gain share and other non-price bonuses since an ECI contractor would only be selected upon qualification criteria rather than price criteria. Therefore, the client must be aware of the percentage fee and other incentives that would satisfy the business model of such big contractors where low percentage fees might not cover the expenses and profits of such contractors. However, setting a high percentage fee might loosen the contractors' controls over the budget. Most interviewees think that the contractor should receive incentives and bonuses regardless of the reimbursement model being utilized if the project is successful. One interviewee stated that pain/gain share could be replaced with time bonuses, providing the same security to the client. The project director mentioned that having a fair individual bonus system for everyone in the project organization should be based on the project's results and not bonus systems dedicated to managers only. However, personal bonuses were not preferred as they can create self-interests and gaps between the individuals in the project organization. The interviewees added that when the relationships between clients and contractors mature, the clients become more experienced and understand other ways of motivation. The project director mentioned that "*an ECI agreement would need people who can accomplish the project to the lowest cost" rather than having financial incentives”*.

One of the interviewees raised concerns about the compensation model in phase 1. Typically, the contractor would be compensated for salaries and hours spent on an ECI project at phase 1, which means that the turnover during this period is much lower than for construction works. This may imply cash flow concerns when phase 1 elapses for a long time. Therefore, the director emphasized that "*phase 1 should get short and all share responsibility toward that*". Moreover, if a cot-plus and percentage fee is adopted, the fee should be higher for phase 1 compared with phase 2 to increase the contractor's revenue. However, such an increase may deplete the budget for phase 2, which some interviewees

think may generate a more even cash flow over both Phase 1 and Phase 2. However, some argue that such an increase may cause problems if the client decides to procure another contractor who would end up with lower compensation in phase 2 due to such an increase of compensation fees depleted at phase 1. This is emphasized when a go/no go clause has been applied. However, any increase in the fee at phase 1 is not acceptable to taxpayers who are the founders of public projects. Additionally, some interviewees consider that including a go/no go clause might entail a failure of the project. Others think that the non-existence of a go/no go clause may jeopardize the project; as the project director mentioned, "*The idea of having such clause is that the contractor should know that he is responsible for the final product, which might jeopardize the project award*".

4.5.1.3 Subdividing Critical Works for Fast-tracking

Some interviewees suggested that the critical construction work could start at phase 1 rather than at phase 2. This could be carried out before the finalization of the target cost as a solution to the low cash flow in Phase 1. However, starting such construction works early might not leave the contractor the opportunity to work against the target price since these works would not be included in the target price; thus, the contractor would not be compensated for these as no cost savings are expected. Therefore, some interviewees suggest that such works should include higher fees. This approach would lead to sub-dividing the projects with a different target price for each sub-division. This subdivision may lead to different subphases at phase 1, which would facilitate the start of phase 2 without the need for phase 1 completion, which eventually can decrease the total lead time of the project. Additionally, this approach would allow the team to evaluate how well the process and the agreements work. However, starting the construction work before finalizing the target price might impose uncertainty on the client, which is crucial for public clients.

The necessity of straightforward and easy-to-comprehend communication in the tendering process. In the first place, the client needs to be made aware of how the contractors

would understand the tender document, and in the second, both the clients and the contractors need to be made aware of how the other interpret their bids. There is a chance of miscommunication, which could be detrimental to both parties. Therefore, it is crucial to have open and transparent communication while buying ECI.

The client may assess the contractor's organization based on their expertise and capacity for cooperation as the most crucial factor, which is organization. The strategy for collaborative issue-solving was the second most crucial factor. If the fee were to exceed a particular level, ECI would no longer serve much of its intended purpose. Most interviewees estimated that this would occur at a weighting of 20 to 25%, which aligns with the literature's suggested range of 20 to 30% (Lahdenperä, 2010). The interviewees from the City of Edmonton adopted a weighting of 10%, allocating greater weight from other qualification criteria other than the price for their public projects.

If no design or cost projections are required, ECI tender prices are considerably lower than fixed-price contracts. An ECI tender, on the other hand, has more non-price requirements that call for different organizational resources whose scope and prices are readily underestimated. ECI heavily relies on non-price criteria; hence when the fee has a low weight, the hit rates would be higher and vice versa. Therefore, ECI would be more suitable for big organizations with substantial overhead and administrative costs, which are unlikely to compete based on low prices. Therefore, these substantial entities would exercise caution when choosing an ECI project to bid on.

4.5.1.4 Timing of Involvement

Most interviewees said it is best to involve contractors as soon as they can make a difference. If done too early, contractor participation and impact on important decisions may be excessive. However, involving contractors too early in the process adds to the procurement process's bureaucracy and costs. On the other hand, it might be challenging to accept and

incorporate contractors' contributions if they join the project too late. This is a result of the time needed to complete the project control and approval procedure and client reluctance. Since ECI does not have one route, it is suggested that more than one ECI model should be developed; however, it was argued that if the project is complex enough, then the contractors might be involved at the business development.

Project stages have a high risk due to knowledge gaps and project uncertainties. The project client should work on the risk allocation of a project to make it fair, appealing to contractors, and encouraging them to engage in the early stages. The interviewees suggested three distinct methods for reducing project risk. The first strategy is to break up a single, extensive project into manageable, more minor contracts, significantly reducing risk. The second strategy would be to create a pay structure appropriate for the level of risk. The third strategy would be to thoroughly analyze the project before inviting bids to reduce its uncertainty.

4.5.1.5 Client Obligations

Contractors may have yet to obtain equal exposure to the project background information as those included in the early phase. This would diminish trust and makes them feel discriminated which is against public legislation. Therefore, ECI clients should be competent in designing a procurement process that provides equality and avoids conflicts and claims. Additionally, clients should be competent in adequately describing a project's scope. Therefore, in-house technical competence and other quality assurance mechanisms are essential. The contractor selection based on past performance, like in the case of Best Value Procurement (BVP), could be one of these mechanisms.

The director of the City of Edmonton stated that public clients always want to ensure that the contractor possesses the necessary qualifications, which should be identified before the contractor selection. Therefore, the contractors are selected firstly on qualifications, and then

the price comes into play. Thus, selection criteria, such as the most economically advantageous tender, are used instead of using only the lowest price.

As contractors are unwilling to share their solutions with their competitors, bringing several contractors in one place to obtain solutions might need to be more efficient. Therefore, it is suggested by interviewees that public clients should first develop an appropriate plan that would preserve the confidentiality of the contractors' solutions before inviting them for early involvement. Therefore, a private, confidential dialogue might be more appropriate to let the contractor expose their ideas and solutions and allow for a helpful comparison.

4.5.1.6 Market Pricing

ECI might help with the issue of contractual risk transfer in Canada. Through ECI, risks can be jointly identified and controlled instead of passed on to contractors who submit competitive bids, with the lowest price often receiving the contract. The construction industry's pricing is cyclical boom/bust, but the open-book approach to ECI may make that less noticeable. Open book pricing often entails more stable and equitable rates than supply and demand dictated solely by the market.

Contractors' tendering expenses might be decreased if more projects were awarded using ECI. In contrast to open tender, when contractors may have a one in ten chance of winning the offer, only the contractor hired for the preconstruction stage invests the resources to price the construction works. In highly competitive markets, open bids inevitably result in lower tender pricing, which could be appealing to clients and consultants. However, this increases the chance that contractors would overcharge or cut corners to finish the job on time and within budget, or even worse, go out of business in the middle of the project.

4.5.1.7 Insurances

When performing services and construction work for any enabling works, the contractor should be required by the PCSA to carry professional indemnity insurance. Professional indemnity insurance should be maintained after the project is finished.

4.5.1.8 Project team and retaining key people.

The parties to the contract should be identified in the PCSA. It should also specify the makeup of the contractor's ECI team and forbid it from altering key personnel without the client's consent. The contractor may offer project managers and site managers to assess the constructability of the design. What is logically foreseeable under the construction contract may vary depending on the makeup of the contractor's ECI team.

4.5.1.9 Toward a universal preconstruction services agreement (PCSA)

To improve project planning using ECI, a universal PCSA might be created for use with various standard construction contracts. The parties using ECI must create their contract agreements during the preconstruction phase because there are no pre-established terms to refer to, despite the apparent benefits of standard form agreements. Even while standard form building contracts are widely employed, allowing clients to select a pre-made standard form contract rather than employing attorneys to create something fresh, this is still the case. These are likely to be significant barriers to adopting ECI because there needs to be a clear description of the process and measurables, as well as opposition from clients and consultants. Standard terms for insurance, permissions, payments, and other issues are favorable at the preconstruction stage. They are essential for the initial phases of a project, including design input, destruction, destructive testing to reveal the structure and services, asbestos testing, testing of the ground conditions, and destruction.

All interviewees agreed that using a standard PCSA enhances ECI. Clearer pre-construction agreements which can precisely define the scope of preconstruction services and obligations of parties, are likely to increase ECI. They suggested a preconstruction services agreement in Canada standard form (PCSA). A clear path for procedures or contract documentation does not appear to exist for clients or consultants using ECI for the first time, leaving parties to navigate independently.

It is interesting to notice that the RFP requests construction timelines, which, if accepted, would act as a contract document from bids. This is a concern since it could result in a contract modification if the client or their consultant changes the construction techniques or the sequence of the activities (Thomas and Wright, 2011, as cited by Finnie, 2021). This shows the advantages of having a standard PCSA that clients and their consultants can readily modify and use for specific projects.

4.5.2 Preconstruction Services Components

The lack of clarity surrounding ECI emerged as a resounding issue from the interviews, and many practitioners saw benefits in creating a standard form of PCSA. The PCSA should explicitly state, among other things, the following based on the findings:

- The scope of the contractor's services, including planning, budgeting, constructability assessment, risk management, value management, and subcontractor procurement
- Important dates for communication exchange and element supply.
- Whether or how the contractor is compensated for their early involvement.
- How may the client discontinue the project?

- The parties' obligations for design and construction, whether for specific aspects of the overall design and the contractor's obligation to notify parties of design problems as soon as possible.

The following sections explain these key aspects:

4.5.2.1 Project scope

The project duration and any liquidated damages for late completion, as well as a description of the works, should be included in the scope. As a result, the contractor can create a basic construction schedule and estimate the cost of their P&G activities.

4.5.2.2 Duty of care

The contractor is not hired to build a product; instead, they are hired to provide preconstruction services. The PCSA should therefore mandate that they function with reasonable skill and care.

4.5.2.3 Liability of providing design Advice

The contractor can comment on the design and offer different approaches. The design team has given its approval to these options. Therefore, once a construction contract has been agreed upon, the PCSA should clarify that the contractor assumes no liability for any designs and that the provisions of the construction contract shall govern. This adheres to the strategy used in the JCT PCSA. This enables the contractor to receive the design.

4.5.2.4 Selection of preconstruction services

The PCSA should include a list of possible preconstruction services under the circumstances. This gives flexibility for various project kinds and allows the parties to agree on the scope.

To clarify and reduce the possibility of a delayed design stage due to "too many chefs in the kitchen," preconstruction services might be linked to preconstruction milestones.

4.5.2.5 Preconstruction milestones

By defining preconstruction milestones, all parties are safeguarded against a delay in the design phase. If the contractor is hired on a cost reimbursement basis, the client or contractor risk accruing costs above their predetermined ECI charge. Delays in the design phase run the danger of reducing the number of detailed drawings, shortening the construction window, or delaying the project's completion.

4.5.2.6 Payment and termination provisions

A set ECI charge may be used to pay the contractor. One common practice is to withhold payment of the ECI fee from the contractor until the job is completed. If both parties agree that the contractor gains from being involved early and make a reasonable profit for the construction contract, this might be set at zero. Contractors incur fees in a competitive tendering process where contractors might only win one out of every ten projects. When they employ project managers and site management to analyze constructability and consider design options, they incur higher costs through ECI.

4.5.2.7 Provisions for documentation inconsistencies or ambiguities

To decrease claims and conflicts during construction, ECI offers more opportunities to resolve problems at the design stage. Most interviewees expected contractors to limit claims while work was being done, but they could not identify any contractual necessity for this. To reduce the danger of time and cost overruns, some respondents explained how the quality and completeness of design documents are vital when agreeing on a fixed-price construction contract. Before agreeing to a fixed-price construction contract, PCSA requirements should compel the contractor to alert the client to document inconsistencies and ambiguities that the

contractor's ECI team can reasonably foresee. This limits the contractor's ability to request changes for misunderstandings that were genuinely unexpected and led to more work or expense after the engineer clarified them. Before committing to a fixed-price construction contract, a clause that allows the contractor to certify the caliber of the design documents may be incorporated.

4.5.3 Summary

In Canada, contractual processes are frequently informal, and written contract terms must be written for early engagement. While some significant clients have created their own ECI contracts, no standard form of ECI contract is apparent, according to the interview results. The ECI contracts analyzed varied in terms of their substance. However, they typically included clauses addressing liabilities, service scope, advanced notice, good faith, professional indemnity insurance, intellectual property, termination, suspension, and dispute resolution.

Securing market resources, maintaining client/contractor connections, organizing the logistics of building around current activities, or offering design constructability and value management guidance are the primary factors to consider when deciding whether to employ ECI. For projects like airport expansions or hospital renovations where the cost of disturbance can outweigh any premium paid for the benefit of logistical planning and reliability, ECI may be especially helpful. Specialized subcontractors can contribute to designing things like facades, structural steel, lifts, and piling through the general contractor or on their own.

Once a conceptual design is complete, the most typical method for ECI in Canada involves hiring a general contractor and basing pricing on fixed price P & G and margins. To arrive at a fixed lump sum construction contract after being appointed, the general contractor hires subcontractors on an open-book basis.

The construction industry faces cyclical market pressures that ECI could assist in mitigating and lower overall tendering costs. The more transparent method may deter contractors from declaring disproportionate profit margins in competitive markets. They should also be able to count on reasonable margins during economic downturns. However, this should be weighed against potentially increased consultancy fees, regardless of whether the contractor assesses fees for early involvement and the difficult-to-quantify added value.

Through ECI, contractors have more leadership at the table. Regardless of the value management and constructability input offered, contractors can better plan construction with their site teams. This is very advantageous given that ECI was discovered to be particularly well-suited to projects requiring logistical planning of construction to current client operations. Building feasibility analysis and risk management go hand in hand. Constructability analysis covers resource and system availability, analysis of design risk in terms of constructability, and logistical planning of construction around current client operations.

4.6 Case Study: City of Edmonton: CCGC Project Delivery Method

This project delivery method is adopted by the City of Edmonton. It consists of two stages where the contractor is being hired as a construction consultant at phase 1. According to one interviewee from the City of Edmonton "*We hire their brain to get expertise and their familiarity of market conditions, they are very authentic*". The interviewee added that consultant does not seem to upset the client "*the hand that they feed, however, the contractor can upset the client, they can ask for money*". The interviewee emphasized that conflicts occur when money is involved which makes the contractor has the tendency more to raise any issues that might result in conflicts rather than a consultant. Thus, contractors are well suited for providing such expertise. the first phase involves a competitive bidding between contractors to be the construction consultant. This align with the legislation which

necessitates the project must be open for a competitive bidding. The interviewees from the City of Edmonton added that "*our objective is to support the private sector who are the real taxpayers which means that the City is working for their growth*". They added also that there are some projects where the City is selected one contractor as a sole source without calling for tenders, however, this is not so common and also there are good reasons for this practice. They stated that this has already been done with one of their underground tunnel projects. The advantage for the selected contractor, if doing well with the preconstruction services which the contractor would provide, then he is likely to be awarded the project. According to the interviewee "*the contractor is given the exclusive opportunity to submit firm price for the construction work*". By the end of the first phase, a contractor is selected. This contractor is paid hourly rate for its preconstruction services. The client would be involved; thus, the client has to have the competence to coordinate and manage the information flow between the design consultant and the contractor.

At the second stage, the contractor would be responsible of providing the preconstruction services and provide his price as a lump sum. This price is compared with the price from a cost consultant which is selected by the City with predefined qualification criteria. The cost consultant is provided the same tender documents, and drawings and be requested to submit a sealed bid form with pricing at the same time as the Construction Consultant "the contractor". These bids are unsealed at the same time by the City. If the price of the contractor is within 10% of the cost provided by the cost consultant, then the contract is awarded to that contractor. An interviewee mentioned that even if the price of the contractor is above the cost consultant above 10%, still the contractor is awarded the construction works which gives the contractor an impression of trust and openness conveyed implicitly to the contractor".

Once the design is complete and the Contractor has met the Consulting performance requirements, the Contractor submits a firm price for the work. If the price is acceptable to

the City, a firm price construction contract is awarded to the Contractor. However, if the price is not acceptable to the City, the City has options for proceeding, including competitively tendering the work, redesigning, bundling portions and retendering. Additionally, the CCGC Contractor can also submit his bid, so he is not abandoned.

4.6.1 Timing of Involvement

The contractor is involved after the completion of preliminary design which would provide the contractor who would be involved at this point after selecting an alternative out of the created design alternatives which have been created at the preliminary design stage. An interviewee from the City of Edmonton added that "*involving the contractor earlier would make him frustrated and might lose* interest". He added that the contractor is involved at 60% of design completion.

4.6.2 Contract and Pricing

The City of Edmonton developed their own contract which best suits their needs. They consider the contract as a risk management tool. Thus, the contract states the preconstruction services in detail. It clearly states that any unexpected conditions would be reimbursed which would give the contractor confidence to innovate, convey trust and reveal stress and pressure. The contractor is required to submit unit prices with quantities that might change. If quantities or unexpected conditions occur, then it permitted to change quantities which have been in the tender accordingly. The price is provided as a lump sum without using open book. An interviewee stated that profit is not exposed and the City is not considering open book pricing as required. This indicates that ECI can be tailored according to the project and client needs.

4.6.3 Construction Consultant Fees

The contractor would submit the hourly rate of all his personnel to be involved with an estimated hours that would cover the scope of work. These figures would be tabulated in the below table:

Table 7: Consulting fees based on a time-basis up to the total upset fee

Personnel	**Rate (per**	**Hours**	**Total**
Project Director	$		
Project Manager	$		
Superintendent	$		
Cost Estimator	$		
Scheduler	$		
Junior PM Support/Drafting	$		
Safety	$		
Specialists	$		
Admin Support	$		
Subtotal			
Disbursements (5%)			
Subtotal with Disbursements			
Upset Fee Payable Before GST			
GST (5%)			
TOTAL UPSET FEEPAYABLE			

4.6.4 Contractor Proposal Submission

The tender to be submitted to the City must consists of two envelopes: non-financial items and financial items. The first envelope should contain non-financial items with a total weight of 90% while the second envelope contains financial items which accounts for a weight of 10%. According to the interviewee from the City, the non-price criteria are very important and the weights of criteria should reflect the root cause of adopting ECI, therefore, the City only accounts a weight of 10% for the price, which indicates that non-price criteria are much elevated.

4.6.5 Preconstruction Services

The contractor shall provide preconstruction services which includes constructability, scheduling, costing, innovation, risk management, and value engineering. The contractor as a construction consultant would develop a construction management plan that sets out how all areas of the work-packaging, staging, scheduling, estimating, permitting, start-up, contracting, roles and responsibilities of all team members involved, cost and schedule control, communications and document control, safety, environmental, traffic, quality, change, and risk management, dispute resolution and claims avoidance, closeout and as-built documentation, and lessons learned. The contractor is responsible to develop traffic and pedestrian accommodation strategies and access management plans for various design options, identify permitting requirements for construction and coordinate with the Project Team to obtain all permits without delay to the Project. The contractor would also be responsible of obtaining the following permits: traffic accommodations permit and work on historical buildings approval. Thus, the process of permit applications is fast-tracked. Moreover, the contractor would review environmental study reports, geotechnical reports, and other supporting documentation to identify missing information or constructability concerns.

4.6.6 Case Study: Preliminary design report vs construction consultant

The project scope was to repair the northbound bridge where Edmonton's 170th Street crosses the CN Rail Bissell Yard. This project used the CCGC project delivery method. The Construction Consultant provided valuable feedback on design options to improve constructability while meeting the City's cost and schedule constraints. The contractor helped in developing detailed design and tender documents The cost estimates of the project was $3.9M while this cost estimates changed after the contractor who acts as a construction consultant has been involved resulting in cost estimates of $5.0 M. Additionally, the project

duration was estimated to be 189 days, however, this duration was changed to 274 days. The Contractor was well prepared and had fully planned all aspects of the work before beginning, which reduced surprises and resulted in minimal change orders for unknowns, as well as no claims or disputes, and the Construction Phase went extremely well, on time and on budget. One interviewee mentioned that this delivery method put the facts into play rather than potentially "*over promising and under delivering*". The table below summarizes the results of preliminary design report against the construction consultant assessment which signify the inputs of the contractor.

Table 8: Prelim Design Report vs. Construction Consultant

Item	**Preliminary Design Report**	**Construction Consultant**
Cost	$3.9 M	$5.0M
Schedule	189 Days (1 season)	274 days (2 seasons)
Traffic	3 traffic switches	2 traffic switches

Figure 18: 170 Street over YHT - Bridge Rehabilitation

4.6.7 ECI Influence on mitigating causes of disputes

Benefits deployed from the ECI implementation can be categorized into four main categories: time compression, acceleration, cost verification, risk management, and claims mitigation (Abu Dief & Elsayed, 2020). Song et al. (2009) studied the effects of the contractors at an early stage on construction schedule performance through an industrial case study. He revealed that ECI leads to improved knowledge transfer and information flow. Another study by Mohamad and Coffey (2010) concluded that construction costs could be optimized by implementing ECI with value management as a decision-making tool. According to Scheepbouwer and Humphries (2011), clients and contractors agree that ECI helps improve project quality and cost control. However, designers argue that increased negotiations and discussion may reduce time savings. Rahmani et al. (2012) stated that the ECI model used in Australia could lead to improved relationships, the effectiveness of contractor's input to design, better risk management, overall improved project delivery, efficient resource utilization, improved contract administration, and improved project quality.

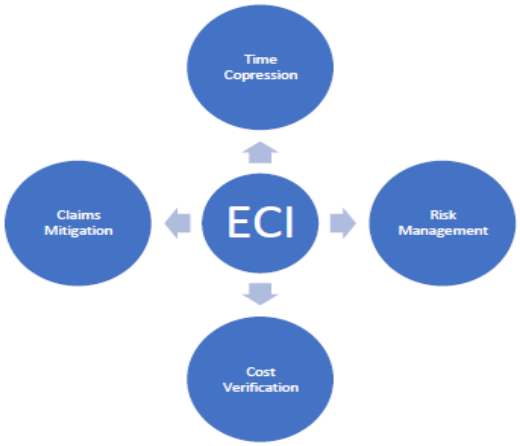

Figure 19: Benefits of ECI as adopted by Abu Dief & Elsayed, 2020.

When the client and contractor work collaboratively, improved constructability reviews affect the design reliability. According to Finnie (2021), a case study mentioned by Franks (1998) involved the contractor early for a project. This project has an additional cost of $0.5 million for earlier involvement; however, savings of $2 million was achieved over the project period compared with traditional procurement. According to Gil, Tommelein, and Ballard (2004), by reducing the time required for appointed contractors to familiarize themselves with the project, shop drawings could be produced earlier and faster, contributing to fast-tracked projects.

Knowledge of constructability is essential in the early stages. Early structural system and detail adjustments are frequently critical to constructability (Sodahl et al., Laedre et al., Svalestuen et al., and Lohne et al., 2014). Technical product and material information is useful for design. Design teams that can provide this mix can gain a significant competitive advantage. The technical solutions can be evaluated in terms of cost, schedule, production safety, and quality, resulting in cost savings and improvements in all areas. Constructability literature indicates that constructability programmes significantly improve cost, schedule, and safety performance (Song et al., 2009). Therefore, constructability knowledge and practical cost information can improve the cost estimates of the design and foresee production costs. Moreover, when the cost estimate exceeds the client's budget, the designers can rework for design modifications to fit into the client's budget derived from the early contractor involvement.

Risk management would benefit from early contractor involvement. In the early stages, risk identification is implemented with the collaboration of all stakeholders. This would help in precisely quantifying the risk's severity and impacts, reducing the risk of "surprise" (Whitehead, 2009). Therefore, the risk management process is improved, and the probability of successful project completion is increased. This would lead to a no-claim, no-blame culture. Moreover, fewer variations might occur during the construction phase (Whitehead,

2009), which comes at a cost when identified at later stages and even adds to the adverse relationships between the client and the contractor, which might consume time, effort, and cost for its evaluation.

- **Realistic pricing**

Contingency is a measure of the efficient use of the budget. When it is not used, the client funds additional construction, allowing designers and contractors to have additional work and an opportunity to grow. Moreover, taxpayers would get more value due to extra funds for infrastructure or public projects. Thus, moving to certainty would help the client allocate the contingency at the time of contract award. Since ECI aims to increase the certainty of project results, it premises that all parties are accountable for solving problems jointly and resolving or avoiding conflicts more effectively. This ensures the efficiency in spending the budget as it spends only on the construction works and not on unnecessary distractions such as liability disclaimers and other legal complications. Therefore, time and cost growth as project performance metrics would not only indicate time and cost savings, but most importantly, they would indicate the change shifting from the schedule, contract amount, and the project's scope of work after the contract award. Thus, adding certainty imposed by ECI would lead to better exploitation of contingency. Moreover, ECI helps reduce risks and increase certainty, avoiding any excessive contingency, which would result in a more realistic contract price that does not lead the contractor to pursue claims in the future (Whitehead, 2009). Although there should not be a significant contingency in the contract price, it should also not be so low that the contractor must devote all their time to pursuing claims.

- **Early material procurement**

ECI allows for procuring the long lead items due to the early contractor involvement, which saves time as the purchasing order is placed at the design phase. Moreover, the delivery time and availability on the site would be accordingly managed. Additionally, the contractor's

resources would be committed to the project, allowing for adequate buffers. The contractor can even start work in areas that would not affect the ongoing design work (Whitehead, 2009). The early start of work by the contractor may be used to compress or fast-track the project's duration, as procurement and even site work could start while the design phase is ongoing.

- **Reduced pre-tender costs**

Timing of involvement during the design phase is one of the challenges; as Hastie et al. (2017) mentioned, design for ECI can vary from schematic to completed construction documentation. When the design is relatively developed, this might avoid many interpretation issues; however, the contractor might lose effectiveness in deriving the design; therefore, having a less developed design may derive contractor inputs and innovation. Mignot (2011) suggested that consultants are retained throughout the project in an advisory role to the client, particularly when the design needs to be developed. These consultants can also be contracted to come back over the defect liability period to ensure the project has been completed correctly.

In the city model, the contractor is involved after completing the preliminary design, at about 60% of design completion. If the contractor is too early, he might have nothing to add or even waste resources (Francis & Kiroff, 2015), which can induce unnecessary costs. Moreover, a detailed cost estimate was not needed since the detailed design was not required prior to the tendering process, as the design and tendering processes overlap. This helps reduce the demand for resources and duplication of roles. As one contractor is involved, no duplication of work is being done by contractors compared with traditional tendering, which might include reimbursement claims presented by unsuccessful contractors.

- **Increased opportunity for innovation**

Since ECI would allow for the early involvement of the contractor to promote the constructability and design reviews while the design has not been fully developed. This method would be appropriate when the project is complex enough requiring innovation. The city model can avoid the client from transferring preliminary design ownership to a contractor who is unsuitable for the project. The process is split into two stages. In the first step, the contractor is hired to advise on the design process. This allows the client to control the design process without the need to negotiate and agree on the entire construction contract. Thus, the client can evaluate the value delivered. Moreover, the price criterion weighted only 10% which implies greater weight on qualifications criteria to procure highly innovative qualified contractor. Moreover, ECI tends to remove the competitiveness since only one contractor is involved (Lahdenpera, 2010) since there would not be a tendency to gain an edge over other bidders. Therefore, adverse relationships are eradicated during the design phase, promoting a healthy collaborative environment that enables effective decision-making and approvals (Whitehead, 2009).

To summarize, ECI provides awareness about the project to the parties. It enables collaborative coordination and workshops to refine the scope and project plan in advance of the construction phase. According to Whitehead (2009), the benefits of ECI are as follows:

- Reduced pre-tender costs: A detailed design is optional for the tendering process. In a market with competition, this helps reduce the need for resources and role duplication.
- A team approach: Cooperation between the client, contractor, and consultant can enhance working relationships, communications, and employee retention.

- Early experience utilization: The client's and the contractor's knowledge are used early in the project's design creation process when it can have the most influence.
- More adaptability and opportunity for invention: Because the design is still in its infancy, there is more potential for imagination and ingenuity.
- The parties' early cooperation makes decision-making and approvals feasible more effectively.
- Early material procurement: This is made possible by earlier collaborative planning and speedier decision-making. This is especially helpful for goods whose delivery lead times are extensive.
- Shorter delivery times: Work on stages can begin as the design and paperwork for future trade packages are produced.
- Greater integration of construction techniques: The participation of all parties involved makes it possible to integrate design and construction techniques.
- Sustainability: Early collaboration among parties can assist in developing new working procedures across the client organization and achieving sustainability goals.
- Reduced possibility of "surprise": Risks can be reduced by enhancing communication and ensuring everyone involved is aware of the project's requirements and costs.
- Fewer variations during construction: Because there are fewer risks and everyone is better informed of the project, fewer variations reduce costs.
- Realistic pricing: While there should not be a significant contingency in the contract price, it should also not be so low that the contractor must devote all their time to pursuing claims.

4.6.8 ECI limitations on mitigating causes of disputes

Due to the absence of an explicit contractual framework for ECI, there is no one definite pathway for ECI, which could create inconsistency. Most of the literature on ECI has identified benefits with no clear drawbacks (Pheng et al., Gao et al., and Lin et al., 2015). According to Rahman and Alhassan (2012), potential issues with ECI include: a lack of "win-win" attitude, a lack of commitment to shared objectives, a lack of team member empowerment, the extent of trust, a lack of a clear boundary, a lack of continuous open and honest communication, non-inclusion of consultants in pain-share/gain-share arrangements, a lack of pro-active problem solving, an unwillingness to compromise, and a failure to develop. The authors added that ECI would require open-book accounting that can drive transparency and honest communication between the client, consultant, and contractor. Therefore, target value contracts may become more significant than fixed price contracts to promote consultants' pain/share (Rahman & Alhassan, 2012). Some clients may think that competitive fixed pricing would give them the power to select among the best bids. Moreover, they might think selecting a contractor under the ECI agreement would be based on the track of records rather than the lowest bid as the design needs to be completed, meaning there is no bid to a design yet. Thus, this may make clients think that preconstruction services are unnecessary, such as constructability reviews, value engineering, etc. (Pheng, Gao, and Lin, 2015).

From a designer's perspective, intellectual property challenges are associated with participating in ECI. There is a concern that adequate regulations are not in place to prevent competitors from "stealing" their design (Bundgaard et al., 2011). However, Hastie et al. (2017) suggested that issues concerning intellectual property could be mitigated by clear definitions in the contract upfront.

ECI requires a radical change from the traditional procurement approach. This change may require new adaption and modification in contracting practices and culture (Song et al., 2009). Moreover, when two-stage ECI is implemented, the transition between the two stages

causes conflicts over risk allocation, program, and budget, which leads to adversarial relationships (Scheepbouwer & Humphries, 2011) that diminish trust.

- **ECI reimbursement mechanism**

ECI does not contain strict rules for the procurement evaluation model or contractual design (Mosey, 2009). Under ECI, the contractor may be reimbursed hourly for the early involvement basis with a possible additional percentage fee, like a consultancy firm (Mosey, 2009). This is not considered adequate for some contractors since they are reimbursed based on their production and not on a return of their employees' salaries. However, according to Nichols (2007), the profit from ECI projects where the risks are shared between client and contractor is supposed to be lower than fixed-price contracts since bearing higher risks might generate more profits (Nichols, 2007). This may not be adequate for contractors' business models, which need to be revised, studied, and evaluated if they would participate in successful ECI agreements. Therefore, all factors that might lead to a change in the business model must be studied and analyzed to perform such an adaptation (Osterwalder, 2004).

The case study employed an hourly rate reimbursement model, which needs to be revised for a contractor's business model, whose profit is based on production rather than binding valuable resources for only getting an hourly rate in return. This may induce the contractor to move quickly to a construction contract, which might affect the quality of the preconstruction services during the ECI phase. Moreover, the contractor might lose interest in being involved in hourly rates. Therefore, a binding agreement should entitle the contractor to be eligible to be awarded the project if the contractor performs accordingly. Otherwise, the client might run the risk of hiring a contractor who is half-hearted about performing preconstruction services.

Moreover, a contractor willing to get paid an hourly rate may invest his resources in expanding his relationships and connections with the client and other stakeholders.

Therefore, he should receive encouragement for his conduct. Having a contractor as a construction consultant on board with the designer's resources might alleviate the burden of an incomplete or ambiguous design that lacks constructability and affordability, eventually reducing the designer's risk of design liabilities. However, the designer had the perspective that the contractor continuously intended to gear the design toward alternatives and construction methods that might not require innovations. Therefore, the designer prefers separation and little involvement from the contractor in the design decisions to preserve quality, sometimes leading to clashes over design issues and ideas.

- **Contractor Selection**

The selection of the contractor is very critical; it is based on qualifications. Thus, the selection should be for a contractor willing to maintain a good relationship with the client and other stakeholders. However, selecting one contractor who would be doing the preconstruction services may jeopardize the quality of the design as the contractor may take advantage of being involved solely and might divert the design to what the contractor has expertise in or derive the design from simple ideas rather than promoting innovation. Thus, the client might feel like they are being taken advantage of. Therefore, the client might need greater participation to ensure that the contractor is performing accordingly. Suppose termination occurs after completing the ECI phase. In that case, this entails a loss of knowledge and might include intellectual property issues, which would require more time to build a new team. Moreover, retendering would be required to select a new contractor, which would incur more costs for the client.

- **Competitive bidding**

Whitehead (2009) argued that ECI is only suitable for large-scale, high-risk projects. Smaller scale projects have little cost savings and benefit from the more expensive and time-consuming process upfront (Eadie & Graham, 2014). However, ECI tends to remove

competitiveness since only one part of preparing the bids (Lahdenpera, 2010) might not be suitable for the public sector, which would require more than one contractor to ensure competitiveness, and low-price criterion must be included. Restrictions of the legislation and act may ensure that no one is given an advantage over others through a competitive, transparent, and open process. Therefore, the legislation may require more than one contractor, which might prevent the clients from providing information during the workshops. However, this can be managed through clearly communicating project outcomes, risks, and issues to be resolved and addressed through the ECI process at the invitation to tender rather than transferring competitive knowledge between the bidders. This also reveals the areas of risks identified by the client, consultant, and contractor and any risks that any of the parties might have missed. Putting such identification forward would also help the contractor speed up the process rather than letting the contractor try to guess.

In the City mode, competitive bidding was employed to select a contractor as construction consultant. Once the contractor is selected, the CC contractor would have the advantage on presenting his bid for a construction contract for a project which the contractor has been already involved in and gained profound engagement about it. The price of the CC contractor is compared with the price from a cost consultant. If the difference is within the range of 10% above or below, then contractor is hired for a construction contract. However, this might add to tension due to competition since the contractor would lower his price to be awarded the construction contract, which might affect the ECI's effectiveness. However, we might not run into such a problem if the contractor has been evaluated in the first place on purely qualification criteria. Moreover, the contractor still wins the project if the price is still within 10% above the cost consultant. From a client perspective, investing 10% more for minimal surprises and high certainty of construction cost and time might appeal to the client. This would be incredibly appealing to the taxpayers and clients since everything is published ahead of the project before the construction starts, which would convey a better image than just overpromising and underdelivering. For policymakers, this would entail the money being

invested efficiently and transparently. However, this is applicable only if the authenticity of the cost consultant estimate is high enough to account for any unforeseen circumstances, construction methods, limitations, and site conditions that might not be feasible when compared with a cost estimate from a highly qualified contractor.

- **Longer time required due negotiations**

The ECI process may consume longer since confrontations and negotiations through workshops may be present at the beginning. However, certainty in the product, cost, and time is delivered once the process starts. As the ECI moves to the second phase, collaboration is reduced; however, it has remained, contrasting with the adversarial relationship in the traditional procurement approach. If parties take different views, there are mechanisms within the contract to escalate it and relationship escalation. Issues can be raised to the next level of management, and if that fails again, there is a process so that it does not sit in the bottom draw; this is important to make people feel safe in the relationship.

- **Short time allocated for detailed pricing**

Mosey (2009) mentioned that when the contractor works alongside the client and its consultant to finalize an acceptable price before the start on site, the time allocated for detailed pricing might be short before the construction work commences, which eventually risks the cost certainty. Moreover, as Rahman and Alhassan (2012) mentioned, the contractor and a consultant can clash over design ideas. Thus, the client must build a no-blame culture in the team to achieve transparency and effective collaboration.

Westgaard et al. (2010) argue that contractors tend to focus on the cost, which would affect the design if the contractors were responsible for its management. Therefore, rather than deriving innovative ideas, the contractor uses simple solutions affected by the cost aspect. However, designers tend to focus on quality which makes them yield to the separated

design as they think that this counterpart action can protect the design for quality (Thomas, 2006). This may lead to an unequal commitment to the project from all stakeholders. Therefore, goals must be aligned and pursued collaboratively.

When the contractor loses interest in the project after completing stage I, his team members leave. With such turnover, the learning curve drops, experiencing performance inferiority, and a longer time is needed to build another team to re-catch the learning curve. On the other side, re-tendering would be required when the client decides not to accept the open book negotiation offer, which can significantly impact performance. Thus, competitive tendering may add to tension for the contractor, such as setting a cost ceiling; therefore, the contractor must be paid for the services it provides during open-book negotiation to secure commitment and ensure there are no intellectual property issues if the contractor has not been awarded a contract.

The ECI contractor may be subjected to conflict-of-interest since he might be selecting material and proposing alternatives from other companies, which entitles him to a loss of profits. Therefore, all stakeholders must change their behavior (Jorgensen & Emmitt, 2009). This change might be difficult and threatening. Thus, building an efficient working environment with mutual respect among the participants would reduce misunderstandings and unnecessary conflicts (Emmitt & Ruikar, 2013).

5. Chapter 5 - ECI Influence on Contractual Risks

5.1 Standard form contracts for ECI

Standard form contracts exist that permit contractor participation in the design phase. This includes contracts for management contracting and construction management released by the New Engineering Contract (NEC) and the Joint Contracts Tribunal (JCT). The Joint Contracts Tribunal (JCT, 2019) and the Institution of Civil Engineers in the United Kingdom released standard form pre-construction contracts to support ECI in 2011 (Finnie, 2021). Both common formats take different approaches (cost reimbursement or target value versus fixed lump sum). Finnie (2021) asserts that the analysis of each contract shows that the ECI pathway is only supported by the JCT PCSA and the NEC ECI Clause. As indicated by Mosey, they offer contract agreements for hiring contractors during the pre-construction stage before agreeing on a construction contract (2011). The JCT PCSA also enables the flexibility of either construction only or novated design and build contracts, as well as lump sum construction contracts.

5.1.1 JCT Pre-Construction Services Agreement (PCSA)

Pre-Construction Services Agreement (General Contractor) (PCSA) and Pre-Construction Services Agreement (Specialist) (PCSA/SP) are common pre-construction services agreements (PCSA) for hiring general contractors and subcontractors released by JCT in 2011. The JCT CSA is used to supplement the JCT standard contracts for building works only or for design and build by designating a contractor to perform preconstruction services through a two-stage tendering procedure. According to JCT, the PCSA can be used with the Construction Management Contract with a few minor modifications but not the Management Building Contract (JCT, 2017). Finally, The JCT PCSA offers standard and detailed terms that allow parties to agree on things like the scope of pre-construction services, payment

arrangements, insurances, and liabilities for providing design input, before agreeing on a construction agreement.

5.1.2 New Engineering Contract (NEC) MC and ECI Clause

A supplemental ECI clause for use with NEC contract options C (target contract with activity schedule) and E (cost reimbursable contract) was made available by NEC in November 2015 (NEC, 2014b). The provision calls for contractors to offer design suggestions or assistance to the client's consultant. It includes fundamental elements for the pre-construction phase, including clauses about updating the contract budget, the contractor's first-stage pricing (rates, resources, overheads and profit, preliminary fees), contractor responsibility for obtaining consents and approvals, client and contractor ownership of intellectual property, the client's right to abandon moving forward with construction, and the contractor's liability for any designs. The provision presupposes that the contractor is compensated for their early involvement and regularly gives cost projections for stage 1 expenditures.

5.2 General Contractor V.S. Consultant Construction Manager

When a general contractor is hired by ECI, he participates in the design process and manage the subcontractors and construction projects as well. However, when a consultant construction manager is hired, the client would directly hire the subcontractors or specialty contractors, and the consultant construction manager would oversee supervising both of those tasks as well as the construction process.

The obligations of a consultant construction manager are softer than those of a general contractor. According to Finnie (2021), JCT CM/A defines the construction manager's duty of care as the construction manager shall exercise the degree of skill, care, and diligence to be expected of a reasonably competent construction manager experienced in carrying out projects of a similar size, scope, and complexity in carrying out his obligations under this Contract. Also, this contract restricts the construction manager's liability for design flaws as

that responsibility would fall to the subcontractor. As a result, the construction manager is not responsible to the employer for any flaws or deficiencies in the Project's design. Furthermore, Clause 2.9.2 exempts the construction manager from any liability if the construction manager is hampered by an act or omission of the Consultant Team, provided the construction manager makes all reasonable efforts to avoid or mitigate the impact of the act or omission.

However, CCGC Form mentions under responsibilities section of the contractor's project manager, he would serve as the CC's single point of contact for the City for all purposes under the Contract and all other City Project documents (clause 2.1.2). Moreover, the contract management of any Subcontractors and Subconsultants, including addressing and communicating to the City's Designated Representative any issues raised by Subcontractors or Subconsultants in respect of the Services (Clause 2.1.5). he would be responsible of managing the CC's relationships with all Subcontractors, Subconsultants, the Design Consultant, other City contractors, and any other key stakeholders (clause 2.1.6). This implies that no direct relation or contractual relationship between subcontractors and client. However, under clause 3.7, the contractor is not being held liable against design documents which may relieve the contractor and foster confidence and preventing the contractor from stepping back as a fear of taking responsibility, however, still the designer assumes the full responsibility of the design which would imply that the contractor is only assisting and making recommendations to the design process. According to the interviewees from the City, the contractor is brought the design stage after the completion of preliminary stage. This implies that the City is not transferring the detailed design to the contractor, thus the City would employ DBB traditional project delivery after the completion of the ECI stage 2 rather than DB approach. With such approach of a design assist, the contractor still has the chance to undergo typical traditional claims approach which is commonly implemented in the industry. However, clause 1.11 states that the city would engage CC to perform the detailed design which implies the establishment of DB approach.

CCGC Contract Form:

"1.11 The City has engaged the Design Consultant to perform detailed design, pre-construction services, resident engineering, and post-construction services for the Project. The CC will be required to communicate and work collaboratively with the City and Design Consultant on a continuous basis, as outlined in this Contract" (CCGC Contract Form, 2021).

This may make confusion on the time of involvement as the interviewees mentioned that the contactor is involved after the completion of preliminary design which implies that the contractor would be providing his preconstruction services during the detailed design stage, however, (clause 1.11) assigns the responsibility of detailed design to the contractor. This could be interpreted as the City requires the contractor to provide preconstruction services during the detailed design and at a certain point, the responsibility of detailed design would be transferred to the contractor which might conflict with the understanding of the interviewees who think that the sole responsibility of the design is upon the designer not the contractor.

CCGC Contract Form:

"3.7 The CC shall not be responsible for providing, nor does the CC control, the Project design and contents of the design documents. By performing the design reviews described in the Description of Work, the CC is not acting in a manner so as to assume responsibility or liability, in whole or in part, for all or any part of the Project design and design documents. The CC's actions in reviewing the Project design and design documents and in making recommendations as provided therein are only advisory to the City" (CCGC Contract Form, 2021).

Unlike to earlier sorts of contracts, which held these contractors accountable for the design, this one may not. As a result, the contractor is held more closely accountable for

design duties and mistakes under ECI because the contractor is responsible for the design at a certain stage that is determined in accordance with the project's demands, scope, clients' expectations, and market. The preconstruction services might also specify the contractor's responsibilities and liabilities regarding preconstruction services offered in the early design stages.

With the help of the employer's or their team of consultants, the contractor can collaborate on complex drawings, the major contract works, or the creation of specialized proposal documents thanks to the Pre-Construction Services Agreement. The final design process of the project, as well as the development of the schedule, cost forecasts, constructability, and any specialty procurement, all benefit from and frequently require the contractor's input during the pre-construction phase. The agreement covers the period of time from the submission of first stage tenders to the submission of a final second stage tender and the execution of a contract for the construction phase.

There are typically provisions in construction contracts that allow the contract administrator to specify contract revisions. If not, the contractor may be able to renegotiate all the contract's provisions (Murdoch and Hughes, 2008). The client has the option to adjust the terms of the agreement by instructing their construction manager regarding scope revisions, as stated in CM/A Article 3.2.3. According to Article 2.1.4 of the procurement responsibilities, the construction manager shall fulfil all tasks expected of the Construction Manager as such agent under each Trade Contract. Unfortunately, there is not a provision for the construction manager to provide modifications to the subcontractors (only completion certificates clauses 2.5 and 2.6 and certificates of making good clause 2.4). (Finnie, 2021).

The obligations of a consultant construction manager are softer than those of a general contractor. The construction manager's duty of care is described in Article 2.7 of the JCT CM/A in a manner comparable to that of every other consultant on the project team:

JCT CM/A:

"2.7 The Construction Manager in the discharge of his obligations under this Contract shall exercise the degree of skill, care and diligence to be expected of a reasonably competent construction manager experienced in carrying out projects of a similar size, scope and complexity" (JCT CM/A as cited by Finnie, 2021).

Clause 2.8 limits the construction manager's liability for design errors:

"2.8 Subject to the indemnities to the Employer given in clauses 6.1 and 6.2, and notwithstanding any liability for design placed on a Trade Contractor under a Trade Contract, the Construction Manager shall not be liable to the Employer in respect of any defect or insufficiency in the design of the Project" (JCT CM/A as cited by Finnie, 2021).

Clause 2.9.2 limits the construction manager from any liability when hindered by an act or omission of the Consultant Team, provided the construction manager takes all reasonable efforts to avoid or mitigate the effect of the act or omission:

"2.9.2 The Construction Manager shall not be liable under this Contract to the extent that the discharge of his obligations is prevented or delayed by any act or omission of the Consultant Team or any member of it, provided that all reasonable efforts have been made by the Construction Manager to avoid or mitigate the effect of any such act or omission on the discharge of his obligations" (JCT CM/A as cited by Finnie, 2021).

5.3 Absolute liability and the inclusive-price principle

When a contractor is being hired through a fixed-price construction contract and if he cannot otherwise create what has been specified, they submit a request for information during construction asking for more drawing details for particularly complex areas. The contract administrator releases drawing specifications. For the specific work, the general contractor

then makes a variation claim. Thus, the contract administrator must establish when the variation is valid, the effect of such claim if submitted from a subcontractor to a consultant construction manager (CCM) when no general contractor is not involved.

Since the responsibility of the design assigned by the City is solely liable to the designer and contractor is only providing pre-construction services in which if the contractor performed well, then he is given the exclusive opportunity to bid on the project. The City thinks that the CC who has been involved in the project during the design stage would be most likely to be well aware of the project needs and constraints which would reflect on the project's performance with the harnessing of relationships experienced along the design to the construction works.

The contract administrator determines whether the contractor should have included sufficient costs for the newly detailed work in their fixed price or if the detailed work differs enough to require a contract variation. The differentiating characteristic is that the contractor was required to account for all costs associated with completing the work, even if they were not noted on the drawings.

According to Dennys and Clay's book (2015, p. 402) as cited by Finnie (2021), if the drawing is included in the contractor's inclusive price, it may be requested as a change "for the contractor's convenience" without incurring additional time or costs. However, how the contract is interpreted, and the agreed-upon scope are ultimately what determines the scope of application. As a result, the contractor might not always be entitled to the expenses of extra materials that are indicated in detailed drawings that were given after the contract was signed. The provision of a schedule of quantities by the client does not necessarily lessen the contractor's absolute liability. While the contractor may rely on the SOQ's correctness to match the designs (without a liability disclaimer in the SOQ), this may not lessen the contractor's overall exposure for unforeseeable events. The long-established rule is that the

client does not guarantee that the design is constructible when they deliver drawings to the tenderer (Bailey, 2007 as cited by Finnie, 2021). Instead, the contractor is the one who, by submitting a fixed price, legally warrants that they can complete the project as planned and do so for their price, even if unforeseen circumstances make performance more challenging, such as constructability issues brought on by the engineer's negligent design (Rosenberg, 2012: p. 16 as cited by Finnie, 2021). This suggests that involving the contractor early in the design process would give him confidence in his tender price, which would increase the client's sense of security that the scope of work is applicable in exchange for that amount of money at the tender submittals, which in turn ensures the contractor's strict liability towards the constructability of the design.

Construction contractors and product producers have the obligation to deliver a product that is suitable for its intended use and free from flaws (Burrows et al., 2012). According to the principle of absolute liability, if a provider agrees to do something in writing, they are obligated to carry it out regardless of any obstacles that may make it more difficult. In contrast to a contract for services, the client does not first need to prove carelessness in the case of absolute liability. The contract administrator must determine how much compensation for unfinished drawings the contractor ought to have included in their fixed price for design development (inclusive price principle). Notwithstanding the fact that there is no definitive legal definition of design constructability. This implies that the contractor must budget enough money to cover all necessary expenses, including those for the permanent construction work. Contract Form Construction Consultant General Contractor expressly requires contractors to budget for all expenditures, whether stated explicitly in the contract or "inferred" from it.

CCGC Form Contract clause 6.2, “Changes to the services”, states the following.

“Except in an emergency, as determined in the sole discretion of the City, no change shall be

made unless in pursuance of a Change Order duly signed by the City and no claim for a change to the cost of this Contract shall be valid unless confirmed by a Change Order or amending agreement. A Change Order shall not be regarded as conferring an extension to the completion dates unless expressly stipulated" (CCGC Contract Form, 2021).

Contractors may be entitled to costs for drawings when they are instructed to resolve matters relating to clause 36.5, "Contamination and Hazardous Products" or section 6 "Changes to the Services", clause 6.4.

CCGC Contract Form:

"36.5. Any change in cost or schedule relating to the Field Work as a result of the unforeseen existence of Contamination will be valued in accordance with Section 6.

Where the CC knows or ought reasonably to know of any act, omission, or decision by the City or its agents which will result or may result in an increase to the cost of this Contract or impacts to the schedule for which the CC could be entitled to additional compensation" (CCGC Contract Form, 2021).

However, additional costs may be deemed within the contractor's inclusive price when the drawings are instructed in response to the contractor's request for greater detail or a change to suit their methods.

5.4 Extent of the contractor's 'inclusive' fixed price

Pricing terms may be flexible with ECI contracts. In parallel with design activities, the contractor is hired to offer preconstruction services. A fixed price incentive contract can be developed during the construction phase when the contractor offers a set price for the preconstruction services and successive target price adjustments for the project as the design develops. To have certainty before to or throughout project phases, clients typically select

this sort of contract. Hence, unless specifically permitted, claims for right to additional costs may not be accepted. Finnie stated three situations when the contract administrator may consider the extent of the contractor's inclusive fixed price:

- When there is no entitlement for instructions sufficiently. This could be considered as a contractor requesting further details.

- Instructions that are sufficiently different to allow for variation claims such as extra work, which is like contract work. This could be interpreted as a contractor requesting more information.

- Instructions completely outside the scope of the contract, which may be refused or performed for rates not specified in the contract. This could be interpreted as client-instructed scope changes.

Absolute responsibility is essentially inapplicable when unanticipated events render performance impossible or significantly alter the terms of the original contract. Hence, the agreement can be deemed dissolved, freeing the parties from any further responsibility. However, in ECI, the threshold for frustration is normally high due to joint planning, risk, and design reviews. Under the idea of restitution based on unjust enrichment, the contractor may be allowed to claim expenses for the work beyond the contract rates if an instruction was found to be a required remedy to prevent situations that would otherwise frustrate the contract. Restitution claims, however, are only legitimate in circumstances where there is no other available legal recourse (Finnie, 2021).

If the contract provides for such events, the work is completed within the scope of the contract. For example, locating, altering, or protecting latent utilities are not considered as a contract variation as mentioned in clause 39.1. Similarly, clause 7.1 at section 7 "Force

Majeure", treats any force majeure that imposes reasonably unforeseeable conditions as variations.

CCGC Contract Form:

"39. Utilities

39.1. If it is necessary to perform Field Work on or near any Utilities, the CC shall at its own expense support the Utility to maintain uninterrupted service. Any damage caused by the CC's operations must be made good at the CC's expense and the CC shall be liable for all claims against or by the City arising in any way from interference with the Utility by the CC" (CCGC Contract Form, 2021).

5.5 Responsibility to Warn

Contractors are required to notify clients about design flaws that would have been reasonably foreseeable to contractors. Early problem detection provides for fixes before costs rise. The following are a few examples of clauses that require the Contractor to notify the City in writing as soon as he learns of anything that could materially change the contract price or delay completion of the contract works or result in a violation of a legal obligation related to the contract works.

CCGC Contract Form:

"36. CONTAMINATION AND HAZARDOUS PRODUCTS

36.3. Before beginning Field Work, the CC shall also conduct an on-site Work Site review of existing materials and structures that might contain harmful substances, examples of which include asbestos, mould, lead, mercury, and poly chlorinated biphenyls (PCBs) and notify the City in writing of its findings. The City will then determine the appropriate course of action.

37. EMERGENCIES

37.2. The CC shall immediately notify the City in the event of any incident which causes, or had the potential to cause, serious injury or damage to a person or property at the Work Site.

39. UTILITIES

39.3. The CC shall notify the operator of any Utility affected by the Field Work not less than 48 hours prior to working on or near the Utility. The CC shall comply with all directions issued by the Utility operator in relation to the Utility.

39.5. The CC, shall at its own expense, notify all Utility operators and ensure that Utility lines are located prior to commencement of the Field Work" (CCGC Contract Form, 2021).

According to clause 15.3, any variation is computed on the assumption that the Contractor had notified of a matter that it should have, accounting for the impact being avoided or lessened, and the contractor shall be accountable for and shall fix any violations and shall bear all expenses.

CCGC Contract Form:

"15. APPLICABLE LAWS

15.3. For greater certainty, Section 15.2. does not apply to any Force Majeure situations, which shall be dealt with as outlined in Section 7. of these General Conditions. The CC shall notify the City in writing requesting direction immediately of any variance or changes that affect the Contract or the Services. If the CC fails to notify the City in writing to obtain direction and performs the Services contrary to the Applicable Laws, the CC shall be responsible for and shall correct any violations and shall bear all costs, expenses and damages attributable to its failure to comply with the Applicable Laws" (CCGC Contract Form, 2021).

The CCGC Form provides the opportunity to require contractors to warn of risks such as inconsistencies or inaccuracies in drawings, and constructability issues. Yet, the JCT PCSA specifically holds the contractor liable for managing errors and discrepancies in project documentation, including data provided to third parties.

5.6 Clarity of contract documents

The contractor may be entitled to repayment for its charges if the detail is provided to clear up any ambiguities in the original documents. The contra proferentem rule states that any ambiguities in a contract's written terms should be read against the party who gave them. The rule often applies to construction plans, specifications, and precise terms or exclusions rather than common phrases. However, with bargaining power and freedom to contractually agree on risk allocation, contra proferentem could be a last resort where ambiguity persists.

CCGC Contract Form:

"6. CHANGES TO THE SERVICES

6.4. Where the CC knows or ought reasonably to know of any act, omission, or decision by the City or its agents which will result or may result in an increase to the cost of this Contract or impacts to the schedule for which the CC could be entitled to additional compensation:

6.4.1 the CC must provide written notice to the City within ten Working Days of the act, omission, or decision and submit to the City a written proposal consistent with Section 6.3. requesting a Change Order;

6.4.2 the City shall consider and render a decision upon this proposal;

6.4.3 if the CC does not submit written notice within the aforementioned ten Working Days, the CC has waived its right to request a Change Order; and

6.4.4 in such cases as outlined in Section 6.4.3., the City shall not be required to issue any Change Order to compensate the CC, nor shall the City be liable to indemnify the CC for costs associated with the act, omission or decision.

6.6. Before any Change Order is issued, the CC shall present a written proposal consistent with

Section 6.3. within ten Working Days of being requested to do so by the City. The City shall consider and render a decision upon this proposal. If the City agrees with the proposal submitted by the CC, the City will issue a Change Order after deciding the extent of the schedule or cost impact, taking into account the written proposal from the CC. If the City does not agree to the change as proposed by the CC, no Change Order will be issued and any changes undertaken will be considered contrary to Section 6.2" (CCGC Contract Form, 2021).

5.7 Designer negligence for constructability

Designers have been found liable for their designs' lack of constructability on the grounds that designs should not rely on exceptional levels of craftsmanship to meet code requirements unless the level is specified and that the documentation quality should be sufficient to enable construction without further design changes. There is no proof that this alters the contractor's commercial obligations when proposing fixed-price construction contracts for client-supplied designs, even if it appears to be at odds with the strict accountability of the contractors.

One of the interviewees from the City stated that "*consultants tend not to upset their clients, however, contractors are not, however, a designer's plans should not require*

clarification, and should document how the construction work is to be undertaken so that code compliance is achieved".

The City is employing the services of the contractor at the design stages, however, the contractor is not incurring a strict liability for constructability unless a DB contract is formed where the full responsibility of the detailed design is transferred to the contractor with tendering fixed-price contracts, however, the City sets assumes the designer to be accountable for the design based on the reasonable standard that they expect of licensed registered designers.

Based on the aforementioned, contractors that enter into fixed-price contracts for designs provided by clients are nonetheless responsible for the expenses of design solutions they require. Separately, if a licensed designer's design is found to be negligent due to violations like insufficient research or poorly readable and detailed drawings, the City may hold them liable (and possibly force them to pay fees).

5.8 Payment and Pricing

In Canada, the most common approach to ECI price formation appears to be based on hourly rate schedule for ECI fees where a competitive selection or tender to select a contractor who would be involved after the completion of preliminary design (60%) as a construction consultant (CC) to assist in design and provide a predefined preconstruction service. The selected contractor based upon performance, would be given the exclusive opportunity to bid on the project as a general contractor through traditional project delivery method. This is different from approached identified by literature. Additionally, the contractor is not adopting an open book cost estimating to submit his bid for construction works which is one of the deviations from the models found through literature review. Moreover, target price is not employed in Canada model as well. In Canada mode, a cost consultant is employed to evaluate the contractor rates and prices which is not found through literature as well.

ECI could reduce industry tendering costs by reducing pointless duplication that develops when an open tender is employed, and numerous contractors are producing bid documents and cost estimates. To attract contractors who might not otherwise take part in a competitive procurement, ECI is used in competitive markets. Ma and Xin (2011) draw attention to the waste that results from numerous contractors spending their own money on research and design analysis in conventional tenders, even though they typically have a one-in-three chance of winning. Although this may bring value to the project, some interviewees drew attention to the fact that contractors frequently devote senior managers to ECI, which implies greater prices than their estimators' time in a single-stage tender.

From the designer’s perspective, ECI could have additional work to assess contractors' rates, which could lead to an increase in consultant costs for ECI. According to one interviewee, ECI's procurement prices may be greater due to the two-stage process and several reviews and recommendations. The interviewees agreed that ECI can increase pricing certainty through two stages of procurement to lower contract variations, but they also felt that contractors had a moral duty to limit variation claims after early involvement.

The cyclical market pressures facing the construction sector may be partially reduced by the transparency of ECI pricing. In competitive markets, contractors are more likely to keep their earnings by adopting ECI open book pricing as opposed to a competitive tender. In contrast, open book pricing generates more fair margins during a recession. Contractors cannot simply bury risk in their pricing in an open-book discussion, therefore more accurate pricing may be required. ECI lowers incorrect pricing assumptions (Mosey, 2011).

Like the CCGC model, Turner and Riding (2015, p. 181) as cited in Finnie, (2021) provide a contractor's perspective on best practices in which the service provider is engaged as a single-source basis and receives financial recognition for their involvement, regardless of whether their solution is accepted, and a long-term relationship is started. Finnie (2021) cites this work. 90% of the examination of proposals is based on the qualification criteria,

which determine the service provider's appointment. After passing through several clearly defined staged gates as the design develops, the service provider finally arrives at a fixed pricing lump sum that is verified by an outside estimator. Construction contracts with agreed lump sum payments are specified in the JCT PCSA and CCGC Form contracts.

5.9 Timing of Involvement

After the final completion of design packages, clients frequently agree to lump sum construction contracts. This may imply that ECI can deliver construction works in a timeframe that is comparable to or equal to that of a typical tender if construction started after final completion of design. As a result, even if the tendering phase may be shorter since it overlaps with the design stage, ECI timing may be comparable when the design is completed before construction. ECI, on the other hand, might prolong the design phase because of the discussions and meetings needed to get feedback, as well as the constant iterations to improve the design. Due to short deadlines, which also limit the time for negotiation, there could not be time privilege. As a result, CCGC has specific preconstruction milestones. According to Whitehead (2009), there is a risk when several contractors may explore or provide other possibilities and alternatives, which could disrupt the orderly progress of the design process. One of the interviewees claimed that ECI might lengthen the design phase for good reasons which would increase value and lower costs and potential problems in the future. As a result, ECI's strength may be observed in the phasing of critical construction works. As in the CCGC form, which emphasizes that the contractor must submit time-phased baseline budget estimates in accordance with the project work breakdown structure and detailed cost estimates (WBS).

“3.2.6. estimating Services, for which the CC shall:

3.2.6.1. be fully conversant with all aspects of construction cost estimating as well as the use of elemental cost analysis and value analysis and management techniques.

3.2.6.2. coordinate with the City to develop a performance monitoring baseline including:

3.2.6.2.1. finalizing Project work breakdown structure ("WBS") for all costs and schedules to be linked to.

3.2.6.2.2. establishing time-phased baseline budget estimates according to the WBS" (CCGC Contract Form, 2021).

According to interviewees from the City, appointment following concept design is consistent with research suggesting that contractors may have minimal participation during the early stages of design (Francis and Kiroff, 2015). They continued by saying that most of the contractor engagement should occur after the preliminary design competition once we have already talked and researched our options and chosen just one. This would mean that the contractor would have to stick to the plan that was decided upon in collaboration with the City and its consultant. Although the regulations require the contractor to submit their price and fees, which at the very least would need the execution of a concept and preliminary design which the interviewees estimated at 60% of the design completion, however, all none of the preconstruction services agreement specifies the timing of involvement for the contractor.

5.10Scope of Work for Preconstruction services

CCGC Form requires tenderers to provide a construction programme which, once agreed becomes a Contract Document (Clause 9.3.1). This is problematic because changes to the contractor's methods or sequence of works caused by the client or their consultant may result in a contract variation. This demonstrates the advantages of having a standardized PCSA form available for customers and consultants to alter and use on projects. By entering the Construction Contract, the Parties' powers, duties, rights, obligations, and responsibilities under this agreement, whether incurred or otherwise, shall terminate. For agreement with the client, the JCT PCSA and CCGC Form provide the client to direct changes to the scope of

work and require the contractor to promptly inform the effect of the instruction before starting.

The CCGC Form specifies by when the contractor must submit a complete and detailed cost estimate, related to the WBS and their time schedule within 15 working days after receipt of all documents for each Major Design Submission Milestone.

"3.2.6.3.1 within 15 Working Days after receipt of all documents for each Major Design Submission Milestone, provide a complete and detailed cost estimate, related to the WBS, with a written review of the documents. The cost estimate shall include a basis of estimate report describing all scope details and assumptions used to develop the estimate at the current stage of design, including supplier estimates" (CCGC Contract Form, 2021).

"3.2.7.2. within 15 Working Days after receipt of all documents for each Major Design Submission Milestone, provide a Project schedule" (CCGC Contract Form, 2021).

In Table 5, the pre-construction services are identified from the literature review. This demonstrates that the scope of ECI contracts and literature are generally consistent. CCGC Form has not analyzed design management as a service by the contractor.

5.11Services Liability and Design Obligations

Like manufacturers, contractors have an absolute duty to provide products that are fit for their intended use (Burrows et al., Finn et al. and Todd et al., 2012). Yet through ECI, the contractor initially offers pre-construction services, acting as a consultant might. The JCT PCSA thus calls for reasonable skill, care, and devotion. The NEC ECI Insurance clause requires the contractor to have insurance against lawsuits resulting from failing to "apply the skill and care generally employed by experts delivering services equivalent to those required in the Works Information". The design liability of the contractor is reduced by the CCGC Form to that of reasonable skill and care. This does not, however, address the contractor's

obligation to offer guidance on design constructability and value management. Except for injury or death, only JCT PCSA addresses the contractor's obligation for design until the construction contract is agreed upon, at which point those terms apply (Finnie, 2021).

"2.8 Where the Pre-Construction Services include design work, the Contractor shall unless otherwise specifically provide in Annex B have no liability of any kind to the Employer under this Agreement for that design work, whether in contract, negligence, breach of duty or otherwise (other than any personal injury or death arising from that work), unless and until the Main Contract is entered into by the Parties, upon entry into which the Contractor's obligations and liability in respect of that design work shall be the same as if it formed part of the design work undertaken by him under the Main Contract and shall be subject to any relevant exclusions or limitations of liability contained in that contract" (JCT PCSA as cited by Finnie, 2021).

The designer's perception of ECI is that it signals a move away from architect-led designs because they may feel intruded upon when design management is handled by another party (Whitehead, 2009). An example provided by Finnie (2021) for a contractor who described recommending an alternative basement design to avoid potential leaking. The contractor assumed that the architect and engineer had assumed responsibility for the design, so removing the requirement for professional indemnity insurance. But, when the basement began to leak, the contractor was threatened with legal action due to the weather-tightness guarantee included in the construction contract. In ECI - Contractors are concerned that by contributing to the design, they may assume design risk.

Unsurprisingly, as conceptual design is often completed prior to contractor involvement, the contractor's responsibilities typically focus on constructability assessment, services coordination, and detailed design input. this was emphasized by the ECI contracts, which placed more emphasis on design constructability and value management rather than design management as a pre-construction service. As a result, respondents identified collaboration

and design management as areas for ECI improvement. As one of the interviewees pointed out which aligns with findings of Tzortzopoulos and Cooper (2007), who discovered that contractors frequently lack design management abilities. Thus, CCGC Form does only transfer the responsibility and liabilities of design to the contractor only when DB is employed, however, at the preconstruction phase, the contractor is only assisting and making recommendations to the design process and the designer holds the sole responsibility of the design. However, interviewees hold the opinion that the contractor's input is extremely valuable to the design process, suggesting that designers or architects may not be able to effectively coordinate design development alone. ECI may help if contractors can provide these skills, and they claim that integrating efforts would be the best course of action. As a result, general contractors can see the chance to add an architect to their ECI team.

The JCT PCSA and CCGC Form contain provisions restricting assignment (Clause 6.3). The JCT PCSA requires a written consent from the client and contractor before any assignment, and the same applies for (Finnie, 2021) and CCGC Form.

"6.3. The CC shall not, without the prior written consent of the City, assign or transfer in any manner whatsoever any of the rights, liabilities, obligations, or benefits of the Contract" (CCGC Contract Form, 2021).

5.12Planning and Risk Management

The interviewees believed that ECI could enhance risk management. One of the interviewees mentioned that single-stage procurement may offer clearer risk distribution, but it might not be handled well. The fact that ECI gives more time to comprehend the project was a major advantage. In contrast, contractors who participate in single-stage procurement have only a few weeks to submit their bid for a project that includes hundreds of drawings that could influence cost. This is consistent with research showing that ECI can help parties recognize and handle risks more cooperatively, hence lowering expensive pricing assumptions (Mosey,

2011). In addition, interviewees believed that overall ECI should theoretically lower the quantity of variation claims, but that in practice this depends on elements including contractors' comprehension of the ECI process, the completeness and quality of documentation, and the clarity of ECI contract documents.

Ambiguities in contract documents are interpreted against the author under the legal doctrine known as contra proferentem. By ECI, contractors' capacity to anticipate and resolve problems can possibly increase and reduce claims, however, one interviewee believed that contractors had a moral obligation to refrain from making claims for minor design flaws after being involved with ECI. Thus, a contractor's early involvement could have a contractual impact on how foreseeably variations would occur. He continued by saying that ECI values fluctuate since the problem was fixed during the design phase. On reviewing contractor variation claims, he stated that one benefit of ECI is that it can consider the contractor's input during the design phase and whether they failed to mitigate a foreseen risk.

Early warning requirements are contained in the JCT PCSA. Any orders that could materially and negatively affect the project must be reported by the contractor, according to JCT PCSA (2.2.2). The contractor oversees controlling errors and inconsistencies in project documentation under clause 2.3, including informing their suppliers of errors and corrections (Finnie, 2021).

5.13Project Team and Relationships Building

According to the interviewees, a quantity surveyor was required to negotiate contractor rates and provide unbiased budget recommendations. But, when some experienced clients accept their take-offs without hiring a quantity surveyor, contractors could feel at ease. Also, respondents believe that ECI can speed up decision-making, which improves design decisions. Most agreed that trust was essential for effective ECI, confirming research that trust is a key component of relational procurement (Rahman and Alhassan; 2012; Rahman

and Kumaraswamy, 2005). As a result, ECI mandates open book accounting between the client, consultant, and contractor.

5.14Retaining Key Personnel and Assignment

The client may experience severe difficulties because of ending the relationship with the contractor and the resulting knowledge loss. As a result, keeping key employees on board and limiting assignment are crucial components of ECI contracts (Ma and Xin, 2011, p. 83 as cited by Finnie, 2021). The following summarizes the ECI document provisions in CCGC Form and JCT PCSA:

JCT PCSA:

"2.1 The Contractor shall perform the Preconstruction Services in accordance with the Employer's Requirements, the Statutory Requirements, and the Programme and with due regard to the Cost Plan and any Third-Party Agreements" (CCGC Contract Form, 2021).

"2.1.2 ensure that, unless otherwise agreed with the Employer, Contractor's Key Personnel shall fulfil their identified roles and that they and the Contract's Representative (or competent deputies) are at all reasonable times available for communication and consultation with the Employer and Project Team; and.3 duly consult with members of his supply chain and, at the Employer's request, endeavour so far as practicable to ensure the attendance at relevant Project meetings of those suppliers whose attendance is necessary or desirable" (CCGC Contract Form, 2021).

"4.2.1 The Contractor shall not remove the Contractor's Representative or any of the Contractor's Key Personnel from their post or replace such person without the Employer's prior approval of the removal or of the replacement appointee. Where practicable, the Contractor shall arrange an appropriate handover period. The Employer shall not unreasonably withhold or delay his approval" (CCGC Contract Form, 2021).

“2 If the Contractor’s Representative or any of the Contractor’s Key Personnel ceases for any reason to hold their post, the Contractor shall, subject to such approval, promptly appoint a replacement” (CCGC Contract Form, 2021).

“4.3 After consultation with the Contractor, the Employer may require the removal of the Contractor’s Representative, of any of the Contractor’s Key Personnel or any other person engaged in the Pre-Construction Services if, in the Employer’s reasonable opinion, their performance or conduct is or has been unsatisfactory” (CCGC Contract Form, 2021).

CCGC Form:

Under section 13 “Subcontractors and subconsultants” in CCGC Form:

“The CC shall not change any Subcontractor or Subconsultant without the prior written approval of the City” (CCGC Contract Form, 2021).

Moreover, under section 14 “personnel changes”, it required from the contractor to retain or minimizes the changes of its key personnel:

“14.1. The CC shall use all reasonable efforts to minimize the possibilities of changes in its Key Individuals” (CCGC Contract Form, 2021).

5.15 Client Obligations

Legislation and common law impose implied obligations on clients. Clients normally need to cooperate and not cause any obstacles. JCT PCSA requires the client to, as soon as practically practical after being notified by the contractor, swiftly correct any delay or obstruction to the contractor caused by a delay or default by the project team (clause 3.3). Also, the client must notify of any updates, changes, or corrections to the information being provided (clause 3.1). Also, the client must give decisions, approvals, and directions in a

timely manner (clause 3.2). However, such obligations were not clear in CCGC Form, rather they were embedded with the clauses.

"1.8. The CC will be working with the City and the Design Consultant to develop the best value design and construction approach" (CCGC Contract Form, 2021).

5.16Payments, suspension, and Termination

Contractors may feel more at ease when a single contractor is engaged and paid regardless of whether their solution is accepted, and a long-term relationship is initiated. Some contractors, however, may not charge for their early involvement as a means of negotiating the project with the client. Furthermore, contractors may see ECI as having the potential to lower overall procurement costs across the industry because only the successful stage 1 contractor prices the construction works. Additionally, contractors might incur higher costs for stage 1 as they might have thought, therefore, CCGC pays the CC contractor on hourly rate.

The client is given the option not to sign a construction contract in the CCGC Form. The JCT PCSA specifically permits the client to give notice and terminate the contractor's employment at any time. Only the JCT PCSA, however, addresses payment if a construction contract is not reached. The contractor is paid hourly according to the CCGC Form. As he is paid even if the contract is terminated, this relieves the contractor of having to waste resources. When a contractor is terminated under the JCT PCSA (10.6), they are also entitled to a portion of their ECI fee back (Finnie, 2021). However, if the contractor is terminated due to insolvency or a breach (10.6.2.3), the client is entitled to deduct the reasonable costs associated with hiring a replacement contractor. The JCT PCSA and CCGC Form enable the client to suspend and recommence the works and even terminate their own employment for continued suspension or non-payment.

5.17Privacy and Intellectual Property

If confidentiality clauses are not present, the clients and contractors may be at risk of exposing commercially sensitive information. JCT and CCGC Form permit the use of the contractor's information by the client (Finnie, 2021). However, CCGC provides exclusive ownership of intellectual property to the client.

JCT PCSA:

"(*8.3) The Employer's consent shall be required to any publication relating to the Project but shall not be unreasonably withheld (8.2)" (JCT PCSA as cited by Finnie, 2021).*

CCGC Form*:*

"20.1. The CC agrees that all base materials, research results, computer programs, drawings, documents and notes or materials of any type whatsoever developed or prepared by the CC or any Subcontractor or Subconsultant in performance of the CC's services under this Contract (the "Documents") shall vest in and become the absolute property of the City, including assignment of all copyright. The CC agrees that this transfer of property and assignment of copyright applies to the Documents notwithstanding that the Documents may contain wording to the contrary" (CCGC Contract Form, 2021)

5.18Insurances

Contractors mostly supply services during ECI, necessitating professional indemnity for misconduct. However, some interviewees brought up the possibility that contractors might conduct more thorough exploratory work than just one-stage procurement, which might necessitate public liability insurance. It is a requirement of the CCGC Form (section 12: clause 12.1.1), JCT, and NEC ECI contracts that the contractor carry public liability and professional indemnity insurances. Beyond the construction phase, professional indemnity

must be maintained, according to the JCT PCSA. The contractor is required under JCT PCSA (7.1) to use "reputable insurance". According to JCT PCSA 7.3, parties (Employer and Contractor) must talk about how to "defend their respective positions" if the insurance is no longer offered at prices that are commercially reasonable (Finnie, 2021).

5.19 Disputes

The JCT PCSA, NEC ECI, and CCGC Form do not restrict access to courts through requiring alternative dispute resolution (Finnie, 2021). This gives the opportunity for continuous learning and improvement from public court judgements about ECI standard contracts.

5.20 Summary of Contractual Risks

In Canada, the City has developed its own contract form with the assistance of attorney which implies that there is no apparent standard form of ECI contract according to the interview results. The City approach for ECI in Canada appears to be involving a general contractor as a construction consultant (CC), who is involved after the completion of preliminary design with pricing based on hourly rate as a consultancy fees and fixed price lump sum for the construction works. Open book cost estimates are not performed in the City model, however, an open book negotiation may be involved if the CC price was not within the range specified at the contract ranging from 8 to 15%.

5.21 Discussion

This chapter demonstrated the elements of ECI implementation including payment, incentives mechanism, approaches used to ECI with different perspectives: clients and contractors. Barriers of ECI implementation by public clients were discussed to demonstrate its applicability to public projects.

6. Chapter 6 - Conclusion

6.1 Thesis Summary

The cause of disputes in the construction industry has been the subject of extensive study. Contract documentation, scope changes, and unfavorable behavioral adaptations of individuals continue to be prevalent in the construction industry, despite calls for improving performance through adopting principles and techniques linked to lean production and supply chain management. Clients should be able to choose the procurement option that best suits their demands if they know their extent. Constructability can be increased, and the likelihood of design changes can be decreased by mandating contractor participation during the design phase. The possibility of scope modifications increases when there is scope uncertainty and no contractor input during design. Scope changes may raise project costs and time and cause claims and disputes. Omission errors occur in contract documents and may only be discovered after construction. Uncertainty-related issues may have yet to be addressed during planning. The time it takes to fix the issue can slow down work or pall for a redesign, which would justify a request for more money or an extension of the deadline.

The organization should consider all influencing factors such as project scope, contractual conditions, particularly the allocation of risk and responsibility, and procurement strategy that can influence the organization's planning, resourcing, and ability to achieve project outcomes. The client's requirements should be examined to assess and define the delivery value. Disputes are dynamic that can evolve contextually over time. This paper has attempted to identify recurring conditions leading to disputes and suggest prevention strategies. Finally, the Literature lacks studies that quantify the causes of disputes in IPD and any relevant statistical studies that would promote IPD performance against the reduction, avoidance, and prevention of disputes.

When compared to a design-build fixed-price contract, ECI entails several changes. The tender is evaluated primarily on non-price criteria, with price being only a minor component of the evaluation basis. Moreover, the contractor and the client develop collaboratively the design, cost estimates and arriving at a target price. Once in Phase 2, the contractor uses open book accounting to provide the client with a complete picture of their economy. In Phase 2, the client and contractor continue to collaborate, encouraging everyone involved to work towards the project's common goals. To avoid introducing self-interest, commercial arrangements must support these objectives. The differences in ECI affect several business model components, and because all components are interdependent, these affect surrounding components.

This thesis intends to explore several approaches of early contractor involvement (ECI) as a project delivery method which can be an effective mitigation strategy for the causes of disputes in the construction industry. In turn, the productivity and quality of deliverables are fostered. The study illustrated that ECI could be tailored in different ways to apply to public projects where competition and open tendering must be maintained. Various payment mechanisms have been discussed with several global approaches applied in countries such as the UK, US, New Zealand, Australia, etc. It is concluded that different payment mechanisms can affect cost and performance of projects. These mechanisms would have different implications on risks and liabilities that may impose or alleviate causes of conflicts and disputes. The following could be established from the research findings:

- No one definite rule for a procurement or contractual routes.
- The profit from ECI projects is lower than in successful fixed-price contracts.
- ECI can be implemented by a range of approaches, including traditional DBB, DB, management contracting, project partnering, and project alliancing.

- The ECI contract can involve one contractor for the two ECI stages, or it may involve more than one contractor for each stage.

- The ECI demonstrated the ability to mitigate various types of claims, such as design, liability, scope, time extension, and termination claims.

- When ECI is applied by involving one contractor, it reduces tendering costs as no cost estimates are required, eventually reducing non-adding activities. Moreover, it removes the duplication of multiple contractors' bidding.

- The profit from ECI projects is lower than in successful fixed-price contracts.

6.2 Take home messages

Policy makers:

- Any additional cost is agreed upon upfront before the construction phase, which implies that all information is published before the project starts, emphasizing transparency and conveying a better image rather than just over-promising and underdelivering.

- Involving qualified contractors very highly can leverage the sustainability of the projects, reduce maintenance and operating costs, and protect the environment. This entails that the money is being invested efficiently and transparently.

Public taxpayers:

- ECI involves agreeing on the costs of the projects collaboratively after addressing the causes that lead to cost and time overruns, which entitles that money is invested for the highest value in return, with all project information being published ahead of the construction works, ensuring transparency.

Client:

- Investing 10% additional cost for minimal surprises and high certainty of construction cost and time should be a priority, which entitles the benefits derived from ECI application.

- If the authenticity of the cost consultant estimate is not high enough to account for any unforeseen circumstances, construction methods, limitations, and site conditions, it might not be feasible to compare it with a cost estimate from a highly qualified contractor. This may result either in the contractor's termination, withdrawal, or reduction of price, jeopardizing the quality of construction works and causing ECI to lose its mission.

Contractor:

- Investing personnel in the ECI phase can be significant in building and maintaining relationships with the client and other stakeholders.

- ECI requires innovation, which is one of the goals that led the client to employ such a delivery method. Therefore, contractors should not tend to gear the design into ideas and alternatives, which the contractor is used to; however, demonstrating innovative ideas can strengthen the relationship with the client and expand your exposure to more projects.

Designer:

- The feedback received from the contractor could leverage and increase the designer's expertise in construction ability, cost control, and value engineering, which can also increase the design's authenticity and reputation.

- Having a contractor as a construction consultant on board with the designer's resources might alleviate the burden of an incomplete or ambiguous design that lacks constructability and affordability, eventually reducing the designer's risk of design liabilities.

6.3 Contributions

During this research, the following were accomplished:

- This study illustrates several ECI pathways and their implications on cost, pricing, and claim entitlement. The study helps construction practitioners to design their own ECI approach that fits their needs.

- ECI is not needed to get rid of competition, but it might not be easy to apply fairness and equity to all contractors. However, ECI can be tailored so it can be applied for public project procurement.

- In Canada, there is no clear written terms for early contractor involvement. The City of Edmonton have prepared their own preconstruction services contract. Typically, the contract covers liability, the scope of services, advance notice, good faith, professional indemnity insurance, intellectual property, termination, suspension, and dispute settlement.

- When deciding whether to use ECI, the main reasons are securing resources in markets, keeping good relationships with clients and contractors, planning construction logistics around ongoing operations, or giving specific advice on design constructability and value management.

- ECI is most suitable for complex large projects where the cost of disruption could be more expensive than any extra cost paid for better planning and reliability.

- There is a lack of clarity in the interpretation of construction contract obligations regarding contractor entitlement to claim for design-related difficulties and the impact of early involvement on contractor entitlement to claim.

- There is little knowledge among construction professionals about standard PCSAs and consequently any associated risks and obligations.

- Liabilities of design responsibilities, designer negligence, and potential sources of claims are affected differently depending on whether management contracting or construction management is used.

6.4 Key Challenges in ECI application

- The absence of defined contractual procedures and pre-construction contract documentation results in ambiguous commitments and expectations.
- A scarcity of genuine high-quality pre-construction services.
- Increased risk transfer to contractors via revised contract terms and performance-based specifications.
- Declining design documentation quality, possibly related to design coordination capability.
- Client and consultant reluctance; perceived lack of competitive tensions; and difficulty measuring added value.

6.5 Potential opportunities to improve ECI

- Standardizing pre-construction agreements with pre-construction milestones, a more precise description of duties and expectations, and flexibility to accommodate different project types and client preferences.
- Adopting alternative solutions suggested by contractors could lead to one area of possible dispute. Contractors might experience ambiguity regarding their obligations and insurance needs.
- Educating clients and consultants about the best project types for ECI, expectations for and timing of contractor involvement, how to use the contractor to reduce project risk through

exploratory work, and how to ensure that designs are complete at the time of agreeing on a fixed lump sum construction contract.

- Contractors are gaining specialized ECI abilities, particularly in coordination, value management, and design constructability.

- Conducting informal ECI on large, complex projects could put the parties in a position of more significant ambiguity regarding what happens if the project is not put into action, what performance by contractors qualifies as sufficient, and who is held accountable for projects that run over budget, are delivered late, or have issues with the design documentation or performance. Because of this, evaluating ECI's success is challenging, and its reputation as a procurement pathway is at stake. Thus, compensating the contractor for their early involvement is a crucial factor. The parties may agree that no payment is made unless the construction contract is not agreed upon, despite the contractor's fault. However, if the project does move forward, the contractor's Preliminary & General costs (P&G) are assumed to include their ECI charge.

- Other topics to research include negotiating subcontractor terms and conditions, the best way to incorporate subcontractors through ECI, and P&G expenses on significant projects.

6.6 Recommendations

Conflict management is a crucial factor contributing to the project's success. Without proper dispute and conflict management, plans would create adverse relationships that undermine trust and collaboration. Therefore, a proper ahead plan for conflicts that foster a healthy environment is essential. The study identified the causes of conflicts, their contextual environment, and how they are managed.

ECI is a project delivery method which can bridge the design and construction process and remove the segregation and fragmentation among these processes. Thus, the stakeholders

should be educated enough for the proper implementation of the ECI process. Moreover, ECI should be considered for large complex projects where early contractor involvement is brough into the design phase to reduce uncertainties caused by the design errors which might entail conflicts and disputes is not properly managed. With such complexity, highly qualified contractors are needed which entails that the qualification criteria have higher weighted compared with price criterion otherwise ECI would lose its effectiveness.

The contractor should be paid for the services during open-book negotiation to avoid intellectual property issues if the contract is not awarded. This would mitigate any scope claims that might erupt due to ambiguity of intellectual property. Moreover, the contractors must fairly compensated, so that they would not focus on moving quickly to phase 2 without the proper completion of the phase 1. Clients should not base the contractors' contributions in phase 1 on the achievement of Phase 2. The compensation of the contractor for their preconstruction services should consider the contractor's business model which does not rely on hourly reimbursement of their employees and workers. Moreover, getting reimbursed as a consultant at an hourly rate can lead the contractor to increase the scope of the project. Thus, the clients must establish reimbursement models that best suit contractor's business model. A fixed fee with bonuses may be believed to better prevent opportunistic behaviors than pain/gain share connected to the target price. Using a fixed contractor fee would not affect the contractor's compensation if reduced project costs occurred due to innovations (Mosey, 2009).

With the increasing complexity of the project, negotiations, and workshops to discuss project details and design implication might prolong phase 1 of the ECI. This would bind valuable resources of contractor without having profit-generating production activities which might lead to loss of the contractor's interest. Thus, phase 1 must be short as possible in a way that the clients may consider or splitting Phase 1 and Phase 2 into sub-phases with different target prices for each sub-phase. Moreover, the clients should start time critical

works before the target price is completed. However, since the contractor would not be able to beat against those excluded work packages which has been started before the final completion of target price, any cost savings generated though innovation would be perceived as if it was achieved in Phase 2 and got an impact on the pain/gain share incentive. This would lead the contractor to focus on creating innovative ideas to reduce cost rather than increasing his profit through the increase of the target price. Such subdivision of the projects into work packages would ease the development process of target price at early stage which would provide a better cash-flow, and less time spent in Phase 1. Before the project is completed, the client can determine how accurate the initial estimates were, thereby gaining insight into the contractor's performance. Finally, procuring the right competent contractor at the first place, is the best mitigation against poor performance.

6.7 Recommendations for Future Research

Construction includes complex relationships that may surpass the project level. A project team has interrelationships at the project level and may come from different disciplines and organizations to execute a project. The current study was limited to internal conflicts among the project parties. The current investigation was limited to internal conflicts among project participants. As a result, future research can concentrate on external conflicts that arise between the project team and its supra-systems. Furthermore, personal conflicts that occur at the individual level should be investigated to determine their effects at the project level. Another suggestion is to conduct a comparison study for the contractual risks in different contracts to analyze the ECI aspect in each contract and its associated implications on the occurrence and performance of disputes. Furthermore, a research study is required to measure the potential benefits of ECI, which would help in assessing the effects of ECI on project performance, dispute occurrence, and overall project cost. Additionally, all the previous would add to the preparation of the pre-construction services contract for contractor involvement before the construction contract is formed. This pre-construction contract could

be adapted to work with all contract types used for the construction phase. Further research can explore the subcontractors' perceptions about the optimal contractual mechanism for involving them during the design stage when construction management route is employed where no general contractor exists. This entails that the Subcontractors' design obligations and liabilities could be studied and analyzed in ECI. Finally, to help validate the interview findings by gathering the opinions of the expert sample population on all concepts raised within the interview sample, a survey questionnaire might be distributed to all interviewees (as an expert sample).

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Appendix A

Semi-structured Interview

Introduction

This semi-structured interview explores the use and perceptions of early contractor involvement in the reduction of disputes. The questions are based on findings from literature review. Early contractor involvement is defined as a procurement process where the entity responsible for planning and managing construction is employed to provide pre-construction services during the design stage, and to deliver the construction works.

Invitation: You are invited to participate in the study being done by Ahmed Attia at the University of Alberta's Hole School of Construction Engineering to meet the requirements for the Master of Science degree. Dr. Farook Hamzeh has overseen this work (Associate Professor, Hole School of Construction Engineering, Faculty Associate, Nasseri School of Building Science & Engineering, Advanced Construction Technologies, and Integrated Building Design). Please get in touch with Dr. Farook Hamzeh through email at hamzeh@ualberta.ca and MSc student Ahmed Attia via email at aabdelaz@ualberta.ca if you have any questions regarding how this research is being conducted. Please continue if you accept to take part in this study:

Purpose of the Study: To reduce disputes in the industry, it is important to identify the root causes of disagreements in the field of construction engineering and evaluate ECI as a procurement strategy. For the sake of maintaining confidentiality, the interview's findings would be kept private. Hence, any information that could be used to identify any of the practitioners or interviewees would not be made public. Everyone who completes the interview receives an email with a summary of the results.

Rights of the Participant: You are free to accept or decline this request to take part in this study. If you want to take part, you have the choice to at any moment reject to answer any questions or to ask any questions you may have regarding the study.

Section 1: Collects information on the interviewees and their organizations:

Name?

Company?

Role?

No of years' experience?

Section 2: Collects data relating to the number, type and scope of projects procured through ECI that the interviewees have been involved in:

Number of projects procured through ECI?

Types (residential, commercial, industrial)?

Range of value?

Section 3: Collects data relating to issues identified from the literature, ECI pathways and risk allocation framework (e.g.., timing of contractor involvement preconstruction services offered, whether contractor paid for early-involvement, form of pricing, procedures for early-termination, ownership of intellectual property, obligations, and liabilities):

Do you consider ECI as a contract reform or project delivery method, or others?

When the contractor or consultant should be involved?

What pre-construction services should be provided?

- planning and sequencing
- Constructability
- Risk mitigation
- value management
- Subcontractor procurement
- Design management
- Liaison with local authorities
- Document or software control (including BIM)

What services were provided by the client's PM?

How was the service provider employed for the pre-construction stage: (lump sum, declared margins on subcontractors and variations, rates for direct works, cost reimbursement)?
Should the service provider be paid for their pre-construction services?
What was the form of pricing for the construction stage (lump sum, cost reimbursement with or without target value or GMP)?
Were contractual risks considered at the pre-construction stage?
Can you compare how managing issues differs between the entity being employed through a contract for works and contract for services?
How clear were contract obligations clear, i.e., absolute liability or reasonable skill and care?
What challenges does the use of target cost principles and economic incentives create in ECI-projects?
Should the profit be based on the target cost or on something else?
What are the challenges or risks that might accompany a long first stage of an ECI, how to make it short?
What are the implications of “go/no go” exit clause, please elaborate? Would this work as an incentivizing towards innovation?
Do you think go/no go clause is beneficial? How to enforce?
Do you think target should have margins of tolerance up or down, how much in percent?
Does ECI affect the contract price and profit? Please elaborate?
What is the effect of ECI on project completion compared with traditional tendering?
What are the challenges in ECI implementation which might cause disputes or disruption?
Do you think ECI can affect the transaction costs: the costs of information gathering, attending meetings, training, site visits, decision-making, conflict resolution, verifying compliances?
Do you think ECI can affect the clarity of documentation and specifications?
Please identify common not specific factors that constitute breach of obligations by the contractor (e.g., no agreement about construction price)?

Do you think ECI lacks standardization and if so, what can be done as improvement?

Can ECI be applicable with FIDIC contracts?

What are the typical pre-contraction services that the contractor should provide at design phase?

What can be done to improve the quality of pre-construction services?

Does ECI derive innovation to the development of new products and material which has influence on the quality and performance of the industry?

What are the impacts of ECI on reducing variation claims and change orders?

Who does assume the liability of the design in ECI arrangement?

Who is best suitable to manage the design: designer, contractor, client's project manager, or else?

Who is best suitable to administer the contract during design and construction phases designer, contractor, client's project manager, or else?

What are the selection criteria of ECI contractor?

Do you think ECI can lead to form qualified management team?

How ECI can affect RFI and inconsistencies of design documentations and specifications?

Does the use of ECI can deepen trust between project parties and can develop trust from the calculus-based level to more advanced levels?

ECI effect on ineffective collaboration between procurement and engineering?

How ECI can provide sufficient bidding duration?

Can ECI be adapted with notion of lowest bidder?

ECI can avoid submission of non-compliant bid?

Does ECI impede fair risk allocation? Risk sharing?

How ECI can control expectations of stakeholders?

What are the procedures that the client can do for early termination?

What are the issues concerning the intellectual property rights for early involvement during design phase?

Who does own the intellectual property of design is a breach occurs from both client and contractor?
How the inclusion of general contractor or a consultant might affect the disputes resolution?
The implementation of “announcing the project with alternative technical solutions” approach may entail some legal barriers, is that valid?

Section 4: Collects data relating to perceptions of risk and pricing (clarity of recourse for performance breach, pricing transparency, control over design decision-making, effect on time, cost, quality, most suitable project type)

Which do you prefer for the fee of target price contracting, if adopted: a percentage of the actual costs or an agreed fixed sum?
What is the effect of ECI on price certainty?
Overall project cost: Transaction cost theory:
Information cost (information gathering)?
Project procurement cost (attending meetings, translation of client’s needs, training, project preliminary design, transition observation, site visits)?
Administration cost (contract administration, decision-making, conflict resolution)?
Enforcement cost (contract enforcement, verifying compliances)?
What the effect of ECI on design decision-making, composition of the project team, and quality of relationships?
What is the best suited project type for ECI?
What are the main barriers to use of ECI?
What key contractual risks should be considered at the pre-construction stage?
What could be done to improve the use of ECI?
Do you think bonds with their all kinds: bid, payment, and performance bonds, can align with ECI concept?

From your perspective, what is the reasonable percentage fee which the contractor should charge?

Section 5: Collects data relating to a typical construction project (e.g., facility type, complexity, location, cost, timescale, procurement method: contractor or consultant, reason for using ECI).

Facility type?

Complexity (simply/ moderate/ complex)?

Location?

Cost?

Time scale (less than one year/ approx. years)?

Reason for using ECI?

Was the contractor responsible for DB or construction only?

Did the general contractor subcontract all work packages?

Appendix B

Causation of construction conflicts and disputes

Table 9: Causation of construction conflicts as adopted by Cheung, S-O., and Yiu, T. (2006)

Causes of Disputes	**Author**
Payment, performance, delay, negligence, quality, and administration as headings of construction disputes.	Conlin *et al.* (1996)
Management, Culture, Communications, Design, Economics, Tendering Pressure, Law, Unrealistic Expectations, Contracts, Workmanship.	Rhys Jones (1994)
The incompatibility of interests, needs, or goals.	Tillet (1991)
Dispute can be viewed as a class or kind of conflict that require resolution.	Brown (1999)
The opposition of interests, values, or objectives.	Hellard (1987)
People, process, and product. When a contractor withheld a piece of information from the client or the engineer which may be due to ignorance or inefficiency of the engineer.	Diekman et al. (1994)
Dispute is linked with difference in perspectives, interests, and one's agenda	Spittler (1992)
Dispute is the formation of a position to maintain in conflict.	Mururu (1991)
Dispute requires resolution and is associated with distinct justifiable issues.	Fenn (1997)

Disputes are due to unrealistic expectation, lack of team spirit and misunderstandings.	Bristow and Sykes (1995)
Change of scope, change conditions, delay, disruption, acceleration, and termination.	Hewit (1991)
Determination of the agreement, Payment related, the site and execution of work, Time related, Final certificate and final payment, Tort related.	Watts and Scrivener (1992)
Contract terms, payments, variations, extensions of time, nomination, re-nomination, availability of information.	Heath *et al. (*1994)
Site overhead, loss of productivity, loss of revenue, and financing costs are the main types of construction dispute.	Semple (1994)
Variation due to site conditions, variations due to client changes, variations due to design errors, unforeseen ground conditions, ambiguities in contract documents, variations due to external events, interferences with utility lines, exceptional inclement weather, delayed design information, delayed site possession.	Kumaraswamy (1997)
A contractual reference is required for technical, legal, and managerial dispute issues.	Totterdill (1991)
Project uncertainty, Contract, working relations and problem-solving effectiveness, environmental and behavioral" factors	Mitropoulos (2001)
Construction contracts, unpredictable events, uncertainties, contradicting provisions	Sykes (1996)
Valuation of variations, valuation of final account, and failure to comply with payment provisions are the major subject matters of dispute in adjudication.	Sheridan (2003)

Project uncertainty, contractual problem, and opportunistic behavior	Mitropoulos & Howell (2001)
Variations, ambiguities in contract documents, inclement weather, late issue of design information/drawings, delayed possession of site, delay by other contractors employed by the client (e.g., utility companies), postponement of part of the project.	Yate (1998)
Time and cost overruns, skills, coping and risks, lack of up-front planning, incomplete design, incorrect or uncoordinated documentation, Poor project management, Changes to scope, authority approvals, variations to scope, contract interpretation, EOT claims, site conditions, late, incomplete, or sub-standing information, obtaining approvals, site access, quality of design, and availability of resources.	Waldron and Dawson (2006)
Client changes after the formulation and signage of the contact, differing site conditions, and inefficiency or unfulfilling of duties by the engineer	Onyango (1993)
Disputes involving payment, delay, defect/quality and professional negligence, variation, delay in work progress, parties' expectations and intraparties' problem were the significant types of dispute source.	Brooker (2002)
Scope changes, weather, and limited access to the works.	Semple, Hartman, and Jergeas (1994)
Errors or omissions in the process of contract documentation, errors in the cost estimators of the initial commitment, changes in conditions, and reactions of clients and/or stakeholders	Vo, Khoa & Nguyen, Phong, Nguyễn, Quyên (2020)
Procurement methods, differing risk allocation	Cheung and Yiu (2006)

Project uncertainty due to risk allocation	Cole (2003)
The use of one of the five disclaimer clauses including uncertainty of work, conditions, delaying events, indemnification, liquidated damages, and sufficiency of contract documents, becomes a general industry practice.	Jergeas et al. (1994)
Human behavior is one of the sources of disputes which might be derived from poor negotiation skills, which may occur when parties are not well prepared for negotiations, or many issues are discussed simultaneously.	Cheung & Yiu (2004)
The inefficiency of the cooperation between the client and the contractor which is represented when the client is not satisfied with the contractor progress, thus, he may not be willing to pay additional costs.	Fadhlullah Ng, Ismail, & Hashim (2019)
Errors are based on practices from people attempting to solve a particular problem. Designers' decision to forego audits, checks, verifications, and reviews before releasing pricing or construction documentation. Despite the significance of such activities, this practice has become the norm due to the financial and time constraints imposed on design firms by their clients.	Love et al. (2008)
Delay in delivery, increased project cost, reduced productivity, loss of profit, or damaged professional or business relationship	Love, Davis, London, & Jasper (2008)
The lack of integration of design and construction is not a matter of incorporating process tools to streamline the processes; however, it is about the efficacy of relationships between individuals within such organizations	Emmitt and Gorse (2006)

These latent conditions fall in one of the categories: Practice – arising from people's deliberate practices, Task – arising from the nature of the task being performed, Circumstance – arising from the situation or environment the project was operating in, Organization – arising from organizational structure or operation, System – arising from an organizational system, Industry – arising from the structural property of the industry; and Tool – arising from the technical characteristic of the tool.	Busby and Hughes (2004)
The inconsistency of value management implementation a tool to aid the briefing process should be integrated as part of professional design management. This integration should be established through the interpersonal communications among the project participants.	Kelly et al. (2003)
Value opportunities are to be best applied early in the design process.	Kelly & Male (1993)
Professional service firms do not share values within the organization and fail to adequately discuss values with clients early in the appointment process.	Maister (1993, 2000)
Contract changes by clients, different site conditions, poor site management, slow paced decision making.	Chan and Kumaraswamy (1997)
Overspending the budget, increasing the cost of payments, untimely or late payments by the client, changes in the number of project days, the settlement of debts, design changes	Cheung and Suen (2002)
Disputes are categorized into either contractual or speculative. The causes of disputes are due to Contract Incompleteness, people factor, and task factor. These three categories include 46 dispute artifacts	Cheung, & Yan Pang (2013)

Table 10: Common causes of disputes by categories as adopted by Cakmak and Pinar (2014).

Category of Disputes	**Causes of Disputes**
Client related	Variations initiated by the client
	Change of scope
	Late giving of possession
	Acceleration
	Unrealistic expectations
	Payment delays
Contractor related	Delays in work progress
	Time extensions
	Financial failure of the contractor
	Technical inadequacy of the contractor
	Tendering
	Quality of works
Design related	Design errors
	Inadequate / incomplete specifications
	Quality of design
	Availability of information
Contract related	Ambiguities in contract documents
	Different interpretations of the contract provisions
	Risk allocation
	Other contractual problems
Human behavior related	Adversarial / controversial culture
	Lack of communication

	Lack of team spirit
Project related	Site conditions
	Unforeseen changes
External factors	Weather
	Legal and economic factors
	Fragmented structure of the sector

Table 11: Summary of causes of conflicts identified from literature review as adopted by Kumaraswamy, (1997).

Common Root Causes	**Causes generated by themselves**	**Common Proximate Causes**	**Claims**
Adversarial (industry) culture	Poor communication	Inaccurate design information	Interference with utility lines
Unfair risk allocation	Lack of competence of project participants	Inappropriate contractor selection	Delayed design information
Unclear risk allocation	Lack of professionalism of project participants	Inadequate design documentation	Delayed site possession
Inappropriate contract type	Inadequate brief	Inadequate contract documents	Ambiguities in contract documents

Vested interest	Inappropriate payment modalities	Acceleration of work	Acceleration Claim
Unrealistic tender pricing	Unrealistic information expectations	Inadequate contract administration	Unforeseen ground conditions
Uncontrollable external events	Personality clashes	Incomplete tender information	Exceptionally inclement weather
Unrealistic time / cost /quality targets (by the client)	Clients' lack of information or decisiveness	Internal conflicts (eg. In joint ventures)	Variations
Changes by the client	Inappropriate contract form	Suspension of work	
Estimating errors	Substantial increase in quantities		
Others, work errors	Price fluctuations (escalations)		

Appendix C

Traditional & Collaborative Agreements

- **Traditional Contracting**

In this approach, the general contractor is tendered on a lump sum basis. The contractor is employed after the design is fully complete. The general contractor subcontracts some work packages. The contractor in this route assumes full responsibility for the construction works. Moreover, the contractor is responsible for the subcontractors' submittals and performance. The client prefers this route since it presents one single point of accountability; thus, the client can claim for general or liquidated damages, and the contractor must remedy any quality defects at their cost. However, the design must be complete since a lump sum for the construction is required before the construction commences, implying that the contractor is not involved in the design. Due to competitive bidding, the contractor tends to submit a lower price, which might be less than the construction cost, to win the bid. Therefore, the contractor may look for opportunities to claim variations.

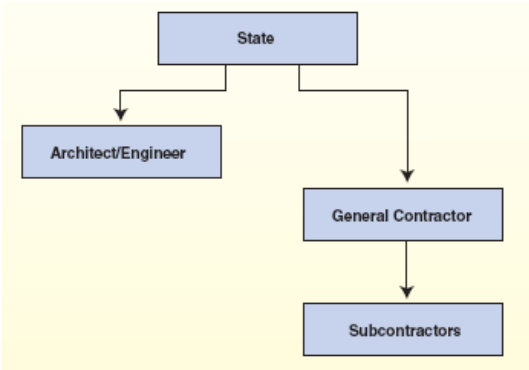

Figure 20: Traditional contracting model as adopted by Paul Guyer (February 3, 2005)

- **Design and Build**

The general contractor is responsible for both design and construction under this route. The design and build contractor may either be responsible for fully developing the design from the client's brief or from a preliminary design already developed by the client's design team

or adopt responsibility for a design already developed either wholly or in part and then contractually novated to them.

Key advantages to the client include single-point accountability for design and construction (Murdoch & Hughes, 2008; Kirkham, 2007). The client can also obtain a single lump sum price for design and construction before investing in a design. This mitigates the risk of paying for receiving tender bids that are over budget after already paying for the design. Ibbs et al. (2003, p385) suggested a possible reason for the design and build projects having the lowest percentage of changes as the contractor has more opportunity to use innovative procedures to construct the facility, which could result in cost savings for the contractor. Also, the improved communication between the contractor and designer allowed for a better and positive constructability review that reduced the need for revisions and changes during the construction stage. Fixed price design and build contracts incentivize contractors to maximize profits through achieving time and cost savings and not to produce an outstanding piece of architectural creation.

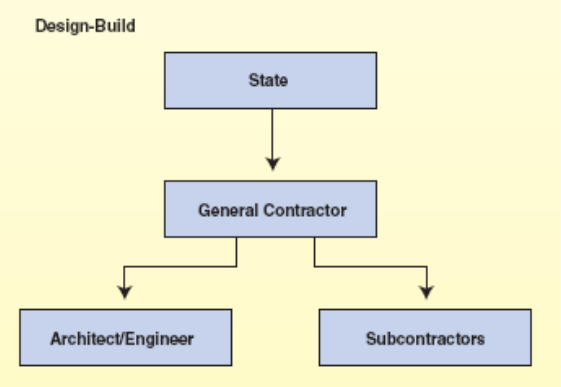

Figure 21: Design and build contracting as adopted by Paul Guyer (February 3, 2005)

- **Novated Design and Build**

In this route, the client employs a design team to prepare the design to about 30-40% completion, then contractors' bidding commences for a fixed price with declared margins based on concept or preliminary design. Then, the responsibility of detailed design is novated to the successful contractor (Doloi, 2008). The essential characteristic of this process is early contractor involvement which occurs before the design completion. The designer's team joins the contractor's team after the contract award (Ng, S.T., & Skitmore, M., 2002).

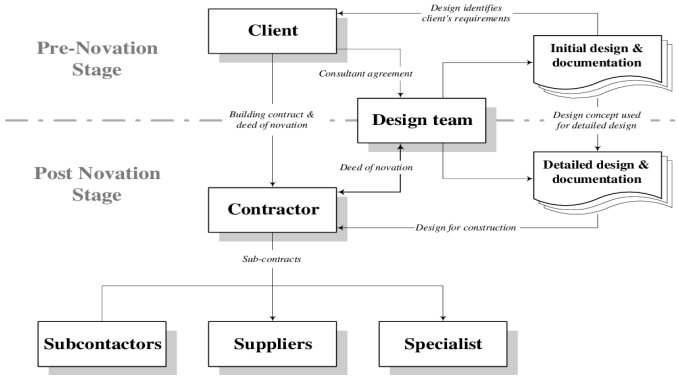

Figure 22: Novated design and build as adopted by Ng, S.T., & Skitmore, M. (2002)

1. Integrated Project Delivery

IPD is characterized by multiparty agreement, shared risk and reward, early involvement of all parties, liabilities waiver, and collaborative decision-making (Becerik-Gerber & Kent, 2010). These characteristics decrease the project cost, as Matthews and Howell (2005) stated. According to AIA, there are nine fundamental principles of IPD projects as follows: (Cook et al., 2007): Mutual Respect and Trust, Mutual Benefit and Reward, Collaborative Innovation, and Decision Making, Early Involvement of Key Participants, Early Goal Definition, Intensified Planning, Open Communication, Appropriate Technology, and Organization and

Leadership are all examples of good decision-making practices. The early involvement of key participants is at the core of such a delivery method.

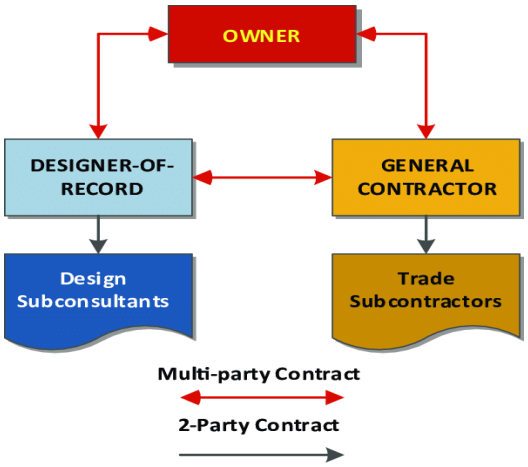

Figure 23: Integrated project delivery as adopted by Gransberg, Douglas & Touran, Ali. (2019)

- **Partnering**

Partnering gathers the client and contractor into a long-term commitment to achieve a mutual business objective. It involves gathering all the primary stakeholders together at the beginning of the project to discuss any potential problems. This arrangement is meant to align the parties' interests (Sakal, 2004). Therefore, Howell indicated that partnering is a solution to the failure of central control to manage production in conditions of high uncertainty and complexity by getting people to work together; however, it does not analyze the underlying issues that are making the situations difficult that contribute to uncertainty and disputes (Howell, 1999). Therefore, from a lean perspective, Partnering and ADR need to address the heart of the problem- how the actual work is done- and their development is further evidence of the fundamental flaws of traditional project management.

• **Alliancing**

An alliance is an arrangement where the client and contractor participants work together as an integrated, collaborative team and make unanimous decisions. Thus, project risks and outcomes are managed together. According to Lahdenperä (2010), there are two categories of alliances: pure and competitive. A target cost contract is developed under pure alliances where the client selects only one contractor to develop the project together. The contractor is selected based on experience, attitude, and capability; however, only one contractor is involved and executes the project.

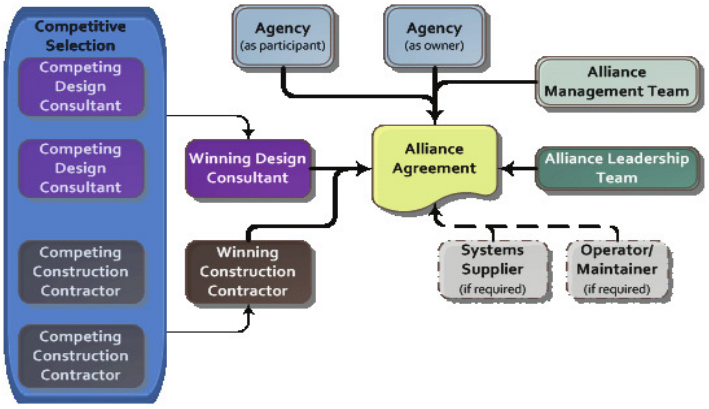

Figure 24: Alliancing contracting (as adopted by Gransberg, Douglas & Scheepbouwer, Eric & Loulakis, Michael., 2015)

• **Public Private Partnership (PPP)**

This route encourages the private sector into major public projects. It is also known as private finance initiatives (PFIs). It reduces government debt and transfers risk to the private sector (Kirkham, 2007). This route may not be suitable for typical commercial construction projects since it requires costly and highly complex contractual arrangements. The consortium provides design, construction, and services over a predetermined period (Kirkham, 2007).

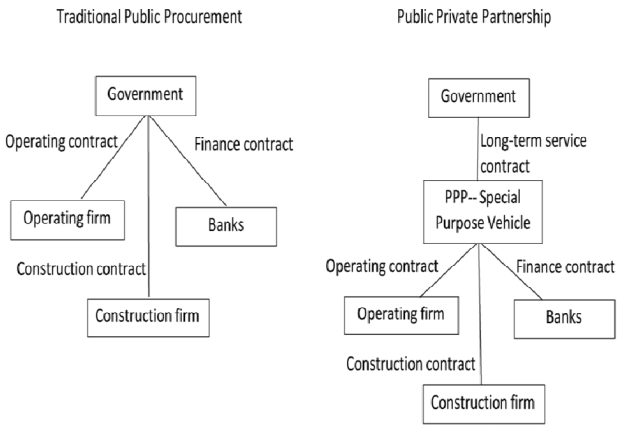

Figure 25: Public private partnership as adopted by Hui, Jin. (2017)

- **Management Contracting Vs. Construction Management**

Management contracting (MC), and Construction Management (CM) attempt to increase the level of integration within the project delivery process. The main difference between management contracting and construction management is that under management contracting, the general contractor assumes a single focal point of responsibility for construction work; however, under Construction management, subcontractors and a consultant are employed directly by the client. Thus, the risk in CM may be higher than in MC, which makes MC as preferable to clients (Male, 2003).

According to Finnie (2021), courts have recognized the obligations of construction manager consultants under the CM route, such as planning, monitoring, and controlling activities with reasonable skill and care obligation which is less strict than the commercial liability adopted by general contractors entering fixed price contracts. Moreover, the work may commence under both routes with an estimated budget rather than a lump sum price due to the uncertainty of the final cost and the lack of control over the price that tendering procedures would provide (Finnie, 2021).

• **Management Contracting**

In this route, the general contractor subcontracts all the work packages allowing early involvement during the design stage based on a management fee. The general contractor can input design, risk management, and value management and can evaluate subcontractor quotes with the client consultants to reveal any concealed issues, thus reducing variations (Mosey, 2011).

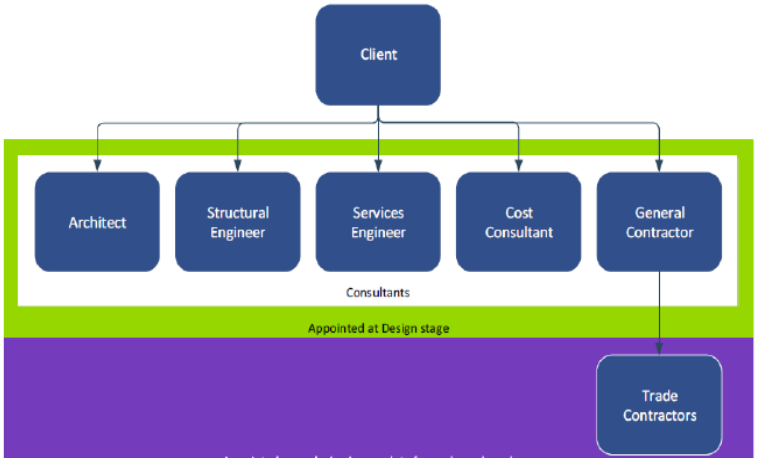

Figure 26: Management Contracting Model as adopted by Finnie (2021)

• **Construction Management**

In this route, the client directly employs subcontractors and a consultant construction manager without employing the general contractor. The consultant construction manager would be employed to manage those subcontractors. The consultant has reimbursed a management consultancy fee, meaning the client would not pay for the general contractor profit margin on his subcontractors. However, the effect might be the same if the client pays the consultant's fee as a percentage of the total work. This route requires experienced clients (Murdoch & Hughes, 2008; Kirkham, 2007) who must operate actively in the management of

the process and be familiar with the product and the process of construction. Therefore, this route suits large complex projects with a client with good construction knowledge.

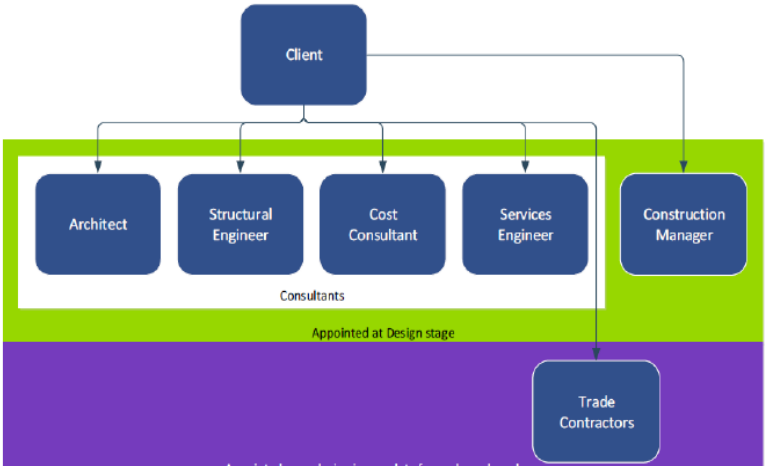

Figure 27: Construction Management Model as adopted by Finnie (2021)

- **Framework Agreement**

A framework agreement is a relational procurement method that establishes the terms for future contracts between client and supplier to be awarded during a given period. It gives the client the right to procure from the supplier during a given period.

- **Traditional Contracting Vs ECI**

The below table summarizes the main differences of traditional and ECI contracting approaches:

Table 12: Comparison of traditional and ECI contracting

Phase	Traditional	ECI
Design	Design must be complete before construction begins	Preconstruction services to be provided by the contractor while the design is in progress (15 – 30%)
Construction	Construction begins only when design is complete after award of contract	Construction can begin after the major design decision are complete and before the final completion of design.
Contractor Involvement	Contractor is only involved after the design completion	Contractor can be involved any time throughout the project life cycles, most preferably, during design phase such as concept, preliminary stages
Contract type	Lump sum price/Fixed price contract	Firm fixed price for pre-construction services. Firm price incentive for construction contract (Other pathways may also exist) As the design matures, the firm price incentive contract may involve successive targets
Scope	Scope must be clear to have a fixed price pricing that would be core criteria for the evaluation of any claim for additional cost	The contract documentations are prepared through coordination among all participants which makes the contractor acquainted with the project requirement, duration, and scope
Evaluation Criteria	May be solely based on price	Qualifications and price
RFP	Include: SOW for project as full design is complete, bidding process and contract terms	Include: SOW for preconstruction services, concept engineering solution, ceiling price, evaluation criteria

Appendix D

Global ECI pathways

- **ECI in UK**

In this model, ECI consists of a two-stage procurement and contractual model that intends to prohibit the attitude of "Bid Low, Claim Later". It is a two-stage procurement and contractual model in which the client hires design and construction professionals early in the project development process using a non-price-based selection process. The contractor is chosen based on their track record, their availability, understanding the project, and quality of new ideas (Laursen & Myers, 2009).

The first stage, which is called Design Phase, consists of two substages. The first stage is Phase 1 A, which involves a portion of the work covering the period from the starting date up to the issue of the draft contract. The second sub-stage is Phase 1B which involves the period from the issue of the draft contract up to the notice to proceed to construction. The contractor creates the project design and follows the submission procedure to obtain the necessary approvals. The submission procedure allows the Highways Agency and the contractor to gradually agree on the various activities needed to complete the project. An activity schedule includes prices for these activities. Because the contractor is paid his actual cost plus a fee percentage, he must be open and collaborative. The fee percentage is fixed at 7.5%. Accounts and records must be constantly kept open for audit. The second phase is called Construction Phase. The contractor is paid or pays a share of any cost savings or overruns against the target cost—the total of the costs for Phase 2 (Molenaar, Triplett, Porter, DeWitt, and Yakowenko, 2007).

The Highways Agency tenders the project with only feasibility plans and selects a contractor–consultant through a purely qualifications-based procurement to complete the delivery team. Then those professionals develop an open book target pricing system with the Highways Agency. The open-book target price process seeks to force the contractor to design or build the project within a specified budget (Molenaar et al., 2007). Later, the target price is fixed as the project's baseline price (Scheepbouwer & Humphries, 2011). The contract

includes the target pricing structure (Molenaar et al., 2007). The Highways Agency's bonus structure involves the design, construction, and final bonuses. The design bonus is paid to the contractor if he designs a project within the project budget. This Bonus is paid in monthly installments throughout the construction phase.

At the end of Phase 1B, the total forecast cost of the project to the Highways Agency is compared with the project budget. The contractor's design share bonus is 25% of the forecast savings. The total forecast cost of the project includes the contractor's target for construction costs and all anticipated external costs:

- Any Highways Agency–retained consultants.
- Any likely future payments and costs of any public inquiry
- The estimated value of any land that needs to be acquired.
- Any other costs that the Highways Agency likely incurs in delivering the project.

Risk allowances are included for all residual risks to the budget. If the forecast cost at the end of Phase 1B is greater than the project budget, the contractor does not recover any bonus, nor does it suffer any reduction in payment. If the Highways Agency proceeds with the project, the contractor still has an opportunity to earn a target share of construction savings and a final bonus in Phase 2. The contractor is paid his actual cost plus a percent fee throughout Phase 2. At the end of Phase 2, the estimates (initial target, adjusted for compensation events throughout Phases 1B, and 2) are compared with the total actual cost plus the percentage fee. The target cost for construction is the total of the estimate at the publication of the conceptual design, which is the exact total used when assessing the design bonus. The contractor is paid a share of any savings calculated according to a formula set out in the contract and pays a share of any cost overruns. The share percentages on savings are lower than those for cost overruns; it is recognized that part of the savings may also result in

the final Bonus being earned. The Final Bonus is calculated at the completion of the final project by comparing the total expenditure incurred by the Highways Agency across the entire contract budget. The expenditures include design and construction bonuses already paid to (or from) or earned by the contractor and an estimate of future costs not yet incurred (such as land costs).

If the total expenditure is less than the contract budget, the contractor receives a bonus equal to 25% of the contract budget savings. To mitigate the risk that the contract budget is initially significantly higher than it needs to be, the final Bonus is capped at 10% of the contract budget. With a bonus share of 25%, the maximum payout would be 2.5% of the contract budget. If the contract budget is exceeded, no final bonus is paid, but the contractor is not reimbursed for any cost overruns.

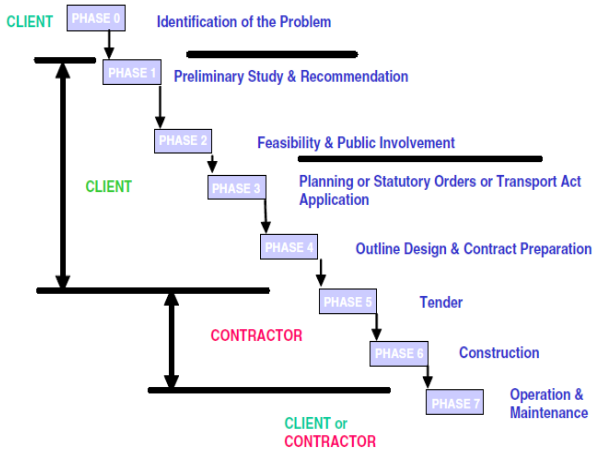

Figure 28: UK Highways Agency's Traditional Project Delivery Approach as adopted by U.S. Department of Transportation, Federal Highway Administration, (November 7, 2014)

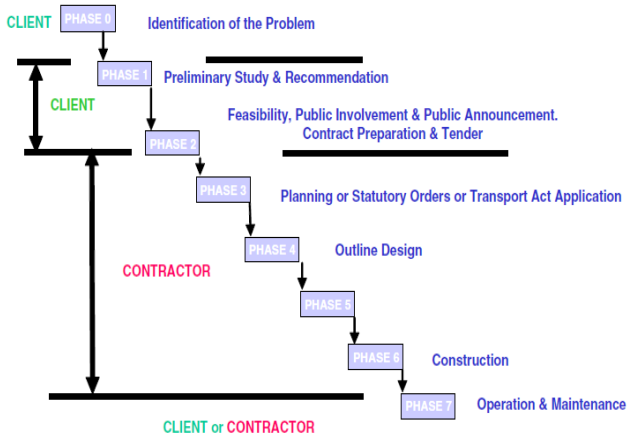

Figure 29: UK Highways Agency's ECI Project Delivery Approach as applied to A500 Stoke Pathfinder Project as adopted by U.S. Department of Transportation, Federal Highway Administration, (November 7, 2014)

The critical characteristics of the UK model are summarized in the following:

- A pain/gain share mechanism in the target pricing process Involves design, construction, and final bonuses.
- Design Bonus: paid if the contractor designs a project within the project budget.
- The contractor's design share bonus is 25% of the forecast savings.
- Construction Bonus: The contractor is paid his actual cost plus a percent fee throughout Phase 2.
- The contractor is paid a share of any savings calculated according to a formula set out in the contract and pays a share of any cost overruns.
- Final Bonus: is calculated at completion of the final project by comparing the total expenditure incurred by the Highways Agency across the entire contract budget.
- If the total expenditure incurred is lower than the contract budget, the contractor is paid a bonus of 25% of the savings achieved on the contract budget.

- The final Bonus is capped at 10% of the contract budget to mitigate the risk that the contract budget is initially substantially higher than it needs to be. Thus, with a 25% bonus share, the maximum paid out would be 2.5% of the contract budget.
- The target pricing structure has been incorporated into the contract (Molenaar et al., 2007).
- The preconstruction phase is linked to the construction phase. This makes sure that the contractor's contribution to the preconstruction phase activities is commercially justified and that the contractor's contribution won't go to a competitor who undercuts their bid price to get the construction phase (Mosey, 2009).
- Pain/gain share mechanism is included in the target pricing process to motivate the contractor to be innovative and design or construct the project on a budget (Molenaar et al., 2007).

- **ECI in Australia**

Queensland Mains Roads introduced the ECI contract in Australia in 2005 (Rahmani, F. et al., Khalfan, M. et al., and Maqsood, T. et al., 2013). Although the method is categorized as Early Contractor Involvement, it is genuinely an innovative approach, unlike any form of contract used before. All government authorities were not prepared to adopt a fully open collaborative strategy, such as an alliance, because they were concerned about demonstrating value for money and having a Target Outcome Price (TOC) rather than a lump sum contract price (Rahmani, F. Khalfan, M., and Maqsood; T., 2013). The Australian version of ECI utilises a two-phase technique and is a hybrid of the British original.

All project partners are responsible for settling any conflicts during the first phase, which resembles design alliancing in that a "no blame" atmosphere often rules the contract. The second phase is a typical design-and-construction (D&C) phase with a lump sum maximum guaranteed price and a conventional risk transfer mechanism.

Often employed in Australia, the ECI model consists of two distinct phases, each with its own contract. Phase 1, Design Development, entails a standard professional consultation

agreement between the participating parties and entails the design progression from an idea to a preliminary design comprising roughly 70% of the whole design process.

The second phase, Design and Construction, completes the detailed design and construction using a standard design and construction contract. Prior to the start of phase 1, the client has already completed a business case, preliminary planning, and a comprehensive design report, and a contractor is selected using a non-price, qualification-based procedure similar to the consultancy selection procedure. The selection procedure includes interviews with the proposed project's on-site staff, designers, and management team at the contractor's or contractor-place designers of business (Swainston, 2006).

After the contractor is selected, the pricing, risks, and design are negotiated and agreed upon. During phase 1, the contractor, client, and designers collaborate to achieve particular goals, such as identifying and assessing project-related risks and designing an acceptable risk management method.

The project team collaborates on the planning, design, documentation, and pricing of the project, after which the contractor delivers a "risk-adjusted price (RAP)" offer for phase 2, a lump sum payment. If the owner accepts the bid, the contractor prepares and completes the detailed design and construction paperwork and then constructs the project. Imagine the proposal does not fit the project's budget or does not demonstrate value for money. In such a circumstance, the client has the ability to terminate the agreement and controls the design's intellectual property rights, allowing him to market the project works as a construction contract (Swainston, 2006). Figure 29 shows the activities of ECI contract.

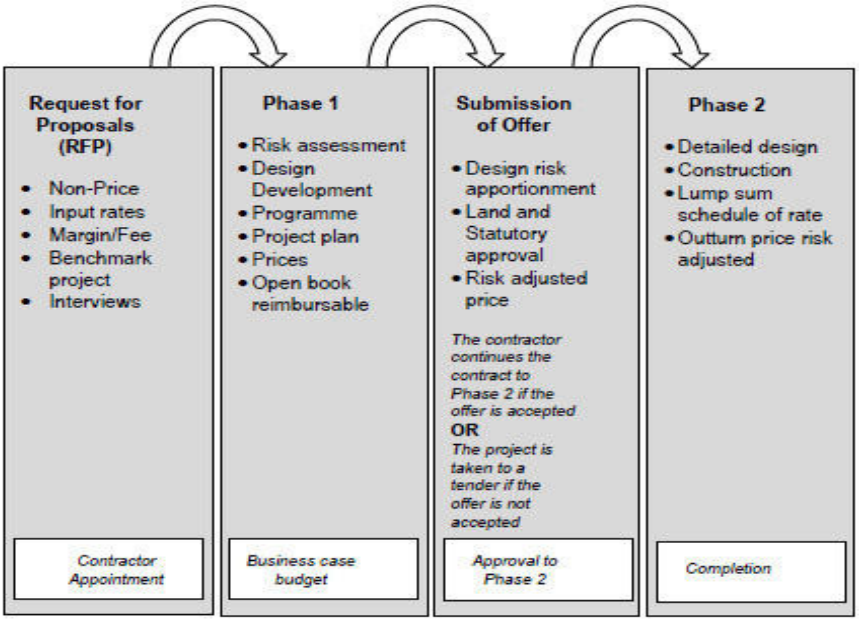

Figure 30: Details of the two-stage of an ECI contract as adopted by Swainston (2006)

The critical features of the Australian version of the ECI contract are a two-staged approach where a D&C contract takes place at the second stage. Moreover, it adopts a collaborative approach without departing significantly from traditional contract forms (Edwards, 2009; Swainston, 2006). The following are the critical characteristics of the Australian ECI model:

- The Australian ECI model is a cross between traditional and UK models (Rahmani et al., 2013).
- The Australian version of ECI employs a two-phase strategy with distinct contracts for each stage.
- The first phase encompasses approximately 70% of the design process, progressing from a concept to a preliminary design. • The second phase encompasses completion of the detailed

design and construction and employs a typical traditional design and build (construct) contract (Swainston, 2006).

- It is a method for public authorities (who were unwilling to adopt a robust collaborative approach) to demonstrate value for money and have a Target Outcome Price (TOC) that differs from lump sum prices (Rahmani et al., 2013).

- The client must use some of its own resources during the assessment process, and external assistance may be required.

- During phase 1, both parties must heavily involve their senior management, and such management involvement is significantly reduced during phase 2.

Two separate phases: at the first stage: (1) Design development

- A contractor is selected on non-price criteria but with a TOC set (Rahmani et al., 2013).

- When the design is finished (from a concept to a preliminary design) for 70%, phase 1 ends.

- Then construction price (TOC) is negotiated (Scheepbouwer & Humphries, 2011).

- If an agreement is reached, the contractor is awarded the contract as traditional DB contract. If an agreement is not established, the client goes to the market (Rahmani et al., 2013).

In the second stage: (2) Design and Construction

- Involves completing the detailed design and construction and employs a typical traditional design and construction contract.

- The price determination (the TOC is not used in the UK) and the specified moment of a 70% completed design between the phases differ from the UK 2-phase model.

Prior to phase 1: a business case is prepared by the client, and little work on preliminary planning and a detailed design report. Once the contractor is hired, price, risks, and design are negotiated and agreed. A contract based on open book reimbursement is signed at the contractor's tender rates, including margins and overhead.

During phase 1, all stakeholders work collaboratively to:

- Identifying and assessing risks.
- Develop an appropriate risk management mechanism.

The contractor then submits a "risk-adjusted price (RAP)" offer for phase 2, a lump sum payment covering all aspects of the project from completing the design to the construction of the project. If a client accepts the offer, the contractor develops the detailed design and construction documentation and carries out the construction of the project. If the offer falls short of the project budget or fails to demonstrate value for money, the client has the option to terminate the contract and owns the intellectual property rights to the design, allowing him to sell the project works as a construction contract (Swainston, 2006).

- **ECI in USA**

An integrated delivery approach, according to USACE, involves a contract that is priced utilizing a procedure known as "Fixed Price Incentive Price Revision" (Successive Targets). Contractors' credentials and prior performance are assessed on a go/no-go basis against a set of evaluation criteria and those determined to be qualified for a short list in this two-step award procedure.

The number of qualifying requirements is minimal, and a contractor is either qualified or not. Such requirements can include the following: the contractor has accomplished the following:

- a minimum of four construction projects for the agency in the past five years.
- at least one project of a specific type (contract value exceeds $X.X million) in the past five years.
- The contractor does not have an unsatisfactory rating in the client (USACE) database.

The price component is developed once the shortlist has been created. The "Ceiling Price," or maximum amount of permitted money for the project, is announced by USACE, along with the technical information the Corps utilized to arrive at that cost estimate. As shown in Figure 30, the competing contractors offered an "Initial Target Price" that included an "Initial Target Cost" (ITC) and an "Initial Target Profit" (ITP). The contractor who meets all qualifying requirements and has the lowest ITP is given the contract. It is essential to realize that "TARGET" is the operative phrase used in the bid process. It denotes that the price fluctuates as the design is fully developed.

ITEM NO	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
0001 **BASE**	**Preconstruction Services** (Fixed Firm Price)	1	Lump Sum	$_____	$_____
0002 **OPTION**	**Construction** (Fixed Price Incentive)				
	Initial Target Cost (**ITC**)	1	Lump Sum	$_____	$_____
	Initial Target Profit (**ITP**)		%	_____%	
	% Profit (between a% and b%)				
	(ITP = ITC x ____%)	1	Lump Sum	$_____	$_____
				TOTAL (NET)	$_____

Initial Target Price

Initial Target Price < Ceiling Price

Figure 31: USACE ECI Bid Form as adopted by Douglas D. Gransberg, Jennifer Shane, Jeanna Schierholz, Stuart Anderson, Carla Lopez Del Puerto, Dominique Pittenger, James McMinimee, (April 2013)

Contractor's design share bonus	25%
Bonus share percentage	25%
Maximum final bonus	2.50%

Construction bonus:

Share range	**Contractor's share percentage**
Less than 80%	15%
80-90%	15%
90-100%	20%
100-110%	50%
110-120%	35%
Over 120%	25%

Potential payments — All figures are in £m

	Tender assumption	Case 1	Case 2	Case 3	Case 4
Phase 1					
Phase 1 actual cost	3	3	4	4	3
Target construction cost	63	65	65	70	70
External costs	20	20	20	20	20
Risk allowance	14	8	8	6	6
Forecast total cost	100	96	97	100	99
Contractor's design share bonus		1.00	0.75	0.00	0.25
Phase 2					
Final target (after compensation events)		69	69	76	76
Final actual cost plus Fee	77	65	72	72	80
Construction bonus share		0.80	-1.50	0.80	-2.00
Final total cost		89.8	95.25	96.8	101.25
Final bonus		2.50	1.19	0.80	0.00
Total bonus		4.30	0.69	1.60	-2.00
Total cost to HA		92.30	96.44	97.60	101.25

Case 1: significant savings through design stage and construction stage
Case 2: savings through design stage, overrun during construction stage
Case 3: no savings through design stage, savings during construction stage
Case 4: little savings through design stage, overrun during construction stage

Figure 32: Example of ECI target Pricing Bonus Arrangements (2004 average exchange rate: $1.00, US dollar = 0.54 British pounds) as adopted by Molenaar, K. R., Triplett, J. E., Porter, J. C., DeWitt, S. D., & Yakowenko, G. (2007).

ECI is a substitute awarding mechanism used by USACE for projects with exceptionally complicated designs. The system replaces the Go/No Go evaluation with an interview process. In this technique, competing contractors present themselves formally, including their corporate credentials, comparable projects they have worked on in the past, the training and expertise of key individuals, project-specific concerns, and preconstruction services components. Each competitor responds to a pre-published list of common questions in the RFP after presenting. Finally, a scenario exercise is presented to the competing contractors. They are given a set amount of time to develop a solution and then present it to the evaluation committee. The best-value award method is used to choose the winning contractor. It is based on a "Cost-Technical Trade-off" analysis that uses the RFP's publicly available evaluation criteria. The exact format, as in Figure 32, is used for the price, which typically receives a 50% weighting. The winning contractor submits its suggested general conditions fee upon contract award.

When creating the project's formal acquisition strategy, USACE chooses the project delivery mode and aims to award the ECI contract between 10% and 15% into the design phase. Around 90% of the project's final cost is determined by design. Like DBB, the lump sum may be modified in response to modifications made to the project's scope during design or construction. The client is given the contractor's actual costs under ECI's "open books" pricing approach. This information is used to calculate the actual amount of profit permitted under the incentive/disincentive program.

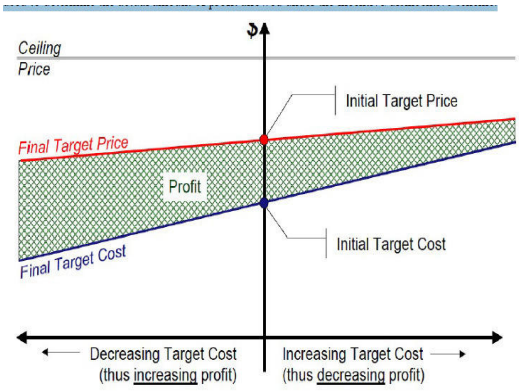

Figure 33: USACE ECI Incentive/Disincentive Scheme as adopted by Douglas D. Gransberg, Jennifer Shane, Jeanna Schierholz, Stuart Anderson, Carla Lopez Del Puerto, Dominique Pittenger, James McMinimee, (April 2013)

- **Target price and pain/gain share**

Target price contracting is advised for complicated, high-risk projects that call for much cooperation between the parties to the contract as well as flexibility (Bower, 2003, as cited in Blad, K., Johansson, 2015). In ECI, it is created and approved during Phase 1 and modified significantly during Phase 2. The four components of a target price are direct cost, risk allowance, overheads, and profit. The expected final project cost is represented by the direct costs and risk allowance, while the overhead and profit represent the contractor's fee. The target price contract's fee might be determined as a percentage of the actual costs or as a

predetermined fixed amount (Bower, 2003, as cited in Blad, K., Johansson, 2015). Furthermore, target price contracts frequently include a sharing formula for over and underspending in relation to the target price. Figure 23 depicts how deviation from the target price results in either a 'pain' or a 'gain'. For savings and expenditures, the ratio of pain or gain can be configured differently (Kadefors and Badenfelt, 2009, as cited in Blad, K., Johansson, 2015). This allows for an equal share of risk when compared to cost-plus contracts, in which the client bears the risk of cost overruns, and fixed-price contracts, in which the contractor bears the risk. A pain/gain share mechanism, on the other hand, may result in discussions about what changes should be made to the target price (CIPFA, 2013, as cited in Blad, K., Johansson, 2015). Contractors benefit from increasing the target price as that can increase the size of the gain share. It is argued that such discussions may divert attention from solving the actual issue at hand, and it is therefore recommended that the contract contains a clearly defined procedure for adjusting the target price as the project proceeds into Phase 2 (CIPFA, 2013 as cited in Blad, K., Johansson, 2015).

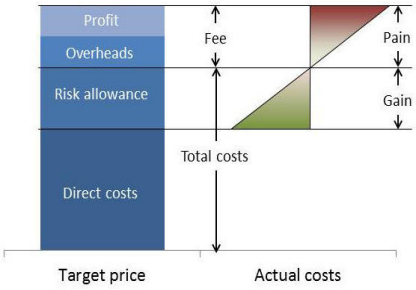

Figure 34: Principles of target price contracting as adopted by as cited in Blad, K., Johansson, (2015).

- **Different reimbursement models and incentives**

Adding incentives to contracts mainly motivates certain preferred behaviors (Blad, K., Johansson, M., 2015). Incentives are most commonly associated with cost, schedule, quality, and safety, but they can also be associated with non-price criteria. When designing the

incentive arrangement, it is essential to consider the sought client-supplier relationship, as incentives can encourage self-interest instead of motivating the project team (Blad, K., Johansson, M., 2015).

The target price could be established so that the contractor would receive additional compensation if the project fulfilled specific targets. Thus, the client can design this arrangement differently with a higher fee and a lower target price instead. When the contractor fee is low, even if the contractor is aware that there are opportunities to increase the compensation if they perform well, the contractor may be dissatisfied with the low fee. As a result, the project's objectives may be overlooked.

Provided that the contractor is reimbursed according to a cost-plus model and a percentage fee in Phase 1, the fee possibly should be higher in Phase 1 than Phase 2 to increase the contractor's revenue during this phase. However, increasing the contractor's compensation in Phase 1 can consume more of the budget for Phase 2, but it could be a solution as it generates a more even cash flow over both Phase 1 and Phase 2. Nevertheless, if the go/no go clause must be applied and another contractor is procured for Phase 2, they might not accept the lower fee for Phase 2. A higher fee in Phase 1 would indeed be more reasonable for the individuals engaged in that period; however, such an arrangement may be challenging to motivate taxpayers, who often are the funders of public projects. However, as the contractor is being reimbursed hourly, they are not losing money. Instead, the emphasis should be on identifying costs that are not covered by the contract and thus are not compensated for. To address the low cash flow in Phase 1, time-critical construction work could begin without formally initiating Phase 2 and thus be excluded from the target price. Since the contractor loses the possibility to beat the target price and receive more pay for these activities, it may be feasible to increase the fee for these projects (Finnie, 2021).

The project can be divided into sub-phases, allowing construction to begin before the full design and target price were completed. Another advantage is that the sub-divisions of Phase 1 and Phase 2 provide the project team with information on how well the process and the agreements work. However, the go/no go exit is harder to enforce as the project elapses since the contractor gets more incorporated into the project the more, they build. Even having a go/no go clause might not benefit the project, affecting the contractor's willingness to outperform. Another concern for the client was that a sub-division implied that construction would start before the final target price. The uncertainty of not knowing the ultimate cost was viewed as particularly problematic for public clients, as politicians attempt to maximize taxpayer funds and the media routinely discloses project costs and potential overruns to the public, which can generate significant opposition.

Contractors must be fairly compensated if ECI is to be a viable option. As a result, interviews concentrate on changes in the revenue streams and cost structure components of the Business Model framework, as well as their financial implications. Because developing a target price early in a large project with high contingencies can be difficult, the ESS project divided the project into several design and construction phases with different target prices. However, it was discovered that this subdivision not only made it easier to build ESS, but also provided the contractor with a better cash flow because the time spent solely on Phase 1 was reduced. In terms of overspending, the contractor has fewer opportunities to outperform the target price via the pain/gain share mechanism. Another advantage of sub-phases is that it prevents the contractor from purposefully raising the target price at an early stage, as the client can learn how to verify the accuracy of the initial estimates. This provides the customer with more information about the contractor's performance but limits their ability to invoke the go/no-go provision and replace the contractor if they are dissatisfied. However, by hiring the right contractor, the client can hopefully avoid these issues.

In addition, the sub-division can assist the client in identifying the incorrect contractor before too many Phase-2 sub-projects are initiated. The literature differs on whether the contractor should be reimbursed for participating in Phase 1. (Mosey, 2009). Contractor contributions at no cost in Phase 1 may result in insufficient resource allocations by the contractor and shift the focus from the intended goals of Phase 1 to completing Phase 2 as soon as possible, regardless of the cost to the client. Receiving hourly compensation as a consultant, on the other hand, may incentivize the contractor to expand the scope of the project. However, Mosey (2009) argued that the best way to secure value for the clients is to reward contractors appropriately for their contributions to the project instead of basing their rewards for Phase 1 on achieving Phase 2.

- **ECI Contract Variations**

- **Early Tender Involvement (ETI)**

Early Tender Involvement entails the participation of two or three competing contractors in value engineering and improving the initial design (Wilson & Abson, 2010). Since the client keeps the designer, unlike the ECI, the tenderer has no responsibility for the design, which is in a far more advanced stage. It requires less design development than in the ECI model. The agreement comprises a fee-for-service basis for the ETI Phase only and explicitly outlines the services and deliverables that the supplier must supply. The agreement is tailored based on the project requirements to guarantee that all parties' commercial interests are in line, leading to the best possible collaboration and result (Bennett, 2013, as cited by Rahmani, 2016).

1.1. Double ECI (dECI)

Two competing groups are appointed in Double ECI (dECI). One of these groups is chosen to proceed with the detailed design and construction. Each group consists of a contractor and a designer to generate contemporary concept designs and pricing estimates. Wilson and

Abson (2010) contend that this model's competitive tension throughout the concept design stage promotes creativity and results in the best value for the money. Usually, the competing groups submitted tender documents would include a comprehensive set of design and project management plans, including risk management, community management, and stakeholder management.

- **Strategic ECI (Umbrella ECI)**

The Queensland government primarily uses the Strategic ECI or Umbrella ECI as an alternative to ECI for their rail track upgrade. According to this concept, the client divides a large project into various packages and chooses an ECI contractor. Each package is finished, and then they call a new D&C contract, possibly appointing the same contractor from the prior package (Department of Main Roads 2009 as cited by Rahmani, 2016).