INVESTIGATION INTO THE FACTORS CONTRIBUTING TO DELAY CLAIMS IN CONSTRUCTION INDUSTRY: A COMPARATIVE STUDY OF SRI LANKA AND CHINA

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DECLARATION

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ABSTRACT

Delay is one of the major issues faced by construction projects in both Sri Lankan and Chinese construction industry. During last decade, many economic and investment linkages have been established between Chinese and Sri Lankan government, which has led to several major construction projects in Sri Lanka. However, delays have caused significant impact on the success of those construction projects and led to delay claims. Hence, there is a need to identify the factors leading to delays in Sri Lankan construction industry. It is also evident that there is lack of a comparative study on delay factors in Sri Lankan and Chinese construction industry. Therefore, this research aims to identify the factors most frequently leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry.

The research was started with a comprehensive literature review followed by a pilot survey. The study used mixed method research approach. A detailed questionnaire survey was carried out under quantitative approach. The frequency of factors leading to delays and significance of factors contributing to delay claims were analyzed and ranked using Relative Important Index (RII) method by the collected data from thirty (30) Sri Lankan and thirty (30) Chinese respondents. The findings of factors most frequently leading to delays and most significant factors contributing to delay claims were presented to a panel of experts under qualitative approach for further analysis and validation

It is revealed that the delay factors of change order / variation by client, unfavorable weather conditions and design errors made by designer are the most significant factors contributing to delay claims in both Sri Lankan and Chinese construction industry. However, the significant factor contributing to delay claims in Sri Lankan construction industry but not in Chinese construction industry are changes in government regulations and laws, political and regional stability and problem raised by local surrounding residents. The significant factor contributing to delay claims in Chinese construction industry but not in Sri Lankan construction industry are unclear and inadequate details in drawing by design consultant, delay in determination by consultant, design changes by owner or his agent during construction. The research findings will be useful for minimizing delays and delay claims in both Sri Lankan and Chinese construction industries and specially construction projects handled by Chinese contractors in Sri Lanka.

Keywords: Delay Factors; Delay Claims; Construction Industry; Comparative Study; Sri Lanka; China

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LIST OF ABBREVIATIONS

Abbreviation	Description
BS	British Standard
CB	Central Bank of Sri Lanka
CNY	Chinese Yuan
GDP	Gross Domestic Product
HML	Hundred Million
LKR	Sri Lankan Rupee
RII	Relative Importance Index
WTO	World Trade Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

The construction industry is complex owing to the industry specific uncertainties and interdependences (Anna and Lars, 2010). Hence, the success of a project involves various aspects and the roles of various stakeholders determine the direction of a project (Norazian and Hamimah, 2013). Rajakaruna, Bandara and Silva (2013) mentioned that the construction industry in Sri Lanka takes a great position in the economic growth in the country. Moreover, Xue, Shen, Wang and Lu (2008) indicated that the productivity of Chinese construction industry experienced a continuous improvement over the years. The rapid growth of the Chinese economy sparked off a great volume of construction activities (Zeng, Tam and Deng, 2003).

Sambasivan and Soon (2007) concluded that the problem of delays in the construction industry is a global phenomenon and the construction industry in Malaysia is no exception. Aibinu and Jagboro (2002) studied that construction delay has become endemic in Nigeria. It is imperative to create awareness of the extent to which delays can adversely affect project delivery and delay had significant effect on completion cost. In Indonesia, it is identified that 47% of the projects were finished within the project period. It is very hard to unite all parties' efforts for the purpose of completion of the project because of the various participants (Trigunarsyah, 2004). A study carried out by Singh (2010) found that of 894 infrastructure projects completed between April 1992 and March 2009 in Bangladesh, the percentage of project with positive time overruns stood at 60.8% in power sector, 79.9% in petroleum sector, 95.1% in ports and 100% in health welfare (Roy, Blomqvist and Clark, 2012). In India, under the National Highway Development Programme in 2002, the India government aimed to improve the conditions of 65,000 kilometers national highways but very few has been completed on time (Roy et al., 2012).

Maduranga, Palamakumbura and Dissanayake (2016) reported that delays were one of the common issues faced by construction projects in Sri Lanka. Ramachandra, Rotimi and Gunaratne (2014) found that time overrun occurs in 90% of the projects in Sri Lanka. Zou, Zhang and Wang (2007) studied the key risks in construction projects in China and found that time overrun is one of the most common and significant influences on the project. It is widely acknowledged for a construction project to be successful when it is completed within the project period, within the budget and being satisfied to the stakeholders (Majid, 2006).

Kumaraswamy (1997) stated that the claims are inevitable and unavoidable and in fact necessary to contractually accommodate unforeseen changes in project conditions. Li (2008) introduced the main form of claim and the reasons of claim were analyzed. He further discussed the claim contents proposed by contractor, the prevention and settlement measures of claim to enhance the engineer's management level. Hu and Jiang (2001) sought for approaches to international practice, stating that after China joining the World Trade Organization (WTO), it will encounter more and more claim problem. Further, they gave an initial inquiry for the difficulty and countermeasure of construction claim.

In this context, claim management plays an important role in a success of a claim. Ren and Anumba (2001) stated that claims management is heavily dependent on the legal principles and other management theories at pre-construction phase, which mainly includes standard construction contract forms, risk management theory and project procurement systems. These principles and theories are vital to avoid construction claims and disputes in the first place and to ensure that claims management starts right if claims cannot be avoided.

Kululanga and Kuotcha (2001) studied the claim management and get the statement that although the construction business environment has moved toward partnering arrangements in recent years, the number of contractual difficulties continue to rise. The construction industry needs to develop methodologies for construction claim management that should overcome their current problems. While some practitioners have been using

some kind of a procedure for claim management process framework measuring tool, a written exposition of such an instrument is not widely available in the literature. Kululanga and Kuotcha (2001) further presented the principles that underlid construction claim process and gives a generic framework that aims at facilitating measurement of construction claim process as one of the strategies for improving construction business processes.

Construction claim is founded by various reasons and it is unpredictable to turn the claim into a success (Kimberly, 2005).

Pathmendra (2015) studied the completion of the projects in field of construction in Sri Lanka. It is stated that delay was a common feature and proving delays in time claims were conflicted area in the construction industry. He further discussed how the delay claims work in minimizing the disputes.

Ramachandra et al. (2014) was indicative of the delays to settlement of contractor claims and on average, 60% of contractors submitted delay claims with only 40% success rate for the project survey in Sri Lanka. Maduranga, Palamakumbura and Dissanayake (2016) reported that most cases for delay of construction projects in Sri Lanka were complex and difficult to analyze. Various delay analysis methods were developed to use in construction industry for the purpose of analyzing delays, however, there was no standard method to analyze a delay claim. Delay techniques were tested in his study for delay claims. Liu and Wang (2006) studied the construction delay claims development in China stating that the awareness of delay claims in China were not mature due to weak contract management and inadequate document control. Yang G. (2009) analyzed the time and cost for delay as a claim based on survey of large-scale projects in China. The influence, implementation environment and contractor's performance were studied and put forwarded the corresponding procedures for urgent works of incomplete construction period delay claims under FIDIC contract conditions. Wu and Fang (1999) studied a risk model of delay claims settlement in which the claim number process is a non-homogeneous poisson process. Yang D. (2003) studied on the principle of delay claims with multi-event

interference and proposed three common points about building contract responsibility sharing for claim and explicated a new idea about delay claim, supported by the Theory of Information Dissymmetry that giving the first duty to clients on the delay claims for extension time, and the first duty to contractors on the financial claims.

Sambasivan and Soon (2007) concluded the ten causes of delay claims as major reasons including contractor's poor site management, contractor's improper planning, inadequate contractor experience, inadequate owner's finance and payment for the project, subcontractor problems, material shortages, labour shortages, equipment failure, lack of communication among all parties and mistakes made during the project duration. Gunduz, Nielsen and Ozdemir (2012) demonstrated the delay claim factors by showing in a fish bone diagram. The factors, interrelations and consequence are also demonstrated by him and further computes the relative importance indices for the causations and rank the crucial causes factors.

1.2 Problem statement

The existing research covered the area of delay analysis techniques, delay claim management and causation of delay claims. However, few articles studied the delay claim factors and investigated the difference between countries.

Hua and Upneja (2007) stated that foreign contractors have created both positive and negative impacts on the construction industry. At present, there are more economic and investment links between China and Sri Lanka (Deyshappriya, 2016). Top Chinese contractors step up pace of work on massive projects in Sri Lanka (Zhang, 2017).

However, delays have caused significant impact on the success of construction projects and led to delay claims in both Sri Lankan and Chinese construction industries. Therefore, to provide suggestions on avoidance and settlement of delay claims in Sri Lankan and Chinese industry, it is important to investigate the delay claim factors in Sri Lanka and China Construction Industry. It is also evident that there is lack of a comparative study on factors leading to delay claims in Sri Lankan and Chinese construction industries.

1.3 Aim of the Study

The aim of this study is to investigate the delay claim factors in Sri Lankan and Chinese construction industries.

The outcome will help practitioners to develop a wider and deeper knowledge of delay claim factors in Sri Lankan and Chinese construction industries.

1.4 Objectives of the Study

The following are the five objectives to be achieved to accomplish the aim of the study.

1. Review sources of construction claims, nature of the delay claims and factors leading to delays.
2. Investigate the factors most frequently leading to delays in Sri Lankan and Chinese construction industry.
3. Identify the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry.
4. Compare the most frequent factors leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry.
5. Investigate the reasons behind the most frequent factors leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry.

1.5 Research Methodology

The research is carried out by data collection with mixed method research approach based on the following sequence.

In Step 1, a comprehensive literature review was conducted for sources of claims, nature of delay claims and types of delay claims to identify delay factors.

In Step 2, literature findings were used to develop a questionnaire. The questionnaire was shown to four experts in a pilot survey to check its completeness and comprehensiveness.

In Step 3, a survey was carried out using a questionnaire to identify the most frequent factors leading to delays and the most significant delay factors contributing to delay claims in Sri Lankan and Chinese construction industry. The questionnaire was distributed to a group of participants working in different construction projects in Sri Lanka and China. A number of sixty samples was used and at least thirty Sri Lankans working in the construction project in Sri Lanka and thirty Chinese working in the construction project in China were involved in data collection. Responses of the questionnaire were then collected and analyzed.

In Step 4, data analysis was done by statistical analysis and using Relative Importance Index (RII) method to demonstrate and priority the delay claim factors in both Sri Lankan and Chinese construction industry.

In Step 5, a panel discussion was carried out with six Sri Lankan and Chinese experts with over twenty years' experience. The purpose of the panel discussion was to obtain their views on findings from the questionnaire survey, comparison of factors between Sri Lankan and Chinese construction industry and validation of findings.

1.6 Scope and limitation of the research

The scope of this study is limited to the Contractor's point of view. Moreover, Employer's/ Client's and Engineer's/Consultant's point of views are not considered in this dissertation. This research is further limited to the projects with contract value over 500 million Sri Lankan Rupees in Sri Lankan and Chinese construction industry.

1.7 Chapter breakdown

Chapter One

It includes the background of Sri Lankan and Chinese construction industry, delays in Sri Lankan and Chinese construction industry, claims, delay claims in Sri Lankan and Chinese industry. Problem is raised and aim, objectives and methodology are set out. Further, the limitation is mentioned in this chapter.

Chapter Two

Literatures are reviewed for the areas of Sri Lankan and Chinese construction industry, delays in Sri Lankan and Chinese construction industry, claims, source of claims, delay claims in both Sri Lankan and Chinese industry. Further, the delay factors are identified using literature.

Chapter Three

Chapter three presents the research methodology used in this study. The research approach, research process, data collection and analysis methods are provided in this chapter.

Chapter Four

This chapter provides the data collection result and analysis. The statistics from the questionnaire is discussed in this chapter. The similarities and differences between the delay claim factors in Sri Lankan and Chinese construction industry are identified using statistics. Further, the delay claim factors are prioritized using RII method to conclude the most significant factors contributing delay claims in both Sri Lankan and Chinese construction industry. A panel of experts are interviewed for further data collection and validation.

Chapter Five

Upon the analyzed result and findings, the factors most frequently leading to delays and the most significant factors contributing to delay claims are concluded and compared in Sri Lankan and Chinese construction industry.

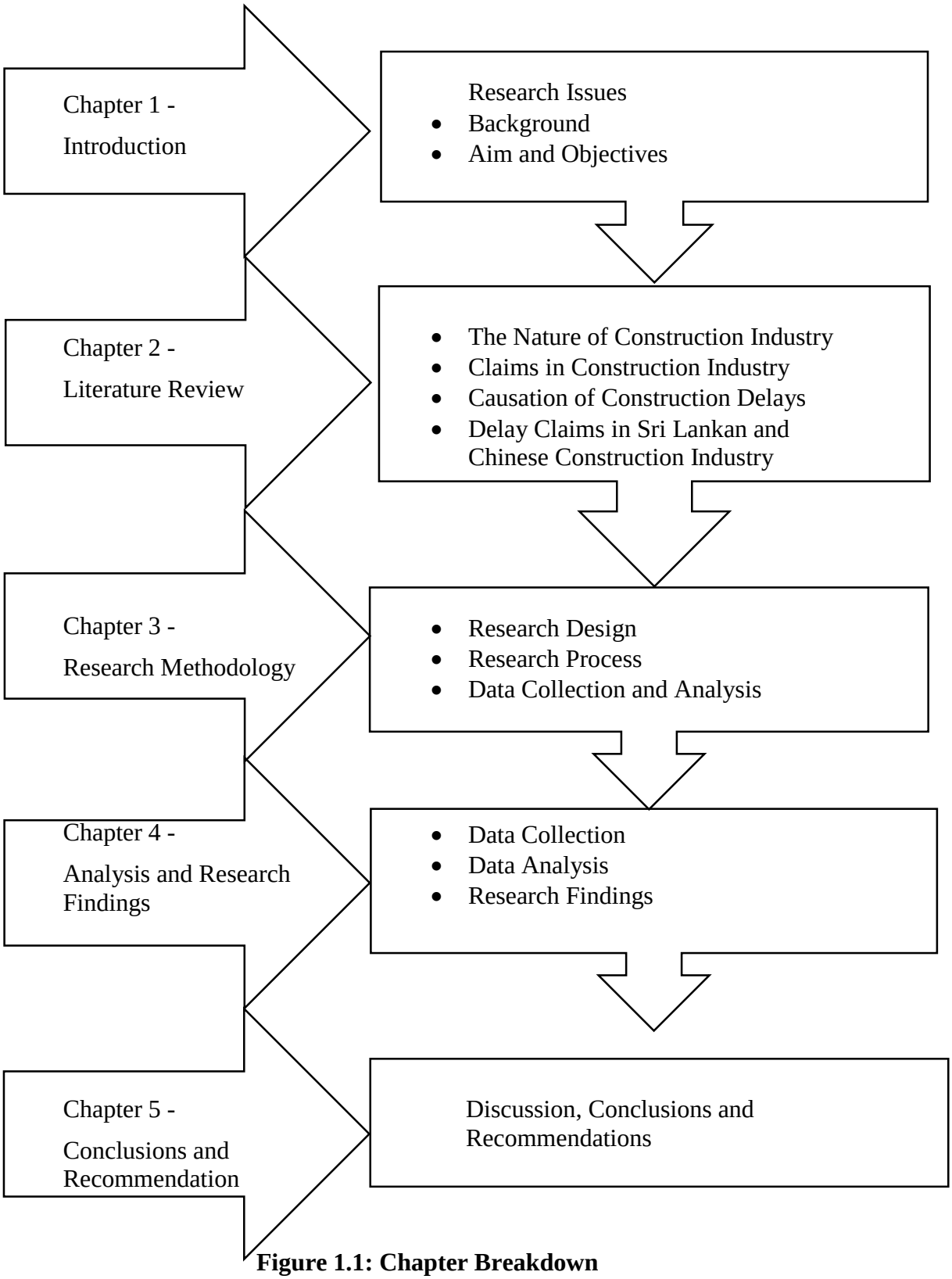


Figure 1.1: Chapter Breakdown

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This research aims to investigate the delay claim factors in Sri Lankan and Chinese Construction Industry. To achieve the aim, construction industry in China and Sri Lanka is reviewed in the area of Gross Domestic Product (GDP) from construction, employees from construction, etc. and the delay phenomenon in construction industry. Sources of claims are reviewed for analysis of the causation of claim with relation analysis between risks, conflicts and disputes to a claim. Then the delay claims are reviewed as to the aspect of its nature and types. Delay factors are summarized for further investigation of how frequent the delay factors lead to delays and how significant the delay factors contribute to delay claims.

2.2 Construction Industry

2.2.1 The Nature of Construction Industry in Sri Lanka and China

The construction industry is complex owing to the industry specific uncertainties and interdependences (Anna and Lars, 2010). The construction industry is complex and unique in nature and the success of a project involves various aspects and the roles of various stakeholders determine the direction of a project (Norazian and Hamimah, 2013).

Rajakaruna et al. (2013) mentioned that the construction industry in Sri Lanka takes a great position in the economic growth in the country. Pathirage (2008) mentioned that the growth of Sri Lankan economy in 2007 was six percent. Sri Lanka government anticipated to have a growth of eight percent in the following years. In Sri Lanka, construction industry is a major part of economy of the country. It contributes eight to ten percent to Gross Domestic Product (GDP) over the years and shows an increasing component proportion in the past years (CB, 2015).

> "Sri Lankan construction industry contributed LKR 108.3 billion to the national GDP in Q1 2011.The year–on-year growth rate was 18.8%. This growth was mainly, driven by large scale development projects in the country and rehabilitation and resettlement programs in the Northern and Eastern provinces" (Ministry of Highway, 2011, p 1)."

Compared to the construction industries in the United States, Japan, and the United Kingdom, the construction industry in China is less developed in its legal framework, industrial structure, technological level, and international market share. However, there is an improving trend of the Chinese construction industry under the underlying principle of World Trade Organization (Xu, Tiong, Chew, & Smith, 2005). Xue et al. (2008) indicated that the productivity of Chinese construction industry experienced a continuous improvement over the years. The rapid growth of the Chinese economy sparked off a great volume of construction activities (Zeng, Tam and Deng, 2003). The change of China's implemented economic reform policies has a significant impact on the operation of the construction industry, which employed a workforce of approximately 50 million (Zou, 2007).

GDP from construction in Sri Lanka has reached yearly averaged 543,728.88 LKR Million from 2010 until 2017, reaching an all-time high of 185,186 LKR Million in the fourth quarter of 2016 and a record low of 77,176 LKR Million in the second quarter of 2010 (Global Finance, 2018). According to Trading Economics global macro models and analysts' expectations, GDP from construction in China to stand at 8,888.00 CNY Hundred Million (HML) monthly in 12 months' time. In the long-term, the China GDP from construction is projected to trend around 66,514.00 CNY HML each quarter in 2020, according to our econometric models (Global Finance, 2018). Figure 2.1 illustrates Sri Lanka GDP from construction from 2015 and its trend (Global Finance, 2018). Figure 2.2 illustrates China GDP from construction from 2015 and its trend (Global Finance, 2018).

Despite the never seen before boost, the construction sector of Sri Lanka is yet to slow down, with the country's infrastructure requiring a complete revamp and the real estate

growth bubble in Colombo not nearing its end, the growth prospects for the country's construction sector still fly high (Sri Lanka Export Development Board Blog, 2018).

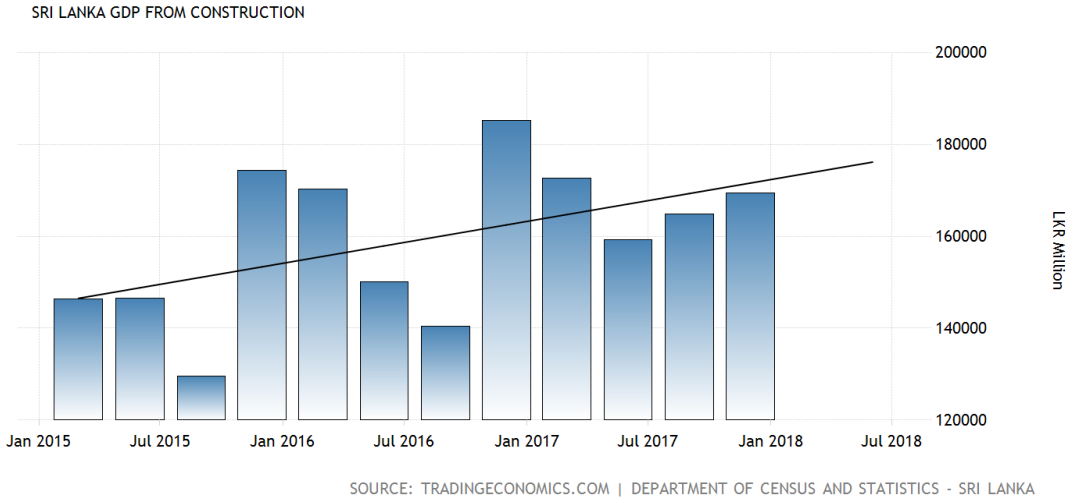


Figure 2.1: Sri Lanka GDP from Construction from 2015 and its trend
Source: (Global Finance, 2018).

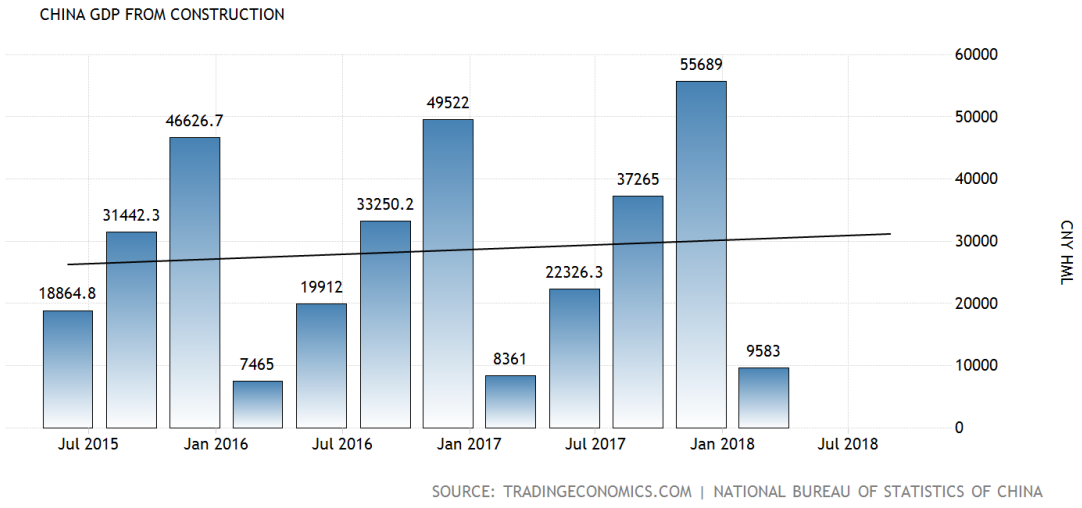


Figure 2.2: China GDP from Construction from 2015 and its trend
Source: (Global Finance, 2018).

Table 2.1 presents a comparison of statistics of Sri Lanka and China in construction industry, the differences and similarity between Sri Lanka and China in GDP, GDP growth,

GDP from construction, construction industry GDP contribution percentage, yearly construction from GDP growth rate, population, employees in construction industry and employment percentage of population in construction industry.

Table 2.1: A Comparison of Statistics of Sri Lanka and China in Construction Industry

Item	Period	Sri Lanka	China	Source
GDP	2017	USD 87.6 billion	USD 12,361.7 billion	(Global Finance, 2018)
GDP growth	2017	5%	6.2%	(Global Finance, 2018)
GDP from Construction	2017	USD 3.46 billion	USD 1,962.5 billion	(Trading Economics, 2018)
Construction Industry GDP Contribution Percentage	2017	3.9%	15.8%	(Trading Economics, 2018)
Yearly Construction from GDP Growth rate	From 2016 to 2018	5.3%	9.4%	(Trading Economics, 2018)
Population	2016	20.8 million	1.403 Billion	(WorldoMeters, 2018)
Employees in the Construction Industry	2016	0.6 million	51.8 million	(Ernst& Young, 2017); (Chrishanthi, 2017)
Employment Percentage of Population in Construction Industry	2016	2.9%	3.7%	(Trading Economics, 2018); (Ernst & Young, 2017); (Chrishanthi, 2017)

2.2.2 Delays of Construction Projects in Construction Industry

Assaf and Al-Hejji (2006) defined the delays of construction projects in construction industry as “the time overrun either beyond completion date specified in a contract or beyond the date that the parties agreed upon for delivery of a project”. Construction delay appeared when there was an event having impact on the final date for the completion of the project (Howick et al., 2009). Arditi and Pattanakitchamroon (2006) held the opinion that delay caused by one party may or may not affect the project completion date.

It is widely acknowledged for a construction project to be successful when it is completed within the project period, within the budget and being satisfied to the stakeholders (Majid, 2006). Assaf and Al-Hejji (2006) suggested that delays are a key problem that occurs in construction projects and the extent of these delays varies from project to project. Mahdavnejad and Molaee (2011) discovered that some projects are only a few days late while certain projects are delayed by over a month or a year. The increasing complexity of present construction projects causes delays and cost overruns have become common facts in the construction industry.

Sambasivan (2007) concluded that the problem of delays in the construction industry is a global phenomenon and the construction industry in Malaysia is no exception. Aibinu and Jagboro (2002) studied that construction delay has become endemic in Nigeria. It is imperative to create awareness of the extent to which delays can adversely affect project deliver and delay had significant effect on completion cost. Chan and Kumaraswamy (1997) studied delays in Hong Kong construction industry and emphasized that timely delivery of projects within budget and to the level of quality standard specified by the client is an index of successful project delivery. In Indonesia, it is identified that 47% of the projects were finished within the project period. It is very hard to unite all party's efforts for the purpose of completion of the project because of the various participants (Trigunarsyah, 2004). A study carried out by Singh (2010) found that of 894 infrastructure projects completed between April 1992 and March 2009 in Bangladesh, the percentage of project with positive time overruns stood at 60.8% in power sector, 79.9% in petroleum sector, 95.1% in ports and 100% in health welfare (Roy et al., 2012). In India, under the National Highway Development Programme in 2002, the Indian government aimed to improve the conditions of 65,000 kilometers national highways but very few has been completed on time (Roy et al., 2012).

Maduranga, Palamakumbura and Dissanayake (2016) reported that delays were one of the common issues faced by construction projects in Sri Lanka. Ramachandra et al. (2014) found that time overrun occurs in 90% of the projects they surveyed in Sri Lanka. Zou et

al. (2007) studied the key risks in construction projects in China and found out the time overrun is one of the most common and significant influences on the project.

Haseeb, Xinhai-Lu, Bibi, Maloof-ud-Dyia and Rabbani (2011) stated that time frame given to the contracts must be achieved by the contractor to compete the project and describe the importance of applying the law by giving him an extra time to complete it, if the employer caused a delay to the project. Delay could occur due to the increase of the scope of the works requiring to be performed within the original contract period (Bramble & Callahan, 2011). Marzouk and EI-Rasas (2013) further stated that delays often lead to disputes and litigation between contracting parties. Whenever there is a delay beyond the period contractually required to complete a project, there is bound to be an effect on expenditure or income either for the contractor or for the project owner or both (Thomas, 2011).

2.3 Claims in Construction Industry

2.3.1 The Nature of Claims in Construction Industry

The Canadian Law Dictionary defines 'claim' as an 'assertion of the right to remedy, relief or property'. Ho and Liu (2004) described construction claim as a request by a construction contractor for compensation over and above the agreed-upon contract amount for additional work or damages' supposedly 'resulting from events that were not included in the contract. Construction claims themselves usually arise as assertions for extra money or time. Claims on construction projects can be based on the contract itself, a breach of contract, a breach of some other common law duty, a quasi-contractual assertion for reasonable (quantum merit) compensation, or an ex-gratia settlement request (Mohan, 1997). Kumaraswamy (1997) stated that the claims are inevitable and unavoidable and in fact necessary to contractually accommodate unforeseen changes in project conditions.

Kimberly (2005) quoted that

> “Just how unpredictable is the claim construction process? Existing empirical studies have asserted that the Federal Circuit reverses 25% to 50% of district

court claim construction decisions. The reversal rate (rate at which the federal Circuit determined the claim construction was wrong) for appealed claim terms from 1996, after *Markman* was decided, 8 through 2003 is 34.5%" (p.239).

Tang (2003) studied the situations of claims for construction projects in China and pointed out there were weakness in claims for the contractor that the concept is vague, lack of specialist and precedent legal cases and mostly struggled in the relations with the client. Hu and Jiang (2001) sought for approaches to international practice, stating that after China joining the World Trade Organization (WTO), it will encounter more and more claim problem. Further, they gave an initial inquiry for the difficulty and countermeasure of construction claim.

2.3.2 Sources of Claims in Construction Industry

2.3.2.1 Correlation between Risks and Claims

British Standard (BS 6079-3:2000) defines risk as the uncertainty of an event happening that can affect the prospects of achieving business or project goals. Project Management Institute (Project Management Institution, 2013) provides more elaborate definition of risk as an uncertain event or condition that if occurs have a positive or negative effect on one or more project objectives such as scope, schedule, cost and quality.

Zack (1997) said that currently, contractors, under the pressure of competition, generally prefer to assume less risk while clients appear willing to push more risks to contractors during the tendering process, which is the major source of the claims. Sykes (1999) has identified risk allocation in standard contract forms and project contracts as an important factor in claims management. In construction projects, both parties take many risks, of human error and of the unexpected, which may cause loss to project participants. Construction contracts are supposed to assign such risks to the parties who have entered into the contracts. Hartman (1998) point out that the management of changes and claims is the management of risks. Project participants, especially, the client team should have a fair attitude to risk allocation in selecting the contractor and contract forms, estimating, scheduling and making detailed contract provisions.

Ratnesh, Iyer and Prakash (2017) reviewed the difference of risks and claims. The comparison of characteristics of risk and claim shows two important similarities, i.e. 'occurrence of uncertain event' and 'consequent loss or gain'. This observation provides an important insight that claims actually assessed impacts of the risks that have occurred in the project. The risks and sources of claims were found to be similar and summarized in Table 2.2.

Table 2.2: Comparison of risks and sources of claims for scope variation
Source: (Ratnesh et al., 2017)

Risks	**Sources of Claims**
Changes of scope, excessive contract variation, scope variation (Keci, 2015)	Variation initiated by owner, change of scope, unforeseen changes (Cakmak & Cakmak, 2014)
Incomplete design scope (Al-Bahar and Crandall,1990)	Variations (Yates,1998)
Design/project scope change due to extra unspecified work, specification change (Creedy , Skitmore, & Wong, 2010)	Variations due to site conditions, client changes, design errors and external events (Kumaraswamy,1997)
Lack of scope definition (El-Sayegh,2008)	Increase in scope (Semple, Hartman, & Jergeas, 1994)

According to above table, similarities can be observed in texts used to describe scope variation as risk and as source of claim.

2.3.2.2 Relationships between Conflicts and Disputes to Claims

Conflict has been defined as 'serious disagreement and argument about something important' and also as 'a serious' difference between two or more beliefs, ideas or interests'. Since conflict is 'inevitable in human relationships', it is predictably preponderant in projects where human relationships proliferate, as in construction (Collins, 1995).

Figure 2.3 illustrates how the relations of conflict and dispute relating with claims. Mohan (1997) further said that the figure shows the way conflicts to lead to improvements, say, in design or construction methodologies, while other conflicts may result in self-destructive disputes, either by themselves or through avoidable claims.

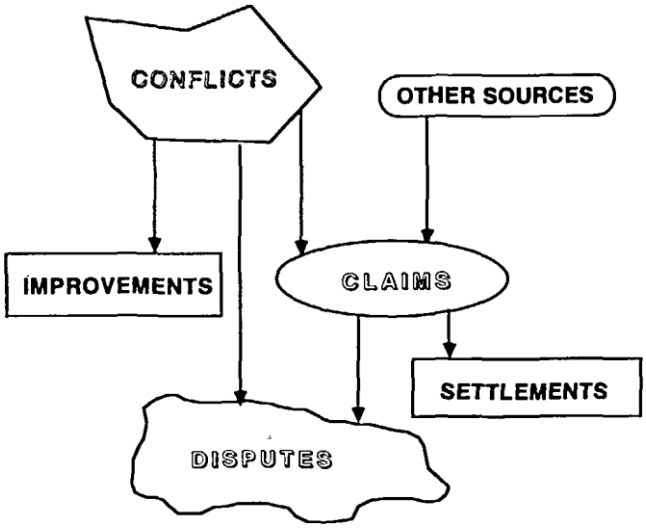


Figure 2.3: Basic relationships between conflicts and disputes as to claims (Mohan, 1997)

Figure 2.3 sets out the basic relationships between conflicts, claims and disputes in construction scenarios. Disputes are taken to imply prolonged disagreements on unsettled claims and protracted unresolved conflict.

> "For example, disputes as to the location or usage of certain site facilities may result from personality clashes between consultants' and contractors' representatives. Such unhealthy conflict and debilitating disputes can of course trigger further misunderstandings, and so even more claims and further disputes" (Mohan, 1997, pp. 98).

> "Conflict, it is proposed, exists wherever there is incompatibility of interest, and therefore is pandemic. Conflict can be managed, possibly to the extent of preventing a dispute resulting from the conflict. Dispute is associated with distinct justiciable issues. Disputes require resolution. This means that they can

be managed: the process of dispute resolution lends itself to third party intervention" (Peter, 1997, pp. 513-518).

A conflict is defined as any action or circumstance resulting from incompatible or opposing needs. A dispute is presented as a disagreement that requires a final determination, which is aided by the intervention of a third party (Peña, Sosa, & McCone, 2003).

2.3.2.3 Sources of Claims

Sources of claims studied by Cheung and Yiu (2006) are related with non-performance, payment and time. The authors identified these sources in details, which are summarized in Table 2.3.

Table 2.3: Triggering Events of Claims (Cheung & Yiu, 2006)

Non-performance	Payment	Time
▪ Inadequate site and/or soil investigation report ▪ Late giving of possession from client ▪ Client takes over the site and denies access to main contractor ▪ Main contractor denies access to the site for the subcontractor ▪ Main contractor fails to proceed in a competent manner ▪ Architect/engineer dissatisfies the work progress of main contractor ▪ Main contractor ceases work on the site	▪ Client fails to pay for variations claims ▪ Argument on the measurement and valuation of contracted work ▪ Delays interim payment from client ▪ Nonpayment to subcontractor by main contractor ▪ Argument on the prolongations costs claimed by main contractor ▪ Prolongations costs claimed by subcontractor	▪ Late instructions from architect or engineer ▪ Consequences on opening for inspection ▪ Argument on the time extension costs claimed by main contractor ▪ Delay works due to utility services organization ▪ Subcontractor works delayed due to main contractor

▪ Subcontractor ceases work on the site ▪ Changes of scope due to extra work ▪ Errors / substantial changes in bills of quantities	▪ Late release of retention monies to main contractor ▪ Assessment of liquidated and ascertained damages against main contractor ▪ Argument on acceleration costs	

Mikhail and Chris (2005) studied the claim causation and process that delay, cost cutting, resequencing of the work, acceleration, change of scope, defective work, strike are the seven scenarios commonly impacting on a construction site for a claim. Vidogah and Ndekugri (1997) point out that claims should be as important as having a clear understanding in the pre-construction and concludes that inadequate study of pre-construction stage would result in a claim. Sai (2013) disclosed that contract provisions are one of the sources of claims stating that the core of all construction contracts is stipulating the obligations of the contracting parties. Changes are considered necessary and unavoidable in all construction projects. To plan for such eventualities, provisions for instructing variations, acceleration, and postponement together with the corresponding time and monetary adjustments incorporated could be turned into claims if not properly managed.

Helen (2007) summarized previous studies and stated sources of claim existing mainly in two fields: organizational issues and uncertainty. The sub-category is shown in Table 2.4.

Table 2.4: Sources of claims (Helen, 2007)

Area	**Discipline**	**Sources of conflict, claim, and dispute**
Organizational issues	Structure	Internal/external organizational structure, delivery systems, inappropriate contract type, contract documents, contract terms, and law
	Process	Performance, quality, tendering pressures, payment, delays, disruption, acceleration,

		administration, formal communication channels, information sharing, reports and poor communication
	People	Misunderstandings, unrealistic expectations, culture, language, communications, incompatible objectives, management, negligence, work habits, and lack of team spirit
Uncertainty	External	Change, variations, environmental concerns, social impacts, economics, political risks, weather, regulations, and unforeseen site conditions
	Internal	Incomplete scope definition, errors in design, construction methods, and workmanship

This classification allows for a hierarchical classification of sources of claims in a construction project. In addition, this classification illustrates how each area and discipline is interrelated and interdependent (Helen, 2007).

2.3.3 Settlement of Claims

Even with the most expert understanding of construction contract and the most reasonable risk-allocation system, claims will continue to present problems if they are poorly managed in practice (Zineldine, 2006). Li (2008) studied and introduced the main form of claim and the generating reasons of claim were analyzed. He further discussed the claim contents of proposed by contractor and the prevention and settlement measures of claim aiming to enhance the management level of engineer and better to control and settle claim. Chen and Wang (2011) studied the area of civil and hydroelectric engineering and stated that engineering variations are always solved by the way of construction claim compensation, which no doubt increases the difficulty of the claim. They further analyzed their processing program and mode of payment and presented that contractor should use the clause of engineering alteration rationally. Defects of drawing and technical specification, changes of owners require and strict inspection and inappropriate refuse of

engineers should be listed in engineering alteration and try to make it legalization to justify a claim. It will make the contractor gain more benefit and decrease loss. Zhou (2003) coupled with the actual practices of engineering construction in Yangzi Petrochemical Company, gives a discussion on the precaution and settlement of contractor's claims as well as the related contents and methods for client's claim. However, his point of view more leans to protect client's legitimate rights and interests.

Claims management is the process of employing and coordinating resources to progress a claim from identification and analysis through preparation, and presentation, before it proceeds to negotiation and settlement (Kululanga, 2011). It is very important for contractors to submit claims according to the steps specified in the contract conditions, provide a detail of the additional costs and time, and present satisfactory evidence (Bakhary, Adnan & Ibrahim,2015). Generally, there are 6 stages in a claim process. It starts with identification and followed by notification, examination, documentation, presentation and negotiation of claims (Zaneldine, 2006). Construction claim identification involves timely and accurate recognition of a change. It is the first and critically important step, and it will be followed by a notification to the other party of a potential problem. Evidently, time limit requirements are also very crucial and critical (Levin, 1998). In general, the contract specifies such duties to both parties. Establishing legal and factual ground on which the claim is to be based is done during examination stage. The fourth stage is the documentation. It plays a very important role in the settlement of claims. All the supporting documents needed including drawings, specification, written instruction, cost breakdown, measurement records and many more should be compiled together. However, in reality, the importance of record management is not realized as much as it should be (Ho, 2004). The entire completed document will then be submitted and presented to client for assessment. Upon receiving the official claim, client will assess and decide on the outcome. They should act fast and avoid procrastination. The final stage is negotiation. This stage concerns the process of negotiation claim to the owner, and mutual resolution of such claim (Ren, 2003). If an agreement cannot be reached and both parties believe that they are in the right position,

they should propose an alternative dispute resolution method. If this fails, the remaining choice is to take the matter to court.

2.3.4 Delay Claims in Construction Industry

2.3.4.1 Nature of Delay Claims

Zaneldin (2006) is of the opinion that claims are common in construction projects and could happen as a result of several reasons that could contribute to the delays on projects. Keane and Caletka (2008) stated that construction delay claims are common occurrence in the projects which need to be dealt with quickly and efficiently. However, delays need to be excusable under the governing contractual provisions in order for the contractor to get the compensation (Cushman, Cater, Gorner & Coppi, 2001). According to Yates and Estein (2006), the construction delay claim process commences at the project inception. The amount of time, energy and cost devoted to the delay claims do not begin when a claim is initially submitted at or near the completion of a project.

Liu and Wang (2006) studied the construction delay claims development in China and stated that the awareness of delay claims in China were not mature and such claims were restricted under the weak contract management and inadequate document control. They gave the suggestion that the theory knowledge for delay claims and construction claim system still needed further development. Yang G. (2009) analyzed the cost for delay as a claim based on survey of large-scale projects in China. The influence, implementation environment and contractor's performance were studied and put forwarded the corresponding procedures for hurry works of incomplete construction period delay claims under FIDIC contract conditions.

Ramachandra et al. (2014) studied the delay claims of dynamic and complex project in Sri Lanka and found that top most frequent reasons for unsuccessful claims include: inadequate documentation to substantiate claims, delayed submission of claim details, failure to establish link between cause and effect of claims and failure to use appropriate delay analysis method.

Wu and Fang (1999) studied a risk model of delay claims settlement in which the claim number process is a non-homogeneous Poisson process. Yang D. (2003) studied on the principle of delay claims with multi-event interference and proposed three common points about building contract responsibility sharing for claim and explicated a new idea about delay claim, supported by the Theory of Information Dissymmetry that giving the first duty to clients on the claims for extension time, and the first duty to contractors on the financial claims.

2.3.4.2 Types of Delay Claims

When it comes to the category relates with effects, legal obligations and consequence, claims are separated into delay claims, suspension claims and termination claims. There is a big difference among them. It will cause a significant amount if not separating the claims and treating in different ways (Richard & Lynsey, 2009). Zaneldin (2006) disclosed that claims can be classified into six categories: contract ambiguity claims, delay claims, acceleration claims, change claims, extra work and different site conditions claims. In his research, delay claims ranked the third as to the frequency in UAE.

Any time related claim situations need to be resolved with regard to three basic elements: causation, liability and damages (Cushman, Carter, Gorman and Coppi, 1999; Williams, 2003).

Menesi (2007) pointed that it is important to classify the delay according to the liability. In addition to suspension, claims are mainly taken place in delays during the project duration. The delay is divided into three categories according to the liability: excusable delays, inexcusable delays and concurrent delays.

1) Excusable delays

Excusable delays are those that are caused by factors beyond each party's control (Bramble & Callahan, 2011; Baker, 2014). Cushman et al. (2001) argue that the excusable delays are beyond the control of either the contractor or the owner for which neither could be held responsible. The common scenarios include weather, acts of God, strikes and war

etc. The liquidated damages are not applicable for such delays, however, if the delay is not the cause of overall delay in completing the project, an excusable delay is not excuse for contractor from liquidated damages (Bramble & Callahan, 2011). In case of excusable delay, normally the contractor is entitled only an extension of time and no additional compensation from the employer (Keane and Calettka, 2008). However, Braimah (2013) held that excusable delays should include compensable delay which is caused by the misconduct of the employer.

(a) Compensable excusable delays

Mohamad (2010) stated that excusable compensable delay is due to the client's actions or inaction. When the contractor encounters such delay, they are entitled to time extension as well as monetary compensation due to the delays. Dodd and Findlay (2006) and Yates and Epstein (2006) agreed on this opinion that compensable excusable delays caused by the client without contributing fault of the contractor or its subcontractor makes the contractor entitled to a time for extension and additional financial compensation for costs of delay. A compensation delay is caused by the employer or his agents who should be responsible for the delays occurred. Examples are site access, delay in design, omission of works by the employer (Keane and Calettka, 2008). An excusable compensable delay usually leads to a schedule extension and exposes the client to financial damages claimed by the contractor (Sambasivan & Soon, 2007). Bramble and Callahan (2011) further pointed out the it is possible for a delay to be compensable without extending the time period of the contract.

(b) Non compensable excusable delays

Non-compensable excusable delays occur due to the "act of god" or unforeseeable causes such as adverse climate conditions which is beyond the control of the owner and contractor. The delays are not contributing any fault of one party that entitles the contractor to extension of time but not to additional cost (Yates & Epstein, 2006). Ahmed et al. (2010) pointed out that when the non-compensable excusable delay event occurs, the party should agree to share the risk and consequences which is that contractor will not contractually

imposed liquidated damages for the period of delay and not any compensation for delay however he will be entitled for an additional time for completion of the works. Bramble and Callahan (2011) mentioned that a non-compensable delay could be transformed into a compensable delay. For example, if the client's delay forces the contractor to perform during adverse climate, the performance of this period is considered as a compensable delay.

Yates and Epstein (2006) gave examples of non-compensable excusable delays to the contractor including owner initiated changes in the work, owner providing misleading information, owner not properly coordinating the work of other contractors and contractor encountering differing site conditions.

2) Non-excusable delays

Non-excusable delays are within the control of the contractor such as equipment mobilization delay, material supply, labour supply and lack of management by the contractor, etc. (Yates & Epstein, 2006). These delays occur due to the fault of the contractor and therefore such delays prevent the contractor from obtaining a time for extension and additional payment (Bramble & Callahan, 2011). Menesi (2007) also said as mostly it is the contractor's problems in managing and scheduling the works so that it is not subject to any additional time and cost reimbursement as to its nature. Non-excusable delays lead to a breach of contract by the contractor and meet termination of the contract in some cases, however, the delay are often difficult for owners to ascertain as the records and schedules are difficult to maintain (Bramble & Callahan, 2011). The reason for such non-excusable delay events including inappropriate selection of competent contractor, lack of management for project changes, delay in materials and equipment mobilizing to the site and lack of mechanism for recording (Afshari, Khosravi, Ghorbanali, Borzabadi, and Valipour, 2011).

3) Concurrent delays

When over one type of delay occurs either at the same time together or independently, impacts the project's critical path, it is a concurrent delay (Ostrowski & Madgette, 2006).

Bramble and Callahan (2011) pointed out that the concurrent delay could also occur where two or more delay events arise at different times, but the effects of the delays are felt at the same time, in which case the period of concurrency of delays could be related by circumstances. Ahmed et al. (2010) further emphasized the importance of the concurrent delay is the responsibility due to both employer and the contractor. The concurrent delay is more complicated when delay periods are different period, which is not totally concurrent, or the delay has a different impact on the types or numbers of each activity (Soon, 2010). In consideration of the complexity, the analysis of concurrent delays needs to restructure according to compensable, non-compensable and non-excusable delays caused by the claimant (Bramble & Callahan, 2011). Tiggeman and Toscano (2010) hold the opinion that the contractor should justify the compensable delay is the dominant cause of the delay in order to claim the loss and expense as a result of concurrent delays.

The contractor is entitled to file a claim as to a delay event when the delay of the event is an excusable delay or concurrent delay. A non-excusable delay is not enabling the contractor to commence a claim (Ahmed et al., 2010; Bramble & Callahan, 2011; Yates & Epstein, 2006).

Ren, Anumba and Ugwu (2003) said that analyzing the various types and causes of delay is an important task to resolving these claims. Cushman et al. (1999) concluded delay causation as another element of delay claims. The causation of the delay is summarized earlier in Table 2.6. This research investigates the causations of the delay that could constitute a delay claim and the influence of delay factors to delay claims.

2.4 Factors Leading to Delays in Construction Industry

Remon (2013) stated that delay means non-completion of project within the project duration agreed upon the contract. Luu (2009) said that the construction project schedule is important in project management because of its impact on the success of the project. As Remon (2013) revealed that the common results of delays are late completion of project, increasing cost, disturb of works, reduction of productivity, third party claims, disputes among the participants, suspension or termination of the project. It causes all

dissatisfaction to all parties involved in the project. Sambasivan and Soon (2007) identified the effects of delay are including time overrun, cost overrun, disputes, arbitration, litigation and abandonment.

Arditi (1985) studied the factors leading to delays in public sponsored project for the period of the ten years from 1970 in Turkey. More than twenty factors were discovered and concluded shortage of material, payments, contractor related and organization of the construction company as the major factor. Baldwin (1971) studied the delays of projects in the USA and identified seventeen factors leading to delays and concluded that weather, labour supply and subcontractor to be the main reason. Sambasivan and Soon (2007) investigated the delay factors in Malaysia and concluded the ten delay factors as major reasons including contractor's poor site management, contractor's improper planning, inadequate contractor experience, inadequate owner's finance and payment for the project, subcontractor problems, material shortages, labour shortages, equipment failure, lack of communication among all parties and mistakes made during the project duration. Gunduz, Nielsen and Ozdemir (2012) indicated categorization of delay factors into groups of up to eleven categories of consultant-related, contractor related, design-related, equipment-related, externality-related, labour-related, material-related, owner-related, project-related, engineer-related and human-behaviour related.

Remon (2013) summarized many of previous studies and combined the situations into nine categories after interviewing 2500 different highly experience construction professional. He classified the delay claims into nine sub-categories and 99 delay factors.

A great number of studies have been carried out as to delays in construction industry for years of various factors contributing to delays. As this research investigates delay claims from the contractor's perspective, it is summarized and categorized into three categories including consultant related delay factors, employer related delay factors, external related delay factors by referring to the past literature without considering contractor related delay factors. Based on the delay factors classified and named by Remon (2013), another 20

literatures were further reviewed and categorized into the consultant related delay factors, client related delay factors and external related delay factors as summarized in Table 2.5.

After summarizing the delay factors from literature, it is further calculated the number of citation of each delay factor from the literatures. The most cited delay factors were unfavourable weather conditions, slowness in decision making and delay in payments. However, the least cited delay factors were misunderstanding of owner's requirements, poor site management, incomplete of specification and other contract documents, tendencies, delay in approval sample material, inadequate information during project feasibility study, lack of capable representative, legal disputes between project participants, delay in manufacturing materials, accidents during construction, ineffective delay penalties. After all the delay factors identified and categorized by reviewing literatures, the delay factors were used to build up the questionnaire to investigate the factors most frequently leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese Construction industry.

Table 2.5: Literature Summary for Delay Factors for Construction Industry

S/No	Delay Factors	Sources (Reference shown below)																				total cited
Consultant Related Delay Factors		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
1	Delay in assessing/approving major changes in the scope of work	×					×		×	×		×			×								6
2	Design errors made by designers	×								×	×	×				×							5
3	Inadequate site investigation	×						×															2
4	Unclear and inadequate details in drawings				×								×										2
5	Delay in design works	×						×	×				×		×								5
6	Delay in reviewing and approving design	×		×			×						×							×			5
7	Delay in performing inspection and testing	×	×		×				×										×	×			6
8	Delay in determination													×								×	2
9	Lack of experience of consultant in construction projects	×					×		×		×						×						5
10	Conflicts between consultants	×	×						×														3
11	Insufficient data collection and survey before design	×													×								2
12	Poor communication and coordination with other parties	×	×						×	×													4
13	Misunderstanding of owner's requirements	×																					1
14	Poor site management																					×	1

15	Inadequate supervision				×	×											×					×	4
16	Discrepancies or interpretation disagreement in contract																	×	×				2
17	Incomplete of specification and other contract documents											×											1
18	Poor use of advanced design software	×														×							2
Client Related Delay Factors		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
19	Tendencies													×									1
20	Intermittent stoppage of work due to cash flow constraints				×			×		×													3
21	Change orders/Variation	×	×		×			×	×		×				×						×	×	9
22	Delay in payments	×				×	×	×	×	×		×						×	×	×			10
23	Changes in material types and specifications during construction											×	×										2
24	Delay in approval sample material								×														1
25	Delay in approving design changes	×							×														2
26	Design changes by owner or his agent during construction	×																×	×		×		4
27	Unrealistic contract duration			×							×						×						3
28	Poor communication and coordination with other parties	×							×														2
29	Slowness in decision making	×	×	×	×	×			×		×	×	×							×		×	11
30	Conflicts between joint-owners	×							×														2
31	Inadequate information during project feasibility study	×																					1

32	Delay in site delivery	×	×						×														3
33	Lack of incentives for contractor to finish ahead of schedule	×		×					×														3
34	Lack of capable representative													×									1
35	Lack of experience of owner in construction projects	×												×							×		3
External Related Delay Factors		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
36	Unfavourable weather conditions	×		×	×			×	×			×	×	×	×		×	×	×	×	×		14
37	Legal disputes between project participants								×														1
38	Shortage of construction materials in market	×							×														2
39	Unexpected surface & subsurface condition	×	×						×		×		×					×		×		×	8
40	Delay in manufacturing materials								×														1
41	Accidents during construction								×														1
42	Environmental and social factors								×					×			×						3
43	Political and regional stability													×		×							2
44	Escalation of local purchase prices	×			×														×				3
45	Global financial crisis	×	×																				2
46	Price fluctuations on the international market	×																	×				2
47	Unreliable suppliers								×	×													2
48	Conflict, war, and public enemy				×											×							2
49	Ineffective delay penalties								×														1
50	Delay in obtaining permits from local authority	×	×	×	×				×	×							×						7

51	Natural disasters (flood, hurricane, earthquake)	×			×										×								3
52	Changes in government regulations and laws	×			×				×										×	×	×		6
53	Delay in providing services from utilities	×							×														2
54	Problem raised by local surrounding residents	×																		×			2
55	Loss of time by traffic control and restriction at project site	×							×														2
[1] (Remon,2013) [2](Gunduz et al., 2013) [3](Hemanta et al.,2012) [4](Aibinu et al., 2006) [5](Al-Khalil et al., 1000) [6](Al-Kharashi et al., 2009) [7](Arditi et al., 1985) [8](Assaf and Al-Hejji, 2006) [9](Assaf et al., 1995) [10](Chan and Kumaraswamy, 1997) [11](El-Razek et al., 2008) [12](Faridi and El-Sayegh, 2006) [13](Iyer and Jha, 2005) [14](Kumaraswamy and Chan, 1998) [15](Ling and Hoi, 2006) [16](Lo et al., 2006) [17](Mansfield et al., 1994) [18](Olawale and Sun, 2010) [19](Sambasivan and Soon, 2007) [20](Nkado, 1995)																							

2.5 Chapter Summary

This chapter first reviews the present situation of construction industry in Sri Lanka and China. The growth of construction industry in Sri Lanka and China increased rapidly in past few years with Sri Lanka meeting a percentage of 5.3% yearly growth rate of construction from GDP and China meeting 9.4%. However, the delays in construction industry are widely existed all over the world including Sri Lanka and China.

Claims are reviewed for the area of definition, unpredictable nature and weakness in claims. Sources of claims are analyzed by referring to the correlation of risk and claims that claims assess impacts of risks and risks have difference with sources of claims following an analysis of relation of conflicts and disputes to a claim. Sources of claims are summarized and claim management is important to settle a claim following the claim process. Delay claims were further reviewed that there are three basic elements to resolve a delay claim: causation, liability, damages. The delay claims could be filed when the claim is due to excusable delay and concurrent delay as to its liability. Non-excusable delay is not able to claim as a result of the fault of contractor.

Many researchers studied the causation of delays in order to examine the reason of a project delay. Different researchers studied the causation of delays in different aspects. In order to summarize the causation of delay, 21 researches were reviewed specially on the factors leading to delays. The delay factors include consultant related, client related and external related factors without consideration of contractor related delay factors as this research is from the contractor's perspective to file a delay claim. The delay factors were reviewed and summarized for further study what is the most frequent factors leading to delays and the most significant factors contributing to delay claims.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter introduces the methodology followed in this study to achieve the aim of the research. It further presents the research process, research design, data collection and analysis techniques used in this study.

3.2 Research Process

Research philosophy adopted in a research provides important assumptions about the way which the researchers views the world and it will under pin the research strategy and research methods chosen for the study (Saunders, Lewis & Thornhill, 2009).

Research process provides an initial framework, sense of stability and direction to go ahead with the research (Crotty, 1998). Rudestam and Newton (2007) studied that process is not linear but a recursive cycle of steps that are repeated over time. It is held by Walliman (2005) that a plan for action is required to be developed, to carry out a research, showing how problems are investigated, what information are collected, using which methods and how this information is analyzed in order to arrive at conclusions and development of recommendations. Figure 3.1 presents the research process developed for this study and the five (05) steps of the research process are as follows:

- Step 1: Literature Review
- Step 2: Questionnaire development and Pilot survey
- Step 3: Questionnaire survey
- Step 4: Data analysis
- Step 5: Expert interviews and findings validation

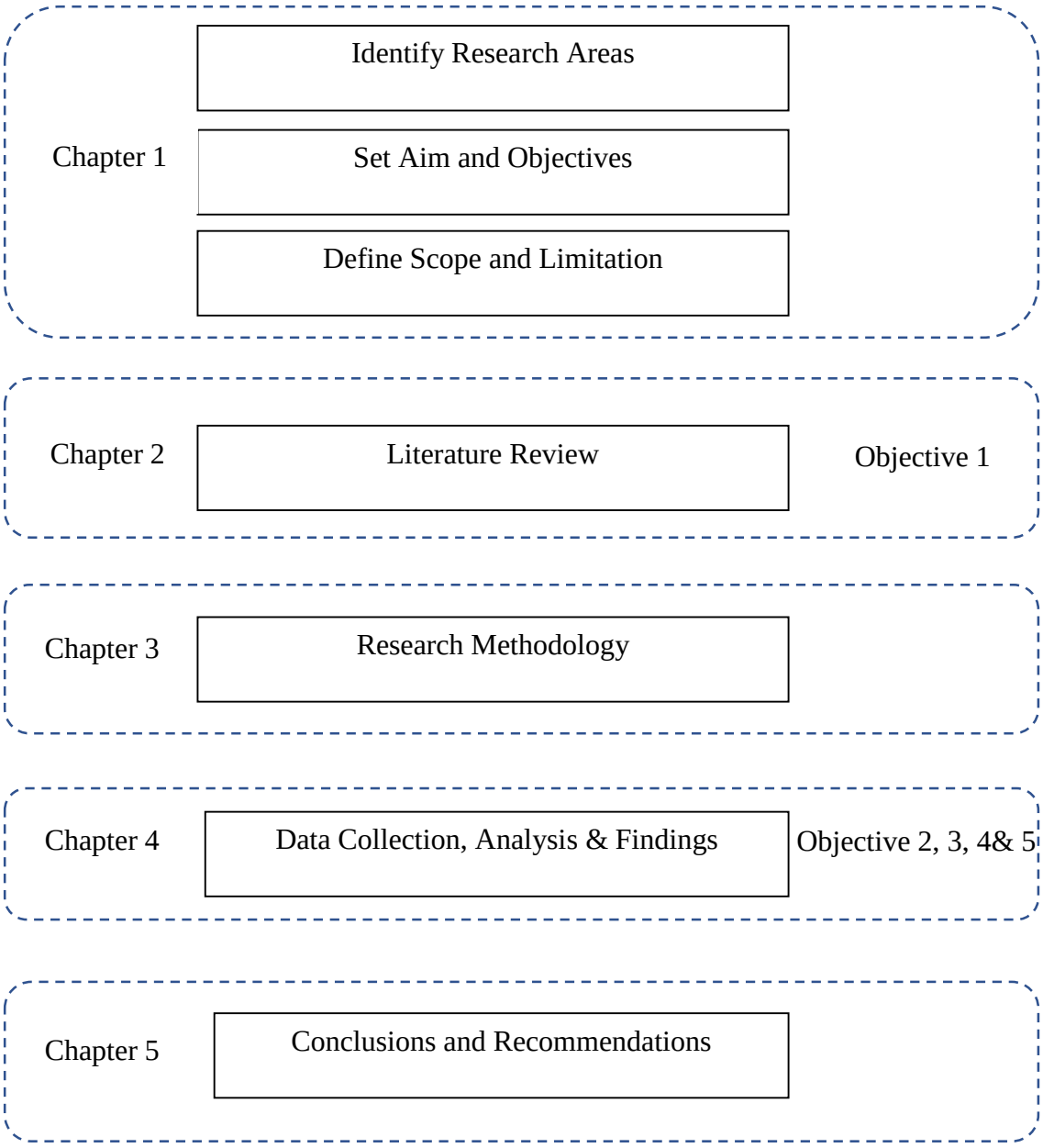


Figure 3.1: Research Process

3.3 Research Approach

Research approaches assist to organize research activities, including the collection of data, in ways that more likely to achieve the research aims (Easterby-Smith, Thorpe, & Lowe, 2002). Research approaches are mainly in two ways, which is quantitative and qualitative

approaches. Fellows and Liu (2003) stated that quantitative approach could relate to positivism, seek to gather factual data, study how facts and relationships accord with theories and the findings of any research executed previously. Several previous researchers have identified delay factors to their investigations related to construction industry. However, the focus of this research is to investigate how these delay factors relate with delay claims. Rea and Parker (2012) is of the opinion that there is no better approach of research than a survey for collecting information from large populations. Survey research allows the researcher to generalize about a large population by studying only a small portion of that population.

Fellows and Liu (2003) stated that the whole population as individuals or groups could be studied by a qualitative approach. The area related with belief, opinions, understandings and different people's ideas can be identified by a qualitative approach. A qualitative approach applies on case study research, ethnography, action research and grounded theory approach. The qualitative approach helps to get holistic, group of people's ideas, environments, programmes, events and phenomenon by interacting closely with the studied group (Creswell, 2014). However, the qualitative research is sometimes regarded as lack of generalizability, relying on researcher's subjective understanding and interpretation (Vaus, 2002).

Creswell (2014) explained mixed methods involves combining or integration of qualitative and quantitative research and data in a research study which provides a more complete understanding of a research problem than either quantitative or qualitative data alone. The research begins with a broad survey to generalize results to a population and then, in a second phase, focuses on qualitative interviews to collect views from participants to help explain the initial quantitative survey.

As this research aims to discuss the delay factors contributing to delay claims in Sri Lankan and Chinese construction industry and as both industries have large populations. Brimah (2008) stated that survey research makes it possible to generalize the results to research population while enabling comparisons between target groups to be made. This

research further adopted a comparative analysis of Sri Lankan and Chinese construction industry. Employees in construction industry in Sri Lanka and China is largely affected by its culture, experience and attitudes as contractors in two different nations, which makes it suitable to adopt a quantitative data collection method for the research. However, the study applied qualitative data collection methods to collect in-depth information on reasons behind the most frequent factors leading to delays and the most significant delay factors contributing to delay claims in Sri Lankan and Chinese construction industry.

Hence, the research applied mixed method research approaches to achieve the aim.

3.4 Data Collection

The research is carried out in five (05) steps under mixed method research approach. Those steps are as follows:

3.4.1 Step 1 – Literature review

A comprehensive literature review was conducted on sources of claims, nature of delay claims and types of delay claims to identify delay factors. This was done by referring different types of literature sources such as journal articles, books, conference proceedings, reports and web documents. Literature findings were used to develop a structured questionnaire for empirical investigation.

3.4.2 Step 2 – Pilot Survey

Pilot survey carries out with a small group of samples to identify any possible problems in the questionnaire such as ambiguity, errors of wordings, completeness and understandings of the respondents, to name a few. It can facilitate the researcher to seek a better guidance of the subject group of respondents in accomplishing the tasks and put forth the problem in general terms, and it is then up to the researcher to narrow it down and phrase the problem in operational terms (Kothari, 2004).

During the pilot survey, the structured questionnaire was shown to four (04) experts who has at least 20 years' experience on claim related issues in construction industry, to check its completeness and comprehensiveness. They were requested to answer the

questionnaire to check the appropriateness for both Sri Lankan and Chinese construction industry, language, completeness, wordings as well as understanding difficulties regarding the questionnaire. After the feedback of the experts of the pilot survey, a few amendments were made to improve the quality and completeness of the questionnaire.

3.4.3 Step 3 – Structured Questionnaire Survey

Structured questionnaire is a widely used and effective instrument for collecting survey information, providing structured, numerical data, being able to be administered without the presence of the researcher, and often being comparatively straight forward to analyze (Wilson and Mclean, 1994). The key part of the research is the structured questionnaire survey which is targeted to respondents as contractors in both Sri Lankan and Chinese construction industry.

This questionnaire survey is based on both Sri Lankan and Chinese who involved in a construction project handling the delay claims with at least five (05) years' experience from different projects. The targeted group of respondents include Chinese professionals working in the construction projects in China and Sri Lankan professionals working in the construction projects in Sri Lanka. The targeted group was selected by purposive sampling technique. Etikan, Musa and Alkassim (2016) stated purposive sampling is nonprobability sampling techniques which have subjective nature in choosing sample and it is not good representative of the population, but it is useful especially when randomization is impossible like when the population is very large.

By considering the purpose of the survey, the questionnaire is organized based on the areas of which delay factors summarized by the literature review and how influencing these delay factors contribute to delay claims.

Janes (2001) stated 30 numbers of response could be enough to carry out the statistical analysis because of central limit theorem holding true when sample size is above 30 in accordance with the generally accepted rule. Hence, a number of 60 samples was used where 30 Sri Lankans working in the construction projects in Sri Lanka and 30 Chinese

working in the construction projects in China were selected for data collection, based on purposive sampling technique.

3.4.4 Step 4 – Quantitative Data Analysis

The data obtained from the survey were ordinal in nature as most of the responses were measured using the Likert scale. Such data cannot be treated using parametric statistics methods unless precarious and perhaps unrealistic assumptions are made about the underlying distributions. It was therefore found appropriate to analyzes it using non-parametric statistics of Relative Important Index (RII) analysis.

Many researchers (Doloi, Sawhney, Iyer & Rentala, 2012; El-Razek et al., 2008; Zaneldin, 2006) recognized RII analysis as an excellent approach for aggregating scores of factors rated on an ordinal scale by respondents. According to Johnson and LeBreton (2004), RII aids in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables

To determine the ranking of the factors from the view of the surveyed, RII was employed as it best fits the purpose of this study.

The following formula was used as follows in the computation of RII (Badu, Manu, Edwards, Adesi and Lichtenstein, 2013).

$$RII=\sum W/A*N$$

Where, W is weighting given to each statement by the respondents and ranges from 0 to 5; A-higher response integer (5); and N-total number of respondents.

W the five-point scale is 1 for insignificant, 2 for moderately insignificant, 3 for neutral relates, 4 for moderately significant,5 for most significant

3.4.5 Step 5 – Panel Discussion with Experts and Validation of Findings

Panel discussion was carried out with six (06) Sri Lankan and Chinese experts with over fifteen years' experience. The purpose of the panel discussion was to obtain the expert views on the common and unique factors leading to delays and factors contributing to

delay claims, most frequent factors leading to delays and the most significant delay factors contributing to delay claims in Sri Lankan and Chinese construction industries and validation of findings. Expert panel discussion findings were analyzed using manual content analysis methods.

3.5 Chapter Summary

This chapter presents the structure of research methodology which was used for studying of the research. Mixed method research approach was decided as the suitable research approach for this study. The structured questionnaire was developed through literature review and by a pilot survey targeting to a small group of professionals to verify the questionnaire. A questionnaire was distributed to the respondents in both Sri Lankan and Chinese construction industry to accomplish the aim and objectives. The data collected from the questionnaire survey was analyzed by the statistical methods of RII analysis as analysis technique. Research findings were finally presented to panel of experts to obtain further opinion. The research findings are presented in Chapter 4.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the collected data and explains the analysis of the collected data from Chinese and Sri Lankan professionals working in construction projects in China and Sri Lanka through a questionnaire survey and panel discussion after a pilot survey. Research findings are described in the following headings: General details of the respondents to the questionnaire survey, panel discussion and research findings. Further it is compared the factors most frequently leading to delays and the most significant delay factors to delay claims between Sri Lankan and Chinese construction industry.

4.2 Pilot Survey

The pilot survey was carried out by distributing the sample of questionnaire to four identified experts as professionals who had at least 20 years' experience on claim related issues in construction industry. The profile of respondents is presented in Table 4.1.

Table 4.1: Profile of Respondents in Pilot Study

Respondent	**Details**
PS1	Chartered Quantity Surveyor who works under a Contractor as Senior Quantity Surveyor with 24 years' QS experience
PS2	Chartered Quantity Surveyor who works under a foreign contractor as Senior Claim Manager with 21 years' claim experience
PS3	Arbitrator and Chartered Engineer who works in a Joint Venture project as a Chief Engineer with 30 yeas' experience of construction disputes resolution
PS4	Chartered Quantity Surveyor who currently owns a Consultancy Organisation and a former Senior Quantity Surveyor with 35 years' experience under foreign contractors

Above respondents were requested to answer the structured questionnaire to check the language, completeness, wordings as well as understanding difficulties regarding the

questionnaire. A few corrections were made with regard to the errors such as changing "compete" to "complete" in the instruction page and wording of "Not significant" Column C of delay factor questionnaire to "Little Significant" as "Yes/No" has been provide in Column B of delay factor questionnaire. The option of "Plant & Equipment" in item 6 in Part I background information for indication of participated project type was added for the completeness. Some unnecessary information was removed as to item B.17 that "in construction projects" was removed out of "lack of experience of owner in construction projects". The delay factors were identified according to the literature review, however, some of the expression was changed to mitigate the understanding difficulty. For example, item A.11 of insufficient data collection and survey before design was changed as to insufficient data collection and survey before design (causing unforeseeable situations) to make respondents understood about to which extend the insufficient data collection and survey before design it refers to. Item B.1 "tendencies" was change as "tendencies & bias" to make respondents have more clear picture about what the item means. Further interpretation was added to items C.4 and C.18 as "Unexpected surface & subsurface condition (such as soil, high water table)" and "Delay in providing services from utilities (such as water, electricity)".

The above feedback from the experts of the pilot survey were incorporated in to the questionnaire to make it more specific and clearer to the general respondent to answer the questionnaire.

4.3 Structured Questionnaire Survey

The questionnaire was distributed through email and by hand to a number of 68 numbers of professionals in Sri Lanka and China. The 60 numbers of effective questionnaires from of professionals from Sri Lanka and China were collected, among which 30 were from Chinese professionals working in the construction project in China and 30 were from Sri Lankan professionals working for the construction project in Sri Lanka. Respondent rate of the questionnaire is 88.2%. The profile of respondents is described as follows in accordance with the statics of the responded questionnaire.

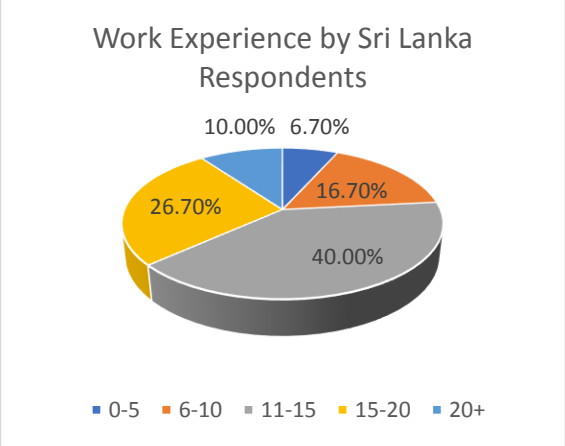
All 60 numbers of respondents work as a contractor.

As shown in Table 4.2 and Figure 4.1, the most Sri Lankan respondents have experience of 11 to 20 years, which takes up 66.7% of all Sri Lankan respondents. Most of Chinese respondents have experience of 6-15 years, which takes up 73.3% of all Chinese respondents. Besides, over 76% of Sri Lankan respondents have more than 10 years' experience in construction industry. Comparatively over 66% of Chinese respondents have more than 10 years' experience.

Table 4.2: Work Experience of Sri Lankan and Chinese Respondents in Construction Industry

Years of Experience	Sri Lankan Respondents		Chinese Respondents	
	Numbers	Percentage	Numbers	Percentage
0-5	2	6.7%	1	3.3%
6-10	5	16.7%	9	30.0%
11-15	12	40.0%	13	43.3%
15-20	8	26.7%	5	16.7%
20+	3	10.0%	2	6.7%

Figure 4.1: Distribution of Work Experience by Sri Lankan and Chinese Respondents in Construction Industry



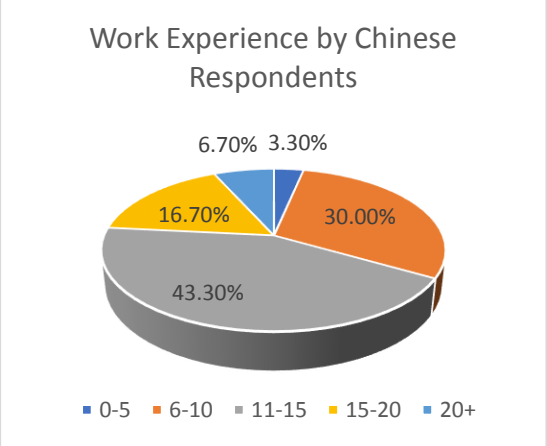


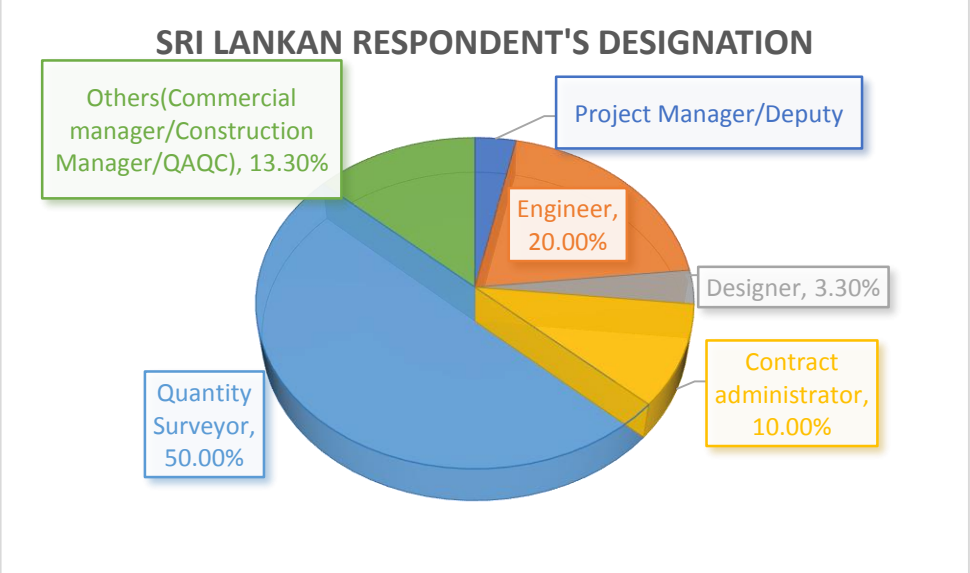
Table 4.3 and Figure 4.2 present the Respondents' Designation in the Projects. Sri Lankan respondents work as quantity surveyors and engineers taking up 50% and 20%

respectively. Chinese respondents work as quantity surveyor and contract administrator taking up 33.3% and 26.7% respectively.

Table 4.3: The Respondents' Designation in the Project

Designation	Sri Lankan Respondents		Chinese Respondents	
	Numbers	Percentage	Numbers	Percentage
Project Manager / Deputy Project Manager	1	3.3%	3	10.0%
Engineer	6	20.0%	5	16.7%
Designer	1	3.3%	2	6.7%
Contract administrator	3	10.0%	8	26.7%
Quantity Surveyor	15	50.0%	10	33.3%
Others (Commercial Manager / Construction Manager / QAQC)	4	13.3%	2	6.7%

Figure 4.2: The Distribution of Sri Lankan and Chinese Respondents' Designation in the Project



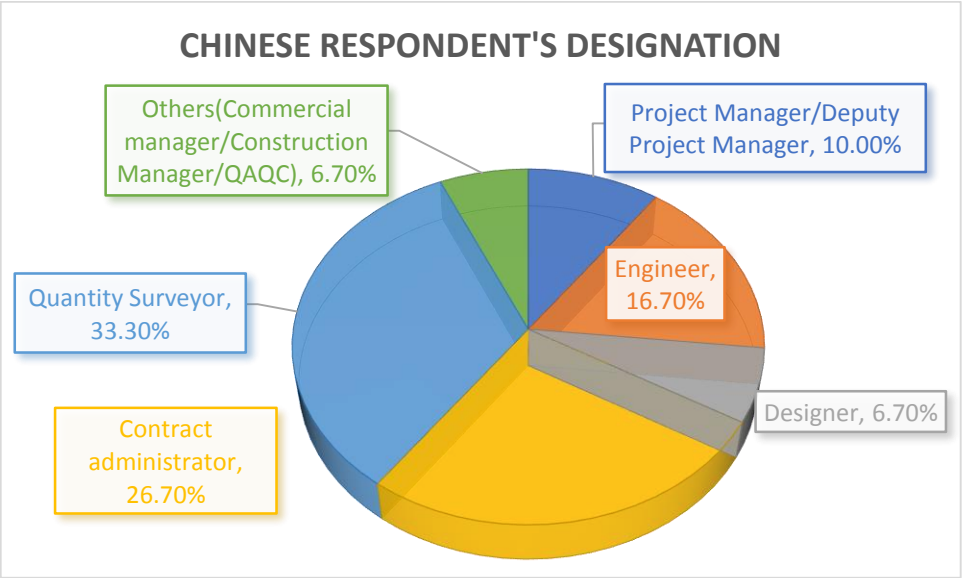
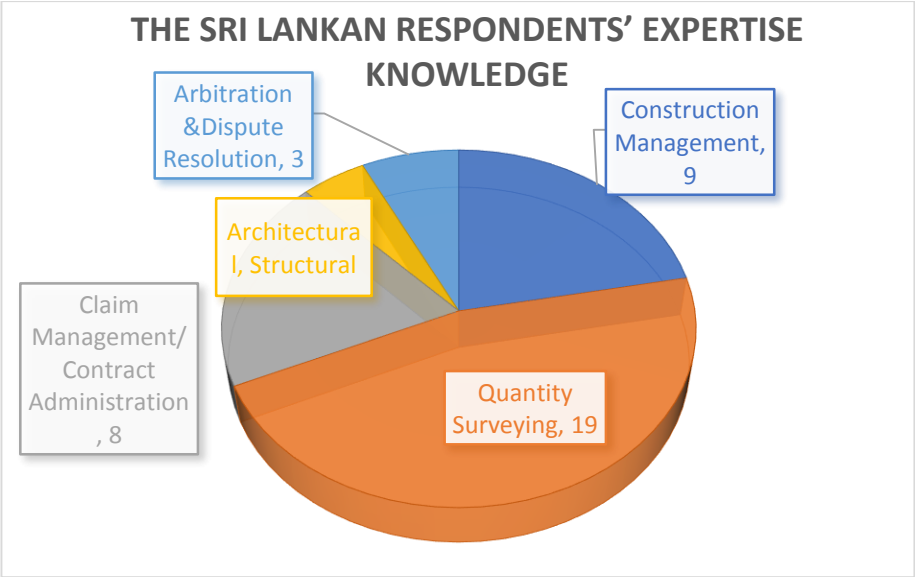


Table 4.4 and Figure 4.3 presents the Sri Lankan and Chinese respondents' expertise knowledge areas. 19 numbers of Sri Lankan respondents have the expertise knowledge on quantity surveying, 9 have knowledge on construction management and 8 have knowledge on claim management and contract administration. In comparison, 15 numbers of Chinese respondents have the expertise knowledge on quantity surveying, 12 on construction management and 12 on claim management and contract administration.

Table 4.4: The Sri Lankan and Chinese Respondents' Expertise Knowledge

Expertise Knowledge	**Sri Lankan Respondents**	**Chinese Respondents**
	Numbers	**Numbers**
Construction Management	9	12
Quantity Surveying	19	15
Claim Management / Contract Administration	8	12
Architectural, Structural Design	2	3
Arbitration & Dispute Resolution	3	1

Figure 4.3: Distribution of Sri Lankan and Chinese Respondents' Expertise Knowledge



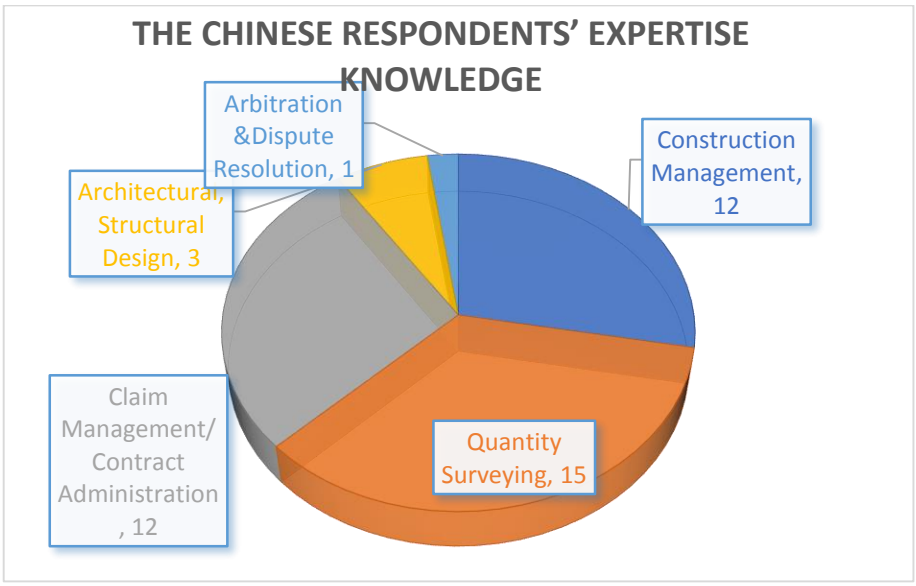
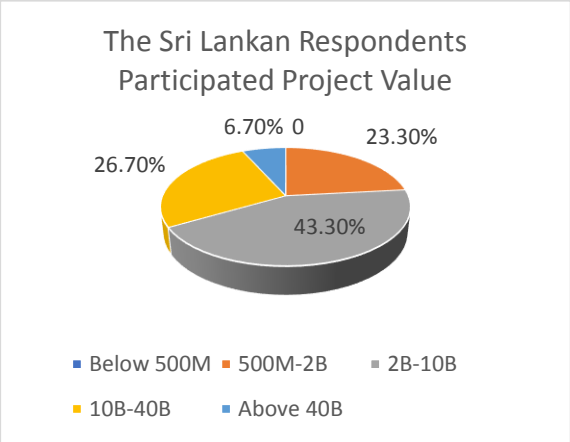


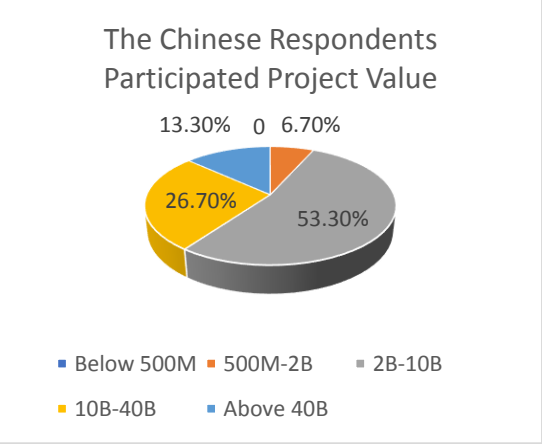
Table 4.5 and Figure 4.4 presents Sri Lankan and Chinese respondents participated based on project value. It shows both Sri Lankan and Chinese respondents' project have a value above 500 million Rupees. Around 43.3% of Sri Lankan respondents have an experience of project value of 2 billion to 10 billion. In comparison, 53.3% of Chinese respondents have an experience of project value of 100 million to 500 million (equivalent to LKR 2B-10B).

Table 4.5: The Sri Lankan and Chinese Respondents Participated based on Project Value

Project Value (LKR)	Sri Lankan Respondents		Project Value (CNY)	Chinese Respondents	
	Numbers	%		Numbers	%
Below 500M	0	0	Below 25M	0	0
500M-2B	7	23.3%	25M-100M	2	6.7%
2B-10B	13	43.3%	100M-500M	16	53.3%
10B-40B	8	26.7%	500M-2B	8	26.7%
Above 40B	2	6.7%	Above 2B	4	13.3%

Figure 4.4: The Distribution of Sri Lankan and Chinese Respondents Participated based on Project Value



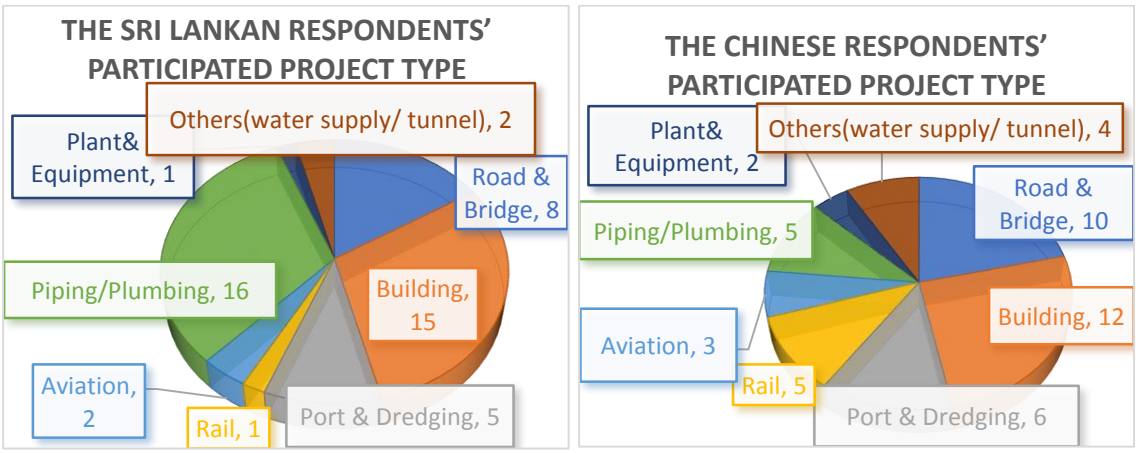


According to Table 4.6 and Figure 4.5, most of the Sri Lankan respondents work in the project types of roads & bridges, buildings and pipe plumbing. Most of the Chinese respondents works the project type of roads & bridges and building projects. Both Sri Lankan and Chinese respondents cover the project areas of road, bridge, building, port, dredging, rail, aviation, piping, plumbing, plant, equipment and others.

Table 4.6: The Sri Lankan and Chinese Respondents' Participated Project Type

Project Type	Sri Lankan Respondents	Chinese Respondents
	Numbers	Numbers
Road & Bridge	8	10
Building	15	12
Port & Dredging	5	6
Rail	1	5
Aviation	2	3
Piping / Plumbing	16	5
Plant & Equipment	1	2
Others (water supply / tunnel)	2	4

Figure 4.5: The Distribution of the Sri Lankan and Chinese Respondents' Participated by Project Type



As shown in Tables 4.2 to 4.6, the profile of respondents has the following characteristics. First, all respondents work under contractors. Second, most of the respondents for both Sri Lankan and Chinese respondents have over 10 years' experience in construction industry. Third, Most of Sri Lankan respondents work as Quantity Surveyors followed by Contract Administrators and there is an equal number working as Contract Administrators and Quantity Surveyors among Chinese respondents. Fourth, the respondents show the experience in construction management, quantity surveying, claim management, contract

administration. Few respondents have experience of architectural, structural design and arbitration & dispute resolution experience among both Sri Lankan and Chinese respondents. Fifth, most of Sri Lankan respondents participate the projects valued from 2 billion to 10 billion Rupees and similar portion of Chinese participants participate the project valued from 500M to 2 Billion CNY (equivalent to 10 Billion to 40 billion Rupees). Sixth, the respondents project experience covers road, bridge, building, port, dredging, rail, aviation, piping / plumbing. A few numbers of Sri Lankan respondents participated the project of plant & equipment.

4.4 Research Findings

The Relative Importance Index (RII) technique was used to rank delay factor based on the frequency of delay factors and the significance of delay factors contributing to delay claims in both Sri Lankan and Chinese construction industry.

4.4.1 Factors Most Frequently Leading to Delays in Sri Lankan and Chinese Construction Industry

To achieve the objective of investigating the factors most frequently leading to delays in Sri Lankan construction industry, the factors leading to delays as identified from literature review and pilot survey were incorporated in to the structured questionnaire. Sri Lankan respondents were requested to score the frequency of the factor appearing in respondents' projects leading to delays. The collected data was analyzed by RII method for ranking the factors most frequently leading to delays. Table 4.7 presents the result of RII of the Sri Lankan respondents for scoring the frequency of each delay factor of consultant related, client related and external related delay factors in the Sri Lankan industry.

Table 4.7: RII of Frequency of Delay Factors in Sri Lankan Construction Industry

Ranking	S/N	Description of delay factor	RII
1	C.1	Unfavourable weather conditions	0.833
2	A.1	Delay in assessing/approving major changes in the scope of work	0.793
3	A.6	Delay in reviewing and approving design	0.787

4	B.4	Delay in payments	0.773
5	B.3	Change orders/Variation	0.753
6	C.17	Changes in government regulations and laws	0.753
7	B.7	Delay in approving design changes	0.747
8	C.8	political and regional stability	0.747
9	B.11	Slowness in decision making	0.740
10	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	0.740
11	B.14	Delay in site delivery	0.733
12	A.2	Design errors made by designers	0.727
13	A.8	Delay in determination	0.727
14	C.15	Delay in obtaining permits from local authority	0.720
15	C.19	Problem raised by local surrounding residents	0.720
16	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	0.713
17	A.3	Inadequate site investigation	0.707
18	B.5	Changes in material types and specifications during construction	0.693
19	C.9	Escalation of local purchase prices	0.680
20	A.4	Unclear and inadequate details in drawings	0.653
21	B.6	Delay in approval sample material	0.647
22	A.5	Delay in design works	0.640
23	A.7	Delay in performing inspection and testing	0.640
24	C.7	Environmental and social factors	0.640
25	B.8	Design changes by owner or his agent during construction	0.633
26	C.20	Loss of time by traffic control and restriction at project site	0.573
27	A.16	Discrepancies or interpretation disagreement in contract documents	0.547
28	B.17	Lack of experience of owner	0.540
29	B.2	Intermittent stoppage of work due to cash flow constraints	0.527
30	B.13	Inadequate information during project feasibility study	0.527
31	C.5	Delay in manufacturing materials	0.520

32	C.13	Conflict, war. And public enemy	0.520
33	A.14	Poor site management	0.513
34	A.15	Inadequate supervision	0.513
35	C.3	Shortage of construction materials in market	0.513
36	A.12	Poor communication and coordination with other parties	0.507
37	B.9	Unrealistic contract duration	0.500
38	C.16	Natural disasters (flood, hurricane, earthquake)	0.500
39	A.18	Poor use of advanced design software	0.493
40	A.13	Misunderstanding of owner's requirements	0.480
41	A.17	Incomplete of specification and other contract documents	0.467
42	C.18	Delay in providing services from utilities (such as water, electricity)	0.453
43	B.1	tendencies	0.433
44	B.10	Poor communication and coordination with other parties	0.407
45	C.6	Accidents during construction	0.400
46	C.11	Price fluctuations on the international market	0.393
47	A.9	Lack of experience of consultant	0.380
48	C.12	Unreliable suppliers	0.373
49	B.16	Lack of capable representative	0.360
50	A.10	Conflicts between consultants	0.347
51	B.12	Conflicts between joint-owners	0.347
52	B.15	Lack of incentives for contractor to finish ahead of schedule	0.347
53	C.10	Global financial crisis	0.340
54	C.2	Legal disputes between project participants	0.320
55	C.14	Ineffective delay penalties	0.267

To achieve the objective of investigating the factors most frequently leading to delays in Chinese construction industry, the factors leading to delays as identified from literature review and pilot survey were incorporated in to the questionnaire. The collected data was analyzed using RII method for ranking the factors most frequently leading to delays. Table 4.8 lists the result of RII of the Chinese respondents for scoring the frequency of each

delay factor of consultant related, client related and external related delay factors in the Chinese industry.

Table 4.8: RII of Frequency of Delay Factors in Chinese Construction Industry

Ranking	S/N	Description of delay factor	RII
1	C.1	Unfavourable weather conditions	0.820
2	A.6	Delay in reviewing and approving design	0.793
3	A.2	Design errors made by designers	0.767
4	A.1	Delay in assessing/approving major changes in the scope of work	0.753
5	B.7	Delay in approving design changes	0.747
6	B.3	Change orders/Variation	0.740
7	B.8	Design changes by owner or his agent during construction	0.720
8	A.7	Delay in performing inspection and testing	0.713
9	B.11	Slowness in decision making	0.707
10	A.8	Delay in determination	0.700
11	A.5	Delay in design works	0.693
12	B.4	Delay in payments	0.673
13	A.4	Unclear and inadequate details in drawings	0.660
14	B.6	Delay in approval sample material	0.640
15	B.14	Delay in site delivery	0.640
16	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	0.633
17	C.7	Environmental and social factors	0.627
18	A.3	Inadequate site investigation	0.580
19	A.15	Inadequate supervision	0.573
20	B.5	Changes in material types and specifications during construction	0.567
21	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	0.553
22	C.15	Delay in obtaining permits from local authority	0.540
23	A.16	Discrepancies or interpretation disagreement in contract documents	0.500
24	B.17	Lack of experience of owner	0.493

25	B.9	Unrealistic contract duration	0.480
26	A.14	Poor site management	0.473
27	C.9	Escalation of local purchase prices	0.467
28	B.13	Inadequate information during project feasibility study	0.460
29	C.5	Delay in manufacturing materials	0.453
30	A.18	Poor use of advanced design software	0.447
31	A.17	Incomplete of specification and other contract documents	0.440
32	A.13	Misunderstanding of owner's requirements	0.440
33	A.12	Poor communication and coordination with other parties	0.433
34	C.17	Changes in government regulations and laws	0.413
35	C.18	Delay in providing services from utilities (such as water, electricity)	0.413
36	C.16	Natural disasters (flood, hurricane, earthquake)	0.407
37	C.3	Shortage of construction materials in market	0.407
38	B.1	Tendencies	0.407
39	C.20	Loss of time by traffic control and restriction at project site	0.400
40	C.19	Problem raised by local surrounding residents	0.393
41	B.2	Intermittent stoppage of work due to cash flow constraints	0.387
42	B.10	Poor communication and coordination with other parties	0.380
43	B.16	Lack of capable representative	0.373
44	C.6	Accidents during construction	0.367
45	B.15	Lack of incentives for contractor to finish ahead of schedule	0.360
46	C.11	Price fluctuations on the international market	0.347
47	C.12	Unreliable suppliers	0.347
48	A.10	Conflicts between consultants	0.333
49	A.9	Lack of experience of consultant	0.327
50	C.14	Ineffective delay penalties	0.327
51	B.12	Conflicts between joint-owners	0.327
52	C.2	Legal disputes between project participants	0.313

53	C.8	political and regional stability	0.280
54	C.10	Global financial crisis	0.280
55	C.13	Conflict, war. And public enemy	0.200

The 15 top most frequent factors leading to delays in both Sri Lankan and Chinese construction industry are shown in Table 4.9.

Table 4.9: Comparison of the Factors Most Frequently Leading to Delays in Sri Lankan and Chinese Construction Industry

Rank	**Sri Lankan Construction Industry**		**Chinese Construction Industry**	
	S/N	**Description of Delay Factors**	**S/N**	**Description of Delay Factors**
1	C.1	Unfavourable weather conditions		
2	A.1	Delay in assessing/approving major changes in the scope of work		
3	A.6	Delay in reviewing and approving design		
4	B.4	Delay in payments		
5	B.3	Change orders/Variation		
6	B.7	Delay in approving design changes		
7	B.11	Slowness in decision making		
8	A.2	Design errors made by designers		
9	A.8	Delay in determination		
10	C.17	Changes in government regulations and laws	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)
11	C.8	political and regional stability	A.4	Unclear and inadequate details in drawings
12	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	B.6	Delay in approval sample material
13	B.14	Delay in site delivery	A.5	Delay in design works
14	C.15	Delay in obtaining permits from local authority	A.7	Delay in performing inspection and testing
15	C.19	Problem raised by local surrounding residents	B.8	Design changes by owner or his agent during construction

As derived from Table 4.9, the factors most frequently leading to delays in both Sri Lankan and Chinese construction industry are unfavourable weather conditions, delay in assessing / approving major changes, delay in reviewing approving design in the scope of work, delay in payments, change orders / variation, delay in approving design changes, slowness in decision making, design errors made by designers, delay in site delivery and delay in determination. However, the factors most frequently leading to delays in Sri Lankan construction industry and not in Chinese construction industry are changes in government regulations and laws, political and regional stability, unexpected surface & subsurface condition (such as soil, high water table), delay in obtaining permits from local authority, problem raised by local surrounding residents. The factors most frequently leading to delays in Chinese construction industry and not in Sri Lankan construction industry are design changes by owner or his agent during construction, delay in performing inspection and testing, delay in design works, unclear and inadequate details in drawings and delay in approval sample material.

4.4.2 Significance of Delay Factors Contributing to Delay Claims in Sri Lankan and Chinese Construction Industry

The next task of questionnaire survey was to identify the most significant factors contributing to delay claims in Sri Lankan construction industry. The collected data was analyzed using RII method and findings are presented in Table 4.10.

Table 4.10: RII of Significance of Delay Factors Contributing to Delay Claims in Sri Lankan Construction Industry

Ranking	S/N	Description of delay factor	RII
1	B.3	Change orders/Variation	0.807
2	C.1	Unfavourable weather conditions	0.793
3	A.2	Design errors made by designers	0.773
4	B.14	Delay in site delivery	0.767
5	C.17	Changes in government regulations and laws	0.760
6	B.4	Delay in payments	0.733
7	C.15	Delay in obtaining permits from local authority	0.733

8	C.16	Natural disasters (flood, hurricane, earthquake)	0.733
9	A.1	Delay in assessing/approving major changes in the scope of work	0.727
10	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	0.727
11	C.8	Political and regional stability	0.727
12	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	0.720
13	C.19	Problem raised by local surrounding residents	0.720
14	A.5	Delay in design works	0.673
15	A.7	Delay in performing inspection and testing	0.653
16	A.4	Unclear and inadequate details in drawings	0.647
17	A.8	Delay in determination	0.640
18	B.6	Delay in approval sample material	0.640
19	C.11	Price fluctuations on the international market	0.633
20	B.8	Design changes by owner or his agent during construction	0.627
21	B.11	Slowness in decision making	0.627
22	B.5	Changes in material types and specifications during construction	0.627
23	A.6	Delay in reviewing and approving design	0.620
24	A.3	Inadequate site investigation	0.620
25	A.17	Incomplete of specification and other contract documents	0.620
26	B.2	Intermittent stoppage of work due to cash flow constraints	0.620
27	B.7	Delay in approving design changes	0.613
28	C.20	Loss of time by traffic control and restriction at project site	0.613
29	C.7	Environmental and social factors	0.600
30	C.9	Escalation of local purchase prices	0.580
31	A.14	Poor site management	0.567
32	C.3	Shortage of construction materials in market	0.567
33	C.18	Delay in providing services from utilities (such as water, electricity)	0.560
34	C.2	Legal disputes between project participants	0.547

35	A.9	Lack of experience of consultant	0.540
36	A.16	Discrepancies or interpretation disagreement in contract documents	0.527
37	C.12	Unreliable suppliers	0.520
38	C.13	Conflict, war. And public enemy	0.513
39	B.9	Unrealistic contract duration	0.507
40	A.12	Poor communication and coordination with other parties	0.500
41	A.13	Misunderstanding of owner's requirements	0.493
42	B.16	Lack of capable representative	0.493
43	B.17	Lack of experience of owner	0.480
44	A.18	Poor use of advanced design software	0.473
45	B.15	Lack of incentives for contractor to finish ahead of schedule	0.467
46	A.10	Conflicts between consultants	0.460
47	B.13	Inadequate information during project feasibility study	0.453
48	B.1	tendencies	0.453
49	B.10	Poor communication and coordination with other parties	0.440
50	A.15	Inadequate supervision	0.413
51	C.14	Ineffective delay penalties	0.407
52	B.12	Conflicts between joint-owners	0.380
53	C.6	Accidents during construction	0.367
54	C.5	Delay in manufacturing materials	0.347
55	C.10	Global financial crisis	0.287

The same exercise was carried out with Chinese respondents and findings are presented in Table 4.11.

Table 4.11: RII of Significance of Delay Factors Contributing to Delay Claims in Chinese Construction Industry

Ranking	**S/N**	**Description of delay factor**	**RII**
1	B.3	Change orders/Variation	0.787
2	A.2	Design errors made by designers	0.767
3	C.1	Unfavourable weather conditions	0.760

4	B.14	Delay in site delivery	0.727
5	B.4	Delay in payments	0.713
6	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	0.707
7	A.5	Delay in design works	0.700
8	A.1	Delay in assessing/approving major changes in the scope of work	0.687
9	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	0.687
10	C.15	Delay in obtaining permits from local authority	0.673
11	C.16	Natural disasters (flood, hurricane, earthquake)	0.660
12	B.8	Design changes by owner or his agent during construction	0.660
13	A.4	Unclear and inadequate details in drawings	0.647
14	A.8	Delay in determination	0.647
15	A.7	Delay in performing inspection and testing	0.640
16	B.5	Changes in material types and specifications during construction	0.633
17	C.7	Environmental and social factors	0.633
18	B.6	Delay in approval sample material	0.627
19	C.17	Changes in government regulations and laws	0.613
20	B.11	Slowness in decision making	0.607
21	A.16	Discrepancies or interpretation disagreement in contract documents	0.607
22	A.6	Delay in reviewing and approving design	0.600
23	A.3	Inadequate site investigation	0.600
24	B.2	Intermittent stoppage of work due to cash flow constraints	0.593
25	B.7	Delay in approving design changes	0.593
26	B.17	Lack of experience of owner	0.540
27	A.17	Incomplete of specification and other contract documents	0.513
28	A.9	Lack of experience of consultant	0.493
29	A.14	Poor site management	0.480

30	B.13	Inadequate information during project feasibility study	0.480
31	C.20	Loss of time by traffic control and restriction at project site	0.467
32	C.9	Escalation of local purchase prices	0.453
33	C.18	Delay in providing services from utilities (such as water, electricity)	0.453
34	C.19	Problem raised by local surrounding residents	0.447
35	A.13	Misunderstanding of owner's requirements	0.420
36	A.12	Poor communication and coordination with other parties	0.407
37	C.8	political and regional stability	0.393
38	C.2	Legal disputes between project participants	0.393
39	B.15	Lack of incentives for contractor to finish ahead of schedule	0.387
40	C.5	Delay in manufacturing materials	0.387
41	C.12	Unreliable suppliers	0.380
42	A.18	Poor use of advanced design software	0.380
43	C.3	Shortage of construction materials in market	0.367
44	B.16	Lack of capable representative	0.360
45	C.11	Price fluctuations on the international market	0.347
46	C.13	Conflict, war. And public enemy	0.347
47	A.15	Inadequate supervision	0.347
48	B.12	Conflicts between joint-owners	0.340
49	B.10	Poor communication and coordination with other parties	0.333
50	A.10	Conflicts between consultants	0.327
51	C.14	Ineffective delay penalties	0.327
52	C.6	Accidents during construction	0.320
53	B.1	Tendencies	0.313
54	B.9	Unrealistic contract duration	0.293
55	C.10	Global financial crisis	0.267

Table 4.12 presents the 15 top most significant delay factors contributing to delay claims in both Sri Lankan and Chinese construction industries.

Table 4.12: Comparison of the Most Significant Delay Factors Contributing to Delay Claims between Sri Lankan and Chinese Construction Industry

Rank	Sri Lankan Construction Industry		Chinese Construction Industry	
	S/N	Description of Delay Factors	S/N	Description of Delay Factors
1	B.3	Change orders/Variation		
2	C.1	Unfavourable weather conditions		
3	A.2	Design errors made by designers		
4	B.14	Delay in site delivery		
5	B.4	Delay in payments		
6	C.15	Delay in obtaining permits from local authority		
7	C.16	Natural disasters (flood, hurricane, earthquake)		
8	A.1	Delay in assessing/approving major changes in the scope of work		
9	C.4	Unexpected surface & subsurface condition (as soil, high water table)		
10	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)		
11	A.5	Delay in design works		
12	A.7	Delay in performing inspection and testing		
13	C.17	Changes in government regulations and laws	A.4	Unclear and inadequate details in drawings
14	C.8	Political and regional stability	A.8	Delay in determination
15	C.19	Problem raised by local surrounding residents	B.8	Design changes by owner or his agent during construction

As derived from Table 4.12, the most significant delay factors contributing to delay claims in both Sri Lankan and Chinese construction industry are change orders / variation, unfavourable weather conditions, design errors made by designers, delay in site delivery, delay in payments, delay in obtaining permits from local authority, natural disasters (flood, hurricane, earthquake), delay in assessing/approving major changes in the scope of work, unexpected surface & subsurface conditions (such as soil, high water table), insufficient data collection and survey before design (causing unforeseeable situations), delay in design works, delay in performing inspection and testing. However, the most significant

delay factors contributing to delay claims in Sri Lankan construction industry and not in Chinese construction industry are changes in government regulations and laws, political and regional stability, problem raised by local surrounding residents. The most significant delay factors contributing to delay claims in Chinese construction industry and not in Sri Lankan construction industry is design changes by owner or his agent during construction, unclear and inadequate details in drawings and delay in approval sample material, delay in performing inspection and testing, delay in determination.

4.5 Panel Discussion with Experts

A panel of experts comprising of three Sri Lankan and three Chinese who have more than 15 years' experience were gathered for the discussion about reasons for the common and different factors most frequently leading to delay and most significantly contributing to delay claims. Profile of the experts presents in Table 4.13.

Table 4.13: Profile of Experts in Panel Discussion

Respondent	**Details**
PE – SL 1	Chartered Quantity Surveyor and Sri Lankan, works under a Contractor as a Senior Quantity Surveyor with 24 years' QS experience
PE – SL 2	Chartered Quantity Surveyor and Sri Lankan, works under a foreign contractor as a Senior Claim Manager with 21 years' claim experience
PE – SL 3	Arbitrator and Chartered Engineer and Sri Lankan, works in a Joint Venture project as a Chief Engineer with 30 years' experience of construction disputes resolution
PE – CN 1	Chartered Engineer and Chinese, works in a Joint Venture project as a Commercial Manager with 20 years' experience of contract claims
PE – CN 2	Senior Chartered Engineer and Chinese, works under a Chinese Contractor with 24 years' experience of project management.
PE – CN 3	Senior Chartered Engineer and Chinese, works in under a Chinese contractor with 28 years' experience of project management.

Findings of Tables 4.9 and 4.12 were shown to the above panel of experts in during the meeting. Questions were brought with regard to their opinion on (a) why they are the common factors most frequently leading to delays between Sri Lankan and Chinese construction industry; (b) why they are the different factors most frequently leading to delays between Sri Lankan and Chinese construction industry; (c) why they are the common factors most significantly contributing to delay claims between Sri Lankan and Chinese construction industry; and (d) why they are the different factors most significantly contributing to delay claims between Sri Lankan and Chinese construction industry.

4.5.1 Factors Most Frequently Leading to Delays in Sri Lankan and Chinese Construction Industry

After discussion with the panel of experts with regard to the reason of common factors most frequently leading to delays in Sri Lankan and Chinese construction industry, opinions were extracted and summarized in Table 4.14.

Table 4.14: Common Factors Most Frequently Leading to Delays Between Sri Lankan and Chinese Construction Industry

	S/N	**Common factors**	**Expert Panel Analysis**
1	C.1	Unfavourable weather conditions	Adverse weather is a normal occurrence in Sri Lanka and China and it has high impact on the project progress
2	A.1	Delay in assessing / approving major changes in the scope of work	Assessing and approving is the obligation of Consultant in Sri Lanka and China. Delay in assessing and approval is common
3	A.6	Delay in reviewing and approving design	Reviewing and approving is the Consultant's obligation in Sri Lanka and China. Delay in reviewing and approval widely exists.
4	B.4	Delay in payments	Delay in payments is a normal situation for construction projects and it is more common for Sri Lanka than China.

5	B.3	Change orders/Variation	Client's project requirements are changing for most projects due to the project complexity.
6	B.7	Delay in approving design changes	In the event of design made by the Contractor, it takes time for client's review and approval. Such occurrence delay the project.
7	B.11	Slowness in decision making	Decision making is the Consultant's obligation in both Sri Lanka and China. Delay in decision making exists.
8	A.2	Design errors made by designers	Design is the Design consultant's works. Errors may occur in design works.
9	A.8	Delay in determination	Determination is the Consultant's obligation in both Sri Lanka and China. Delay in determination exists.

Different factors most frequently leading to delays between Sri Lankan and Chinese construction industry were analyzed and presented in Table 4.15.

Table 4.15: Different Factors Most Frequently Leading to Delays Between Sri Lankan and Chinese Construction Industry

	S/N	**Different factors**	**Expert Panel Analysis**
In Sri Lankan Construction Industry			
1	C.17	Changes in government regulations and laws	There are frequent changes in government regulation and laws in Sri Lanka for past years especially in taxes. In comparison, China shows a very steady regulation and laws.
2	C.8	political and regional stability	The political and regional stability in Sri Lanka are not steady specially in elections, strike, terrorism attack etc. In comparison, China shows a very steady political and regional stability
3	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	There is a lack of investigation and record on underground condition in Sri Lanka. In

			comparison, the information and data is of e-storage in China.
4	B.14	Delay in site delivery	Site delivery is sometimes difficult in Sri Lanka due to the land privacy and acquisition barriers. In comparison, lands are mostly own by the government and land acquisition is easier in China.
5	C.15	Delay in obtaining permits from local authority	There are authority delays and longer procedures prevail in permits in Sri Lanka. In comparison, there are more online procedures in China.
6	C.19	Problem raised by local surrounding residents	There are more chances available for residents to complain. In comparison, there are few channels for residents' complaining.
In Chinese Construction Industry			
1	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	The cases of design are made by design consultant instead of contractor are more in China. Therefore, there are more possibilities in design consultant's incapability causing delay.
2	A.4	Unclear and inadequate details in drawings	The cases of design are made by design consultant instead of contractor are more in China. Therefore, there are more possibilities for design consultant in its incapability causing delay.
3	B.6	Delay in approval sample material	There is no specific reason for there being more cases of delay in approval of sampling material in China. However, it exists.
4	A.5	Delay in design works	The cases of design are made by design consultant instead of contractor are more in China. Therefore, there are more possibilities for design consultant in its incapability causing delay.
5	A.7	Delay in performing inspection and testing	There is no specific reason for there being more cases of delay in performing

			inspection and testing in China. However, it exists.
6	B.8	Design changes by owner or his agent during construction	There is no specific reason for there being more cases of delay in owner's design changes in China. However, it exists.

4.5.2 Factors Most Significantly Contributing to Delay Claims in Sri Lankan and Chinese Construction Industry

After discussion with the panel of experts with regard to the reason of common factors most significantly contributing to delay claims between Sri Lankan and Chinese construction industry, opinions summarized in Table 4.16.

Table 4.16: Common Factors Most Significantly Contributing to Delay Claims in Sri Lankan and Chinese Construction Industry

	S/N	Common factors	Expert Panel Analysis
1	B.3	Change orders/Variation	Client's project requirements are changing for most projects due to the project complexity. Changing orders and variation which requires more time for completion will lead to delay claims by the Contractor.
2	C.1	Unfavourable weather conditions	It is normally applicable as "no fault principal" for adverse weather claim. The Client will bear the risk of time for completion and the Contractor will bear the cost. It can be claimed for extension of time as a delay claim.
3	A.2	Design errors made by designers	Design errors made by the design consultant will contribute to a delay claim if the error causes the contractor to re-work or else.
4	B.14	Delay in site delivery	The Contractor is not assessable to the site which leads to the contractor not to commence the works. It constitutes a delay claim.

5	B.4	Delay in payments	Delaying in payment will cause a delay claim if it affects the Contractor's cash flow to reduce the rate of progress.
6	C.15	Delay in obtaining permits from local authority	Delay in obtaining permits will cause a delay claim if it constitutes the disturbance by the authority or lack of assistance by the Client.
7	C.16	Natural disasters (flood, hurricane, earthquake)	Natural disaster known as Force Majeure will contribute to a delay claim as it most probably affects the works.
8	A.1	Delay in assessing / approving major changes in the scope of work	The Consultant's failure to approving the changes in work scope leads to a delay claim filed by the Contractor for delaying of works.
9	C.4	Unexpected surface & subsurface condition (such as soil, high water table)	If unexpected surface & subsurface condition is encountered, the Contractor is entitle for a delay claim of the works due to the unforeseeable physical conditions.
10	A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	If the insufficiency of survey done by the consultant, it may causes inaccurate or unexpected situation for the works which will constitute a delay claim.
11	A.5	Delay in design works	The Design Consultant is delaying in issuing drawings to the Contractor causing delaying of the works. The Contractor can file a delay claim.
12	A.7	Delay in performing inspection and testing	The Consultant's failure to inspect or test at site causing the contractor unable to complete the works. The Contractor can file a delay claim.

Different factors most significantly contributing to delay claims between Sri Lankan and Chinese construction industry were analyzed and presented in Table 4.17.

Table 4.17: Different Factors Most Significantly Contributing to Delay Claims in Sri Lankan and Chinese Construction Industry

	S/N	Different factors	Expert Panel Analysis
In Sri Lankan Construction Industry			
1	C.17	Changes in government regulations and laws	Law changes will incur a delay claim once it the changes affect the work progress. It has shown a more frequent government regulation and laws changes in Sri Lanka for past years than China. The factor is more significant contributing to a delay claim in Sri Lanka.
2	C.4	political and regional stability	Political and regional stability may constitute a Force Majeure case which enables a delay claim by the Contractor. Sri Lanka shows a less stable situation than China and more likely to have such delay claim.
3	A.11	Problem raised by local surrounding residents	It may cause a delay claim if third party is delaying in the works. Residents have more channel in Sri Lanka for complaints and raising problems than what is in China so that it is more significant contributing to a delay claim in Sri Lanka.
In Chinese Construction Industry			
1	A.4	Unclear and inadequate details in drawings	Inaccurate and inadequate design which causes the delay of works will cause a delay claim by the Contractor. It is supposed that the cases of design are made by design consultant instead of contractor are more in China. This factor contributes more to a delay claim in China.
2	A.8	Delay in determination	If the Consultant is failing to make a determination and causes the delay of works, the Contractor is entitled to file a delay claim. In China, there is many cases for Engineer's is not oblige his duty so that this factor may be more significant contributing to a delay claim in China

3	B.8	Design changes by owner or his agent during construction	If the Client's requirement is changing causing design change in construction stage resulting in a delay of works a delay claim could be filed by the Contractor. There is no typical clue for there being more cases of delay in design changes by the owner during construction in China than in Sri Lanka. However, it may exist.

4.6 Chapter Summary

This chapter presents the data collected from pilot study, structured questionnaire survey and panel discussion. Data collected from structured questionnaire survey was analyzed using RII method and ranked each delay factors based on frequency and significance contributing to delay claims. The objective of identifying the factors most frequently leading to delays in Sri Lankan and Chinese construction industry and investigating the most significant delay factors contributing to delay claims in Sri Lankan and Chinese construction industry are achieved. Further, the factors most frequently leading to delays and the most significant delay factors contributing to delay claims are compared between Sri Lankan and Chinese construction industry. The factors in common and difference most frequently leading to delays and most significantly contributing to delay claims in Sri Lankan and Chinese construction industry are analyzed by a panel of experts.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This research aims to investigate the factors most frequently leading to delays and identify the most significant factors contributing to delay claims by a comparison of Sri Lankan and Chinese construction industry. To achieve the aim and objectives of the research, comprehensive literature was reviewed to find out the factors causing delays from previous researchers. Based on the analysis of collected data from Sri Lankan and Chinese respondents of questionnaire survey followed by a panel of expert meeting interview, this chapter is intended to conclude the results and make recommendations of the research.

5.2 Conclusions

Project delay is a global phenomenon in construction industry. The causation factors and sources of delays were reviewed by literature and the factors leading to delays were identified accordingly as derived from twenty-one researches. The factors leading to delays can be identified under consultant related delay factors, client related factors, contractor related factors and external related factors. As this research is at the contractor's perspective, the contractor related factors are not considered in this study to avoid the biasness. By conducting a questionnaire survey, the factors most frequently leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry are investigated and concluded.

The first objective of the research was achieved by reviewing the literature of sources of construction claims, nature of delay claims and factors leading to delays. The factors leading to delays were further categorized and merged into the respective categories. It was identified and summarized total of fifty-five factors leading to delays in three categories i.e. consultant related delay factors, client related factors, external related factors. Further, the factors reviewed was calculated for the cited times among the reviewed literatures and found that there were eleven factors leading to delays cited only

once and the most commonly cited factors leading to delays were unfavourable weather conditions, slowness in decision making and delay in payments.

The second and third objectives of the research were achieved by a conducting a questionnaire for investigating the factors most frequently leading to delays and the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry. A pilot survey was conducted after developing the questionnaire and distributed to three experts for reviewing and correcting the errors, understanding difficulties, ambiguities, contradictions, optimizing questionnaire structure and wordings. The sixty numbers of effective questionnaires were then received from a group of sixty respondents consisting thirty Sri Lankan and thirty Chinese respondents. The respondents were analyzed initially to have a certain years' work experience in Sri Lankan and Chinese construction industry and participating the projects mostly as contract administrators and quantity surveyors, engineers as well as project managers, designers and other major designation in the project. They have major expertise knowledge on quantity surveying, claim management and construction management as well as architectural, structural design and arbitration & dispute resolution. The project value of all participants exceed five hundred million rupees and type of projects covers road, bridge, building, port, dredging, rail, aviation, piping, plumbing, plant, equipment and water supply etc. The Sri Lankan and Chinese respondents have sufficient work experience and knowledge and show a similar background and work experience.

The factors leading to delays were collected from the Sri Lankan and Chinese respondents and the top fifteen most frequent factor leading to delays were calculated and ranked by RII method. It was found that the factors most frequently leading to delays in Sri Lankan construction industry are unfavourable weather conditions, delay in assessing/approving major changes, delay in reviewing approving design in the scope of work. However, the most frequently leading to delays in Chinese construction industry are unfavourable weather conditions, delay in reviewing approving design, design errors made by designers. Unfavourable weather conditions is the most frequent factor leading to delays in both Sri Lankan and Chinese construction industry. There are 9 factors in common and 6 factors

in difference among the top fifteen factors most frequently leading to delays in Sri Lankan and Chinese construction industry.

The factors contributing to delay claims were collected from the Sri Lankan and Chinese respondents and the top fifteen most significant factors contributing to delay claims were calculated and ranked by RII method. It was found that the most significant factors contributing to delay claims in Sri Lankan construction industry is change orders/variation, unfavourable weather conditions and design errors made by designers. However, the most significant factors contributing to delay claims in Chinese construction industry is change orders/variation, design errors made by designers and unfavourable weather conditions. Change orders/variation and unfavourable weather conditions are the most significant factors contributing to delay claims in both Sri Lankan and Chinese construction industry. There are 12 factors in common and 3 factors in difference among the top fifteen factors most significantly contributing to delay claims in Sri Lankan and Chinese construction industry.

The fourth objective of comparing the factors most frequently leading to delays in Sri Lankan and Chinese construction industry and comparing the most significant factors contributing to delay claims in Sri Lankan and Chinese construction industry was achieved by comparing the top fifteen factors most frequently leading to delays in Sri Lankan and Chinese construction industry ranked by RII. It was found that 9 factors most frequently leading to delays were same between Sri Lankan and Chinese construction industry including unfavourable weather conditions, delay in assessing/approving major changes in the scope of work and delay in reviewing and approving design etc. and there were 6 factors most frequently leading to delays were different between Sri Lankan and Chinese construction industry. In addition, 12 factors most significantly contributing to delay claims were same between Sri Lankan and Chinese construction industry including change orders/variation, unfavourable weather conditions and design error made by designer etc. and there were 3 factors most significantly contributing to delay claims were different between Sri Lankan and Chinese construction industry.

The fifth objective of reviewing and analyzing the possible reasons for the common and different delay factors leading to delays and contributing to delay claims between Sri Lankan and Chinese construction industry was achieved by the analysis conducted under a panel of experts consisting of six (6) Sri Lankan and Chinese in one interview meeting. It was explained that the common factors most frequently leading to delays and most significantly contributing to delay claims such as unfavourable weather conditions are widely existing and change order/variations may from time to time occur in the project in both Sri Lankan and Chinese construction industry.

The different factors most frequently leading to delays and most significantly contributing to delay claims in Sri Lankan and Chinese construction industry were discussed and analyzed based on their previous projects' experience in Sri Lankan and Chinese construction industry and commented that the factors of change in government regulation and law, political and regional stability, unexpected surface & subsurface condition (such as soil, high water table), delay in site delivery, delay in obtaining permits from local authority, problem raised by local surrounding residents had more adverse effect in Sri Lankan construction industry than Chinese construction industry so that these factors were more likely to lead to delays and contribute to delay claims in Sri Lankan construction industry than in Chinese construction industry. However, the factors of insufficient data collection and survey before design (causing unforeseeable situations), unclear and inadequate details in drawings, delay in design works were commented by the panel of experts that these factors are the works to be done before construction by the client himself or by hiring consultant but not contractor. These contracting method of separating contracting investigating, design and construction may be more popular in Chinese construction industry than in Sri Lankan construction industry as it is more common to have an experienced design-build contractor in Sri Lankan construction industry especially for high-value project.

5.3 Recommendations for Industry Practitioners

In consideration of the findings and the comments after reviewing by the panel of experts, the recommendations are made in view of mitigation of project delays and minimizing the failure of delay claims.

Point One: the identified delay factors shall be paid more attention to and be taken into consideration to monitor and control the project delays during the execution of the project in both Sri Lankan and Chinese construction industry.

Point Two: from a contractor's perspective, whenever the most significant delay factors contributing to delay claims investigated and concluded, it is suggested for the contractor to take immediate action to file a claim within the limitation of time for claim in both Sri Lankan and Chinese construction industry.

Point Three: As shown in this dissertation for the difference of factors for frequency and its significance contributing to delay claims, it is recommended for the Chinese contractors participating Sri Lankan construction projects and the Sri Lankan contractors participating the Chinese construction projects to specially attend to the difference delay factors and exercise his endeavor to identify and manage the delay factors in case of any unexpected cases due to his past experience gained only in Sri Lankan construction industry or Chinese construction industry.

5.4 Further Research

This research is carried out to find out the factors most frequently leading to delays and the factors most significantly contributing to delay claims in Sri Lankan and Chinese construction industry. While carrying out the research, following further research areas were identified.

The research has identified the factors most frequently leading to delays in Sri Lankan and Chinese construction industry. Therefore, a study for avoiding and mitigating the factors most frequently leading to delays needs to be undertaken in Sri Lankan and Chinese construction industry to avoid and mitigate the delays.

The research has identified the factors most significantly contributing to delay claims in Sri Lankan and Chinese construction industry. Therefore, a study for claim management for the factors most significantly contributing to delay claims needs to be undertaken in Sri Lankan and Chinese construction industry to substantiate the delay claims by the contractor.

The research is conducted under the contractor's perspective. It could be extended to the client's perspective to avoid the delay claims from the contractor.

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APPENDIX I

QUESTIONNAIRE SURVEY

Investigation into the Factors Contributing to Delay Claims in Construction Industry: A Comparative Study of Sri Lanka and China

Dear Sir/Madam,

I am following M.Sc. in Construction Law and Dispute Resolution degree program at Department of Building Economics at University of Moratuwa. In fulfilment of this degree program, I am conducting the research on "Investigation into the factors contributing to delay claims in construction industry: A comparative study of Sri Lanka and China". The research plans to fulfill the research aim through using this questionnaire.

1. Investigate the factors most frequently leading to delays in Sri Lankan and Chinese construction industry.
2. Identify the most influencing factors contributing to delay claims in Sri Lankan and Chinese construction industry.
3. Propose recommendations for mitigation of delay claims in Sri Lankan and Chinese construction industry.

I would be very grateful if you could complete the attached questionnaire within your busy work schedule. Your information provided will be kept in strict confidence, it will be only used for the purpose of this research.

Yours faithfully,

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Part I Background Information

1. You work as:

☐ Contractor ☐ Employer ☐ Consultant ☐ Others_____

2. How many years participate in Construction Industry

☐ 0-5 ☐ 6-10 ☐ 11-15 ☐ 15-20 ☐20+

3. What is your designation in the Project(s):

☐ Project Manager/ Deputy Project Manager ☐ Engineer ☐ Designer/Architect

☐ Contract Administrator ☐ Quantity Surveyor ☐ Others_____

4. Please indicate your personal experience in relation to the listed functions

Experience (years)	0-5	6-10	11-15	15-20	20+
Construction Management	☐	☐	☐	☐	☐
Quantity Surveying	☐	☐	☐	☐	☐
Claim Management/Contact Administration	☐	☐	☐	☐	☐
Architectural, structural, & MEP Design	☐	☐	☐	☐	☐
Arbitration & Dispute Resolution	☐	☐	☐	☐	☐

You could base on one or several of your participated projects (Chinese respondents should base on Chinese projects; Sri Lankan respondents should base on Sri Lankan projects) to fill in the Questionnaire. Please indicate the following information for the project(s) with ***Multiple Choice*** *allowed.*

5. Please indicate the size of the Project(s) you have participated (Note: M for Million, B for Billion).

For Chinese respondents (Unit: CNY):

□ below 25M □25M-100M □100M-500M □500M-2B □ Above 2B

For Sri Lankan respondents (Unit: LKR):

☐ below 500M ☐ 500M-2B ☐ 2B-10B ☐ 10B-40B ☐ Above 40B

6.What is the project type you participated?

☐ Road & Bridge ☐ Building ☐ Port & Dredging ☐ Rail ☐ Aviation

☐ Piping/Plumbing ☐ Plant & Equipment ☐ Any other *(please state)*_____

Part II Key factor Evaluation

In this part, you are requested to evaluate below using the table given in the questionnaire

1) How frequent the factors leading to delays appeared in your indicated project(s)?
2) How influencing/significant the delay factors contribute to delay claims
3) What are the recommendations to avoid and prevent delay factors to mitigate delay claims?

Column A

Weighting: Five-point scale is

1- Never 2- Rarely 3 - Occasionally 4 -Often 5- Always

Column B

Select *Yes* or *No* for whether the delay factor can contribute to a delay claim

Column C

Weighting: Five-point scale is

1- Not significant 2- Slightly significant 3 – Moderately significant 4 – Significant 5- Very significant

Consultant Related Delay Factors

		Column A					Column B		Column C				
Delay Factors for Construction Industry		**How frequent this factor leading to delays appeared in your project(s)?**					**Can this factor contribute to a delay claim?**		**If Yes, select how significant such delay factor contribute to a delay claim**				
Consultant Related Delay Factors		**Never**	**Rarely**	**Occasionally**	**Often**	**Always**	**Select Yes or No**		**Little Significant**	**Slightly Significant**	**Moderately Significant**	**Significant**	**Very Significant**
A.1	Delay in assessing/approving major changes in the scope of work	1	2	3	4	5	Yes	No	1	2	3	4	5
A.2	Design errors made by designers	1	2	3	4	5	Yes	No	1	2	3	4	5
A.3	Inadequate site investigation	1	2	3	4	5	Yes	No	1	2	3	4	5
A.4	Unclear and inadequate details in drawings	1	2	3	4	5	Yes	No	1	2	3	4	5
A.5	Delay in design works	1	2	3	4	5	Yes	No	1	2	3	4	5
A.6	Delay in reviewing and approving design	1	2	3	4	5	Yes	No	1	2	3	4	5
A.7	Delay in performing inspection and testing	1	2	3	4	5	Yes	No	1	2	3	4	5
A.8	Delay in determination	1	2	3	4	5	Yes	No	1	2	3	4	5
A.9	Lack of experience of consultant in construction projects	1	2	3	4	5	Yes	No	1	2	3	4	5

Consultant Related Delay Factors		Never	Rarely	Occasionally	Often	Always	Select Yes or No		Little Significant	Slightly Significant	Moderately Significant	Significant	Very Significant
A.10	Conflicts between consultants	1	2	3	4	5	Yes	No	1	2	3	4	5
A.11	Insufficient data collection and survey before design (causing unforeseeable situations)	1	2	3	4	5	Yes	No	1	2	3	4	5
A.12	Poor communication and coordination with other parties	1	2	3	4	5	Yes	No	1	2	3	4	5
A.13	Misunderstanding of owner's requirements	1	2	3	4	5	Yes	No	1	2	3	4	5
A.14	Poor site management	1	2	3	4	5	Yes	No	1	2	3	4	5
A.15	Inadequate supervision	1	2	3	4	5	Yes	No	1	2	3	4	5
A.16	Discrepancies or interpretation disagreement in contract documents	1	2	3	4	5	Yes	No	1	2	3	4	5
A.17	Incomplete of specification and other contract documents	1	2	3	4	5	Yes	No	1	2	3	4	5
A.18	Poor use of advanced design software	1	2	3	4	5	Yes	No	1	2	3	4	5

Client Related Delay Factors

		Column A					Column B		Column C				
Delay Factors for Construction Industry		**How frequent this factor leading to delays appeared in your project(s)?**					**Can this factor contribute to a delay claim?**		**If Yes, select how significant such delay factor contribute to a delay claim**				
Client Related Delay Factors		**Never**	**Rarely**	**Occasionally**	**Often**	**Always**	**Select Yes or No**		**Little Significant**	**Slightly Significant**	**Moderately Significant**	**Significant**	**Very Significant**
B.1	tendencies	1	2	3	4	5	Yes	No	1	2	3	4	5
B.2	Intermittent stoppage of work due to cash flow constraints	1	2	3	4	5	Yes	No	1	2	3	4	5
B.3	Change orders/Variation	1	2	3	4	5	Yes	No	1	2	3	4	5
B.4	Delay in payments	1	2	3	4	5	Yes	No	1	2	3	4	5
B.5	Changes in material types and specifications during construction	1	2	3	4	5	Yes	No	1	2	3	4	5
B.6	Delay in approval sample material	1	2	3	4	5	Yes	No	1	2	3	4	5
B.7	Delay in approving design changes	1	2	3	4	5	Yes	No	1	2	3	4	5
B.8	Design changes by owner or his agent during construction	1	2	3	4	5	Yes	No	1	2	3	4	5

Client Related Delay Factors		Never	Rarely	Occasionally	Often	Always	Select Yes or No		Little Significant	Slightly Significant	Moderately Significant	Significant	Very Significant
B.9	Unrealistic contract duration	1	2	3	4	5	Yes	No	1	2	3	4	5
B.10	Poor communication and coordination with other parties	1	2	3	4	5	Yes	No	1	2	3	4	5
B.11	Slowness in decision making	1	2	3	4	5	Yes	No	1	2	3	4	5
B.12	Conflicts between joint-owners	1	2	3	4	5	Yes	No	1	2	3	4	5
B.13	Inadequate information during project feasibility study	1	2	3	4	5	Yes	No	1	2	3	4	5
B.14	Delay in site delivery	1	2	3	4	5	Yes	No	1	2	3	4	5
B.15	Lack of incentives for contractor to finish ahead of schedule	1	2	3	4	5	Yes	No	1	2	3	4	5
B.16	Lack of capable representative	1	2	3	4	5	Yes	No	1	2	3	4	5
B.17	Lack of experience of owner	1	2	3	4	5	Yes	No	1	2	3	4	5

External Related Delay Factors

		Column A					Column B		Column C				
Delay Factors for Construction Industry		**How frequent this factor leading to delays appeared in your project(s)?**					**Can this factor contribute to a delay claim?**		**If Yes, select how significant such delay factor contribute to a delay claim**				
External Related Delay Factors		**Never**	**Rarely**	**Occasionally**	**Often**	**Always**	**Select Yes or No**		**Little Significant**	**Slightly Significant**	**Moderately Significant**	**Significant**	**Very Significant**
C.1	Unfavourable weather conditions	1	2	3	4	5	Yes	No	1	2	3	4	5
C.2	Legal disputes between project participants	1	2	3	4	5	Yes	No	1	2	3	4	5
C.3	Shortage of construction materials in market	1	2	3	4	5	Yes	No	1	2	3	4	5
C.4	Unexpected surface & subsurface condition (such as soil, high water table)	1	2	3	4	5	Yes	No	1	2	3	4	5
C.5	Delay in manufacturing materials	1	2	3	4	5	Yes	No	1	2	3	4	5
C.6	Accidents during construction	1	2	3	4	5	Yes	No	1	2	3	4	5
C.7	Environmental and social factors	1	2	3	4	5	Yes	No	1	2	3	4	5
C.8	political and regional stability	1	2	3	4	5	Yes	No	1	2	3	4	5
C.9	Escalation of local purchase prices	1	2	3	4	5	Yes	No	1	2	3	4	5
C.10	Global financial crisis	1	2	3	4	5	Yes	No	1	2	3	4	5
C.11	Price fluctuations on the international market	1	2	3	4	5	Yes	No	1	2	3	4	5

External Related Delay Factors		Never	Rarely	Occasionally	Often	Always	Select Yes or No		Little Significant	Slightly Significant	Moderately Significant	Significant	Very Significant
C.12	Unreliable suppliers	1	2	3	4	5	Yes	No	1	2	3	4	5
C.13	Conflict, war. and public enemy	1	2	3	4	5	Yes	No	1	2	3	4	5
C.14	Ineffective delay penalties	1	2	3	4	5	Yes	No	1	2	3	4	5
C.15	Delay in obtaining permits from local authority	1	2	3	4	5	Yes	No	1	2	3	4	5
C.16	Natural disasters (flood, hurricane, earthquake)	1	2	3	4	5	Yes	No	1	2	3	4	5
C.17	Changes in government regulations and laws	1	2	3	4	5	Yes	No	1	2	3	4	5
C.18	Delay in providing services from utilities (such as water, electricity)	1	2	3	4	5	Yes	No	1	2	3	4	5
C.19	Problem raised by local surrounding residents	1	2	3	4	5	Yes	No	1	2	3	4	5
C.20	Loss of time by traffic control and restriction at project site	1	2	3	4	5	Yes	No	1	2	3	4	5

附件 I

问卷调查

工程领域导致延期索赔的延误因子调查：基于中国和斯里兰卡的对比研究

尊敬的女士/先生，

本人在斯里兰卡 Moratuwa 大学就读工程法和争端解决的硕士研究生。为完成学位内容，本人正在进行关于“工程领域导致延期索赔的延误因子调查：基于中国和斯里兰卡的对比研究”的课题研究。本课题通过问卷的形式，拟完成以下课题研究目标：

4. 调查在中国和斯里兰卡工程领域导致工程延期的最常见因子
5. 识别在中国和斯里兰卡工程领域，导致工程延期索赔最重要的影响因子。
6. 为中国和斯里兰卡工程领域的延期索赔提供建议。

非常感谢您在百忙之中抽出时间填写该问卷，我们承诺对您的相关信息保密，仅用于该课题研究。

此致

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第一部分 背景

2. 您的职业角色是:

☐ 承包商　☐ 业主　☐ 监理　☐ 其他_____

2. 在工程行业多少年从业经验（年）

☐ 0-5　☐ 6-10　☐ 11-15　☐ 15-20　☐20+

3. 您在项目的职位是：

☐ 项目经理/项目副经理　☐ 工程师　☐ 设计/建筑师

☐ 合同管理经理/主管　☐ 工料测量经理/主管　☐ 其他_____

4. 请说明以下几个领域的从业经验（年）：

从业经验 (年)	0-5	6-10	11-15	15-20	20+
工程管理	☐	☐	☐	☐	☐
工料测量	☐	☐	☐	☐	☐
索赔管理/工料测量	☐	☐	☐	☐	☐
建筑/结构/强弱电	☐	☐	☐	☐	☐
仲裁/争议解决	☐	☐	☐	☐	☐

请您就您所参与的一个或多个项目经验（中国受访者针对中国的项目经验；斯里兰卡受访者针对斯里兰卡的项目经验）填写以下问卷.，请回答填写项目信息，可以多选：

5. 请指出您所参与或参考的项目规模

中方受访人员（单位：人民币）

□ 2500 万以下　□2500 万-1 亿　□1 亿-5 亿　□5 亿-20 亿　□ 大于 20 亿

斯里兰卡受访人员 （单位：卢比）

☐ 5 亿卢比以下 ☐ 5 亿-20 亿卢比 ☐ 20 亿-100 亿 ☐ 100 亿-400 亿 ☐ 大于 400 亿

6.您所参与的项目类型：

☐ 路桥 ☐ 建筑 ☐ 港口疏浚 ☐ 铁路 ☐ 机场

☐ 市政管道 ☐ 设备厂房工程 ☐其他（请说明）_____

第二部分 关键指标评估

在本部分中，请评估以下内容并填写问卷表

4) 在你参与/参考的项目中，这些延误因子有多常见？
5) 这些延误因子引起工程延期索赔的影响程度有多少？
6) 对避免或减弱延误因子导致延期索赔有何建议？

第A列

权重：5分制

1- 不会 2- 很少 3 – 偶尔 4 –经常 5- 总是

第B列

针对延误因子是否会导致延期索赔，请选择 *是或否*

第C列

权重：5分制

1- 几乎不影响 2- 轻微影响 3 – 有些影响 4 – 比较影响 5- 非常影响

与监理相关的延误因子

		第 A 列					第 B 列		第 C 列				
工程行业延误因子		该延误因子导致项目延期的可能性					该延误因子是否导致延期索赔		如果导致延期索赔，请选择该延误因子对延期索赔影响程度有多少？				
与监理相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
A.1	对工作范围的改变批复延迟	1	2	3	4	5	是	否	1	2	3	4	5
A.2	设计方的设计错误	1	2	3	4	5	是	否	1	2	3	4	5
A.3	现场勘察不够	1	2	3	4	5	是	否	1	2	3	4	5
A.4	图纸细节不清楚不充分	1	2	3	4	5	是	否	1	2	3	4	5
A.5	设计工作延误	1	2	3	4	5	是	否	1	2	3	4	5
A.6	设计（改变）审核或批复延误	1	2	3	4	5	是	否	1	2	3	4	5
A.7	验收或测试延误	1	2	3	4	5	是	否	1	2	3	4	5
A.8	监理（计量/争议）确认延误	1	2	3	4	5	是	否	1	2	3	4	5
A.9	监理缺少工程项目经验	1	2	3	4	5	是	否	1	2	3	4	5

与监理相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
A.10	监理之间冲突	1	2	3	4	5	是	否	1	2	3	4	5
A.11	设计前不充分的数据收集和调查 (引发不可预见的情形)	1	2	3	4	5	是	否	1	2	3	4	5
A.12	与相关方沟通、协调差	1	2	3	4	5	是	否	1	2	3	4	5
A.13	错误理解业主需求	1	2	3	4	5	是	否	1	2	3	4	5
A.14	现场管理差	1	2	3	4	5	是	否	1	2	3	4	5
A.15	监管不到位	1	2	3	4	5	是	否	1	2	3	4	5
A.16	合同文件存在歧义或释义不一致的情况	1	2	3	4	5	是	否	1	2	3	4	5
A.17	规范和合同文件不完备	1	2	3	4	5	是	否	1	2	3	4	5
A.18	较差的设计软件的使用	1	2	3	4	5	是	否	1	2	3	4	5

与业主相关的延误因子

		第 A 列					第 B 列		第 C 列				
工程行业延误因子		该延误因子导致项目延期的可能性					该延误因子是否导致延期索赔		如果导致延期索赔，请选择该延误因子对延期索赔影响程度有多少？				
与业主相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
B.1	偏向偏见	1	2	3	4	5	是	否	1	2	3	4	5
B.2	由于现金流受限而间歇性暂停工程	1	2	3	4	5	是	否	1	2	3	4	5
B.3	改变指令及变更	1	2	3	4	5	是	否	1	2	3	4	5
B.4	付款延误	1	2	3	4	5	是	否	1	2	3	4	5
B.5	在施工期间改变材料类型和规范要求	1	2	3	4	5	是	否	1	2	3	4	5
B.6	样品的批复延迟	1	2	3	4	5	是	否	1	2	3	4	5
B.7	设计批复延迟	1	2	3	4	5	是	否	1	2	3	4	5
B.8	在施工期间业主改变设计	1	2	3	4	5	是	否	1	2	3	4	5

与业主相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
B.9	合同期不切实际	1	2	3	4	5	是	否	1	2	3	4	5
B.10	与相关方沟通、协调差	1	2	3	4	5	是	否	1	2	3	4	5
B.11	确定及决定慢	1	2	3	4	5	是	否	1	2	3	4	5
B.12	业主内部的冲突	1	2	3	4	5	是	否	1	2	3	4	5
B.13	提供的项目可行性研究期间信息不足	1	2	3	4	5	是	否	1	2	3	4	5
B.14	现场准入延误	1	2	3	4	5	是	否	1	2	3	4	5
B.15	让承包商缺少提前完工的动力	1	2	3	4	5	是	否	1	2	3	4	5
B.16	缺少有能力的业主代表	1	2	3	4	5	是	否	1	2	3	4	5
B.17	业主缺少经验	1	2	3	4	5	是	否	1	2	3	4	5

与外部相关的延误因子

		第 A 列					第 B 列		第 C 列				
工程行业延误因子		该延误因子导致项目延期的可能性					该延误因子是否导致延期索赔		如果导致延期索赔，请选择该延误因子对延期索赔影响程度有多少？				
与外部相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
C.1	不理的气候条件	1	2	3	4	5	是	否	1	2	3	4	5
C.2	工程相关方的法律争议	1	2	3	4	5	是	否	1	2	3	4	5
C.3	市场上工程材料短缺	1	2	3	4	5	是	否	1	2	3	4	5
C.4	不可预见的地下或地表情况(如土壤、地下水位等)	1	2	3	4	5	是	否	1	2	3	4	5
C.5	材料制造商延误	1	2	3	4	5	是	否	1	2	3	4	5
C.6	工程期间的事故	1	2	3	4	5	是	否	1	2	3	4	5
C.7	环境和社会因素	1	2	3	4	5	是	否	1	2	3	4	5
C.8	政治和地区的稳定性	1	2	3	4	5	是	否	1	2	3	4	5
C.9	本地物价上涨	1	2	3	4	5	是	否	1	2	3	4	5
C.10	全球金融危机	1	2	3	4	5	是	否	1	2	3	4	5
C.11	全球市场的价格上涨	1	2	3	4	5	是	否	1	2	3	4	5

与外部相关的延误因子		不会	很少	偶尔	经常	总是	选择是或否		几乎不影响	轻微影响	有些影响	比较影响	十分影响
C.12	不可靠的供应商	1	2	3	4	5	是	否	1	2	3	4	5
C.13	冲突、战乱和敌对行为	1	2	3	4	5	是	否	1	2	3	4	5
C.14	无效的延误惩罚	1	2	3	4	5	是	否	1	2	3	4	5
C.15	当地部门的许可获取延误	1	2	3	4	5	是	否	1	2	3	4	5
C.16	自然灾害（洪水、飓风、地震）	1	2	3	4	5	是	否	1	2	3	4	5
C.17	政府法律法规的变动	1	2	3	4	5	是	否	1	2	3	4	5
C.18	服务商延迟供应（水、电等）	1	2	3	4	5	是	否	1	2	3	4	5
C.19	周边居民的干扰	1	2	3	4	5	是	否	1	2	3	4	5
C.20	交通和项目现场限制导致的时间损失	1	2	3	4	5	是	否	1	2	3	4	5