UNIVERSITY OF SOUTHERN QUEENSLAND
FACULTY OF HEALTH, ENGINEERING AND SCIENCES

INVESTIGATING THE CAUSE OF REQUESTS FOR INFORMATION (RFIS) IN CIVIL CONSTRUCTION PROJECTS

A dissertation submitted by

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ABSTRACT

Requests for Information (RFIs) are an important means for contractors to formally request additional information from the principal during construction projects.

Minimisation of the number of RFIs generated during a civil construction project is ideal for all project stakeholders as they form the basis of unpredictable and mitigable time spent managing construction. Additionally, existing research has linked excessive RFIs to other project costs including variations, extensions of time and disputes.

This research concludes that poor project documentation, outdated forms of contract, lack of communication and delays in adopting available technology are the primary causes of RFIs in high budget building construction projects.

This research was intended to determine the cause of RFIs in civil construction projects. The project methodology was to use case studies from an engineering and project management consultancy based in Cairns, Black & More. Case studies were also conducted on four building construction projects to allow comparison between the data collected in this research and the existing literature.

The results for the building construction case studies were comparable to that of the existing research, with 77% of RFIs received as a result of inconsistencies, errors or omissions in the project documentation. The results for civil construction projects were mostly comparable the building projects, however, on average only 34% of RFIs were received as a result of missing, unclear or incorrect information.

The total number of different design disciplines involved in the project appeared to have the greatest correlation with the number of RFIs received for a construction project, regardless of the nature of construction.

There were some limitations to the research due to the relatively small sample size, however the results highlight the opportunity for improved outcomes through changes to management practices, contractual forms and relationships between project stakeholders in civil construction projects.

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Jared Black

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CHAPTER 1: INTRODUCTION

1.1. Why Study Construction?

Engineers Australia reports that poor project documentation, outdated forms of contract and a lack of effective communication contributes an additional 10-15% to construction project costs. It is estimated that at least $12 billion was wasted in Australia in 2005 alone. In addition to the financial costs, these factors are perceived to contribute to problems including:

- High stress levels
- Loss of efficiency
- Decreases in competition
- Loss of morale
- Adversarial behaviour (Engineers Australia, 2005).

1.2. Project Stakeholders, Documentation and RFIs

1.2.1. Civil Construction Management – The project team

Modern civil construction projects require the involvement of many stakeholders. Clients, contractors and multi-disciplinary project teams are all heavily involved in the successful delivery of a civil construction project.

A typical project team will involve civil engineering and project management consultants at a minimum. Generally, project teams will also include sub consultants providing planning advice, surveying and specialist technical expertise.

1.2.2. The Role of Documentation

All of the information developed by the project team needs to be effectively and completely communicated to a principal contractor (and subsequently all subcontractors) by means of the project documentation.

Over time, factors including; increases in technology; project complexity; and competition have put greater pressure on consultants to produce design documentation for lower prices and in shorter timeframes.

This approach appears to provide value for money to the client, however there is a growing body of research which suggests there are hidden costs associated with this approach in the building construction industry.

Hidden costs arise with this approach as the 'next customer' using the documentation, the principal contractor, is left without adequate information to undertake the work at the time of award of contract. The contractor must subsequently request this information from the principal during the construction period, resulting in considerable time and cost implications for all stakeholders (Leong & Tilley, 2008).

1.2.3. The Request for Information (RFI)

Additional information is obtained through the Request for Information (RFI) process. This process is intended to allow contractors to formally request additional information from the design consultants through the superintendent. This information can be (Andrews, 2005):

- A request for clarification of drawing/specification information
- A request for necessary information that is missing from the drawings/specification
- A request for instruction where existing conditions differ from the conditions shown/assumed in the drawings/specification
- A request for the consultant to verify proposed error/defect rectification methodology
- A request for the consultant to confirm a verbal discussion with the contractor

Ultimately, it is possible to misuse the RFI process either deliberately or unintentionally, by referring to other forms of communication between project stakeholders as an RFI.

1.2.4. Documentation Issues and RFIs

Existing research undertaken on building construction projects has shown that there is a direct relationship between project documentation deficiency and an increase in project RFIs. The time that is spent dealing with these RFIs costs all project stakeholders time and money (Tilley, 1997).

The time that potential design and construction issues are identified has a significant impact on the cost to address the issue. Figure 1.1 below shows the relationship between project time and the potential for management decisions to produce cost savings.

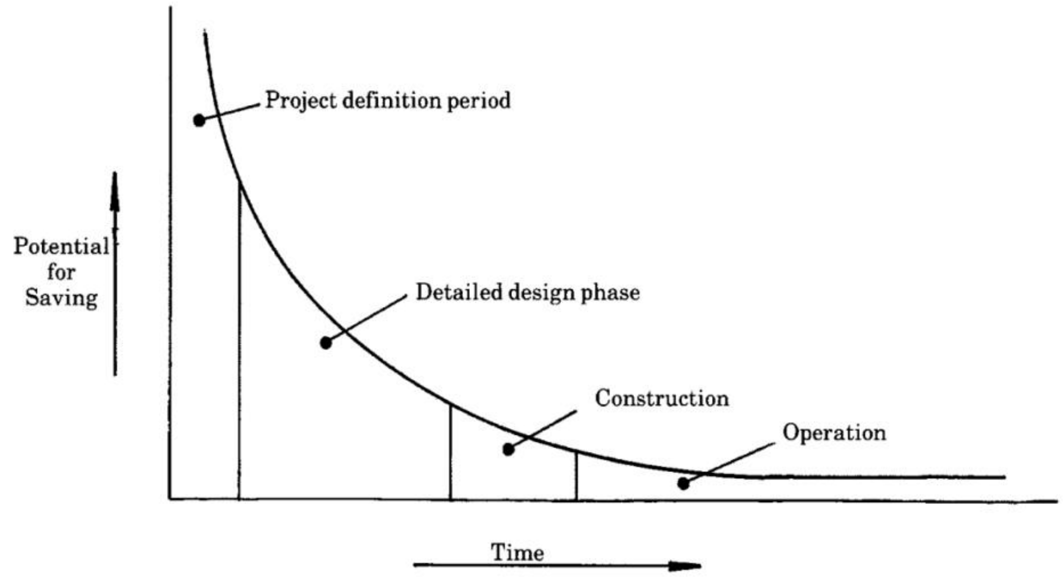


Figure 1.1: Decisions affecting Project Cost (University of Southern Queensland, 2014)

The following questions were developed to define the aims and objectives of this research.

Regarding the nature and consequences of RFIs:

- What areas of the documentation lead to RFIs?
- What project parameters (total cost, construction time) affect the number of RFIs?
- What are the consequences of RFIs (variations or extensions of time)?
- From the above, what comment can be made on the quality of the project documentation provided to contractors?

For comparison of the case study data with existing research:

- How does the case study data for building construction projects compare with civil construction projects?
- How does the case study data for building construction projects compare with existing literature?
- From the above, what comparison can be made between the existing research and the case study data for civil construction projects?

It was initially anticipated that this research will indicate that improvements in documentation would lead to improvements in project outcomes for all stakeholders.

1.3. Project Aims

An investigation of primary causes of RFIs in Civil Construction from a project management and civil design perspective.

The purpose of this research is to determine the major project factors that contribute to RFIs in Civil Construction projects, and determine the consequences of those RFIs.

The time and cost involved in addressing RFIs (the “business consequences”) and the influence that the contributing factors have on extensions of time and contract variations (the “project consequences”) are the major focus of this research.

1.4. Project Objectives

From the questions detailed in section 1.1.5, this research aims to:

- Examine the cause and consequences of RFIs in Civil Construction
- Identify ‘problem’ areas in project documentation that frequently result in RFIs;
- Identify projects that are likely to be high risk from a construction management perspective;
- Suggest areas where improvements can be made from the findings, with a emphasis on standard forms and processes; and
- Suggest areas where further research is required, could complement the findings.

1.5. Overview of Dissertation

This research is presented as a dissertation consisting of five chapters. The remainder of the dissertation is as follows:

Chapter 2: Literature Review. The literature review details the previous research relating to RFIs in the construction industry and provides a background on known issues in the construction industry.

Chapter 3: Methodology. This chapter describes the research methodology for the project. The case study data that was collected is shown in detail.

Chapter 4: Results and Discussion. This chapter presents the data from the project case studies, analyzing and measuring the results against the queries in the project aims above.

Chapter 5: Conclusion. The conclusion details the conclusions that have drawn from the results and discussion, the limitations of the research methodology and identifies areas that warrant further investigation.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

Despite advances in technology, it is widely accepted that the improvement in performance of the construction industry is not in line with that of other industries. There is a growing body of research that implicates poor performance from all project stakeholders as the primary cause of dissatisfactory project outcomes (Hughes et al, 2013).

From a designer's perspective, research indicates not only is performance not improving, but the quality of project documentation has been declining for the past 30 years. This research indicates that poor project documentation costs the construction industry 10-15% of the total amount expended each year (Engineers Australia, 2005).

This literature review has been undertaken to provide a context for this dissertation regarding civil construction projects.

The topics that will be reviewed include the following:

- Background on Construction
- Construction Contracts
- Contract Stakeholders
- Project Team
- Project Documentation
- Project Performance Measurement
- The Request for Information
- Types of RFIs
- The RFI Process
- Cause of RFIs
- Consequences of RFIs
- Recommendations for change

2.2. Background on Construction

Dating back to around 2700 BC, construction projects were undertaken by a Master Builder who was given sole responsibility for delivering the project. This methodology meant that the person who designed the works also constructed them. Around the 19th century, as construction projects became more complex, input was needed by an engineer, an architect and a contractor. These three stakeholders work increasingly in isolation from each other in modern construction (Hughes, et al, 2013).

Overall, construction currently contributes approximately 8% of Australia's total Gross Domestic Product (Australian Construction Industry Forum, 2016). This includes employment of approximately 730,000 people across 230,000 businesses. Furthermore, the Australian Bureau of Statistics estimated that $1 million spent on construction would lead to an output of $2.9 million overall (Engineers Australia, 2005).

Ballard (2005) has compared construction to any other production system, albeit a complex system with a large amount of uncertainty. Where there is any wasted time and effort the project stakeholders must bear additional costs in order to finish the works.

2.3. Construction Contracts

A contract is a legally enforceable agreement between two parties to perform services for a consideration. A contract must involve an agreement (offer and acceptance), intent and consideration (University of Southern Queensland, 2014).

Construction projects in Australia typically utilize a standard form of contract, even for projects with a value over $100M. These standard forms are either "fixed price", where the price to undertake the contract are based on a lump sum or schedule of rates or "prime cost", where the actual cost is paid; plus a specified amount for the contractor's service. The form of contract is often selected due to familiarity to the contract stakeholders rather than due to suitability for the works (Sharkey et al., 2014).

The traditional forms of contract have been criticized for creating conflict and competition between project stakeholders who are ultimately reliant on each other (.

2.4. Contract Stakeholders

A construction contract involves three basic stakeholders:

1. The principal
2. The contractor
3. The superintendent

2.4.1. Principal

The principal is the party that pays for the construction project, but is not necessarily the end user of the works. It is the principal's responsibility to engage the consultants to administer the contract.

2.4.2. Contractor

The contractor is the party that is engaged to the principal under the construction contract, and managed externally by the superintendent.

The contractor is responsible for construction of the project, either using their own personnel or through subcontractors. The more complex the project, the more subcontractors required to undertake the specialized components in the work scope.

The contractor typically will manage the construction phase with a project team of their own.

2.4.3. Superintendent

The superintendent is the engineer (or architect, for building projects) who administers the contract and acts as a neutral party between the principal and the contractor (Dinsmore 2013). The superintendent typically serves as the link between the principal, the contractor and the project team; who designed the work.

2.5. Project Team

A multi-disciplinary project team is key to the successful delivery of a civil construction project.

A typical project team will involve civil engineering and project management consultants, with sub consultants providing planning advice, surveying and specialist technical advice/design where required.

2.6. Project Documentation

All the information developed by the project team needs to be effectively (and completely) communicated to a principal contractor (and subsequently all subcontractors) by means of the project documentation.

Over time, factors including increases in technology, project complexity and competition have put greater pressure on consultants to produce design documentation for lower prices and in shorter timeframes (Hughes et al, 2013).

This approach appears to provide value for money to the client, however there is a growing body of research which suggests that there are hidden costs associated with this approach in the building construction industry (Tilley, 1997).

Hidden costs arise with this approach as the ‘next customer’ using the documentation, the principal contractor, is left without adequate information to undertake the work at the time of award of contract. The contractor must subsequently request this information from the superintendent during the construction period, resulting in considerable time and cost implications for all stakeholders (Leong & Tilley, 2008).

Poor quality design and documentation is estimated to account for 7% of total construction cost, with variations and rework accounting for an additional 10%. This means that a 10% improvement in efficiency would improve the construction industry’s contribution to GDP by approximately 2.5% (Engineers Australia, 2005)

2.7. Project Performance

2.7.1. Measuring Project Performance

Project performance can be broadly measured by considering time and cost overruns and stakeholder satisfaction following project completion.

More detailed assessment of the performance of a project can be undertaken by considering the number of RFIs that are submitted and determining the cause and effect of the RFIs. This is particularly useful from the designers perspective, as the number of RFIs can be considered as a measure of "design completeness" (Tilley, 1997).

2.7.2. Causes of success/poor performance

Cheng et al (2010), indicates that the primary factors that contribute to project success are:

- Complexity
- Form of contract
- Relationship between project participants
- Project Manager competency
- Abilities of key project members

The contributing factors of poor performance include (Tilley, McFallan and Sinclair (2002).:

- Organisational separation
- Poor integration, coordination and communication between stakeholders
- Adversarial contracts and poor relationships between stakeholders
- Departures from established quality standards
- High levels of non-productive time, poor working practices and working conditions
- Lack of customer focus

2.8. The Request for Information (RFI)

The Request For Information (RFI) process is intended to allow contractors to formally request additional information from the design consultants through the superintendent. This information can include:

- A request for clarification of drawing / specification information
- A request for necessary information that is missing from the drawings / specification
- A request for instruction where existing conditions differ from the conditions shown / assumed in the drawings / specification
- A request for the consultant to verify proposed error / defect rectification methodology
- A request for approval of shop drawings, samples or some other submission required by the contractor
- A request for approval of an alternative design/construction methodology
- A request for the consultant to confirm a verbal discussion with the contractor (Andrews, 2005)

2.9. Types of RFIs

Previous research has classified RFIs into separate types based on the information that is requested from the principal.

Research undertaken by the CSIRO has classified RFIs into five basic categories (Tilley, 1997):

- Information Clarification – The contractor requests information that is missing, unclear or wrong in the project documentation
- Submissions for Approval – The contractor submits technical information or documentation for approval
- Information Confirmation – The contractor requests official clarification of verbal advice or confirmation of information in documentation
- Alternative Design Solutions – The contractor submits an alternative design solution for approval
- Other – Any other type of RFI received

Research undertaken by Navigant Construction classified RFIs into the following types (Hughes et al, 2013):

- Construction coordination – An RFI related to the coordination of procedures, schedules and safety items.
- Constructability issues – An RFI related to difficulty expected or encountered constructing works as designed.
- Change of staging/phasing – An RFI related to a proposed change to the original sequence of construction which has been determined to be inadequate or inefficient.
- Design change – An RFI related to a request to modify the original design to simplify construction or to correct a construction error.
- Design clarification – An RFI related to additional information requested required to understand and clarify an aspect of the design.
- Different method – An RFI related to a proposed change in installation or construction process.
- Design coordination – An RFI related to the coordination of the design and documentation between entities.
- Deleted scope – An RFI related to the contract scope, in particular line items to be removed from the project.
- Incomplete plans/specs – An RFI related to a suspected error or omission in the design and documentation.
- Material change – An RFI related to a request to substitute materials for cost or performance reasons.
- Differing site conditions – An RFI related to discovery of site conditions that were unknown at the time of design/tendering.
- Utility conflict – An RFI related to the discovery of services or utilities that were unknown at the time of design/tendering.
- Value engineering – An RFI related to a proposed method to reduce costs or improve construction value.
- Other – Any other type of RFI received

2.10. The RFI Process

A simplistic overview of the RFI process would be:

1. RFI generated by contractor (or subcontractor)
2. RFI issued to the relevant technical staff (via superintendent)
3. The problem is reviewed and a solution, acceptance or a clarification is determined
4. Superintendent issues a formal RFI response to the contractor

Initially RFIs were intended for technical queries only, but the process is commonly used by contractors querying and clarifying special conditions of contract or details in the annexures to the general conditions of contract.

Figure 2.1 below shows a flow chart which fully details the process for the building construction RFI process.

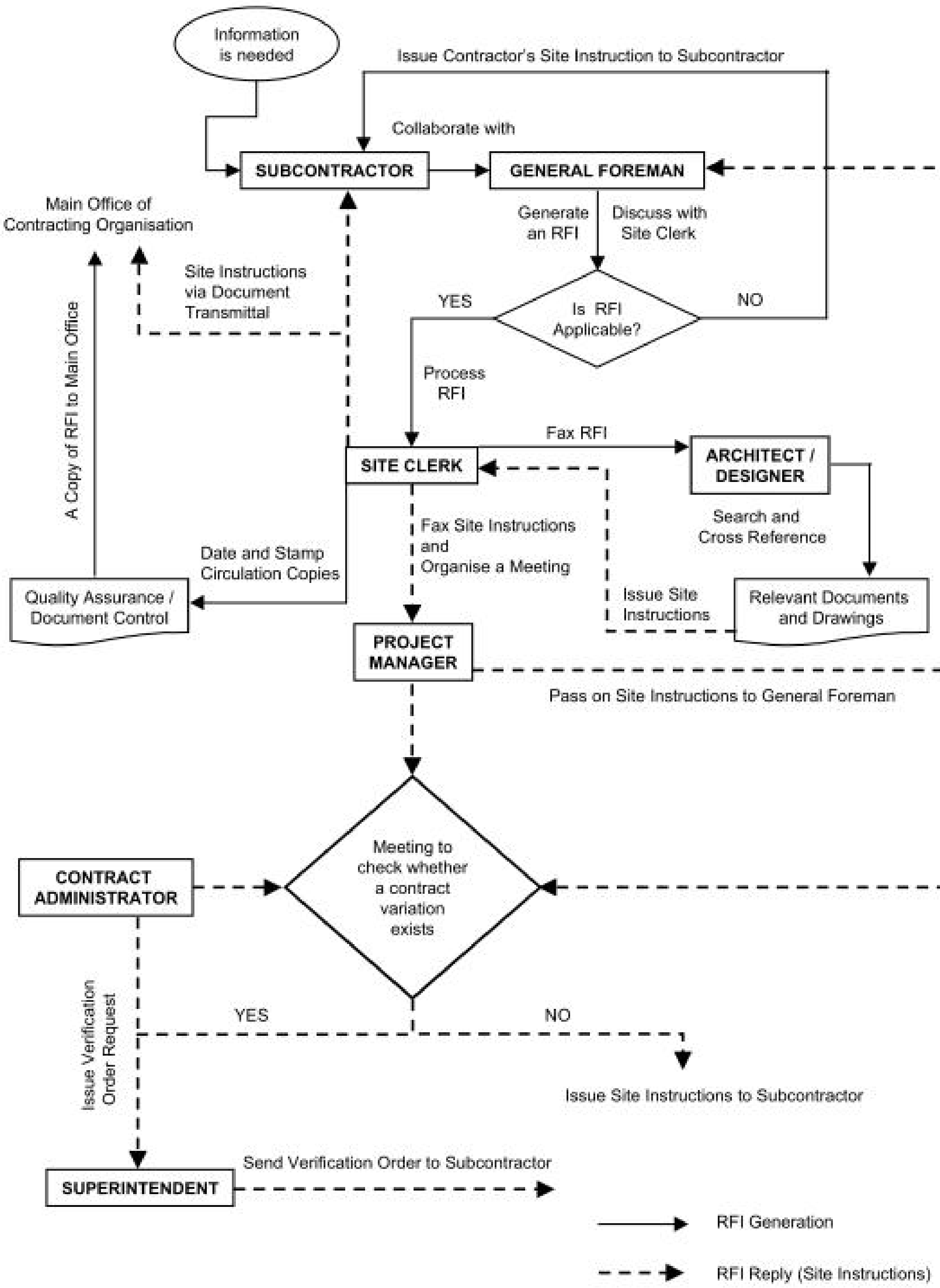


Figure 2.1: The RFI process as adopted by quality-assured organizations (Mohamed, Tilley & Tucker, 1998)

2.11. Cause of RFIs

Current research agrees that the number of RFIs that are submitted during a building construction project is a direct result of a variety of factors including:

- Project value
- Project complexity
- Project type
- Contract type
- Duration of Construction
- Gross area (Dinsmore, 2013)

How these factors are effectively managed is dependent on the Project Manager. It is the responsibility of the Project Manager to ensure that all of the documentation and drawings effectively communicate the contract requirements/specifications and then to assess tenders and select the appropriate contractor based on their tender submission. Failure to effectively communicate all the construction information is implicated as the primary cause for excessive numbers of RFIs during construction.

Figure 2.2 below shows the apparent cause of RFIs based on case studies on construction RFIs.

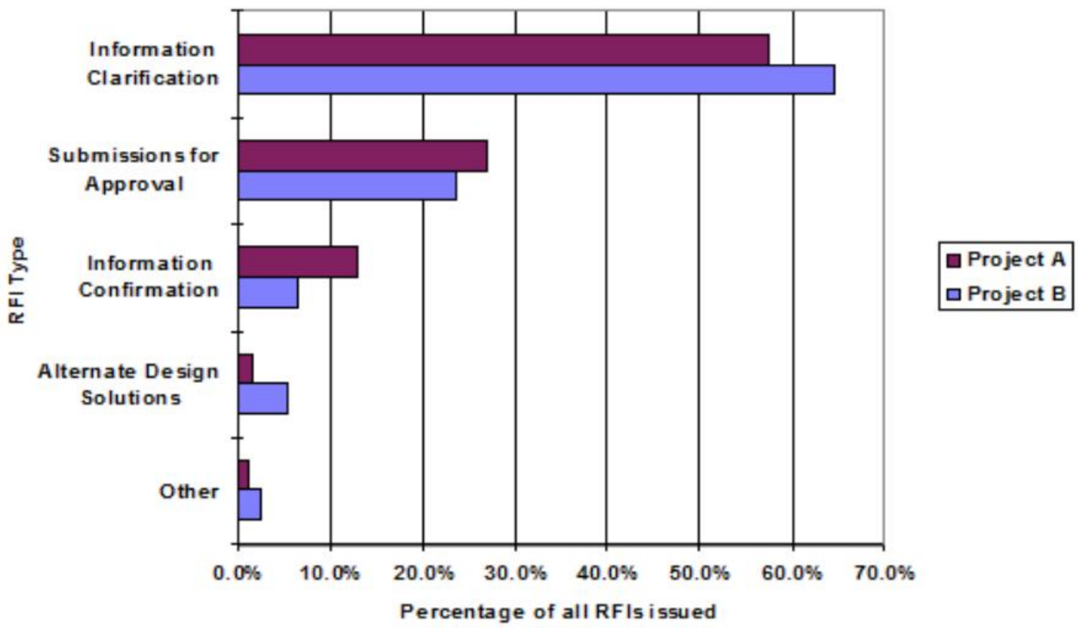


Figure 2.2: Cause of RFIs (Tilley, 1997)

This study further explained that the RFIs raised as “information clarifications” were required due to a lack of detail in the project documentation. Overall, almost all of the RFIs generated relate to the information that was supplied to the contractor by the principal through the project team (Tilley, 1997).

2.12. Measuring the severity of RFIs

The “Forward Thinking Index” (FTI) is a lean construction tool that quantifies the ability of the project team to anticipate construction issues and accommodate these into the construction methodology. The FTI is equal to the number of RFIs that do not result in a delay divided by the total number of RFIs submitted by the contractor (Higgins et al, 2012; Hughes et al, 2013).

The Information Clarification Extent (ICE) Performance Indicator and Information Clarification Severity (ICS) Performance Indicator have been proposed as measures of design and documentation quality by the CSIRO (Tilley, 1997).

The ICE Performance Indicator provides a measure of number of RFIs submitted that relate to design issues, adjusted to accommodate the relative size and complexity of the project (the ‘extent’ of the design deficiency). ICE is equal to the total number of information clarification RFIs submitted by the contractor divided by a complexity factor. The complexity factor proposed by Tilley (1997) for a building project was the gross floor area multiplied by the duration in months squared.

The ICS Performance Indicator provides a measure of number of RFIs submitted that relate to design issues and result in delays to project delivery (the ‘severity’ of the design deficiency). ICS is equal to the sum of the delays due to RFIs divided by the total number of information clarification RFIs submitted by the contractor (Tilley, 1997)

2.13. Consequences of RFIs

On average, the number of RFIs received have been calculated to be 9.9 per million dollars of construction cost. This is based on ACONEX project data for large infrastructure projects between $5 million and $5 billion in construction value. There was significant variability between RFIs received and the construction cost, with larger (over $1 billion) projects receiving RFIs at a lesser rate (1.1/$1M) when compared with smaller (over $5 million) projects (17.2/$1M).

The consequences of RFIs can be “business consequences” which are costs borne by the project team, superintendent or contractor in the form of wasted resources, or “project consequences” which are borne by the principal in the form of time and cost overruns (Hughes et al, 2013).

2.13.1. Time required for RFI process

The RFI process has been estimated to take between 8 and 12hrs of consultant time (Hughes et al, 2013; Tilley, 1997). Figure 2.3 below shows the number of RFIs received per week for a major infrastructure project.

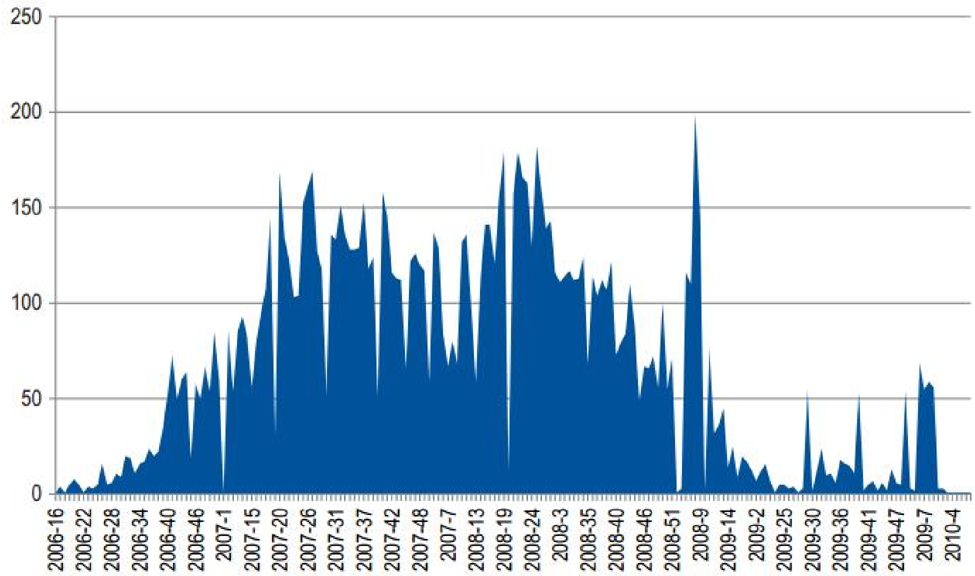


Figure 2.3: Construction Industry Stakeholder Vision (Hughes et al, 2013)

A typical week during this project saw 50 RFIs submitted, with many weeks exceeding 100 and 150 RFIs.

It is possible that the time required for each RFI is greater as research suggests that the contractor commonly has to re-submit an RFI as the initial response does not contain sufficient information (Mohamed, Tilley & Tucker, 1998).

Separate from the time required to respond to the RFI, it is suggested that the indirect construction management time required is 2-2.5 higher where variations and/or extensions of time are issued. (Tilley, 1997)

It is expected for Civil construction projects, where an RFI relates to information provided by a civil designer, the time required to respond to an RFI will be comparable due to the time required for communication, administration and the resubmission of appropriate documentation.

2.13.2. Variations Orders (VOs)

Variations Orders are changes, additions or deletions to the scope of works as at the time of Contract award.

There is evidence that contractors may chase variations from the outset of a project as a means to provide profit subsequent to being engaged as a low-cost option (Cushman & Carpenter,1990*).*

On average, research has shown that there is one variation awarded for every four RFIs in building construction projects (Tilley, 1997).

Variations have the potential to disrupt contractors cashflows where there is an obligation to carry out works at the contractor's cost until the variation can be paid by the principal.

2.13.3. Extensions of Time (EoTs)

Research indicates that the effective and timely movement of information between project stakeholders is an important part of satisfactory management of construction projects (Mead, 2001).

Time lost waiting for information that should have been provided either at tendering or, at worst, at contract award, results in reduced contractor productivity. More than 20% of RFI's receive no replies (Hughes et al, 2013). Where responses are received, RFI responses are shown to be late 67% of the time. Where excessive RFIs are required the contractor is entitled to delays (and costs) for construction delivery under most forms of contract. (Leong/Tilley, 2008).

In a 2012 study on time buffers in construction project task duration, "Quality of Documents" was found to be the third most frequent (behind "Project Complexity" and "Complexity of Trade task") and most severe cause of time buffer in construction projects (Russel et al 2012)

2.13.4. Risk of abuse

Research from Navigant has shown that contractors have the ability to abuse the RFI process to increase profits made on construction projects (Hughes et al, 2013). Drew and Waggoner (2002) highlighted the following means of RFI abuse by contractors:

- Identifying clear ambiguities in the documentation that should have been addressed prior to award.
- Submitting a large number of RFIs to establish a "paper trail" to support later claims for damages related to faulty design and documentation.
- Overwhelming the designer with RFIs in order to claim delay damages (for extensions of time)
- Attempting to obtain approvals for substitution requests where the substitution is less costly than the specified product.
- Performing works identified in an RFI and then claiming a variation to the contract sum after works have been completed.

Deficient design and documentation obviously opens the consultant and client to these risks to a greater degree.

2.13.5. Disputes and litigation – Claiming excessive RFIs

Excessive RFIs have also formed the basis of legal disputes where contractors have been delayed.

In *Caddell Construction Co., Inc. vs The United States*, the Court noted the steel detailing subcontractor had issued 180 RFIs in the first month of the project. This fact was used by Caddell to claim that the original design was defective. Ultimately the Court ruled that a large number RFIs is not necessarily an indication of defective plans.

In *Dugan & Meyers Construction Co., Inc. vs Ohio Department of Administrative Services et al.* the state had received over 700 RFIs, many of which did not receive a timely response. The court determined that the state did not offer any evidence to rebut the claims that incomplete and inaccurate design documentation were the underlying cause of delay in completing the project. Dugan & Meyers ultimately did not prevail, but only because cumulative impact arguments have been rejected in Ohio previously, and the contract had no agreed and enforceable damages delay clause.

Despite some notable court rulings in favour of the client in these cases, it is unlikely that contractors will be deterred from litigation in circumstances where excessive RFIs are submitted.

2.14. Recommendations

The available research that has been examined provides recommendations for improvement in the construction industry.

In their 2005 report, *Getting it Right the first time*, Engineers Australia issued the following recommendations to address the declining performance of project documentation.

1. Better project briefs, risk management and more transparent risk allocation
2. Better communication between stakeholders
3. Increased ethics, accountability and business practices
4. Usage of an overall design manager for construction projects
5. Better training and working conditions for staff, along with better utilization of technology
6. Creation of a vision for the future for the construction industry
7. Communication, marketing and stakeholder participation in industry change
8. Continuous improvement

Figure 2.4 below shows Engineers Australia's vision for each stakeholder in the construction industry.

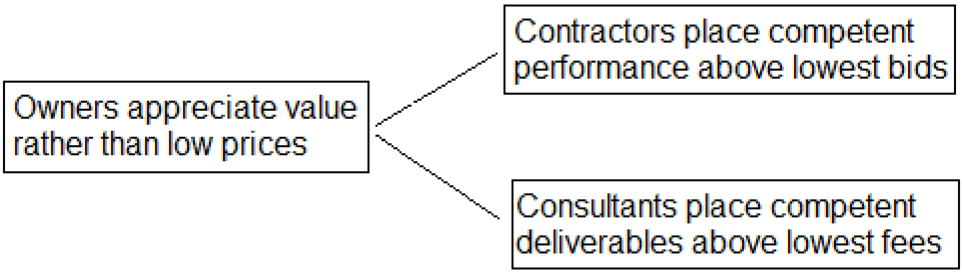


Figure 2.4: Construction Industry Stakeholder Vision (Engineers Australia, 2005)

Other more generic improvements have been suggested including:

- Professional standards raised by stakeholders
- Re-evaluation and allocation of risks
- Appointment of a design manager to monitor performance

- Appreciation of resources required for optimized designs
- Whole industry approach to skills shortages
- Optimizing use of technology
- Improving communication practices and procedures
- Developing Process control suitable for the project (ad hoc, but standardized) (Liddell, 2014)

Navigant have put in place recommendations that can be executed immediately by designers and clients, these included:

- Using a standardized RFI process
- Consider the use of software specifically for RFIs.

In contrast to some studies, Al Sehaimi and Koskela (2005) argue that the recommendations provided in previous research are too generic in nature, and where no actual tools for improvement are suggested, the utility of further traditional studies are limited.

Further studies are required to determine the actual effect of each proposed improvement. Chin (2012) found that there were no improvements to the time required for a RFI response on a case study projects utilizing a web based RFI information processing system. It was suggested that this was due to computer malfunctions, operator caused delays and batching of RFIs for submission.

CHAPTER 3: METHODOLOGY

3.1. Measuring project complexity

The existing research that has been examined on building construction clearly indicates that undesirable project outcomes attributed to poor quality project documentation. The current consensus is that while all project stakeholders are ultimately responsible for the poor quality project documentation, the root cause of the issues is project complexity.

"How do we measure project complexity?"

There are many measures of project complexity: complexity that arises from technical issues, complexity that arises from logistical issues and complexity that results directly from project stakeholder issues.

The following list details the forms of project complexity (as seen from the perspective of a professional contract administrator) that were considered for this research:

- Delivery timeframes;
- Geographic location;
- Weather conditions and issues with exposure of the site to adverse conditions;
- Materials specified and availability to source locally;
- Sophistication of proposed project and engineering solutions included in the scope;
- Availability of site information prior to design and construction;
- Physical, environmental and Government/planning constraints on the project;
- Number of design disciplines and interdependency between the design disciplines;
- Form of Contract;
- Community impacts of the proposed scope of works;
- Experience and sophistication level of project team (including principal, designer, superintendent and contractor); and
- Client type (Government level or private) and associated risk profile.

3.2. Data Source

Industry data from managing construction projects can be used for case studies. This was considered to be the best quality information available for this research as general comments, surveys and common perceptions from industry stakeholders have been utilized quite extensively by the existing research that was reviewed and summarized in Chapter 2.

The primary source of information for my research was project data from Black & More (B&M), a project management and engineering business based in Cairns. Black & More primarily manage projects in Far North Queensland, including Cape York Peninsula and the Torres Strait.

I gained permission from Black & More to use project data for this research. There was no requirement for ethics clearance from USQ to undertake case studies.

One condition of the use of the information was that projects, clients and contractors were not specifically named, instead generic reference numbers were used to identify the separate projects.

3.3. Outline of Research Methodology

The goal of the research methodology was to consider all the measures of project complexity, either by:

1. Removing the measure by only considering projects with specific parameters; or
2. Quantifying and recording the measure.

RFI data was also collected from several building projects, in order to compare the RFI data from the civil construction case studies with the existing literature reviewed in Chapter 2.

It was intended that comparing building project data would help to place any comments on civil construction RFI data and documentation quality in to context with the existing body of research on RFIs and project documentation quality in building construction projects.

3.4. Civil Construction Case Study Parameters

The following parameters were used to limit the civil construction projects that were considered for the research:

3.4.1. Type of Project

This research focuses on civil construction projects. Examples of civil construction projects used for this research include:

- Road and sealing upgrades
- Drainage upgrade works
- Subdivision projects

3.4.2. Total Number of Projects

To keep data manageable nine projects were considered for the research. Originally more projects were anticipated (25 in the initial proposal). A combination of high numbers of informal RFIs and lack of suitable projects meant the lesser number were included in the research.

3.4.3. Project Value

Projects with a value ranging from $500,000 to $15 million were included in the research.

3.4.4. Project Completion Date

Projects that have been finalized from 2010 – 2017 were included in the research so that values could be directly compared and records are relatively easy to access. Projects from the past seven years were stored electronically rather than attempting to rely on access to paper files.

3.4.5. Form of Contract

Only ‘Construction only’ projects were included for this research. This was because in ‘Design and Construct’ projects, stakeholders apportion risk and responsibility differently, with the contractor responsible for undertaking designs in-line with a performance specification. Hence ‘Design and

Construct' projects typically have RFIs of a different nature when compared with 'Construction only' projects.

3.4.6. Location

Only projects from Far North Queensland and the parts of North West Queensland that lie in Cape York Peninsula were considered for this research. Figure 3.1 below shows a map with the regions of Queensland with the areas included in the research shown in red.

Figure 3.1: Regions of Queensland (Department of State Development, 2017)

3.5. Building Case Study Parameters

The same project parameters detailed in Section 3.4 were adopted for the building case studies used to compare civil construction data with existing literature. Four building construction projects were used in the research. These projects included remote community housing infrastructure and major renovations to existing buildings.

3.6. Case Study Data

Overall 4 building projects and 9 civil construction projects were found that fit the parameters outlined in Sections 3.4 and 3.5.

For each project a generic reference number was assigned to the project (i.e. C-01), and the following data was collected:

1. Year Completed
2. Contract Sum
3. Regional Index (From Rawlinson's Construction Cost Guide)
4. Contract Type
5. Project Duration (Months)
6. Number of Design Disciplines
7. Number of Construction Plans
8. Distance to a City (Cairns)
9. Total Number of each type of RFI
10. Total Number of RFIs submitted informally
11. Total Number of RFIs
12. Number of Variations awarded
13. Sum of Variations
14. Total Extension of Time Awarded (Days)

The classification of the RFIs in each case study is based on existing research on RFIs undertaken by the CSIRO. Each classification is detailed in Table 3.1 below:

Table 3.1: RFI Types, Reference and Definition

RFI Type	Ref.	Definition
Information Clarification	ICL	The contractor requests information that is missing, unclear or wrong in the project documentation
Submissions for Approval	SAP	The contractor submits technical information or documentation for approval
Information Confirmation	ICO	The contractor requests official clarification of verbal advice or confirmation of information in documentation
Alternative Design Solutions	ADS	The contractor submits an alternative design solution for approval
Other	OTH	Any other type of RFI received

3.7. Data Analysis

From the case study data that was collected, the following was produced:

- Adjusted contract sum, accounting for locality loading.
- Mean value for building and civil construction projects of:
  - Total Number of each type of RFI
  - Total Number of RFIs submitted informally
  - Total Number of RFIs
  - Number of Variations awarded
  - Sum of Variations
- Number of RFIs per $1M of Contract Sum
- Number of RFIs per design discipline
- Number of RFIs submitted per VO awarded
- Number of ‘Information Clarification’ (ICL) RFIs per $1M of Contract Sum
- Number of ‘Information Clarification’ (ICL) RFIs per design discipline
- Number of ‘Information Clarification’ (ICL) submitted per VO awarded

Plots were used to visually determine whether there is a significant relationship between factors.

Statistical examination of the case study parameters compared with the case study data was undertaken by applying a simple linear regression model to the plots and calculating the coefficient of correlation (r value) and coefficient of determination (r^2 value). This comparison was undertaken to determine the correlation between RFIs in civil construction projects and each measure of project complexity.

Statistical examination of the case study data compared with other case study data by applying a simple linear regression model to the plots and calculating the R^2 value. This comparison was undertaken to determine the correlation between RFIs in civil construction projects and variations/extensions of time (“project consequences”). This provides circumstantial evidence regarding the cause of negative project outcomes that can be predicted by assessing RFIs.

The “business consequences” of RFIs in civil construction projects were examined from the designer and superintendent’s perspective. The quantum of this cost was estimated by estimating the time taken for each response, and multiplying that by the charge out rate typical of that project role.

Emphasis was placed on investigating the cause and consequences of ‘Information Clarification’ (ICL) RFIs. This is because RFIs of this classification are a considered to be the direct result of poor quality project documentation by the existing research. As such, information clarification RFIs are considered to be the responsibility of the designer.

3.8. Project Costs / Risk assessment

3.8.1. Project Costs

There were no costs required to undertake the research. The resources required for this project were limited as this was a desktop study.

All resources were provided by the student, with the case study data coming from industry sources. ICT requirements including hardware and Microsoft Word, Project and Excel software were provided by the student.

All information for the case studies were provided by Black & More.

3.8.2. Personal Safety Risk Assessment

The personal risks for this research project were assessed using the University of Southern Queensland’s Safety Risk Management System, as a part of the ENG4111 Progress report.

As this is a desktop study the level of risk evaluated was considered to be negligible. Things such as ergonomics hazards become an issue over a relatively long period of time. Similarly, risks such as fire, electric shock, temperature, tripping hazards were considered rare enough to not require additional controls outside of routine procedures.

CHAPTER 4: RESULTS AND DISCUSSION

4.1. Building Projects

4.1.1. Building Project 1 (B-01)

B-01 was a building project in a regional town west of Cairns, undertaken in 2015. The scope of works consisted of renovations and extensions to an existing government building. As the works were renovations, there were a lot of unknown factors at the time of design. The timeframe for the works was extended due to wet weather, and ultimately the scope of works was varied by the client during construction, leading to further delays to the overall project.

The works were undertaken by an experienced Cairns-based builder, and the form of contract was a Queensland Government Standard Contract (based on AS2124 General Conditions of Contract)

The contract sum for the works was $1,433,920.00 (GST Excl.), and the original timeframe for completion was approximately six months from contract award. 32 construction plans were included in the contract, and 5 design disciplines were included in the scope of works.

A breakdown of the project details collected for B-01 is included below in Table 4.1.

Table 4.1: B-01 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2015
Form of Contract	Queensland Government
Contract Sum (Excl. GST)	$1,422,920.00
Regional Index	1.15
Adjusted Contract Sum (Excl. GST)	$1,246,886.96
Construction Period	6 Months
Distance to Cairns	80km
Number of Design Disciplines	6
Number of Construction Plans	32

A breakdown for the RFIs received for project B-01 is shown below in Table 4.2.

Table 4.2: Breakdown of RFIs received for B-01

RFI Ref.	Number received	Percentage
Information Clarification – ICL	68	70
Submissions for Approval – SAP	6	7
Information Confirmation – ICO	11	12
Alternative Design Solutions – ADS	6	6
Other – OTH	3	3
Total RFIs received	94	
Total RFIs received informally	3	

Figure 4.1 below shows a breakdown of the RFIs received for B-01 by type.

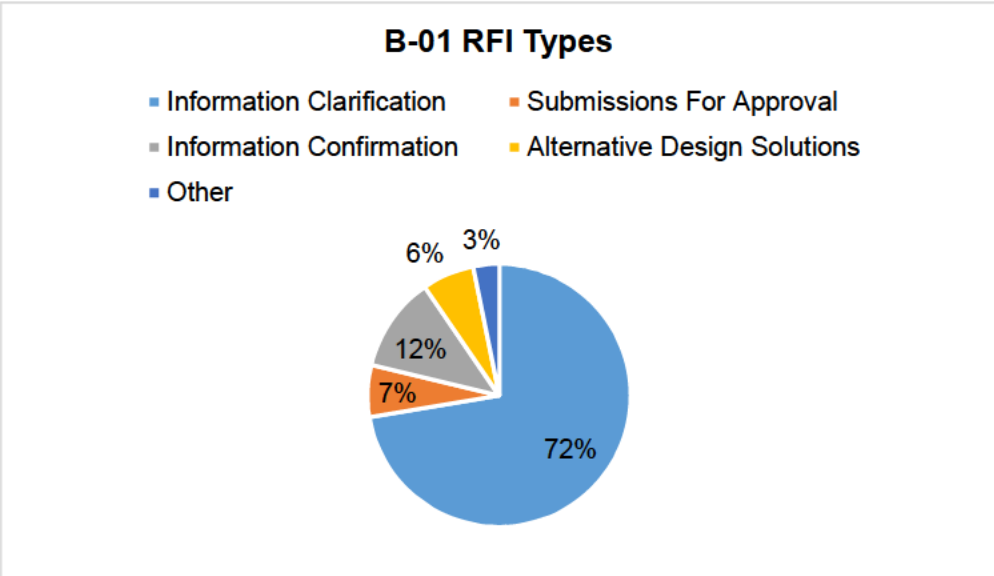


Figure 4.1: Breakdown of RFIs received for B-01 by type

For B-01, 66 variations were made to the contract sum, with a total value of $459,978.15. Overall, 27 days were awarded as extensions of time, with agreed damages for delay paid to the Contractor.

Some of the variations to the scope were undertaken following Practical Completion at the request of the client.

4.1.2. Building Project 2 (B-02)

B-02 was a housing project in a remote community in the Torres Strait, undertaken in 2015. The scope of works consisted of new houses on a recently completed subdivision. The timeframe for the works was extended due to principal and contractor caused delays.

The works were undertaken by a Cairns based builder, and the form of contract was AS2124 General Conditions of Contract

The contract sum for the works was $2,467,955.00 (GST Excl.), and the original timeframe for completion was approximately eight months from contract award. 129 construction plans were included in the contract, and seven design disciplines were included in the scope of works.

A breakdown of the project details collected for B-02 is included below in Table 4.3.

Table 4.3: B-02 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2015
Form of Contract	AS2124
Contract Sum (Excl. GST)	$2,467,955.00
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$1,371,086.11
Construction Period	8 Months
Distance to Cairns	800km
Number of Design Disciplines	7
Number of Construction Plans	129

A breakdown for the RFIs received for project B-02 is shown below in Table 4.4.

Table 4.4: Breakdown of RFIs received for B-02

RFI Ref.	Number received	Percentage
Information Clarification – ICL	44	73
Submissions for Approval – SAP	3	5
Information Confirmation – ICO	7	12
Alternative Design Solutions – ADS	3	5
Other – OTH	3	5
Total RFIs received	60	
Total RFIs received informally	3	

Figure 4.2 below shows a breakdown of the RFIs received for B-02 by type.

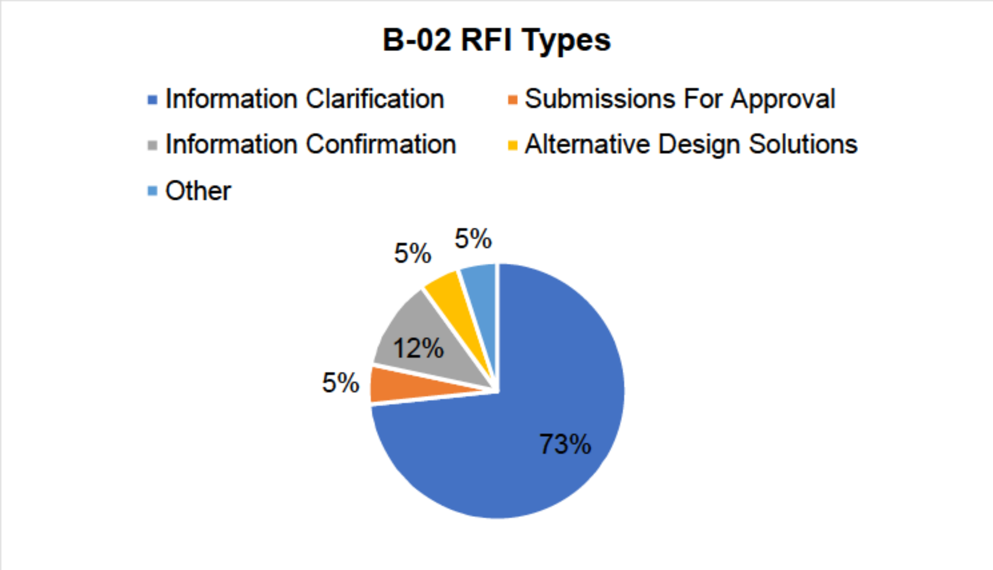


Figure 4.2: Breakdown of RFIs received for B-02 by type

For B-02, 8 variations were made to the contract sum, with a total value of -$254,850.00. Overall, 6 days were awarded as extensions of time, with Liquidated damages applied to the overrun past the agreed Practical Completion date.

4.1.3. Building Project 3 (B-03)

B-03 was a housing project in a remote community in the Torres Strait, undertaken in 2015. The scope of works consisted of new houses on a recently completed subdivision. The timeframe for the works was extended due to principal and contractor caused delays.

The works were undertaken by a Cairns based builder, and the form of contract was AS2124 General Conditions of Contract

The contract sum for the works was $4,461,431.00 GST Excl.), and the original timeframe for completion was approximately eight months from contract award. 97 construction plans were included in the contract, and seven design disciplines were included in the scope of works.

A breakdown of the project details collected for B-03 is included below in Table 4.5.

Table 4.5: B-03 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2015
Form of Contract	AS2124
Contract Sum (Excl. GST)	$4,461,431.00
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$2,478,572.78
Construction Period	8 Months
Distance to Cairns	800km
Number of Design Disciplines	7
Number of Construction Plans	97

A breakdown for the RFIs received for project B-03 is shown below in Table 4.6.

Table 4.6: Breakdown of RFIs received for B-03

RFI Ref.	Number received	Percentage
Information Clarification – ICL	94	78
Submissions for Approval – SAP	6	5
Information Confirmation – ICO	8	7
Alternative Design Solutions – ADS	8	7
Other – OTH	8	3
Total RFIs received	**120**	
Total RFIs received informally	4	

Figure 4.3 below shows a breakdown of the RFIs received for B-03 by type.

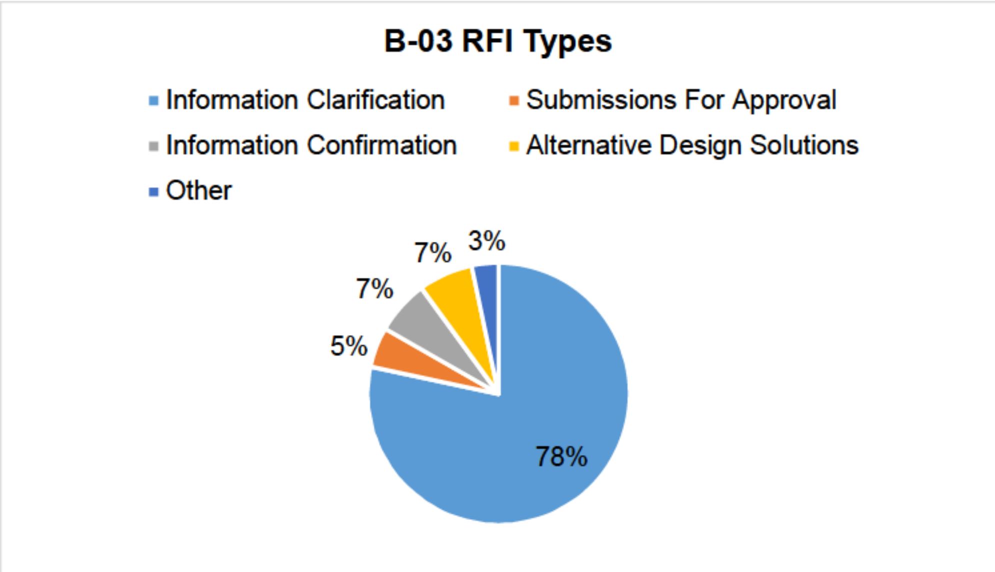


Figure 4.3: Breakdown of RFIs received for B-03 by type

For B-03, 28 variations were made to the contract sum, with a total value of $254,850.00. Overall, 5 days were awarded as extensions of time, with Liquidated damages applied to the overrun past the agreed Practical Completion date.

4.1.4. Building Project 4 (B-04)

B-04 was a housing project in a remote community in the Torres Strait, undertaken in 2015. The scope of works consisted of new houses on a recently completed subdivision. The timeframe for the works was extended due to principal and contractor caused delays.

The works were undertaken by a Cairns based builder, and the form of contract was AS2124 General Conditions of Contract

The contract sum for the works was $4,461,431.00 GST Excl.), and the original timeframe for completion was approximately eight months from contract award. 97 construction plans were included in the contract, and seven design disciplines were included in the scope of works.

A breakdown of the project details collected for B-04 is included below in Table 4.7.

Table 4.7: B-04 project details and case study parameters

Case Study Parameter	**Project Details**
Year Completed	2015
Form of Contract	AS2124
Contract Sum (Excl. GST)	$3,254,054.75
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$1,807,808.19
Construction Period	8 Months
Distance to Cairns	800km
Number of Design Disciplines	7
Number of Construction Plans	97

A breakdown for the RFIs received for project B-04 is shown below in Table 4.8.

Table 4.8: Breakdown of RFIs received for B-04

RFI Ref.	Number received	Percentage
Information Clarification – ICL	86	83
Submissions for Approval – SAP	6	6
Information Confirmation – ICO	6	6
Alternative Design Solutions – ADS	3	3
Other – OTH	2	2
Total RFIs received	**103**	
Total RFIs received informally	2	

Figure 4.4 below shows a breakdown of the RFIs received for B-04 by type.

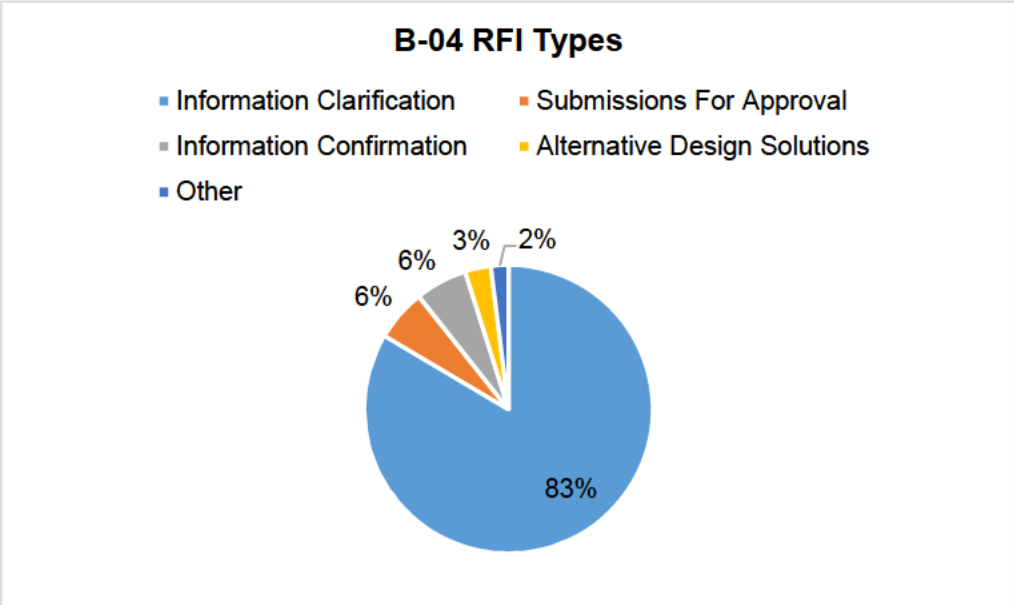


Figure 4.4: Breakdown of RFIs received for B-04 by type

For B-04, 25 variations were made to the contract sum, with a total value of $268,261.36. Overall, 4 days were awarded as extensions of time, with Liquidated damages applied to the overrun past the agreed Practical Completion date.

4.1.5. Building Projects overview

Figure 4.5 below shows the average breakdown of the RFIs received for the building projects examined.

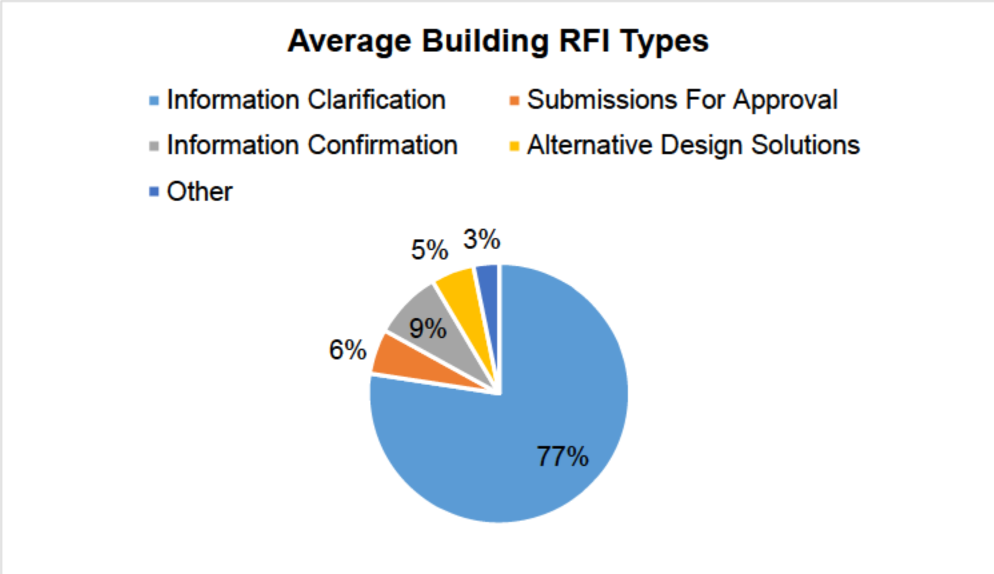


Figure 4.5: Breakdown of RFIs received for building projects by type

4.2. Civil Construction Projects

4.2.1. Civil Construction Project 1 (C-01)

C-01 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2016. The scope of works consisted of upgrades to three creek crossings on a community road by means of large (~300m long) concrete causeways, with concrete approaches and reinforced box culverts for minor drainage. The works were completed on time, and on budget despite constraints with local concrete availability and the annual wet season.

The works were undertaken by an experienced civil contractor, and the contract was based on AS2124 General Conditions of Contract.

The contract sum for the works was $4,246,387.87 (GST Excl.), and the original timeframe for completion was approximately four months from contract award. 20 construction plans were included in the contract, and 2 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-01 is included below in Table 4.9.

Table 4.9: C-01 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2016
Form of Contract	AS2124
Contract Sum (Excl. GST)	$4,246,378.87
Regional Index	1.70
Adjusted Contract Sum (Excl. GST)	$2,497,869.92
Construction Period	4 Months
Distance to Cairns	606km
Number of Design Disciplines	2
Number of Construction Plans	20

A breakdown for the RFIs received for project C-01 is shown below in Table 4.10.

Table 4.10: Breakdown of RFIs received for C-01

RFI Ref.	Number received	Percentage
Information Clarification – ICL	10	34
Submissions for Approval – SAP	7	24
Information Confirmation – ICO	4	14
Alternative Design Solutions – ADS	4	14
Other – OTH	4	14
Total RFIs received	**29**	
Total RFIs received informally	22	

Figure 4.6 below shows a breakdown of the RFIs received for C-01 by type.

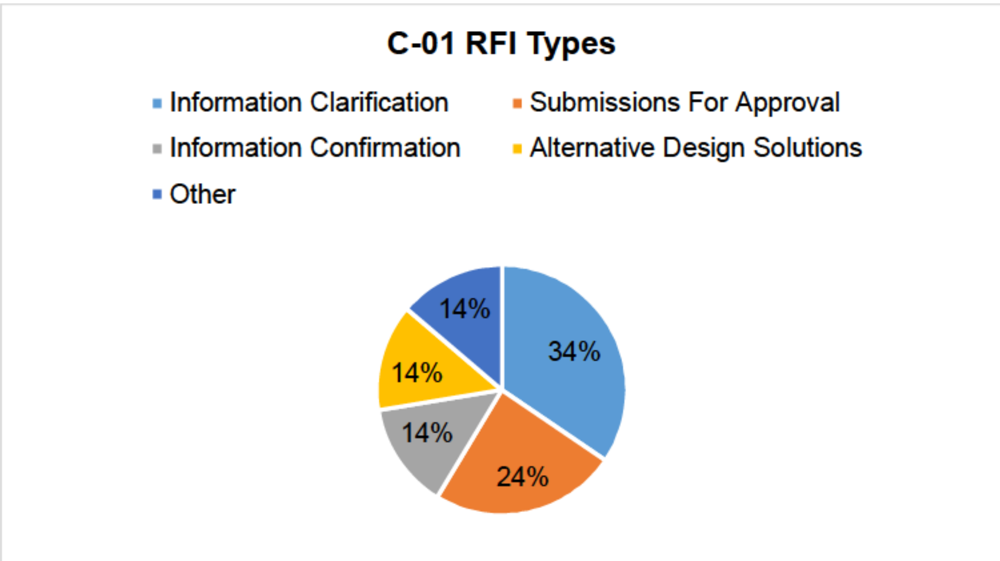


Figure 4.6: Breakdown of RFIs received for B-01 by type

For C-01, 14 variations were made to the contract sum, with a total value of -$14,936.84. Overall, 0 days were claimed and awarded as extensions of time.

4.2.2. Civil Construction Project 2 (C-02)

C-02 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2015/16. The scope of works consisted of rectification of natural disaster damage to the community access road, along with drainage upgrades to six creek crossings and approximately 5km of bitumen sealing to the road. The works were completed over two years, due to road closures and load limits during the annual wet season. The only timing constraints placed on the contractor by the client were based around funding expiry deadlines.

The works were undertaken by a civil contractor with experience in the region, and the form of contract AS2124 General Conditions of Contract.

The contract sum for the works was $12,588,417.77 (GST Excl.), and the original timeframe for completion was approximately 16 months from contract award. 11 construction plans were included in the contract, and 3 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-02 is included below in Table 4.11.

Table 4.11: C-02 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2016
Form of Contract	AS2124
Contract Sum (Excl. GST)	$12,588,417.77
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$6,993,565.43
Construction Period	16 Months
Distance to Cairns	766km
Number of Design Disciplines	3
Number of Construction Plans	11

A breakdown for the RFIs received for project C-02 is shown below in Table 4.12.

Table 4.12: Breakdown of RFIs received for C-02

RFI Ref.	Number received	Percentage
Information Clarification – ICL	14	24
Submissions for Approval – SAP	14	23
Information Confirmation – ICO	10	17
Alternative Design Solutions – ADS	11	18
Other – OTH	11	18
Total RFIs received	**60**	
Total RFIs received informally	55	

Figure 4.7 below shows a breakdown of the RFIs received for C-02 by type.

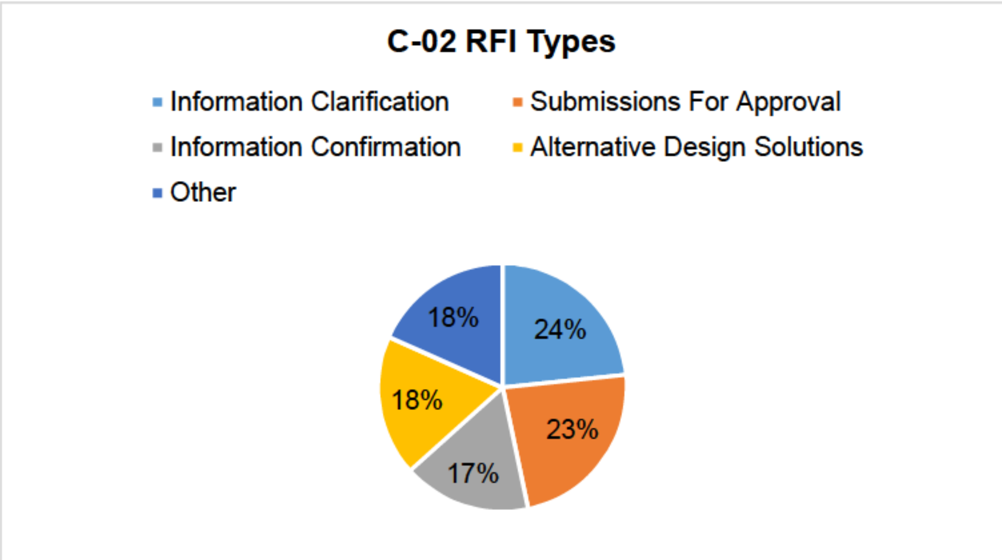


Figure 4.7: Breakdown of RFIs received for C-02 by type

For C-02, 10 variations were made to the contract sum, with a total value of $389,713.69. Overall, 36 days were claimed and awarded as extensions of time.

The variations to the contract included works unrelated to the original scope, including provision of a concrete works in other parts of the community.

4.2.3. Civil Construction Project 3 (C-03)

C-03 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2016. The scope of works consisted of drainage upgrades to eight creek crossings and approximately 6km of bitumen sealing to the main access road, an existing concrete causeway river crossing was also upgraded and repaired under the contract.

The works were undertaken by a civil contractor with experience in the region, and the form of contract AS2124 General Conditions of Contract.

The contract sum for the works was $4,531,593.00 (GST Excl.), and the original timeframe for completion was approximately 4 months from contract award. 25 construction plans were included in the contract, and 3 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-03 is included below in Table 4.13.

Table 4.13: C-03 project details and case study parameters

Case Study Parameter	**Project Details**
Year Completed	2016
Form of Contract	AS2124
Contract Sum (Excl. GST)	$4,531,593.00
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$2,517,551.67
Construction Period	4 Months
Distance to Cairns	766km
Number of Design Disciplines	3
Number of Construction Plans	25

A breakdown for the RFIs received for project C-03 is shown below in Table 4.14.

Table 4.14: Breakdown of RFIs received for C-03

RFI Ref.	**Number received**	**Percentage**
Information Clarification – ICL	7	17
Submissions for Approval – SAP	6	15
Information Confirmation – ICO	10	25
Alternative Design Solutions – ADS	11	28
Other – OTH	6	15
Total RFIs received	**40**	
Total RFIs received informally	40	

Figure 4.8 below shows a breakdown of the RFIs received for C-03 by type.

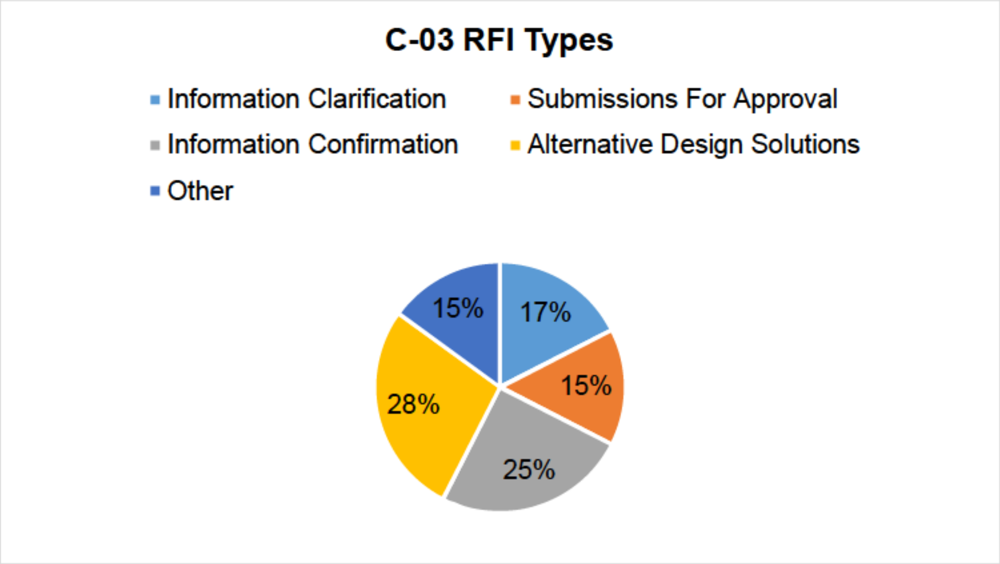


Figure 4.8: Breakdown of RFIs received for C-03 by type

For C-03, 13 variations were made to the contract sum, with a total value of $312,291.62. Overall, 12 days were claimed and awarded as extensions of time.

4.2.4. Civil Construction Project 4 (C-04)

C-04 was a civil construction project in a remote community in the Torres Strait, undertaken in 2015. The scope of works consisted of a subdivision on a hilly site.

The works were undertaken by an experienced Cairns-based contractor, and the form of contract was a AS2124 General Conditions of Contract.

The contract sum for the works was $3,093,509.73 (GST Excl.), and the original timeframe for completion was approximately four months from contract award. 17 construction plans were included in the contract, and four design disciplines were included in the scope of works.

A breakdown of the project details collected for C-04 is included below in Table 4.15.

Table 4.15 C-04 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2015
Form of Contract	AS2124
Contract Sum (Excl. GST)	$3,093,509.73
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$1,718,616.52
Construction Period	4 Months
Distance to Cairns	800km
Number of Design Disciplines	4
Number of Construction Plans	17

A breakdown for the RFIs received for project C-04 is shown below in Table 4.16.

Table 4.16: Breakdown of RFIs received for C-04

RFI Ref.	Number received	Percentage
Information Clarification – ICL	9	21
Submissions for Approval – SAP	13	30
Information Confirmation – ICO	6	14
Alternative Design Solutions – ADS	7	16
Other – OTH	8	19
Total RFIs received	**43**	
Total RFIs received informally	43	

Figure 4.9 below shows a breakdown of the RFIs received for C-04 by type.

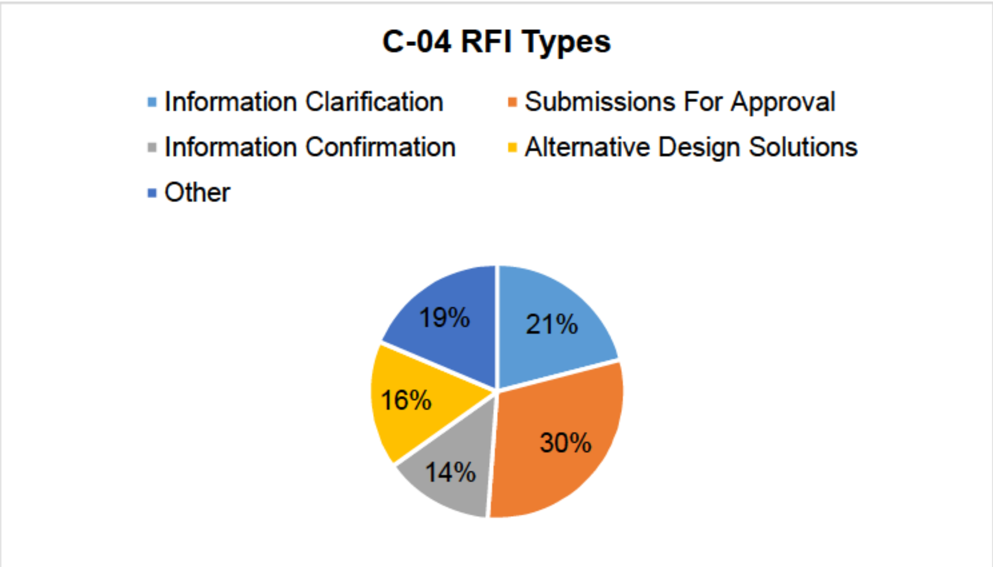


Figure 4.9: Breakdown of RFIs received for C-04 by type

For C-04, 17 variations were made to the contract sum, with a total value of $442,288.11. Overall, 50 days were awarded as extensions of time.

4.2.5. Civil Construction Project 5 (C-05)

C-05 was a civil construction project in a regional town North of Cairns, undertaken in 2015. The scope of works consisted of upgrades to the waterfront precinct, including roadworks, retaining structures, erosion control and some minor building works.

The works were undertaken by the local council, with portions of the work undertaken by subcontractors engaged under AS2124 General Conditions of Contract.

The total contract value for the works was $5,599,213 (GST Excl.), and the original timeframe for completion was approximately twelve months from contract award. 76 construction plans were included in the contract, and 6 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-05 is included below in Table 4.17.

Table 4.17 C-05 project details and case study parameters

Case Study Parameter	**Project Details**
Year Completed	2015
Form of Contract	AS2124
Contract Sum (Excl. GST)	$5,599,213.00
Regional Index	1.40
Adjusted Contract Sum (Excl. GST)	$3,999,437.86
Construction Period	12 Months
Distance to Cairns	327km
Number of Design Disciplines	6
Number of Construction Plans	76

A breakdown for the RFIs received for project C-05 is shown below in Table 4.18.

Table 4.18: Breakdown of RFIs received for C-05

RFI Ref.	Number received	Percentage
Information Clarification – ICL	30	43
Submissions for Approval – SAP	8	12
Information Confirmation – ICO	15	22
Alternative Design Solutions – ADS	7	10
Other – OTH	9	13
Total RFIs received	**69**	
Total RFIs received informally	59	

Figure 4.10 below shows a breakdown of the RFIs received for C-05 by type.

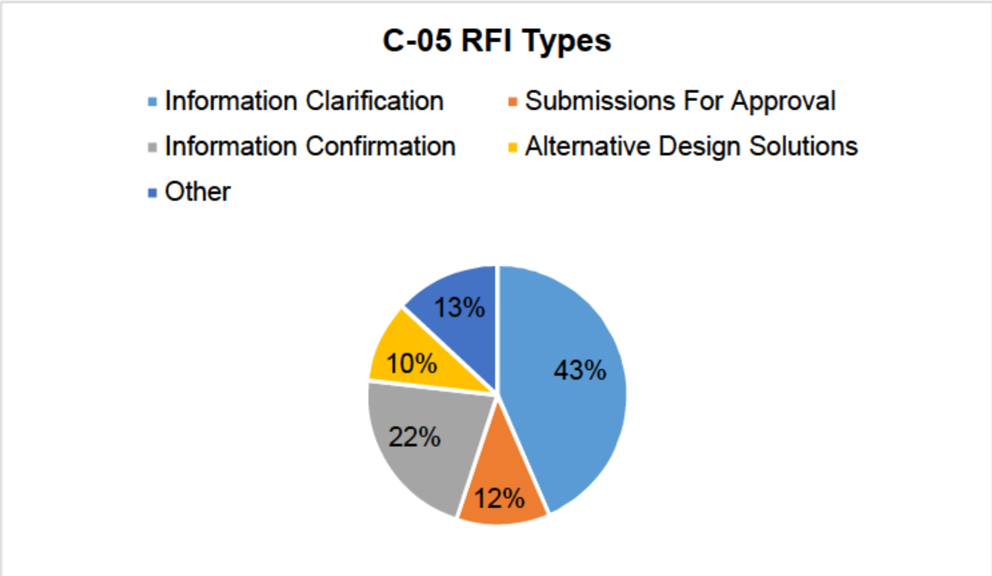


Figure 4.10: Breakdown of RFIs received for C-05 by type

For C-05, 25 variations were made to the contract sum, with a total value of $536,953.24. Overall, 35 days were awarded as extensions of time.

4.2.6. Civil Construction Project 6 (C-06)

C-06 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2016. The scope of works consisted of upgrades and sealing of the esplanade nearby the community, including a large concrete intersection to the access road, barge ramp and esplanade.

The works were undertaken as a joint venture between the local council and a civil contractor based in the region, and the form of contract was based on AS2124 General Conditions of Contract.

The contract sum for the works was $646,822.00 (GST Excl.), and the original timeframe for completion was approximately 8 months from contract award. 8 construction plans were included in the contract, and 2 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-06 is included below in Table 4.19.

Table 4.19: C-06 project details and case study parameters

Case Study Parameter	**Project Details**
Year Completed	2016
Form of Contract	AS2124
Contract Sum (Excl. GST)	$646,822.00
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$359,345.56
Construction Period	8 Months
Distance to Cairns	766km
Number of Design Disciplines	2
Number of Construction Plans	8

A breakdown for the RFIs received for project C-06 is shown below in Table 4.20.

Table 4.20: Breakdown of RFIs received for C-06

RFI Ref.	Number received	Percentage
Information Clarification – ICL	6	25
Submissions for Approval – SAP	4	17
Information Confirmation – ICO	4	17
Alternative Design Solutions – ADS	4	17
Other – OTH	6	25
Total RFIs received	24	
Total RFIs received informally	24	

Figure 4.11 below shows a breakdown of the RFIs received for C-06 by type.

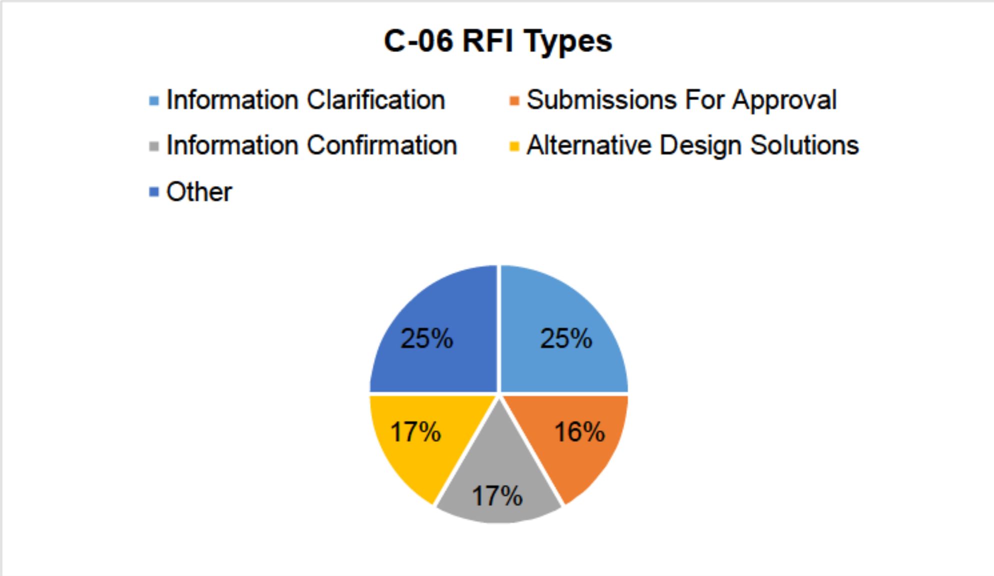


Figure 4.11: Breakdown of RFIs received for C-06 by type

For C-06, 1 variation was made to the contract sum, with a value of $200,454.00. Overall, 22 days were claimed and awarded as extensions of time.

4.2.7. Civil Construction Project 7 (C-07)

C-07 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2010. The scope of works consisted of a new subdivision, with a large sewer rising main and water connection to the nearby community.

The works were undertaken under two separate contractors, awarded to one Cairns-based civil contractor. The form of contract was AS2124 General Conditions of Contract.

The contract sum for the works was $4,700,00 (GST Excl.), and the original timeframe for completion was approximately 9 months from contract award. 59 construction plans were included in the contract, and 3 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-07 is included below in Table 4.21.

Table 4.21: C-07 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2010
Form of Contract	AS2124
Contract Sum (Excl. GST)	$4,700,000.00
Regional Index	1.50
Adjusted Contract Sum (Excl. GST)	$3,133,333.33
Construction Period	9 Months
Distance to Cairns	372km
Number of Design Disciplines	3
Number of Construction Plans	59

A breakdown for the RFIs received for project C-07 is shown below in Table 4.22.

Table 4.22: Breakdown of RFIs received for C-07

RFI Ref.	Number received	Percentage
Information Clarification – ICL	11	38
Submissions for Approval – SAP	7	24
Information Confirmation – ICO	3	11
Alternative Design Solutions – ADS	5	17
Other – OTH	3	10
Total RFIs received	**29**	
Total RFIs received informally	11	

Figure 4.12 below shows a breakdown of the RFIs received for C-07 by type.

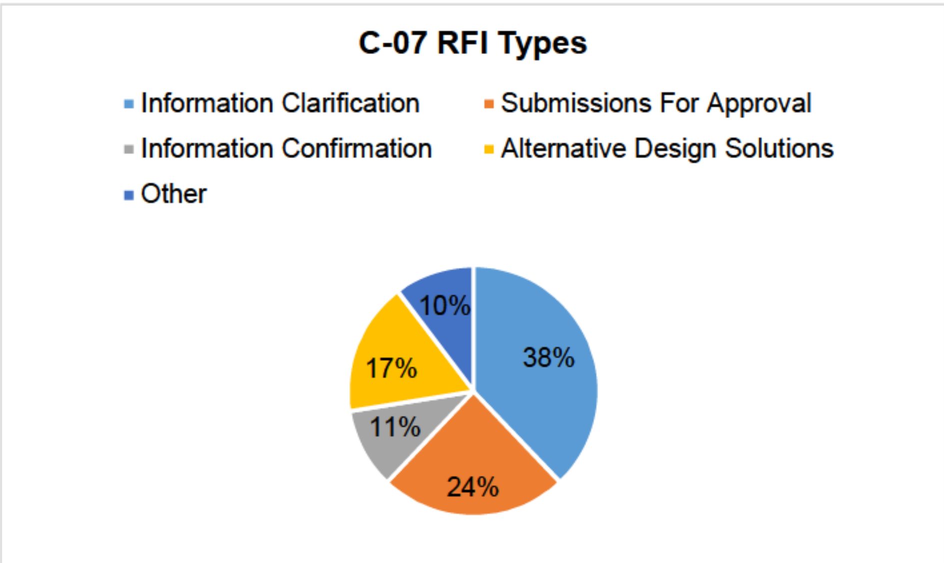


Figure 4.12: Breakdown of RFIs received for C-07 by type

For C-06, 38 variations were made to the contract sum, with a value of $138,757.00. Overall, 31 days were claimed and awarded as extensions of time.

4.2.8. Civil Construction Project 8 (C-08)

C-08 was a civil construction project undertaken in a remote indigenous community in Cape York Peninsula, in 2014. The scope of works consisted a new subdivision within the community.

The works were undertaken by a Cairns-based contractor, specializing in building works. There is an ongoing legal dispute between the principal contractor and the subcontractor who provided the concrete for the subdivision works. The Contract was based on AS2124 General Conditions of Contract

The contract sum for the works was $3,186,777.20 (GST Excl.), and the original timeframe for completion was approximately six months from contract award. 33 construction plans were included in the contract, and 2 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-08 is included below in Table 4.23.

Table 4.23: C-08 project details and case study parameters

Case Study Parameter	Project Details
Year Completed	2014
Form of Contract	AS2124
Contract Sum (Excl. GST)	$3,186,777.20
Regional Index	1.80
Adjusted Contract Sum (Excl. GST)	$1,770,431.78
Construction Period	6 Months
Distance to Cairns	766km
Number of Design Disciplines	2
Number of Construction Plans	33

A breakdown for the RFIs received for project C-08 is shown below in Table 4.24.

Table 4.24: Breakdown of RFIs received for C-08

RFI Ref.	**Number received**	**Percentage**
Information Clarification – ICL	15	47
Submissions for Approval – SAP	7	22
Information Confirmation – ICO	3	9
Alternative Design Solutions – ADS	4	13
Other – OTH	3	9
Total RFIs received	**32**	
Total RFIs received informally	30	

Figure 4.13 below shows a breakdown of the RFIs received for C-08 by type.

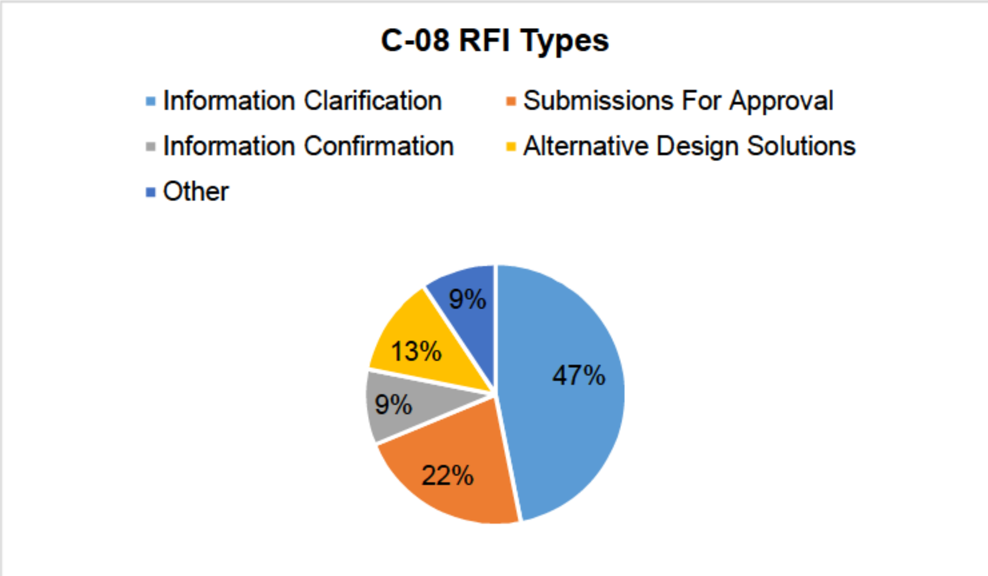


Figure 4.13: Breakdown of RFIs received for C-08 by type

For C-08, 1 variation was made to the contract sum, with a value of -$20,000.00. Overall, 54 days were claimed and awarded as extensions of time.

4.2.9. Civil Construction Project 9 (C-09)

C-09 was a civil construction project undertaken in Cairns, in 2014. The scope of works consisted of drainage, earthworks, retaining wall, road pavement and intersection works associated with extensions to a shopping Centre car park.

The works were undertaken by a Cairns-based contractor, and the form of contract was AS2124 General Conditions of Contract. The works interfaced with other contracts and designers as car park and intersection upgrades were undertaken alongside an extension to the main building.

The contract sum for the works was $1,408,001.00 (GST Excl.), and the original timeframe for completion was approximately 8 months from contract award. 62 construction plans were included in the contract, and 4 design disciplines were included in the scope of works.

A breakdown of the project details collected for C-09 is included below in Table 4.25.

Table 4.25: C-09 project details and case study parameters

Case Study Parameter	**Project Details**
Year Completed	2014
Form of Contract	AS2124
Contract Sum (Excl. GST)	$1,408,001.00
Regional Index	1.09
Adjusted Contract Sum (Excl. GST)	$1,291,744.04
Construction Period	8 Months
Distance to Cairns	0km
Number of Design Disciplines	3
Number of Construction Plans	62

A breakdown for the RFIs received for project C-09 is shown below in Table 4.26.

Table 4.26: Breakdown of RFIs received for C-09

RFI Ref.	**Number received**	**Percentage**
Information Clarification – ICL	33	49
Submissions for Approval – SAP	15	22
Information Confirmation – ICO	10	15
Alternative Design Solutions – ADS	5	7
Other – OTH	5	7
Total RFIs received	**68**	
Total RFIs received informally	53	

Figure 4.14 below shows a breakdown of the RFIs received for C-06 by type.

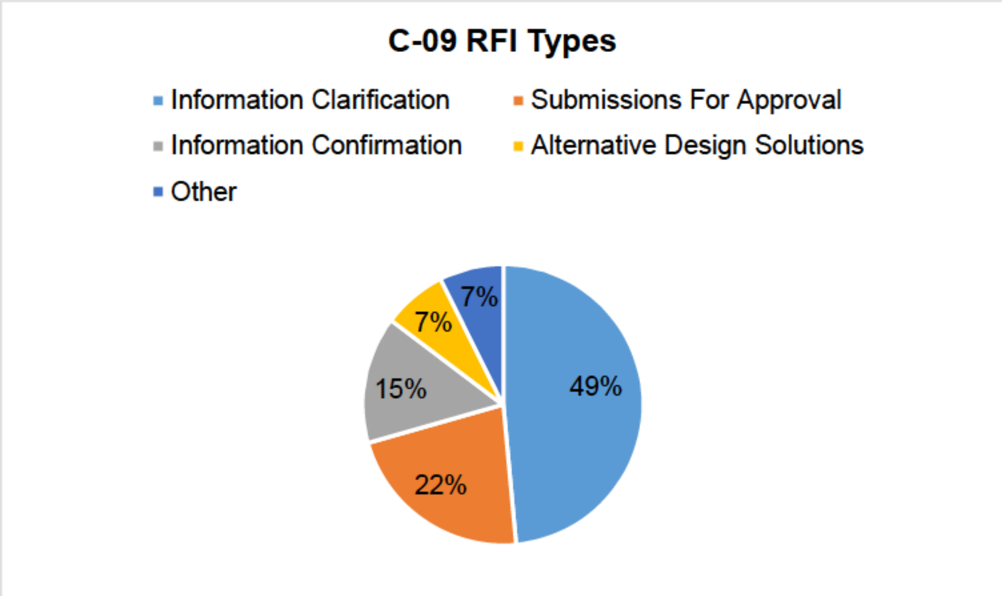


Figure 4.14: Breakdown of RFIs received for C-09 by type

For C-09, 20 variations were made to the contract sum, with a value of $360,444.15. Overall, 114 days were awarded as extensions of time.

4.2.10. Civil Construction Projects overview

Figure 4.15 below shows the average breakdown of the RFIs received for the civil construction projects examined.

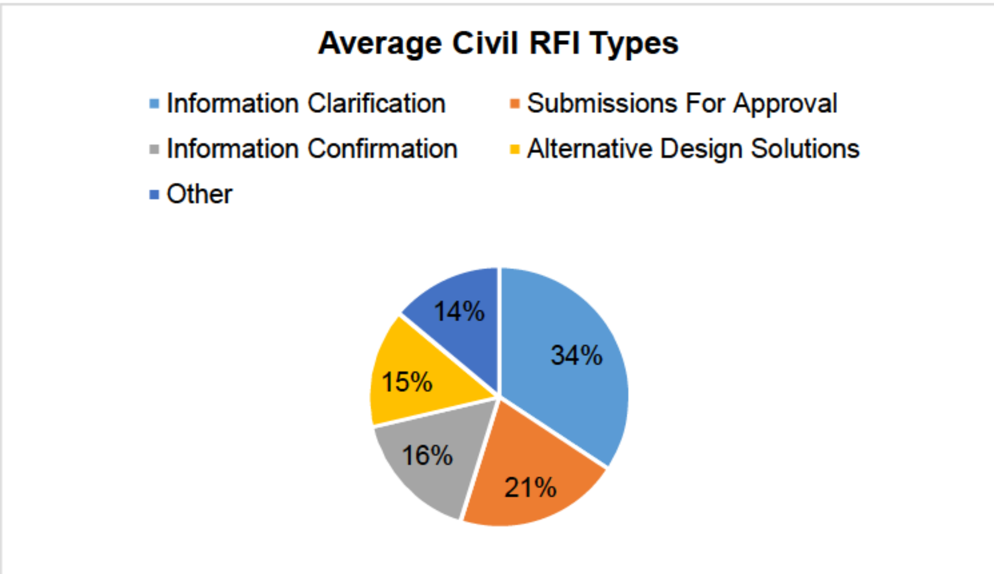


Figure 4.15: Breakdown of RFIs received for civil construction projects by type

4.3. Case Study RFIs

4.3.1. Total Number of RFIs Received

Figure 4.16 below shows the total number of RFIs received in each of the case studies examined as a part of this research. The building construction case studies are shown in blue, and civil construction case studies are shown in orange.

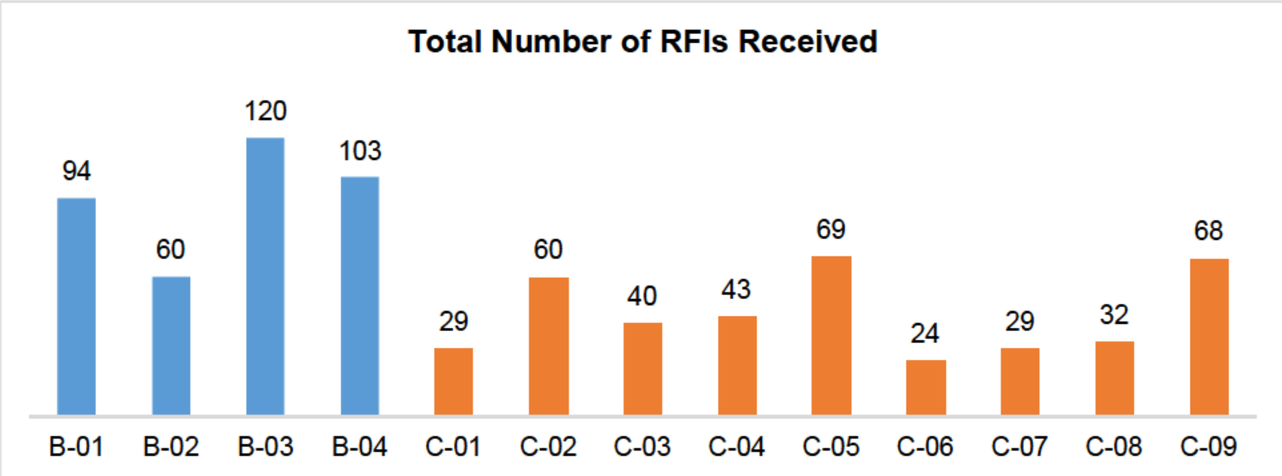


Figure 4.16: Total number of RFIs received by project

There was an average of 94.3 RFIs received per building construction case study, with a standard deviation of 21.9 and an average of 43.8 RFIs received per civil construction case study, with a standard deviation of 16.6.

The number of RFIs received were divided by the construction cost (in millions of dollars) to account for the different relative sizes of each case study project. Figure 4.17 below shows the number of RFIs received for each case study per million dollars of construction cost.

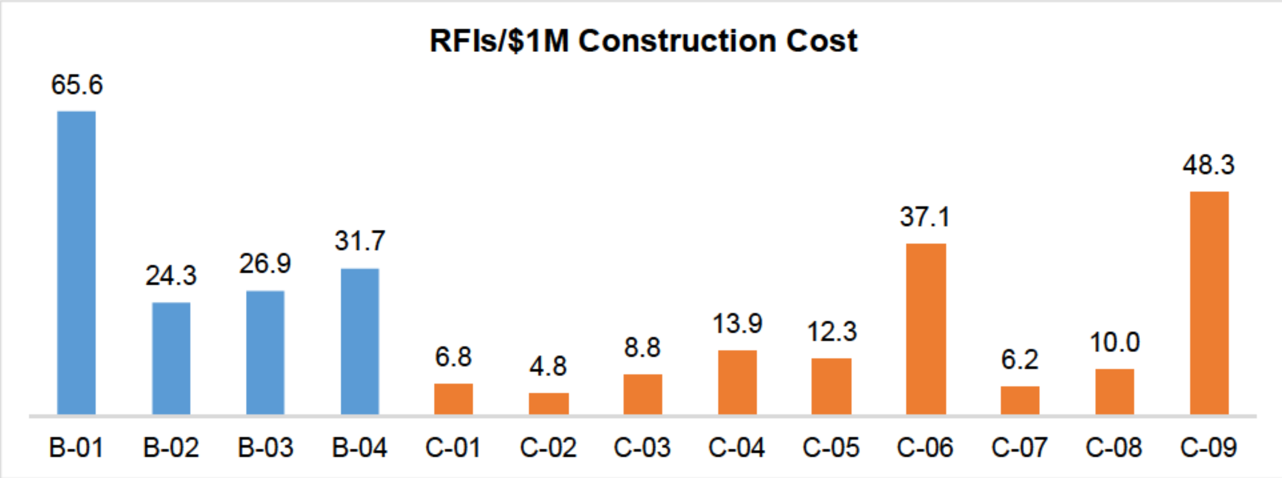


Figure 4.17: RFIs per $1M by case study project

On average, the building projects received significantly more RFIs per million dollars of construction cost, with an average of 37.1, compared to an average of 16.5 RFIs received per million dollars of construction cost for the civil construction projects.

It is noted that the number of RFIs received when accounting for construction cost varied significantly between projects.

4.3.2. Number of Information Clarification RFIs Received

Figure 4.18 below shows the number of Information Clarification RFIs received in each of the case studies examined as a part of this research. The building construction case studies are shown in blue, and civil construction case studies are shown in orange.

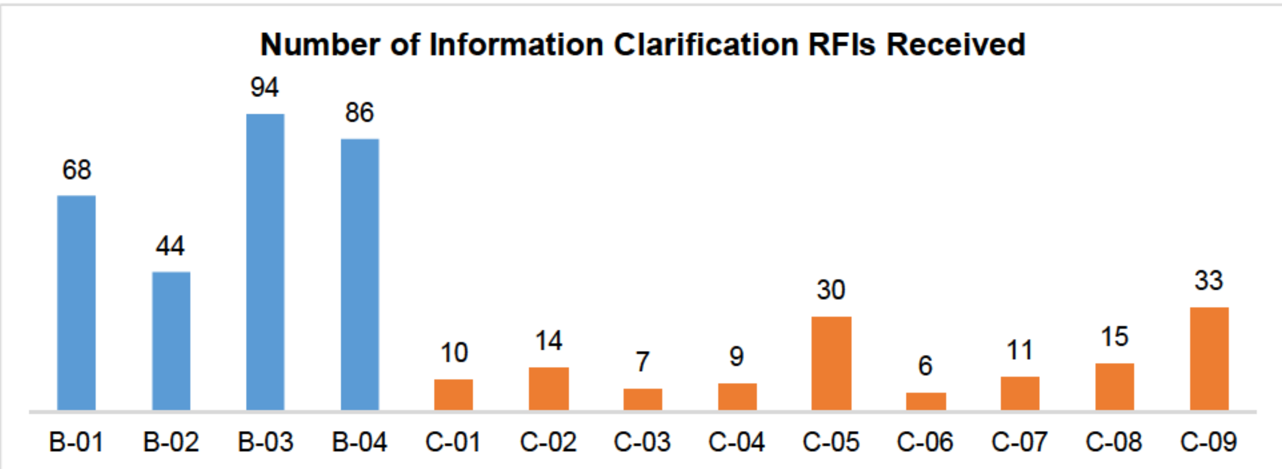


Figure 4.18: Total number of 'Information Clarification' RFIs received by project

There was an average of 73.0 information clarification RFIs received per building construction case study, with a standard deviation of 19.2 and an average of 15.0 RFIs received per civil construction case study, with a standard deviation of 9.3.

The number of information clarification RFIs received were divided by the construction cost (in millions of dollars) to account for the different relative sizes of each case study project. Figure 4.19 below shows the number of information clarification RFIs received for each case study per million dollars of construction cost.

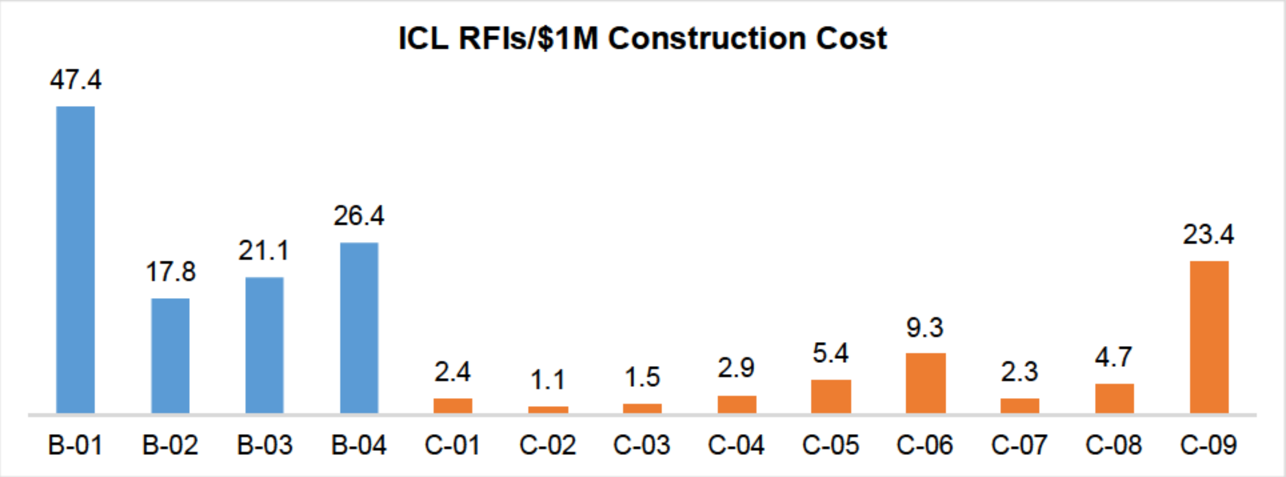


Figure 4.19: ICL RFIs per $1M by case study project

On average, the building projects received significantly more RFIs per million dollars of construction cost, with an average of 28.2, compared to an average of 5.9 RFIs received per million dollars of construction cost for the civil construction projects.

4.3.3. Number of Informal RFIs

Figure 4.20 below shows the number of informal RFIs for each of the case study projects.

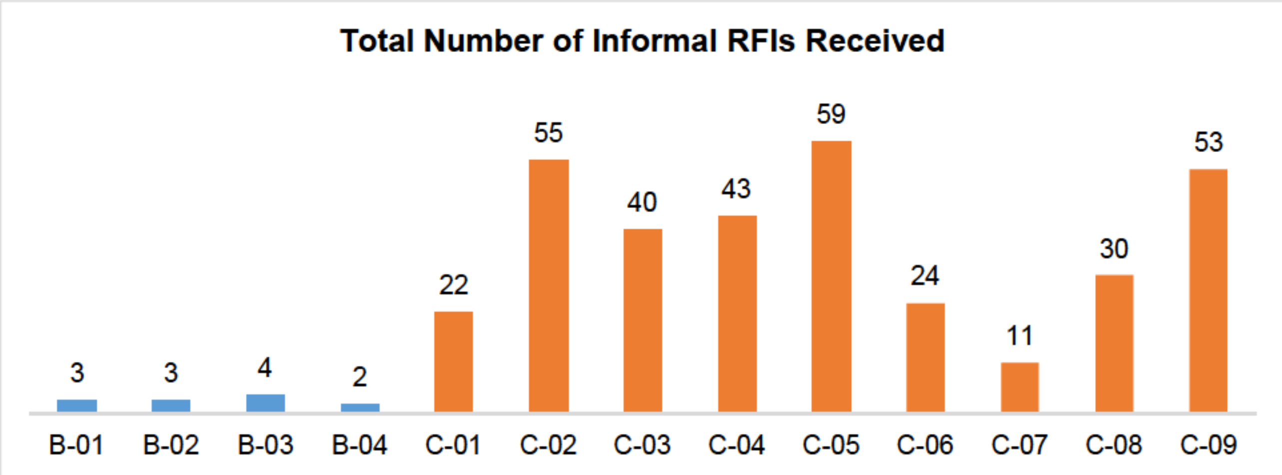


Figure 4.20: Total number of informal RFIs received by project

It is clear from this chart that significantly greater numbers of RFIs are being submitted informally in civil construction projects, rather than being submitted and tracked in a controlled manner.

4.4. Comparison with Literature

The building construction case studies were primarily undertaken to link the civil construction case studies to the existing research that primarily focuses on building construction projects. The comparison was undertaken by comparing the number of RFIs received per $1M of construction cost and comparing the proportion of each RFI classification received.

4.4.1. Comparison of the breakdown of RFIs received

Figure 4.21 below shows a breakdown of the RFIs received for each of the building

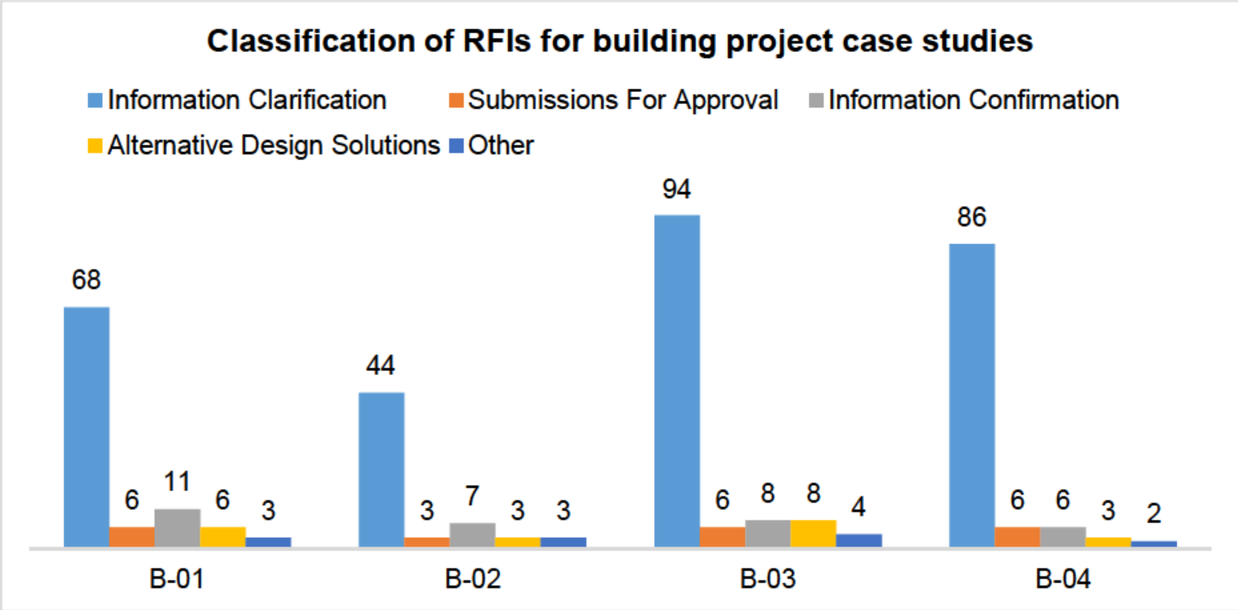


Figure 4.21: Breakdown of RFIs received in building case studies by classification

The breakdown of the RFIs equates to an average of 77% of the total RFIs submitted a result of inconsistencies, errors or omissions (as information clarifications).

Research undertaken using case studies in 1997 found that 57.4% and 64.6% of RFIs were submitted for two building construction projects. Figure 4.22 below shows a breakdown of RFIs by type for these projects.

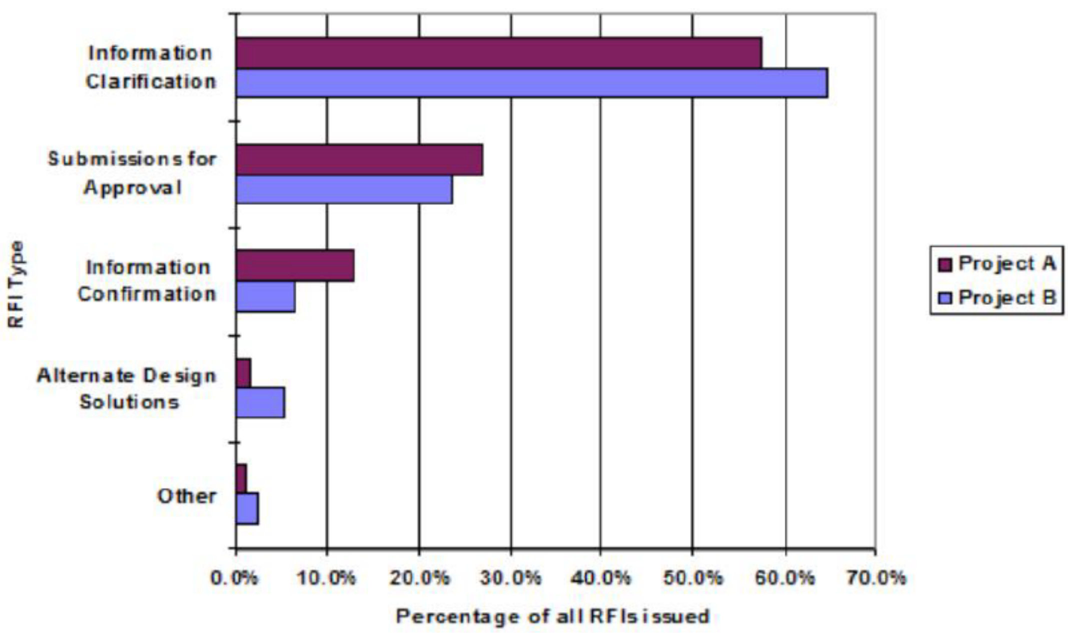


Figure 4.22: RFI Types encountered for building construction projects (Tilley, 1997)

Although a lesser proportion of information clarification RFIs were submitted in the literature, the projects used for case studies were significantly larger projects – new buildings with 7,400m^2 and 13,000m^2 gross floor area respectively, compared with regional and remote building projects with less $5M construction cost.

It is noted that during larger construction projects there would be a significantly higher proportion of RFIs relating to submissions requiring approval by the superintendent or confirmation of onsite discussion. This is reflected in the differences between the case studies used in this project and the existing research.

4.4.2. Comparison of number of RFIs received per $1M

On average, the building case study projects received 28.2 RFIs per million dollars of construction cost, for projects with a construction cost between $1.4M and $4.5M.

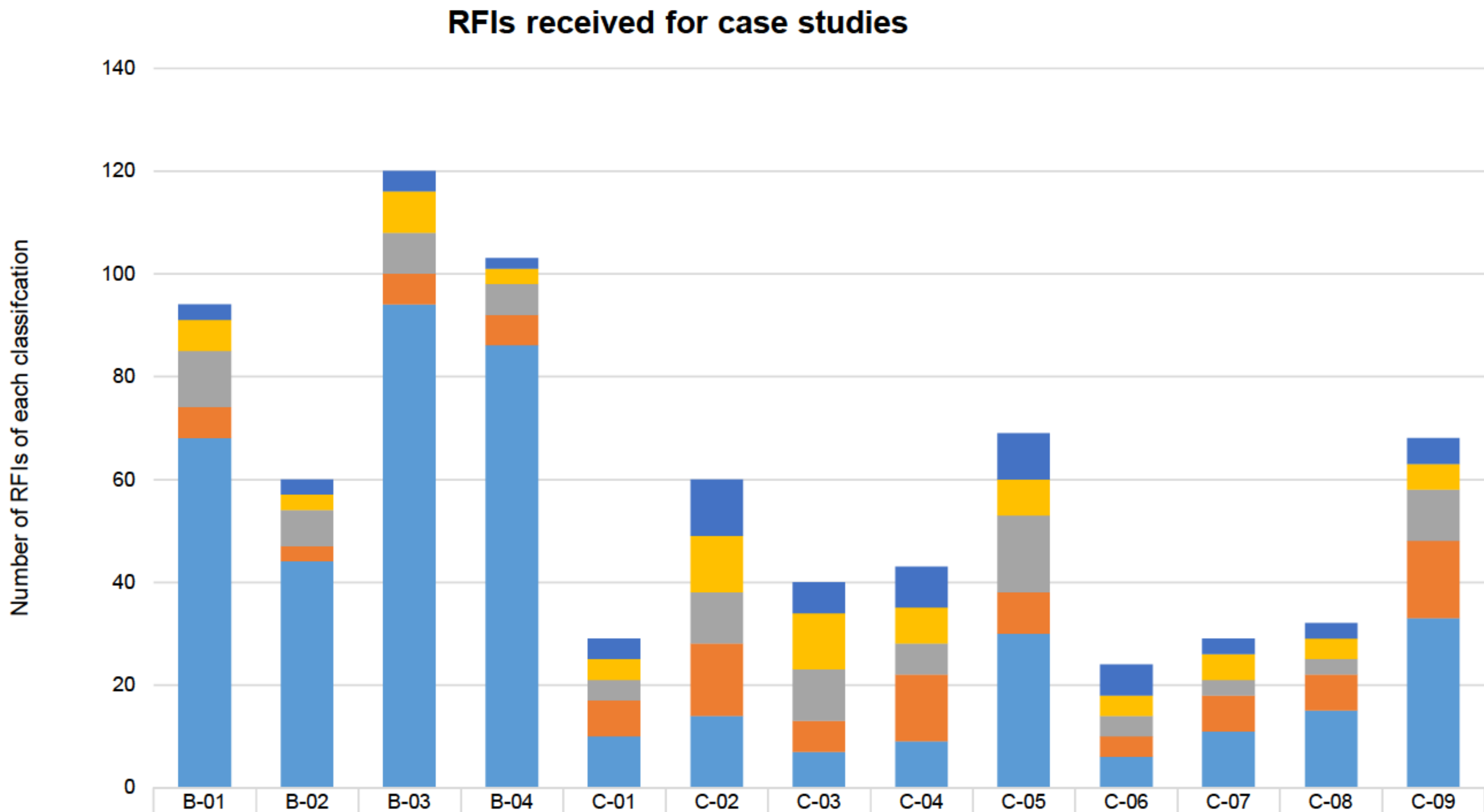
Research undertaken by Navigant using ACONEX project data found that an average of 17.2 RFIs were submitted per million dollars for projects with a construction value of $5M - $50M (Navigant, 2013).

Significantly more RFIs were received for the building case studies, however it is as expected that a greater number of RFIs would be received per $1M on smaller construction projects.

Overall the results from the building case studies were considered to be comparable to the existing research.

4.5. Comparison of Building and Civil Construction RFIs

Figure 4.24 below shows the total RFIs received for each case study broken down by RFI classification.



	B-01	B-02	B-03	B-04	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08	C-09
Other	3	3	4	2	4	11	6	8	9	6	3	3	5
Alternative Design Solutions	6	3	8	3	4	11	11	7	7	4	5	4	5
Information Confirmation	11	7	8	6	4	10	10	6	15	4	3	3	10
Submissions For Approval	6	3	6	6	7	14	6	13	8	4	7	7	15
Information Clarification	68	44	94	86	10	14	7	9	30	6	11	15	33

Figure 4.23: RFIs received for each project separated by classification

Figure 4.25 below shows the average percentage breakdown of RFI classifications received for the building construction case studies.

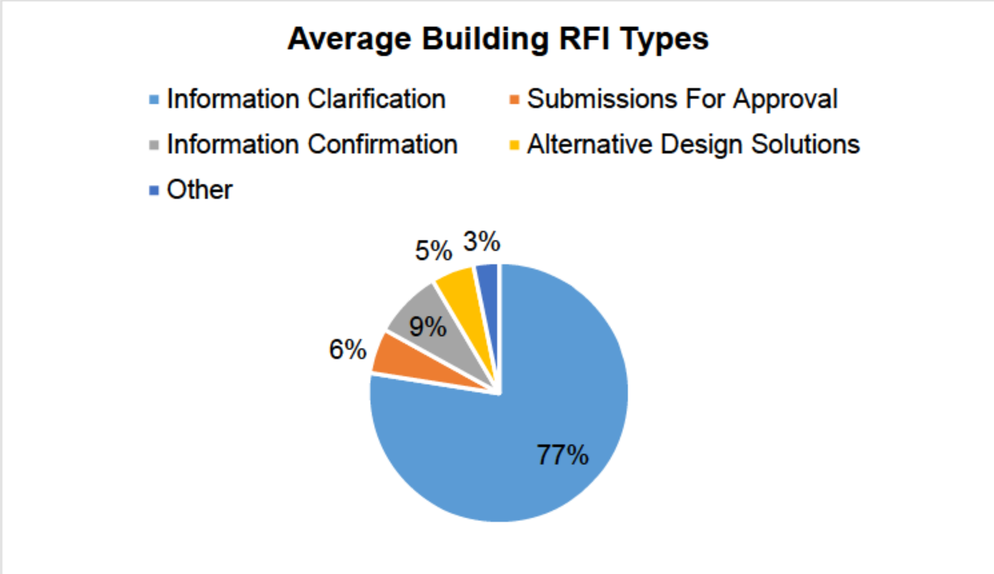


Figure 4.24: Breakdown of RFIs received for building construction projects by type

Figure 4.26 below shows the average percentage breakdown of RFI classifications received for the civil construction case studies.

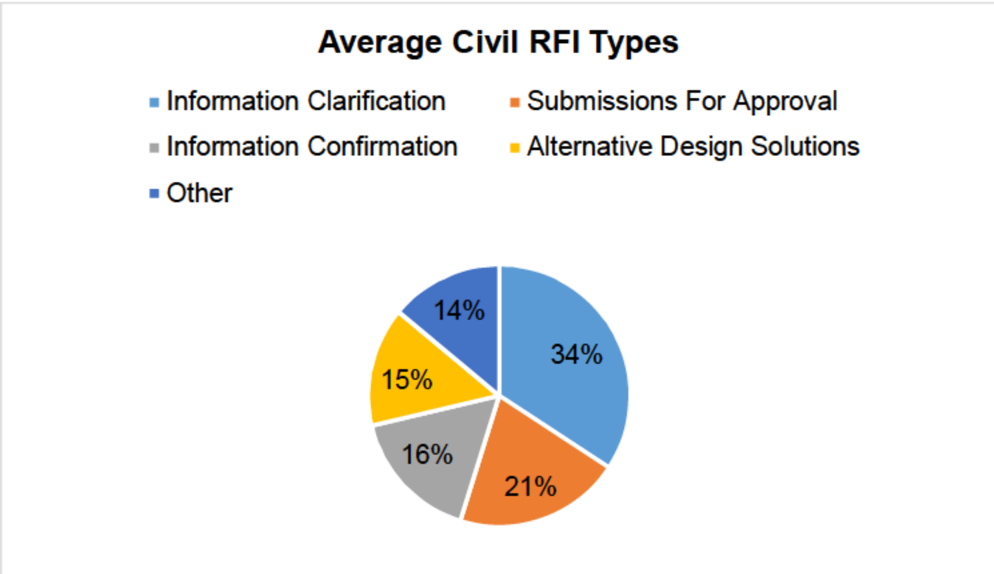


Figure 4.25: Breakdown of RFIs received for civil construction projects by type

As noted in section 4.3 and shown in figures 4.24-26 there are significant differences between the proportion of each RFI type and total number of RFIs received for building and civil construction projects. On average the building construction projects received a higher number of RFIs (94.3 vs 43.8) and a significantly greater proportion of information clarification RFIs (77% vs 34%).

4.6. Causes of RFIs in Civil Construction

The project parameters collected for each civil construction case study were plotted against the total number of RFIs received for that project.

4.6.1. Distance from a city area (Cairns, QLD)

Figure 4.27 below shows the comparison of the distance of a project site from Cairns with the number of RFIs for received for the project.

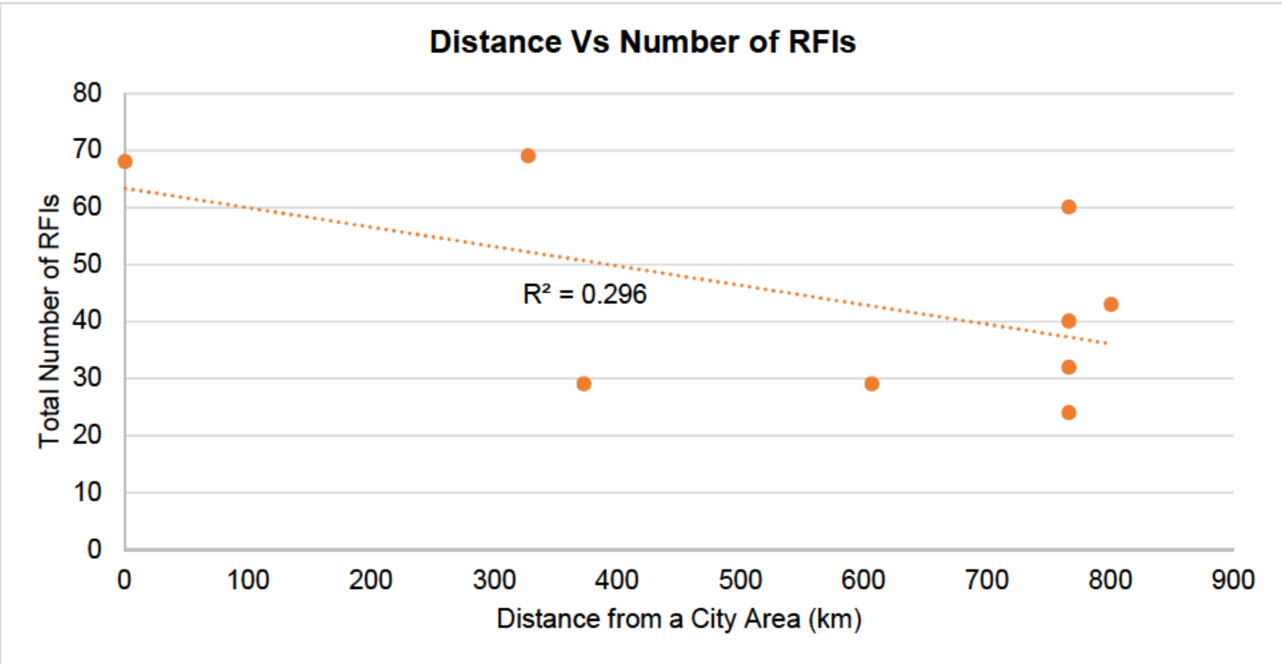


Figure 4.26: Distance from a City Area and Total RFIs received

There was a moderate correlation (R = 0.54) between the variables, with the number of RFIs decreasing the further away the construction site is from a city area. This is unexpected as there is increased logistical complexity involved in construction in remote locations. This suggests that either:

- The project team's experience in remote works was greater than in more metropolitan areas.

- The projects being undertaken in remote locations are simpler in scope when compared with the closer projects.
- Outliers in the data have affected the results
- In remote projects, contractors more regularly undertake works without approval rather than questioning the documentation.

4.6.2. Construction Value

Figure 4.28 below shows the comparison of the construction value of the project with the number of RFIs for received for the project.

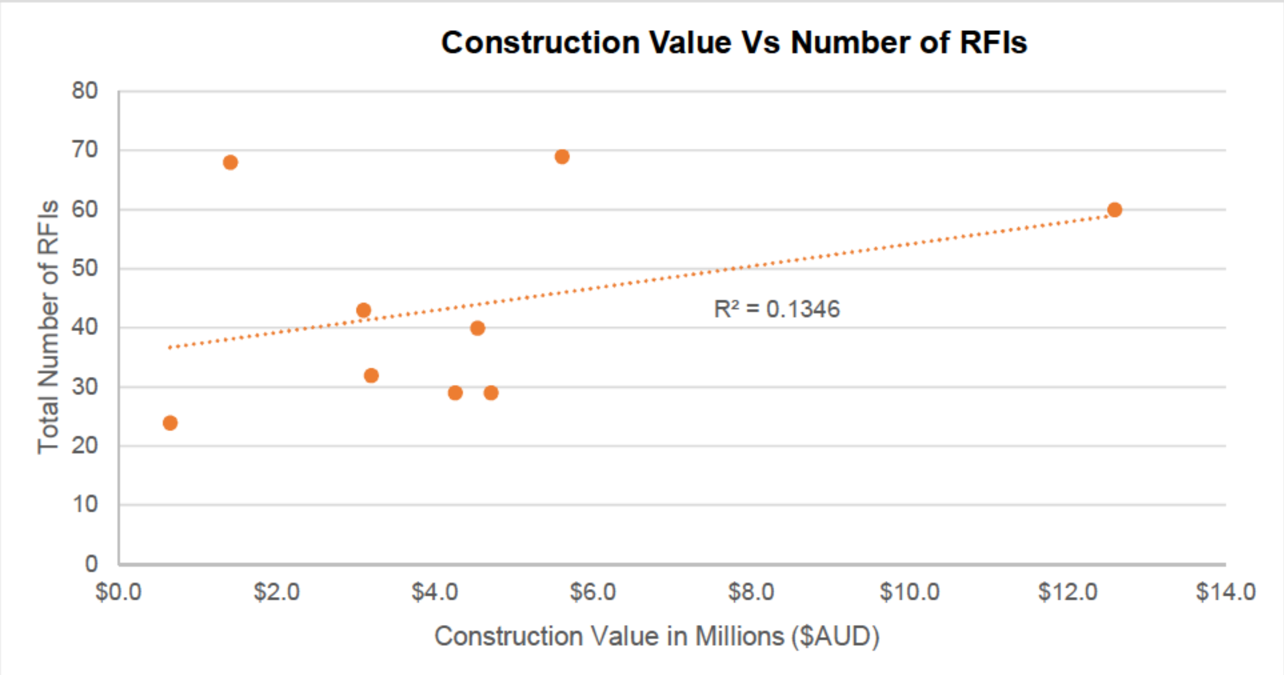


Figure 4.27: Construction Value and Total RFIs received

There was a weak correlation (R = 0.37) between the variables, with the number of RFIs increasing with an increased construction cost. There is not enough correlation between the two variables to make any conclusions regarding the effect of construction value on the number of RFIs expected for a civil construction project.

4.6.3. Construction Value adjusted for locality

Figure 4.29 below shows the comparison of the locality-adjusted construction value of the project with the number of RFIs for received for the project. The construction value was adjusted to consider the project location by dividing the contract sum by the regional index from *Rawlinson's Construction Cost Guide*.

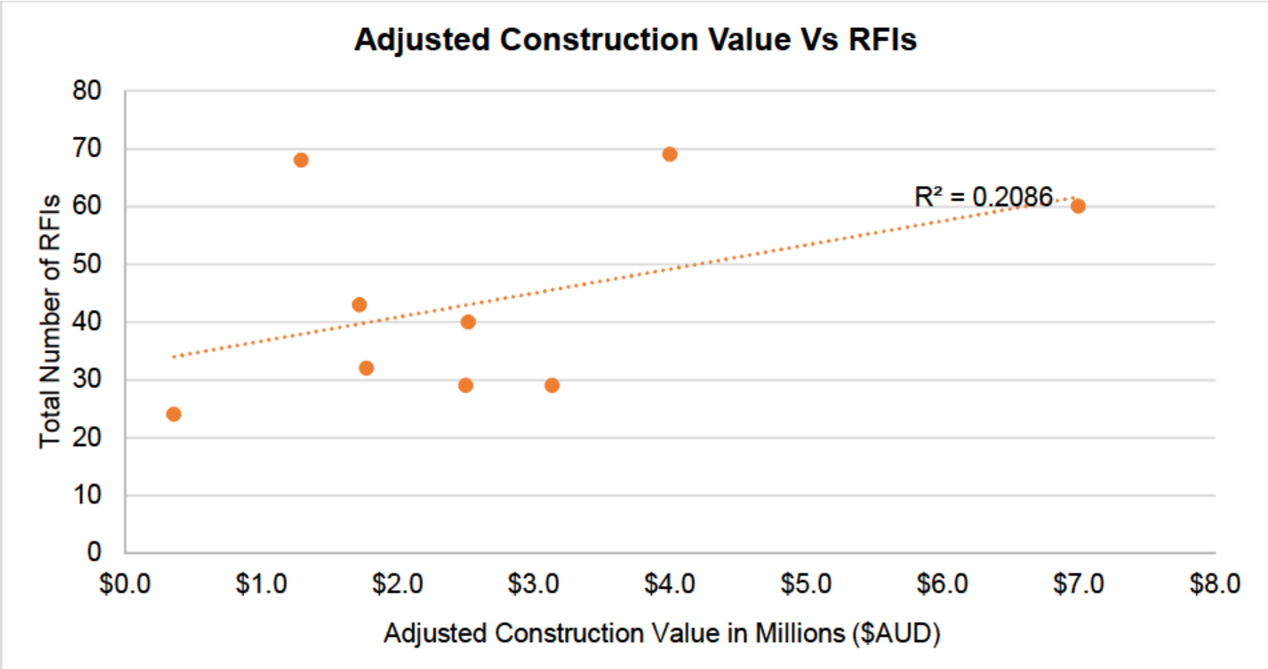


Figure 4.28: Adjusted Construction Value and Total RFIs received

There was a slightly stronger correlation (R = 0.46) between the variables when compared with the raw construction value for the case study projects. The number of RFIs received appears to increase with an increase in locality-adjusted construction cost. However, as with the comparison of the raw construction value and RFIs received, there is not enough correlation between the two variables to make any conclusions regarding the effect of locality-adjusted construction value on the number of RFIs expected for a civil construction project.

4.6.4. Contract Duration

Figure 4.30 below shows the comparison of the locality-adjusted construction value of the project with the number of RFIs for received for the project.

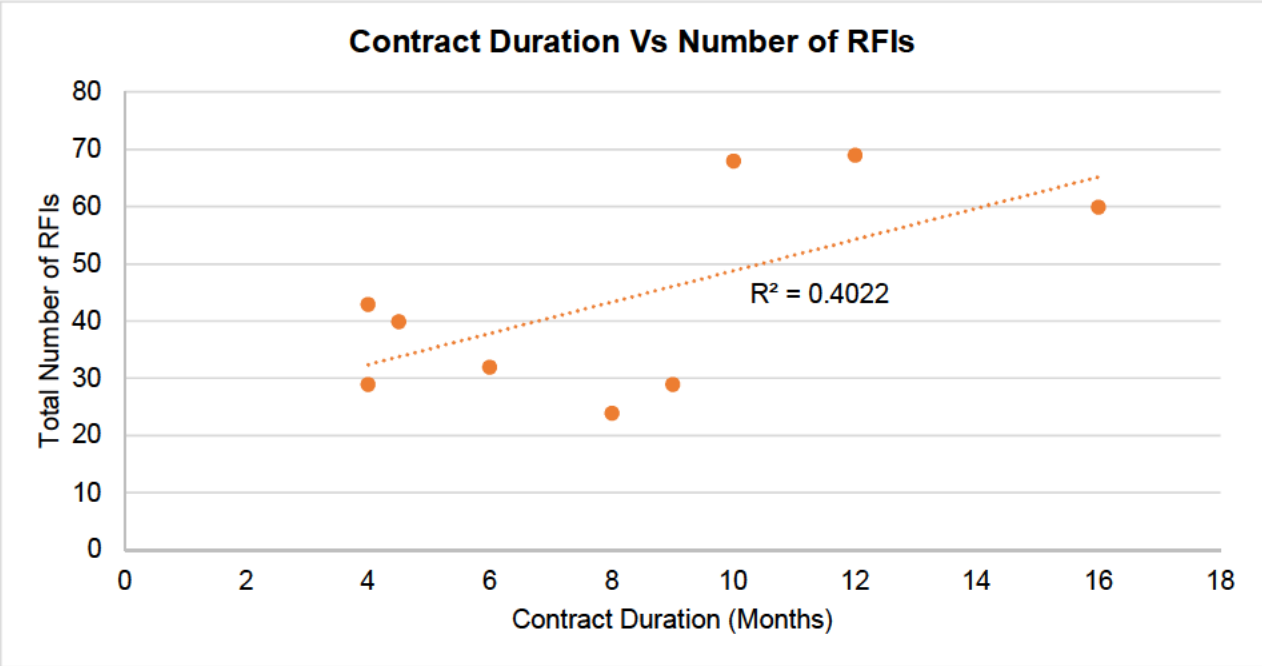


Figure 4.29: Contract Duration and Total RFIs received

There was a moderate correlation (R = 0.63) between the variables, with the number of RFIs received increasing with an increase in the duration of construction on site.

4.6.5. Number of Construction Plans

Figure 4.30 below shows the comparison of number of construction plans in the project documentation with the number of RFIs for received for the project.

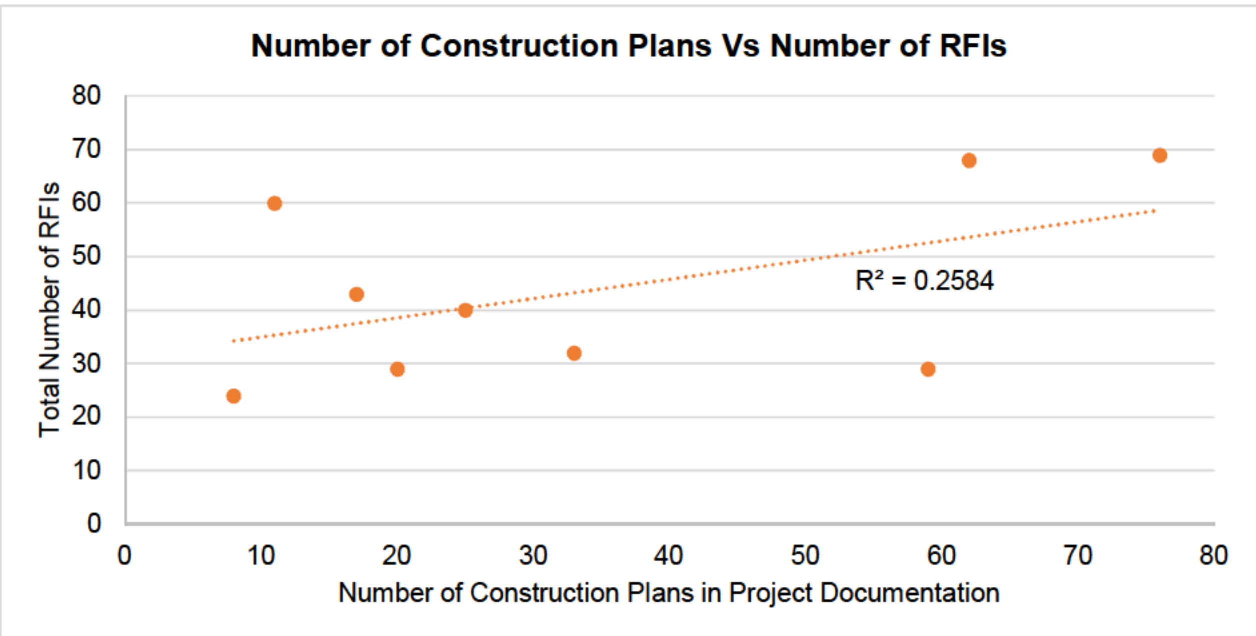


Figure 4.30: Number of Construction Plans and Total RFIs received

There was a moderate correlation (R = 0.50) between the variables, with the number of RFIs received increasing with an increase in the number of construction plans in the project documentation.

4.7. Causes of Information Clarification RFIs in Civil Construction

The project parameters collected for each civil construction case study were plotted against the number of information clarification (ICL) RFIs received for that project.

4.7.1. Distance from a city area (Cairns, QLD)

Figure 4.32 below shows the comparison of the distance of a project site from Cairns with the number of information clarification RFIs for received for the project.

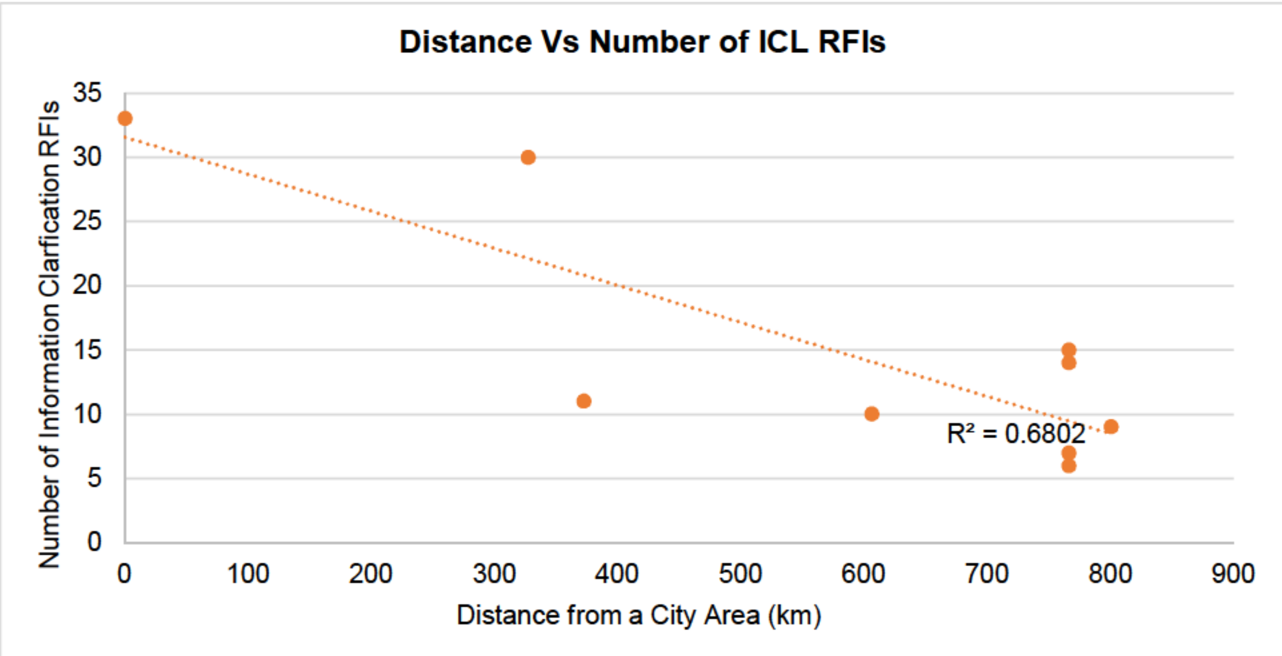


Figure 4.31: Distance from a City Area and ICL RFIs received

There was a strong correlation (R = 0.82) between the variables, with the number of information clarification RFIs expected decreasing the further away the construction site is from a city area. This suggests that one or more of the potential causes identified in section 4.6.1 is influencing the data, as there is definitely added complexity involved in remote infrastructure projects.

4.7.2. Construction Value

Figure 4.33 below shows the comparison of the construction value of the project with the number of RFIs for received for the project.

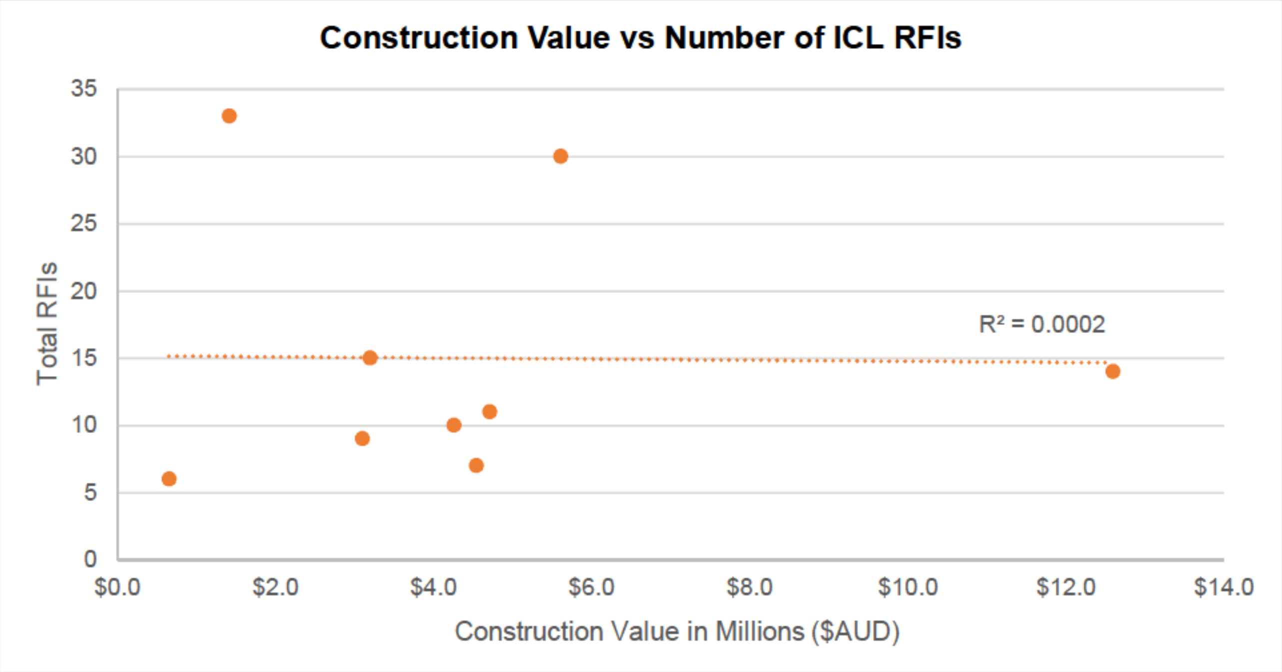


Figure 4.32: Construction Value and ICL RFIs received

There was no correlation (R ~ 0) between the construction value and information clarification RFIs received for the civil construction case studies. This indicates that more case studies are needed to determine what relationship, if any, there is between contract value and RFIs in civil construction projects.

Civil construction is easily scalable, with a relatively simple design often provided for large scale earthmoving or road construction works. This suggests that price alone may not be a good measure of the risk of receiving many RFIs for a project.

4.7.3. Contract Duration

Figure 4.34 below shows the comparison of the locality-adjusted construction value of the project with the number of RFIs for received for the project.

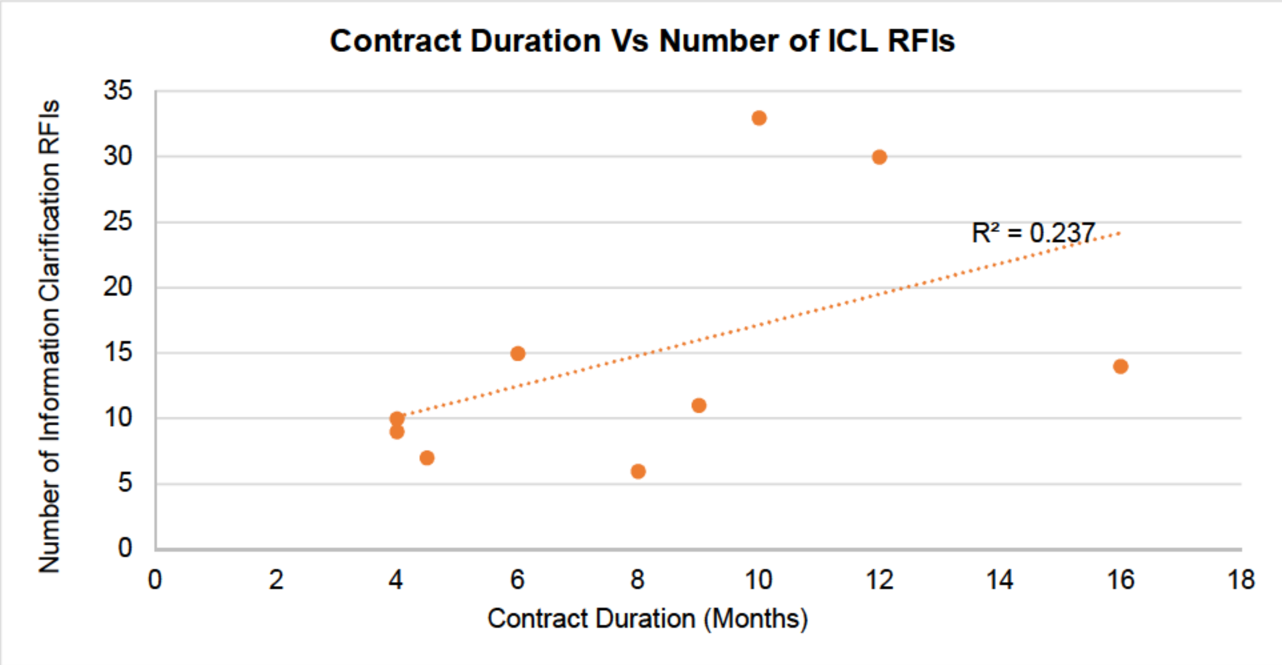


Figure 4.33: Contract Duration and ICL RFIs received

There is a weak correlation (R = 0.49) between the variables, with the number of information clarification RFIs received increasing with an increase in the duration of construction on site.

The correlation between the contract duration and the total number of RFIs received is stronger than the correlation between the contract duration and the number of information clarification RFI received. It is expected that this is because as the project duration increases, the number of submissions from the contractor for superintendent approval and written confirmations of onsite discussions will also increase.

4.7.4. Number of Construction Plans

Figure 4.35 below shows the comparison of number of construction plans in the project documentation with the number of RFIs for received for the project.

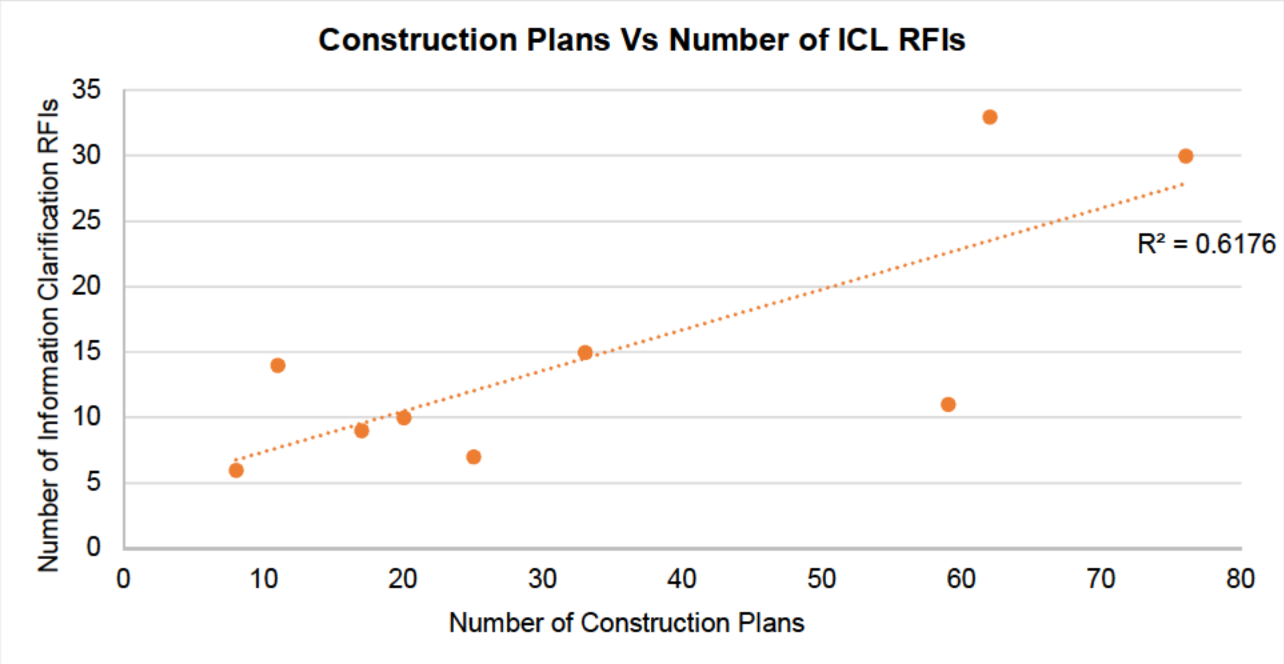


Figure 4.34: Number of Construction Plans and ICL RFIs

There was a moderate correlation (R = 0.79) between the variables, with the number of information clarification RFIs received increasing with an increase in the number of construction plans in the project documentation.

There was a stronger correlation between the number of construction plans and information clarification RFIs received than between the number of construction plans and the total RFIs received.

4.8. Predicting RFIs in Construction Projects

There was some level of consistency between the results from building and civil construction projects. Figure 4.35 below shows a chart with the RFIs received per design discipline for each case study project.

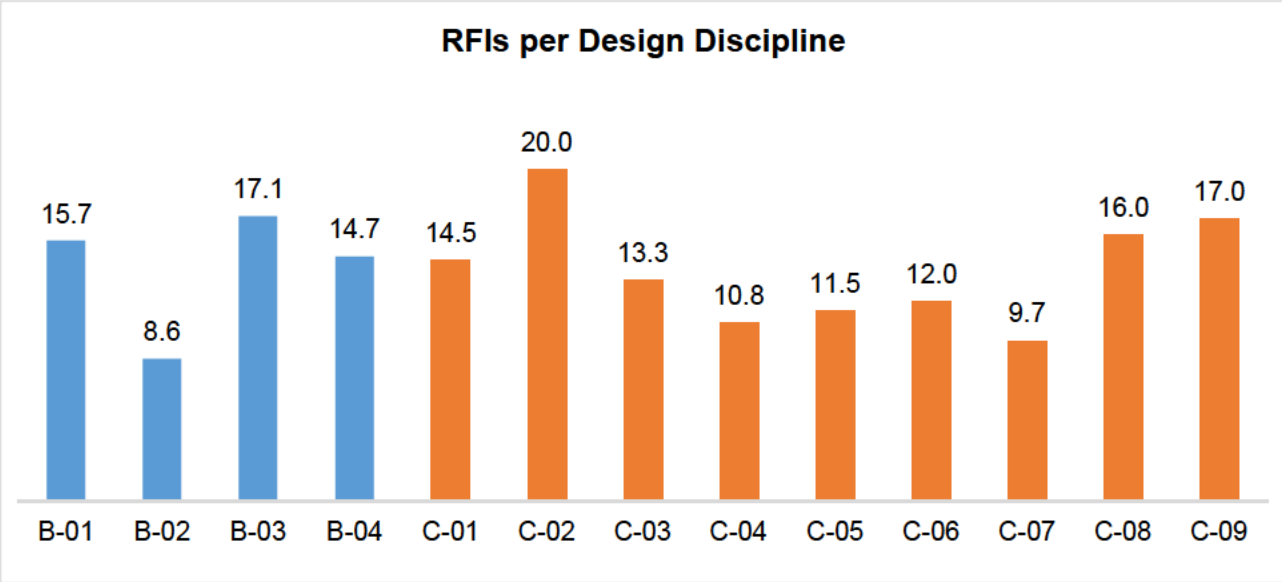


Figure 4.35: Number of Design Disciplines and Total RFIs received

The average amount of RFIs received per design disciplines was 14.0 and 13.9 for building and civil construction projects respectively.

Figure 4.36 below shows a comparison of the number of design disciplines in each case study projects and the total number of RFIs received for each project.

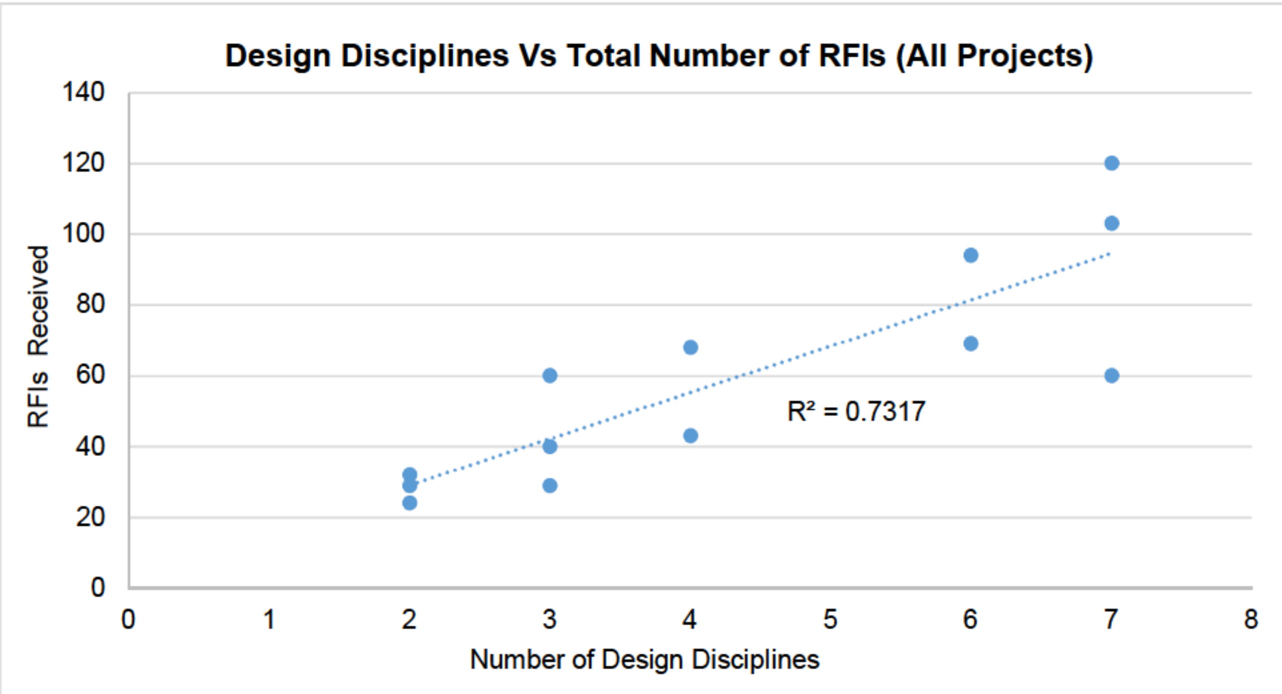


Figure 4.36: Number of Design Disciplines and Total RFIs received

There is a strong correlation (R = 0.86) between the number of design disciplines involved in an engineering project and the total number of RFIs received.

Figure 4.36 below shows a comparison of the number of design disciplines in each case study projects and the number of information clarification RFIs received for each project.

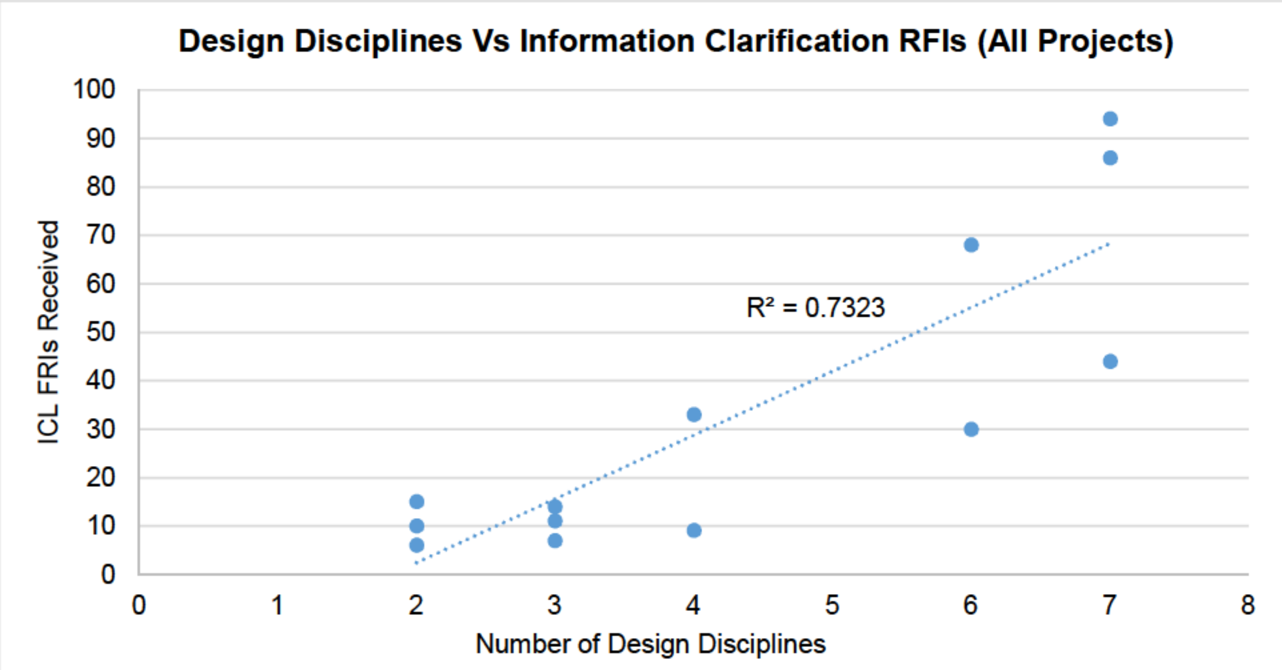


Figure 4.37: Number of Design Disciplines and ICL RFIs received

There is a strong correlation (R = 0.86) between the number of design disciplines involved in an engineering project and the number of information clarification RFIs received.

These results indicate that the number of design disciplines is the best indicator of excessive RFIs in construction projects regardless of the nature of construction.

4.9. Project Consequences of RFIs in Civil Construction

4.9.1. Variations awarded

Figure 4.38 below shows the comparison of the total number of RFIs received for the civil construction case study projects with the number of variations to the contract sum awarded.

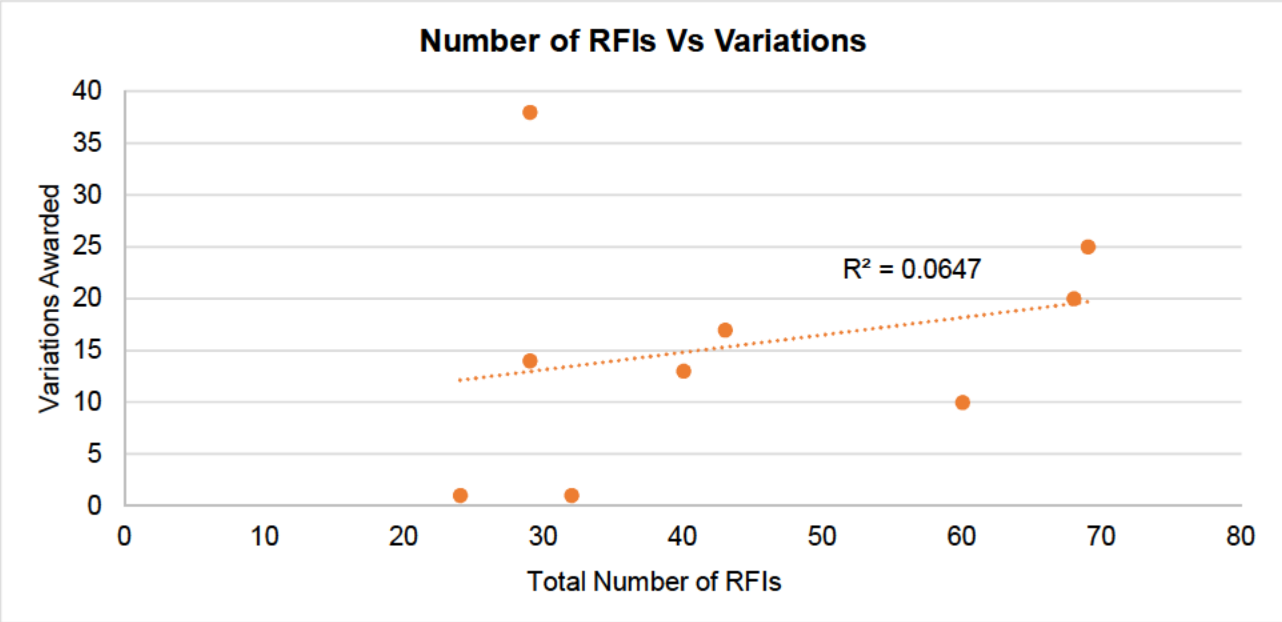


Figure 4.38: Total number of RFIs and number of variations awarded

There was a weak correlation (R = 0.25) between the number of RFIs received and the number of variations to the contract sum awarded. The number of variations awarded slightly increased as the number of RFIs received for the project increased, but the correlation between the two variables was too weak to draw any conclusions from this.

4.9.2. Sum of variations awarded

Figure 4.39 below shows the comparison of the total number of RFIs received for the civil construction case study projects with the sum of the variations to the contract sum awarded.

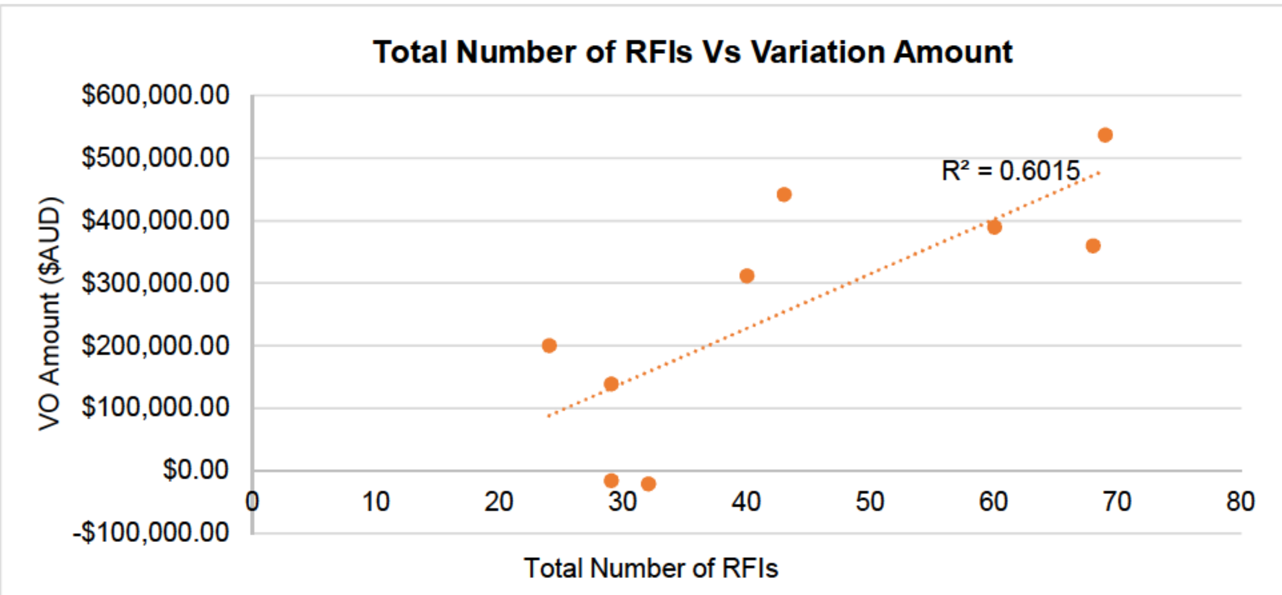


Figure 4.39: Total number of RFIs and value of variations awarded

There was a moderate correlation (R = 0.78) between the number of RFIs received and the sum of the variations awarded. The sum of variations awarded increased as the number of RFIs received for the project increased.

4.9.3. Extensions of Time

Figure 4.40 below shows the comparison of the total number of RFIs received for the civil construction case study projects with the number of days extension of time awarded.

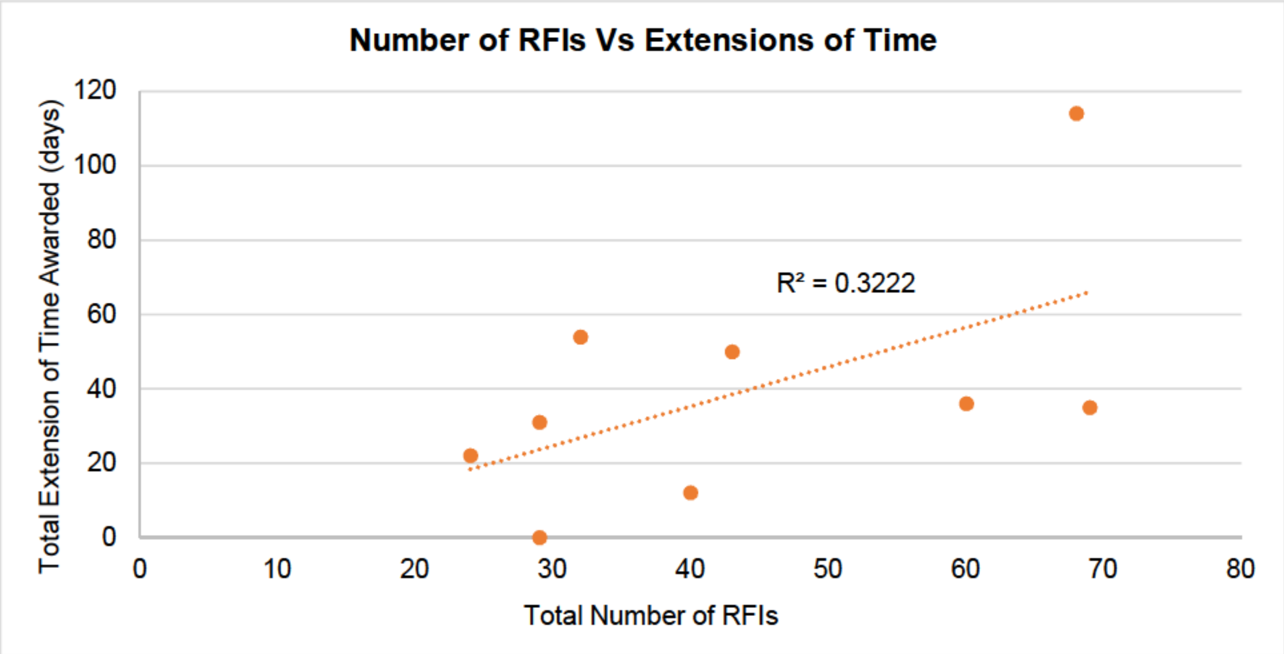


Figure 4.40: Total number of RFIs and extensions of time awarded

There was a moderate correlation (R = 0.57) between the number of RFIs received and the total number of days extension of time awarded. The total number of days extension of time increased as the number of RFIs received for the project increased.

4.10. Project Consequences of ICL RFIs in Civil Construction

4.10.1. Variations awarded

Figure 4.41 below shows the comparison of the number of information clarification RFIs received for the civil construction case study projects with the number of variations to the contract sum awarded.

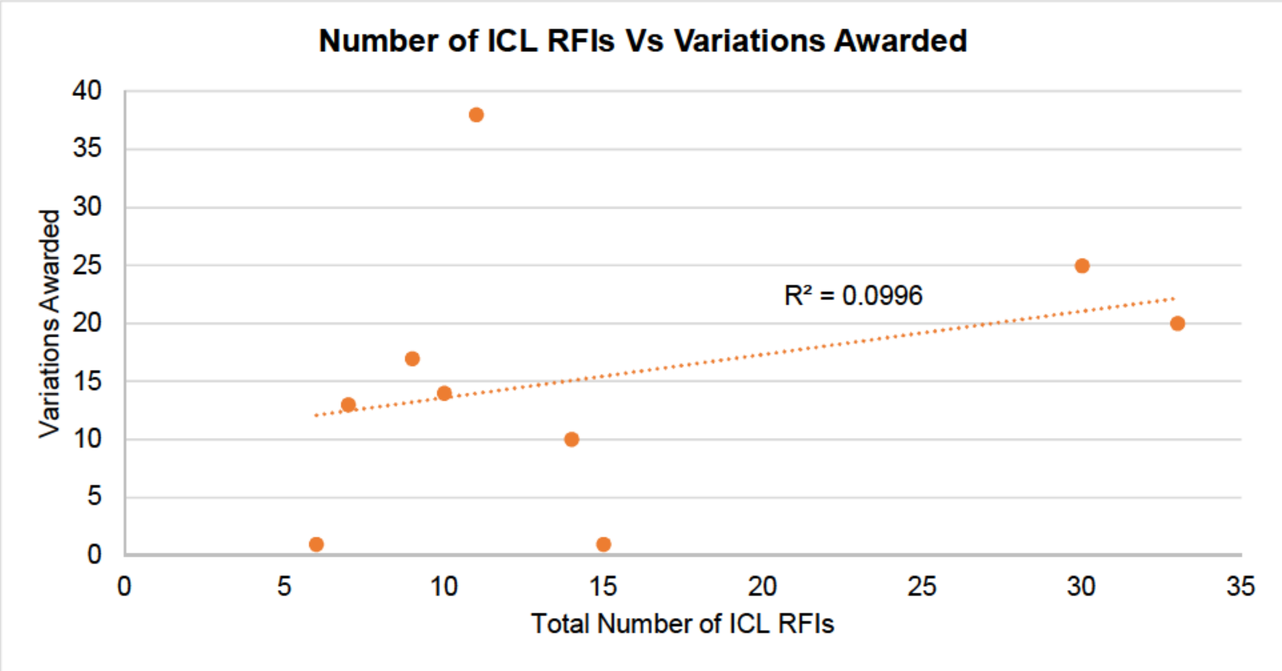


Figure 4.41: Number of ICL RFIs and number of variations awarded

There was a weak correlation (R = 0.32) between the number of information clarification RFIs received and the number of variations to the contract sum awarded. As with the comparison of total RFIs and number of variations awarded, the number of variations awarded slightly increased as the number of information clarification RFIs received for the project increased. However, the correlation between the two variables was too weak to draw any conclusions from this.

4.10.2. Sum of variations awarded

Figure 4.42 below shows the comparison of the number of information clarification RFIs received for the civil construction case study projects with the sum of the variations to the contract sum awarded.

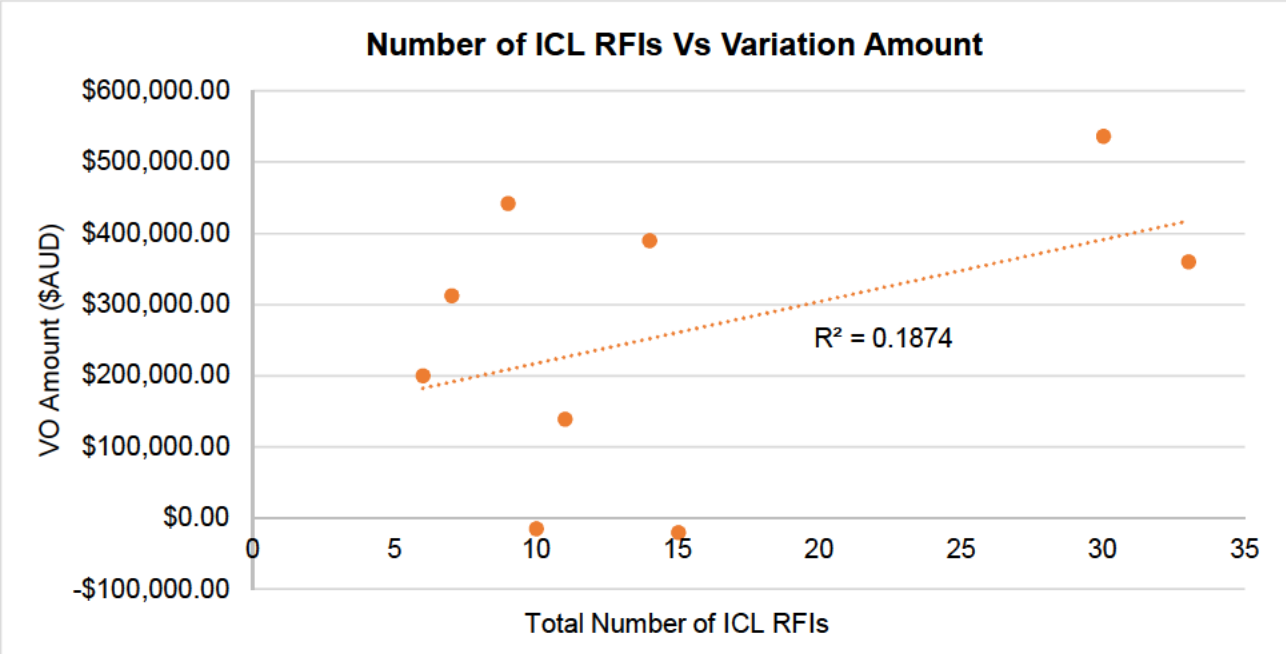


Figure 4.42: Number of ICL RFIs and value of variations awarded

There was a weak correlation (R = 0.43) between the number of information clarification RFIs received and the sum of the variations awarded. The sum of variations awarded increased as the number of RFIs received for the project increased.

These results suggest that only some of the variation amount awarded as a result of RFIs received is due to information clarification RFIs submitted by the contractor.

4.10.3. Extensions of Time

Figure 4.43 below shows the comparison of the number of information clarification RFIs received for the civil construction case study projects with the number of days extension of time awarded.

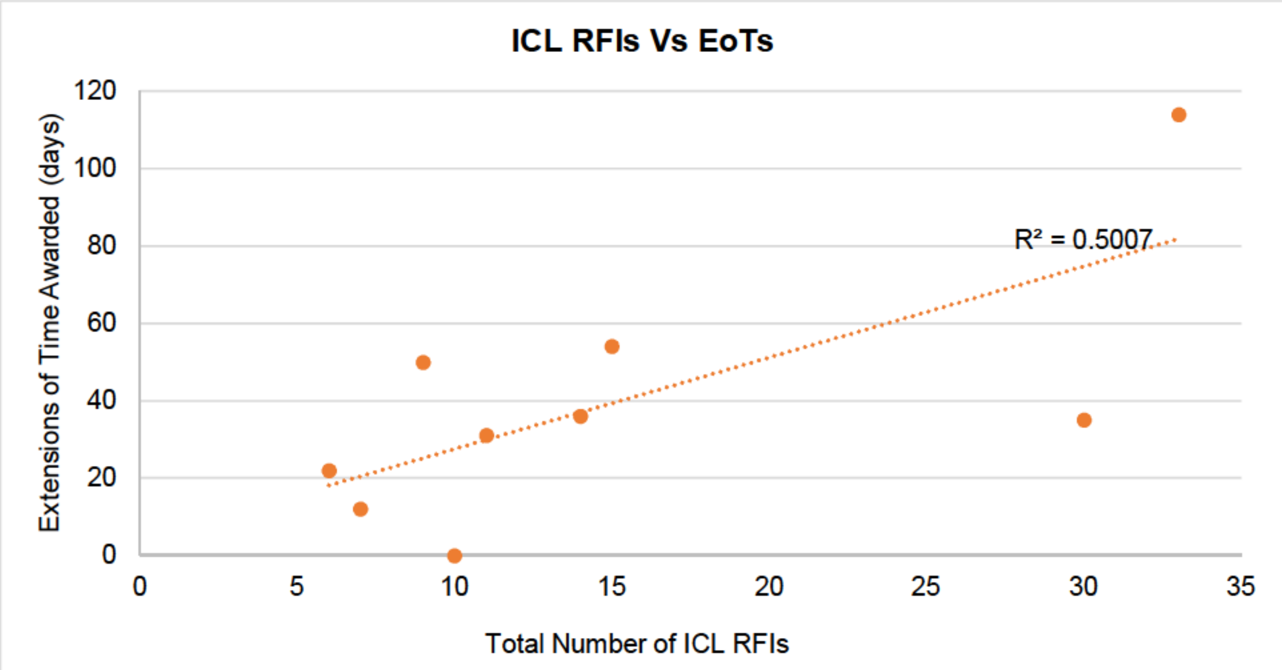


Figure 4.43: Number of ICL RFIs and extensions of time awarded

There was a moderate correlation (R = 0.71) between the number of information clarification RFIs received and the total number of days extension of time awarded. The total number of days extension of time increased as the number of information clarification RFIs received for the project increased.

There was a stronger correlation between the number of information clarification RFIs received and extensions of time awarded than between the total RFIs received and extensions of time awarded.

4.11. Business Consequences of RFIs in Civil Construction

The cost of RFIs is not entirely passed to the client in the form of delays and variations to the contract. The time spent issuing and responding to forms RFIs is an unpredictable cost to the designer, superintendent and contractor.

A part of this research was estimating the business consequences of RFIs from the perspective of the superintendent/civil designer. This was done by estimating the time required for a response and multiplying this by the charge out rate for each position.

Table 4.27 below details the cost borne by the superintendent/civil designer for a typical RFI response.

Table 4.27: Time cost estimate per RFI response – superintendent/designer

Position	Rate	Time	Cost
Superintendent's Representative	$200/hr	0.50 hours	$100.00
Senior Project Manager/Engineer	$180/hr	1.00 hour	$180.00
Project Manager/Engineer	$160/hr	3.00 hours	$480.00
Administration	$100/hr	2.00 hours	$200.00
TOTAL			**$960.00**

It is estimated that a single RFI costs the superintendent/civil designer an average of $960.00 in time spent managing the RFI, communicating with the contractor and issuing a response.

4.12. Limitations

The following limitations of this research have been identified:

4.12.1. Sample Size

The sample size of civil construction case studies was smaller than initially planned. This limits the investigation into the extent that parameters such as construction value and distance effect the number RFIs received.

The small sample size also means that outliers in the data have a greater impact than in a larger data set.

4.12.2. Correlation of Variables

The data gathered as a part of this research only provides a level of correlation between the variables. This means that the investigation has only provided circumstantial evidence regarding the cause and consequences of RFIs in civil construction projects.

4.12.3. Data Source

The data for the project has come from one consultancy. It is expected that some aspects of construction management will be routinely managed well, and that some aspects of construction management will be undertaken poorly. It is expected that these areas will be slightly different between different consultancies.

CHAPTER 5: CONCLUSION

5.1. Achievements

During this research RFIs in construction projects were investigated using case studies from an engineering and project management company, Black & More. To compare the data from the case studies with existing research on building projects, four building project case studies were also undertaken.

5.1.1. Comparison of Building Construction and Civil Construction

There were an average of 94.3 RFIs received per building construction case study and an average of 43.8 RFIs received per civil construction case study.

Of these RFIs, 77% of the building project case study RFIs were received as a result of inconsistencies, errors or omissions in the project documentation, or ‘information clarification’ RFIs. The results for civil construction projects case were mostly comparable to the building projects, however, on average only 34% of RFIs received were information clarification RFIs.

The building projects also received significantly more RFIs per million dollars of construction cost, with an average of 37.1, compared to an average of 16.5 RFIs received per million dollars of construction cost for the civil construction projects.

5.1.2. Cause of RFIs in Civil Construction

It was determined that the project parameters that most strongly correlated with number of RFIs received in civil construction projects were construction duration and the number of construction plans. The project parameters that poorly correlated with the number of RFIs received in civil construction projects were construction value and the distance the construction site was from a metropolitan area.

The total number of different design disciplines involved in the project appeared to have the strongest correlation with the number of RFIs received for a construction project, regardless of the nature of construction.

5.1.3. Project Consequences of RFIs in Civil Construction

The total number of RFIs received for a civil construction project was moderately correlated with the sum of the variations to the contract sum awarded, and the total number of information clarification RFIs received for a civil construction project was moderately correlated with the total days extension of time awarded to the contract.

5.1.4. Business Consequences of RFIs in Civil Construction

It was estimated that the cost of a typical RFI response would be approximately $1,000. If this cost is not included in the superintendent/civil designers fee, then it must be borne by the consultant.

5.1.5. Limitations

There were some limitations to the research due to the relatively small sample size, however the results highlight the opportunity for improved outcomes through changes to management practices, contractual forms and relationships between project stakeholders in civil construction projects.

5.2. Recommendations

5.2.1. Industry-wide Participation

This research indicates that the issues faced in the civil construction case studies are comparable to those faced in construction projects Australia-wide. This means that industry-wide participation is ultimately required, including:

- Clients need to be willing to pay higher prices for engineering and project management consultancy services to ensure quality documentation is produced for construction.
- Consultants need to take responsibility for ensuring the ‘next customer’ is accommodated by their deliverables. The risk for omissions should not be passed onto the contractor with generalized clauses, or to the client with rolling commissions for construction management.
- Every stakeholder needs to place quality, capability and value ahead of seeking the lowest bid.

Additionally:

- Consideration should be given to minimum rates for engineering services to increase documentation quality and promote competition.
- Consideration should be given to alternative forms of contract that better suits the construction industry going forward.

5.2.2. Consultant Specific Recommendations

This research has determined that projects with multiple design disciplines, numerous construction plans or a long construction duration should be flagged as high risk from construction management perspective – greater attention is required for design, documentation and review of subconsultant information.

Many of the RFIs received in the civil construction case study projects were received informally. This highlights the need for stricter management of RFIs.

An improved management system should be developed, including:

- A list of definitions in the contract – what constitutes a design clarification RFI compared to a response to non-conformance, request for substitution, submissions for superintendent approval, etc.
- A clause in the contract conditions detailing the RFI process, including timeframes required for a response (10 business days is recommended) and RFI form requirements. The RFI form shall include:
    - Project name and number
    - Date of RFI
    - Number of RFI
    - Company name and contact
    - Contact information
    - Specification and/or drawing number
    - Program activity impacted
    - Priority
    - Subject name
    - A description of the information required
    - Estimate of the potential time and cost impact (if any)
    - Time requested for response (‘ASAP’ must not be accepted)

    - Space for a response, including a date and contact name
- A process where an RFI that does not meet the contract requirements is returned to the contractor without response and instructions to resubmit in accordance with the contract document.
- A standard form used for classifying and registering RFIs to be generated for each project. This should include a column for status and response details.

This improved management system should give consideration to tracking RFIs using specialized software (rather than generic spreadsheet software such as excel) as well as the use of RFI performance indicators for assessment of design and project management performance using RFIs received from the contractor who is physically delivering the project.

5.3. Further Work

There are several opportunities to undertake further work based on this investigation. Increasing the sample size and utilizing project data from other engineering consultancies would confirm the findings of this research.

This investigation was undertaken with a goal of determining the cause of RFIs in civil construction, and attempting to determine the business and project consequences of these RFIs.

There is an opportunity to study civil construction further using performance measurement tools such as the ‘forward thinking index’ (FTI), or developing new performance indicators based on the parameters identified in this research.

There were significantly more RFIs in civil construction projects that were classified as ‘other’ – RFIs that do not fit into the other classifications used for this research. This indicates that further work could be undertaken finding more suitable classifications for RFIs in civil construction projects.

All of the case studies undertaken used AS2124 general conditions of contract, the is an opportunity to investigate time and cost overruns and disputes in alternative forms of contract to determine whether there is a superior alternative for civil construction projects.

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APPENDICES

Appendix A: Project Specification (V2)

Engineering Research Project 2017

Project Specification

For: Jared Black [redacted]

Title: Investigating the cause of Requests for Information (RFIs) in Civil Construction Projects

Major: Civil Engineering

Supervisor: Paul Tilley

Enrolment: ENG4111 – EXT S1 2017
ENG4112 – EXT S2 2017

Project Aim: An investigation of primary causes of Requests for Information (RFIs) in Civil Construction from a project management and civil design perspective.

My goal is to determine the major factors that contribute to RFIs in Civil Construction projects, and determine the consequences of these RFIs.

The time and cost involved in addressing RFIs (Business consequences) and the influence that the underlying factors have on Extensions of Time and Contract Variations (Project Consequences) are the focus of this research.

Programme: Version 1 – 15 March 2017

Semester 1 Start – 27 February 2017

1. Finalise data (and data sources) to be examined from Civil Construction Projects
2. Examine possible projects to be used for research
3. Draft Project Specification

Project Specification – 15 March 2017

4. Finalise Project Specification with Supervisor
5. Draft dissertation structure
6. Adapt ENG4110 Project Proposal for use in dissertation
7. Confirm suitable case study projects to be used
8. Collect RFI data from case study projects
9. Begin to dissertation in draft structure
10. Draft Progress Report

Progress Report – 24 May 2017

11. Adapt dissertation based on Supervisor feedback (from progress report)
12. Begin to adapt dissertation into a presentation for the USQ seminar

Partial Draft Dissertation – 6 September

13. Finalise dissertation based on Supervisor feedback (from draft dissertation)
14. Finalise presentation for the USQ seminar

Presentation at USQ – 17 September

15. Last minute changes based on discussions / questions at USQ seminar
16. Finalise dissertation for submission

Submit Final Report – 12 October 2017

If time and resources permit:

17. Examine variation consequences of RFIs
18. Examine RFIs from sub consultants perspective to complement PM perspective (this will be from the beginning if I can source information from other consultants B&M work with)

Appendix B: RFI Data Spreadsheet

Project Parameters

Ref. No.	Year	Contract Sum	Regional Index	Adjusted Contract Sum
B-01	2015	$1,433,920.00	1.15	$1,246,886.96
B-02	2016	$2,467,955.00	1.80	$1,371,086.11
B-03	2016	$4,461,431.00	1.80	$2,478,572.78
B-04	2016	$3,254,054.75	1.80	$1,807,808.19
Building Project Average		**$2,904,340.19**		**$1,726,088.51**
C-01	2016	$4,246,378.87	1.70	$2,497,869.92
C-02	2015/16	$12,588,417.77	1.80	$6,993,565.43
C-03	2016	$4,531,593.00	1.80	$2,517,551.67
C-04	2015	$3,093,509.73	1.80	$1,718,616.52
C-05	2015	$5,599,213.00	1.40	$3,999,437.86
C-06	2016	$646,822.00	1.80	$359,345.56
C-07	2010	$4,700,000.00	1.50	$3,133,333.33
C-08	2014	$3,186,777.20	1.80	$1,770,431.78
C-09	2014	$1,408,001.00	1.09	$1,291,744.04
Civil Project Average		**$4,444,523.62**		**$1,638,713.68**

Project Parameters

Ref. No.	Contract type	Design Disciplines	Construction Period	Distance to major city (km)	No. Construction Plans
B-01	Qld Government	6	6	80	32
B-02	AS2124	7	8	800	129
B-03	AS2124	7	8	800	97
B-04	AS2124	7	8	800	183
Building Project Average		**6.8**	**7.5**	**620.0**	**110.3**
C-01	AS2124	2	4	606	20
C-02	AS2124	3	16	766	11
C-03	AS2124	3	4.5	766	25
C-04	AS2124	4	4	800	17
C-05	AS2124	6	12	327	76
C-06	AS2124	2	8	766	8
C-07	AS2124	3	9	372	59
C-08	AS2124	2	6	766	33
C-09	AS2124	4	10	0	62
Civil Project Average		**3.2**	**8.2**	**574.3**	**34.6**

RFI Data

Ref. No.	Requests For Information (RFIs)						
	Information Clarification	***Submissions For Approval***	***Information Confirmation***	***Alternative Design Solutions***	***Other***	***Informal RFI***	***TOTAL RFIs***
B-01	68	6	11	6	3	3	94
B-02	44	3	7	3	3	3	60
B-03	94	6	8	8	4	4	120
B-04	86	6	6	3	2	2	103
Building Project Average	**73.0**	**5.3**	**8.0**	**5.0**	**3.0**	**3.0**	**94.3**
C-01	10	7	4	4	4	22	29
C-02	14	14	10	11	11	55	60
C-03	7	6	10	11	6	40	40
C-04	9	13	6	7	8	43	43
C-05	30	8	15	7	9	59	69
C-06	6	4	4	4	6	24	24
C-07	11	7	3	5	3	11	29
C-08	15	7	3	4	3	30	32
C-09	33	15	10	5	5	53	68
Civil Project Average	**15.0**	**9.0**	**7.2**	**6.4**	**6.1**	**37.4**	**43.8**

RFI Data

Ref. No.	RFI			
	$/RFI	*RFI/$1M*	*ICL RFI/$1M*	*RFI/Discipline*
B-01	$15,254.47	65.6	47.4	15.7
B-02	$41,132.58	24.3	17.8	8.6
B-03	$37,178.59	26.9	21.1	17.1
B-04	$31,592.76	31.7	26.4	14.7
Building Project Average	**$31,289.60**	**37.1**	**28.2**	**14.0**
C-01	$146,426.86	6.8	2.4	14.5
C-02	$209,806.96	4.8	1.1	20.0
C-03	$113,289.83	8.8	1.5	13.3
C-04	$71,942.09	13.9	2.9	10.8
C-05	$81,148.01	12.3	5.4	11.5
C-06	$26,950.92	37.1	9.3	12.0
C-07	$162,068.97	6.2	2.3	9.7
C-08	$99,586.79	10.0	4.7	16.0
C-09	$20,705.90	48.3	23.4	17.0
Civil Project Average	**$103,547.37**	**16.5**	**5.9**	**13.9**

Project Consequences

Ref. No.	Variations			Total EoT Awarded (days)
	Variations	*Variation Sum*	*RFIs per VO*	
B-01	66	$459,978.15	1.4	27
B-02	8	-$254,850.00	7.5	6
B-03	28	$208,977.81	4.3	5
B-04	25	$268,261.36	4.1	4
Building Project Average	**31.8**	**$170,591.83**	**4.3**	**10.5**
C-01	14	-$14,936.84	2.1	0
C-02	10	$389,713.69	6.0	36
C-03	13	$312,291.62	3.1	12
C-04	17	$442,288.11	2.5	50
C-05	25	$536,953.24	2.8	35
C-06	1	$200,454.00	24.0	22
C-07	38	$138,757.00	0.8	31
C-08	1	-$20,000.00	32.0	54
C-09	20	$360,444.15	3.4	114
Civil Project Average	**15.4**	**$260,662.77**	**8.5**	**39.3**