A STUDY ON MANAGEMENT OF CLAIMS FOR TIME EXTENSIONS BY SRI LANKAN CONTRACTORS

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The Dissertation is submitted in partial fulfillment of the requirement for the degree of Master of Science in Construction Project Management

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Declaration

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The above candidate has carried out research for the Masters Dissertation under my supervision

……..

Prof. A.K.W. Jayawardane

Research Supervisor Date : ……..

Abstract

Due to the complexity of civil engineering contracts and the tendencies for delays to occur, completion of projects on time is somewhat unusual in the field of construction in Sri Lanka and has a very poor record in completion of projects on time. Since these delays are such a common feature, it is essential for construction professionals to understand how they should be dealt with in standard building contracts. Proving or justifying delays in time claims are highly conflicted area in construction Industry.

This research was targeted to investigate the current extension of time claim management practices followed by the Sri Lankan Construction contractors and their problematic areas. Thereafter to propose recommendations to improve the delay analysis practices and to minimize the disputes in the area of time claim management.

Research findings indicate that Contractors fail to gather, analyse and present data as evidence to such an extent that there is a high rejection rate of claims made. It was revealed that 41% of respondents prepare claims without following a proper delay analysis technique. It was also found that 59% of claims are awarded with 50% or lesser satisfaction rate. Subsequently it was disclosed that the main causes for rejection of time extension claims are insufficient supporting documentation and failing to demonstrate of cause and effect of delaying events. Furthermore, it was surprising to note that 43% of the contractors are unaware of any of the basic delay analysis techniques. 83% of the contractors are using project management software to prepare construction programme which is one of the basic tools in proving delays in 50% or more of their contracts. It is also found that 83% of contractors are using computers in more than half of their construction sites enabling computerization of project management activities at construction sites.

Under this background recommendations were developed to improve the record keeping at sites, preparing an effective construction programme, effective recording of delay events, issuance of notice for delay events, awareness of delay analysis techniques and to prepare of check list for time extension claims. Finally areas that need further studies were identified.

Acknowledgement

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Last but not the least, my wife and parents for giving me the strength to complete the research and for their endless encouragement and support.

Dedication

Dedicated

to my beloved parents

and

wife

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List of Abbreviations

Abbreviation	Description
AACEI	Association for the Advancement of Cost Engineering International
ADR	Alternate Dispute Resolution
CAB	Collapsed As-Built
CPM	Critical Path Method
CRE	Contractor Risk Event
DAM	Delay Analysis Method
DAS	Delay Analysis System
DAS	Delay Analysis System
EOT	Extension of Time
ERE	Employer Risk Event
FIDIC	Fédération Internationale Des Ingénieurs-Conseils (International Federation of Consulting Engineers)
IAP	Impacted As-Planned
ICTAD	Institute for Construction Training and Development
IESL	Institute of Engineers, Sri Lanka
LD	Liquidated Damages
NCASL	National Construction Association of Sri Lanka
RDA	Road Development Authority
SCL	Society of Construction Law
TIA	Time Impact Analysis

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CHAPTER 1 : INTRODUCTION

1.1. Background

Project management is the process of planning, organizing, and managing tasks and resources to accomplish a defined objective, usually within constraints of time, resources or cost. A project plan can be simple, for example, a list of tasks and their start and finish dates written on a notepad, or it can be complex, for example, thousands of tasks and resources and a project budget of millions of rupees.

Most projects share common activities, including breaking the project into easily manageable tasks, scheduling the tasks, communicating with the team, and tracking the tasks as work progresses.

There are three factors that shape every project (PMBOK Guide, 2004).

- **Time:** The time to complete the project reflected in the project schedule.
- **Cost :** The project budget, based on the cost of the resources, the people, equipment, and materials required to do the tasks.
- **Scope:** The goals and tasks of the project and the works required to Complete them.

This trio of time, cost, and scope is the project triangle. Adjusting one of these elements affects the other two. While all three elements are important, typically one will have the most influence on the project.

The relationship between these elements differs in every project and determines the kinds of problems that will be encountered and the solutions that can be implemented. Knowing where we are constrained or flexible makes it easier to effectively plan and manage a project.

Considering the complexity of civil engineering contracts and the tendencies for delays to occur, completion of a project on time is somewhat unusual in the field of construction in Sri Lanka. Since the delay to completion is such a common feature of civil engineering projects, it is essential for construction professionals to understand how they are dealt with in standard building contracts.

Failure to complete the works is a breach of contract on the part of the contractor. The normal remedy for breach is claim for damages, which requires careful calculation.

Construction delays can be defined as time overrun either beyond the contract date or beyond the date that the parties agreed upon for delivery of a project (Assaf & Al-Hejji, 2006). On average 69% of donor funded projects are delayed in the execution stage (Jeyakanthan & Jayawardane, 2012).

Proving or disproving a construction delay claim is a substantial undertaking in the best of circumstances. But the analysis of construction delays takes a major leap in difficulty when there are multiple sources or causes of delay with interrelated effects. Even on straightforward projects, numerous activities for innumerable reasons are not completed exactly as scheduled. Is every activity that is not completed as scheduled a "Delay" or are many of these inconsequential when assessing liability in a delay claim context? Sorting the consequential from the inconsequential only begins with establishing the projects' critical path through Critical Path Method (CPM) analysis. While there are some more or less established rules of logic and law that have been developed for analysing multiple and concurrent causes of delay, the task quickly becomes very difficult in the complex and convoluted factual situation typical of most major construction disputes.

Contractors are liable for liquidated damages (LD) in the event of late completion. For causes beyond the contractor's control, extension of time can be claimed. The burden of proof of such delay is rest on the contractor. This is a very complex area in building contracts that any contractor is bound to deal with.

1.2. Problem Definition

The construction industry in Sri Lanka has a poor record with respect to completion of projects on time and conflicts are common in extension of time claims (Gunasekera, 2005). In most cases concurrent delays are used as an excuse to avoid responsibility for extension of time claims (Jergeas & Hartman, 1994).

In a construction contract, the contractor is under the obligation of completing the work within a specified time period. In the case of late completion, the contractor is normally liable to pay LD for the period of delay, or is entitled to extension of time and potential claims depending on the cause of delay. A claim for an extension of time of the completion date arises from various reasons.

Proving or Justification of Delays in time claims is a highly conflicted area in construction Industry (Al-Moumani, 2000). If two or more delays are running in parallel there have always been disputes in extension of time (Kumaraswamy & Yogeswaran, 2003).

To claim extension of time or potential claims, contractor has to prove that the delay is beyond his control (Client's fault or a natural cause) with evidence. On the other hand client has to know actual reason that caused the delay with evidence. The contractor is eligible for time extension and potential claims only if he can prove with evidence that the delay was not his fault. But proving that is not that straight forward.

The level of complexity steps up considerably when the situation involves different causes of delay acting on different degrees at the same time. By not having a properly established method in Sri Lanka for delay analysis leads to disputes in most of the situations. Therefore, proving or disproving delay claim is often leads to disputes and a commonly accepted guidelines and procedures can neutralize this situation.

Limited number of research studies had been carried out relevant to the delays in construction industry in Sri Lanka. One such research was carried out by Jayawardane and Pandita (2003) to understand and mitigate the factors affecting construction delays. Samarakoon (2009) has researched on causes and effects of delay in medium scale building construction projects in Sri Lanka. Both studies were mainly focused on factors affecting the delays and their effects. Furthermore, Jeyakanthan (2010) has studied on understanding and mitigating of project delays in donor funded road projects in Sri Lanka.

However, no studies were found in the area of extension of time claim management and how to minimize disputes in the construction industry due to this delay claims. Therefore, with the intention of addressing that area "A Study on Management of Claims for Time Extensions by Sri Lankan Contractors" is selected as the research topic.

1.3. Objectives

The purpose of this study is to discover how the extension of time claims being managed by the Sri Lankan Construction industry and developing of recommendations to improve the current practices.

The main aim was targeted to achieve the following objectives:

1. To Study the current extension of time claims management practices followed by the Sri Lankan Construction Contractors.
2. To identify the problematic areas in the above practices.
3. To study the widely accepted practices and guidelines for time claim management in other countries.
4. To develop recommendations to improve the extension of time claims management in Sri Lankan context.

1.4. Methodology

In this study both the quantitative and qualitative research methods were used together. Primarily four case studies were carried out to get an initial understanding and sound base for developing the questionnaire as the findings of the case studies are not conclusive and cannot be used to make generalizations about the population of interest. The most generally accepted use of combined methods is to begin with a qualitative exploration of some little-studied problem so that measurement instruments can be developed for later quantitative research.

Having identified the need to study delay analysis practices in industry, the objectives were formulated and the research study commenced with investigations

into current theory and practices of time claim management in Sri Lanka and abroad through literature survey.

Thereafter four projects were selected as case studies and extensive investigation done on area of delay analysis, granting extension of time and other areas related to time extension of those projects. Project staff, covering all the stake holders of the projects was also interviewed. Subsequently, a questionnaire was developed with the help of the findings of the case studies, interviews and literature review and the questionnaire survey was carried out.

For this research one of the non probability sampling techniques, judgment sampling was used and contractor's registered with Institute for Construction Training and Development (ICTAD) and having grading of C1, C2, C3 and C4 were selected.

From the findings of literature review, case studies, interviews and questionnaire survey, recommendations were developed to improve the extension of time (EOT) claim management practices among the Sri Lankan Construction Contractors.

1.5 Scope and Limitations

This research was mainly focused on the delay analysis practices by the contractors and mainly deals with the construction phase of projects. Therefore, the findings of this research may only be applicable to the construction phase.

As the contractors with higher grades of ICTAD registration C1, C2, C3 and C4 used for the study, recommendations derived may be only applicable to the major contractors.

1.6 Main Findings

The study revealed that time claims are a common scenario in Sri Lankan Construction industry and from the submitted time claims about 59% of situations were being awarded with 50% or lesser satisfaction rate. It was noticed that there is a very high incidence of rejection of time extension claims due to the insufficient supporting documentation and non demonstration of causes and effects of delaying events.

Although contemporaneous records play a pivotal role in delay analysis, it was revealed that proper emphasis is not given for record keeping by the contractors and eventually looses their ability of proving delays. Updated work programme and progress records necessary for time claims had been maintained by only 91% and 78% of the contractors respectively. The study further identified that 39% of respondents had experience in keeping records separately by the Engineer and the contractor, out of which 61% of situation had experienced discrepancies between the in 50% or more such records.

It was also noted that majority of contractors (83%) were using computers in more than 50% of their sites and trend was the same for using project management software for the preparation of construction programme, which is good move towards the computerization of project management activities.

The results further revealed that 76% of time claims were prepared by the respective project staff and in remaining situations it was by external consultant and in house expertise solely assigned for claim management. It was surprised to note that 43% of the contractors were unaware of any of the basic delay analysis techniques. This unawareness had forced them to prepare global claims, where claim is not properly substantiated.

Above facts were further confirmed when they were requested to rank the order of the barriers/bottlenecks of implementing an accurate delay analysis technique. Majority had opted to the following ranking order.

1. Not maintaining adequate records to adopt a proper analysis technique
2. Not having the expertise
3. Inability to spend time/money on advance technique.
4. Contract specifies a particular method

1.7 Guide to Report

The reporting of the research work in this dissertation follows the same logical flow of the methodology described at Section 1.4.

Report is organized into five logically related chapters as illustrated below.

Chapter I

Presents a general overview of the dissertation comprising a brief introduction and description of the subject matter of the research as well as the specific problems under investigation. It also sets out aims and objectives, the manner in which the research was carried out, as well as a summary of its achievements and structure of the dissertation.

Chapter 2

Reports on the search and review of all relevant technical, professional and academic literature which established what is known about the subject matter including problematic issues of delay analysis from a theoretical perspective.

Chapter 3

Describes the methodology and data collection of the study.

Chapter 4

Analyse the collected data in detail.

Chapter 5

Concludes the findings of the research referring to the objectives and provides some recommendations to improve the delay analysis practices among contractors in Sri Lankan construction industry.

CHAPTER 2 : LITERATURE REVIEW

2.1. Introduction

This chapter briefly explains of delays in construction industry mainly in the building construction, and describes in depth about the time claims and the current practices of delay analysis through a comprehensive literature review. Construction delays being a popular topic among researchers many researches have been carried out covering different aspects of delays.

2.2. Previous Studies on Delays in Construction Industry

Leishman (1991) presented the legal consequences of delays in construction. Yates (1993) developed a decision support system for construction delay analysis called Delay Analysis System (DAS). DAS is a software program that adds the capability for determining possible causes for project delays and suggests alternative courses of action to prevent further delays. The main categories of delays in DAS include engineering, equipment, external delays, labor, management, material, owner, subcontractors, and weather. He has further discussed industrial participation in the development of the delay analysis system program and describes the purpose and development of the program, its technical parameters, usage, and program output. A sample case study was also presented that demonstrates how the program is utilized and the type of output it provides. He has gathered the required details for the development of the software trough a questionnaire survey.

Ogunlana and Promkuntong (1996) studied the delays in building projects in Thailand, as an example of developing economies. They concluded that the problems of the construction industry in developing economies could be nested in three layers:

(1) Problem of shortages or inadequacies in industry infrastructure, mainly supply of resources;

(2) Problems caused by clients and consultants; and

(3) Problems caused by incompetence of contractors.

Ogunlana and Promkuntong (1996) had carried out their study with the help of a questionnaire survey. Mansfield and Ugwu (1994) studied the causes of delay and cost overrun in construction projects in Nigeria. He had first identified significant

causes of cost overrun in the building projects through literature review and discussions with some parties involved in construction industry. Thereafter findings of the literature review were implemented and a questionnaire developed. The results showed that the most important factors are financing and payment for completed works, poor contract management, changes in site conditions, shortage of material, and improper planning.

Kikwasi (2012) also have investigated the causes and effects of delays and disruptions in construction projects in Tanzania. His population of the study comprised of clients, architectural and quantity surveying consulting firms, construction firms and regulatory boards. The sample size of 60 respondents was estimated comprising of 33 construction firms, 10 quantity surveying, 10 architectural consulting firms, five clients and two statutory bodies. Two sampling procedures were used. Lists of consultants and contractors who had their offices based in Dar-es-Salaam had obtained from respective regulatory boards offices and websites. Random sampling was used to select consultants and contractors. Kikwasi (2012) has ranked the causes for delays and effect of delays from his study.

Al-Momani (2000) conducted a quantitative analysis of construction delays by examining the records of 130 public building projects constructed in Jordan during the period of 1990-1997. The researcher presented regression models of the relationship between actual and planned project duration for different types of building facilities. The analysis also included the reported frequencies of time extensions for the different causes of delays. The researcher concluded that the main causes of delay in construction projects relate to designers, user changes, weather, site conditions, late deliveries, economic conditions, and increase in quantities.

Alkass, Mazerolle, & Harris (1996) presented a paper which discusses different delay analysis techniques that are currently used by practitioners in the construction industry. It also discusses a proposed new delay analysis technique called the Isolated Delay Type. These techniques were tested against a case example and their strengths and weaknesses highlighted.

Empirically based time performance research measures either construction time (physical building time) or contract time (performance measured against the date stipulated in contracts).

Jeyakanthan (2012) has carried out a research on mitigating delays in donor funded road projects in Sri Lanka. He has first carried out a detailed literature review through books, journals, articles, government publications, publications of donors and e-resources and developed a comprehensive inventory of problems for the study. Thereafter researcher has done a preliminary interviews and pilot surveys with industrial experts, project managers and academics to validate the findings out of the literature survey. A qualitative and quantitative design had been adopted for this case study research. Twenty six cases were studied in this research. The project management phases were used as a basic frame work to map the identified objectives and a detailed study on their correspondence were carried out in selected case studies to quantify the contributions of project delays in each phase. Base on those findings Jeyakanthan (2012) had developed strategies to mitigate the project delays in each phase.

Another research carried out by Samarakoon (2009) to identify the causes and effect of delays in medium scale building projects in Sri Lanka has concluded that the improper project management as the main cause of project delays and shortage of labour as the second major cause. Researcher has first identified the causes and effects of the project delays using the findings of previous researches and interviewing the professionals working in the medium scale building projects in Sri Lanka. Then a questionnaire was prepared using the findings and a pilot study was carried out among ten professionals working in medium scale building construction projects. Samarakoon (2009) has calculated importance and severity of each cause and effects using the importance index and severity index respectively. By using those two indices, relative important index was calculated. This was used to rank identified causes and effects. According to those findings, Samarakoon (2009) has developed guidelines for consultants, contractors and clients to minimize project delays in medium scale building projects.

Samarakoon (2009) has further identified cost overrun as the major effect of project delays and has ranked effects of project delays in following order.

1 Cost overrun

2 Time overrun

3 Disputes

4 Arbitrations

5 Litigation

6 Total abandonment

Braimah & Ndekugri (2008) have carried out a research on factors influencing the selection of delay analysis methodologies. This reseachers had opted for a mixed research methodology considering the multiplicity of the research's aims and objectives, coupled with the diversity in types and sources of data to be collected as the most appropriate methodology to adopt. It involved the collection of data at two different stages. A quantitative research strategy involving the use of a cross-sectional survey was adopted in the first stage to explore current delay and disruption analysis practice, followed by an in-depth qualitative investigation of issues informed by the survey. A major factor that influenced the choice of the survey strategy was mentioned as the large and diverse nature of the research population as delay claims are prevalent in different forms and in many different types of organizations. Braimah & Ndekugri (2008) expressed that there is no better method of research than a survey for collecting information about large populations. They have used non-probability sampling techniques in selecting their sample due to the absence of a specific sampling frame for construction firms with experience of delay.

Fernando (2013) has carried out a reseach on clients daly in infrastucture projects selecting cases from Road Development Authority (RDA). Researcher has identified client delay factors throgh the literature review and thereafter data was collected by recording the EOT claims details of RDA projects to identify the impact of these client delay factors on RDA projects and then statistical analysis was done to quatify the amount of client delay in RDA projects.

2.3. Construction Delays and Types

Construction delays can be considered as time lag in completion of activities from a fixed time as per contract or they can be defined as late completion or late start of activities to the planned schedule or contract schedule (Kikwasi, 2012). When project delay occurs it means that project cannot be completed within stated time, which means that there will be extensions of time required which will further result in fine, increased cost due to inflation, termination of contract, court cases etc. or combinations of above stated factors.

Keane and Caletka (2008) have categorized construction delays in the following broad categories according to how they operate contractually.

a. Compensable delay

A compensable delay is one where a contractor is entitled to financial recovery in the form of direct and indirect time related costs arising from an employer risk event.

b. Concurrent or parallel delay

Concurrent or parallel delays occur when there are two or more independent delays during the same time period. Concurrent delays are significant when one is an employer risk event and the other a contractor risk event, the effects of which are felt at the same time. When two or more delay events arise at different times, but the effects of them are felt (in whole or in part) at the same time, this is more correctly termed ‘concurrent effect’ of sequential delay events.

c. Critical delay

A delay to the progress of any activity on a critical path of a project which causes delay to the project completion.

d. Excusable delay

Excusable delay is a delay for which a contractor will have relief from damages (EOT) and potential financial entitlement depending on contractual circumstances.

e. Non-excusable delay

Delay caused by contractor.

f. Local delay

A delay to a group of isolated activities which are not on a critical path and which do not impact on the planned completion date.

2.4. Classification of Delay Events

Keane and Caletka (2008) further expressed that the delay event are occurred as a result of risk events in following three categories:

- **Employer Risk Event**: an event, circumstance or cause which, under the Contract (or by subsequent determination of a formal tribunal), is at the risk and the responsibility of the employer.
- **Contractor Risk Event**: an event, circumstance or cause which, under the Contract (or as later formally determined), is not at the risk and the responsibility of the employer.
- **Neural Event:** a neutral event is a non-compensable and excusable event which may result in the contractor being awarded time, but no damages for delay. Whether an event is excusable or not will be determined by the terms of the contract. (e.g. force majeure, exceptionally adverse weather)

2.5. Core Principles Relating to Delay and Extension of Time

In the Delay and Desruption Protcol introduced by the Society of Construction Law in 2002 it has identified following core principles relating to delay, compensation and extension of time as illustrated by Keane and Caletka (2008).

a. Programme and records

It is recommended that the contractor should prepare and the Engineer agree to a baseline programme. This programme should be updated to reflect actual progress and any extensions of time granted. It is also recommended that the parties should

agree on the type of records that should be kept to identify the cause and extent of delays. Model specifications are provided for the preparation, submission, updating and revising of construction programmes as well as a model records specification. Penalties and sanctions are offered to deal with failure to comply with the programme provisions.

b. Purpose of extension of time

It states that the benefit of an extension of time for a contractor is solely to relieve the contractor of liability for damages (e.g. LD) for delay to the contract completion date. The benefit for the employer is twofold. First it maintains the right to establish a new contract completion date, thus preventing time for completion of the works becoming 'at large'. Also it preserves the employer's right to deduct damages from the contractor.

c. Entitlement to extension of time

Applications and awards of extensions of time should be dealt with 'at the time' the event occurs. This requires both parties to accept a risk transfer mechanism and negotiations for time and money, at the time, to be signed off by both parties as 'full accord and final settlement for all related damages, direct or indirect'. Delay and disruption protocol of Society of Construction Law (SCL) discourages either party playing the 'wait and see' game, as delays rarely go away by themselves and the later an application is left, the more difficult it will be to assess its impact accurately.

d. Procedure for granting extension of time

The SCL Protocol recommends that extensions of time are awarded close to the time a delay event occurs, e.g. prospectively, to avoid the 'wait and see' position frequently adopted by contract administrators. This position is often endured by contractors under the erroneous expression that it will assist their likely recovery position later. The underlying principle is that an extension of time should be based on 'entitlement' not need.

e. Effect of delay

The SCL Protocol suggests that the risk of the potential effect of an event can be transferred to the contractor (via a prospective extension of time) before the impact of that event is actually known.

f. Incremental review of extension of time

To address the concern that, based purely on a prospective delay analysis, more time might be granted than a proper as-built analysis would later justify, the SCL Protocol suggests that extensions of time could be awarded incrementally based on the known impact from time to time.

g. Float as it relates to time

This point touches on a hotly debated issue, namely who owns the float in a contract programme. On this point the SCL Protocol endorses the usual contractual position that an extension of time will only be granted where float on the critical path(s) has been reduced to below zero and thus the contract completion date is delayed. This view assumes that the contract does not indicate that one party or the other 'owns' the float.

h. Float as it relates to compensation

To balance the SCL Protocol's stance on ownership of float, the protocol suggests that contractors are entitled to direct time related costs (not overheads) for periods of delay which reduces float. This could be interpreted to apply only when a contractor is working to an 'early completion' programme (i.e. when 'terminal float' exists along the critical path). An accurate, approved and transparent programme, updated from time to time, is essential for this to work in practice.

i. Concurrent delay

Not only did the SCL Protocol tackle the issue of float, it also took on another major or controversial issue namely, 'concurrent delay'. It says employer risk events entitle a contractor to an extension of time when concurrent delays are present. The protocol also addresses the financial aspect of concurrent delay.

The protocol provides a clear definition of 'concurrent delay' making the term interchangeable with 'concurrent effect'. This is a more accurate description of the common scenario, as true concurrent delays are rare and often contested. The general principle for 'compensable' delay used in the US applies. A contractor can only recover costs which directly result from a compensable event. If those costs cannot be discretely isolated from any non-compensable causes (i.e. the costs would have been incurred in any event), the contractor is not entitled to any recovery of time related costs.

j. Identification of float and concurrency

As a practical point, the identification of float and concurrency contemporaneously are only possible if all programming management provisions are complied with (i.e. a programme which is approved and properly updated).

k. After the event delay analysis

For this approach to work practically, reliable programmes would have to be available for any form of prospective delay analysis to be applied. Many delay analyst Engineers might set his as an invitation prospectively to create a programme from which delays can be impacted. Many would say that a contractor should not benefit from a prospective analysis when they failed to provide to the Engineer contemporaneous programmes which would have allowed such an analysis to take place at the time. Reconstructed programmes, created solely to measure the impact of change 'after the event' should be applied with caution.

l. Mitigation of delay and mitigation of loss

It is suggested that 'mitigation' as a contractual obligation should be read as 'reasonable steps to minimize loss' but not 'unreasonable steps that result in a greater loss'. There is some subjectivity in the term 'reasonable', and specific contract provisions may increase the obligation to mitigate beyond what is suggested in the SCL Protocol.

m. Link between extension of time and compensation

Entitlement to additional time does not automatically provide an equal entitlement to additional money. It is unfortunate that many hold contractors to the same burden of proof for time as they do for money. The protocol recognizes that there are different tests for time and money.

n. Valuation of variations

The SCL Protocol suggests that when negotiating variations, the parties, where possible, should agree the direct costs, along with time related costs (and revisions to the programme) as full accord for a change.

o. Basis of calculation of compensation for prolongation

The SCL Protocol recognizes that the recovery of additional compensation for delay is based on causal links from delay events to the actual cost incurred. The time related costs must be 'work actually done, time actually taken up or loss and/or expense actually suffered'. Where possible, the SCL Protocol suggests the option of pre-agreeing a fixed daily rate for delay (similar to a pre-agreed rate of liquidated damages).

p. Relevance of tender allowances

It is said that bid allowances, or tender allowances, have little relevance. Bids are often 'unbalanced' and not reflective of the actual cost incurred when delay damages are experienced.

q. Period for evaluation of compensation

A key phrase used throughout the SCL Protocol is 'at the time'. Delay events should be analyzed at the time they occur, and the costs associated with that delay should be assessed relative to the work that was ongoing 'at the time' the delay event occurred (rather than during the extended contract performance period).

r. Global claims

Global claim is a claim for the total project over-run, calculated by comparing the actual completion date with the planned completion date, where there has been no discrete causal link established between the delay claimed and the individual employer risk events relied upon.

This is a common practice of contractors making composite or global claims without substantiating cause and effect is discouraged by the Protocol and rarely accepted by the courts.

s. Acceleration

Where the contract provides for acceleration, payment for the acceleration should be based on the terms of the contract. Where the contract does not provide for acceleration but the Contractor and the Employer agree that accelerative measures should be undertaken, the basis of payment should be agreed before the acceleration is commenced. It is not recommended that a claim for so-called constructive acceleration be made. Instead, prior to any acceleration measures, steps should be taken by either party to have the dispute or difference about entitlement to EOT resolved in accordance with the dispute resolution procedures applicable to the contract.

t. Disruption

Disruption (as distinct from delay) is disturbance, hindrance or interruption to a Contractor's normal working methods, resulting in lower efficiency. If caused by the Employer, it may give rise to a right to compensation either under the contract or as a breach of contract.

2.6 Delay Analysis

According to Kean and Caletka (2008) the purpose of delay analysis is to satisfy the causation requirement in such a way that it can be used to assess the resulting damages. Ultimately, determining liability for each event will be decided by the engineer, architect, project managers, adjudicator, arbitrator, judge or other third party dispute decider. Delays can be excusable, non-excusable, compensable and non-compensable. There are a few tests which must be satisfied for a delay to be

considered excusable and compensable. If a delay event cannot be shown to be excusable, it will be deemed non-excusable, and if a delay event cannot be shown to be compensable, it will be deemed non-compensable by default.

2.6.1 The use of CPM techniques

CPM is a step-by-step technique for process planning that defines critical and non-critical tasks with the goal of preventing time-frame problems and process bottlenecks. The CPM is ideally suited to projects consisting of numerous activities that interact in a complex manner.

The CPM was developed in the 1950s by DuPont, and was first used in missile-defense construction projects. Since that time, the CPM has been adapted to other fields including hardware and software product research and development. Various computer programs are available to help project managers use the CPM.

The practice of CPM scheduling is supported by many international professional bodies though not regulated by any one institution. Firstly, one must accept that a CPM programme is simply a model of only one possible sequence of events required to complete a given project. The assumptions that were relevant to establishing that sequence are also relevant to the analyst carrying out a forensic delay analysis. Each assumption relied upon when creating the original CPM programme (e.g. labour levels, activity durations, activity sequences and relationships) are risks which could be affected by unforeseen events, conditions, or implemented change. These all require management, regular monitoring and intervention to keep a project on course or move the goal-posts when necessary.

2.6.2 Delay analysis techniques

Delay analysis techniques are known by many generic titles. Each method can be applied in several ways and the widely known methods of delay analysis are subject to frequent misuse (Keane & Caletka, 2008). This can be commonly experienced in the modern day construction industry. The application of the same technique by two opposing experts often produces varying and inconsistent conclusions. The name applied to a technique is not as important as the application of that method. Keane & Caletka (2008) say, though there are many variations on the themes, all of the

commonly applied forensic delay analysis techniques generally conform to one of the following primary categories:

a) As-Planned versus As-Built

b) Impacted As-Planned (IAP)

c) Collapsed As-Built (CAB)

d) Time Impact Analysis (TIA)

Keane & Caletka (2008) are of the view that though many in the industry also list 'windows analysis' as a technique, but the term 'windows' simply refers to the period of time being analyzed. Windows can be identified at regular intervals (e.g. weekly, monthly) or irregular periods determined by the completion of significant key tasks (e.g. the achievement of a key milestone). When key milestones are relied on, the same approach is sometimes referred to as 'watershed' analysis

Each of the above primary techniques have many secondary derivatives, depending on the number of delays being analyzed, the frequency and/or duration of the windows, the time periods being analyzed, and whether they are to be applied prospectively (contemporaneous, forward-looking, predictive modeling) or retrospectively (forensic, after the fact analysis, as-built delay modeling).

In the Knowledge Map for Delay Analysis Development by Yang & Kao (2009), 35 Nr of such derivatives have been listed out.

1. Reams' Systematic Approach
2. What-if
3. But-for (or termed collapsing technique)
4. Contemporaneous Period Analysis (or termed Windows Analysis)
5. Global Impact Technique
6. Net Impact Technique
7. Adjusted As-built CPM Technique
8. Snapshot Technique

9. Time Impact Technique (or termed modified as-built)
10. Isolated Delay Type
11. Impacted Baseline Schedule
12. After-the-fact and Modified CPM Schedule
13. Dollar-to-time Relationship
14. Collapsed As-built Method (or termed As-built Less Delay Analysis)
15. As-built Method (or termed As-planned vs. As-built)
16. As-planned Method
17. Affected Baseline Schedule
18. Bar Chart Analysis (or termed As-built Bar Chart)
19. Scatter Diagram
20. As-built Network
21. As-built Subtracting Impacts
22. Baseline Adding Impacts
23. B&B's Delay Analysis Method
24. Modified As-built Method
25. Impacted As-planned Method (or termed As-planned Plus Delay Analysis)
26. CPM Update Review
27. Linear Schedule Analysis
28. Construction Delay Computation Method
29. Modified Windows Analysis
30. Impacted As-built CPM
31. New Isolated Delay Type
32. Apportionment Delay
33. Daily Windows Delay Analysis

34. Modified But-for Method

35. Delay Section

a). As-planned versus as-built technique

The as-planned versus as-built schedule delay analysis is a retrospective method which involves comparing the baseline, or as-planned, construction schedule against the as-built schedule or a schedule that reflects progress through a particular point in time. This analysis method is typically utilized when reliable baseline and as-built schedule information exists, but the contemporaneous schedule updates either do not exist or are flawed to the extent that they are not reliable to support a delay analysis.

Table 2.1 - Strengths and weaknesses of the as-planned versus as-built technique.

Strengths	Weaknesses
• Intuitive and easy to understand • Conclusions are readily supported by as-built records. • Does not require frequently updated progress schedules. • Does not require logical relationships or float to be expressly provided in as-planned programme • Can identify concurrency in the period work was actually carried out • Can identify critical delay in the period in which the work was actually carried out, and the period in which the costs were actually being incurred	• As-built sequence must relate to as-planned sequence for activity level variance method • Requires analyst to deduce the as-built critical path absent monthly progress updates • As-Built programme required • Constructing proper as-built programme could be resource intense and expensive

Source: (Keane & Caletka, 2008)

b). IAP technique

This method is also known as 'what if' method and involves prospective delay analysis. Keane and Caletka (2008) describe the IAP technique as the simplest form of critical path-based analysis. The SCL Protocol refers to this technique as the 'impacted as-planned'. The SCL Protocol states that: 'Impacted as-planned is based on the effect of employer risk events on the planned programme of work. This is thought to be the simplest form of delay analysis using CPM techniques since it involves the least amount of variables. The usefulness of the impacted as-planned technique is restricted due to the theoretical nature of the projected delays that are determined using this technique and uncertainty as to the feasibility of the contractor's as planned programme.' The SCL Protocol envisaged the IAP technique as one which would assist in demonstrating extension of time entitlement only, and not prolongation costs.

Table 2.2 Strengths and weaknesses of the IAP technique

Strengths	Weaknesses
• Least amount of variables in 'cause-effect' equation	• Does not account for changes to logic or durations of planned activities
• Does not require as-built programme	• Produces theoretical results based on a hypothetical question
• Can be carried out contemporaneously	• Cannot identify true concurrent delay
•Does not require progressed programmes	
• Easy to understand	

Source: (Keane & Caletka, 2008)

C). CAB technique

The CAB analysis methodology is a retrospective technique that begins with the as-built schedule and then subtracts activities representing delays or changes to demonstrate the effect on the completion date of a project but for the delay or change. Generally, this method is applied in cases where reliable as-built schedule information exists, but baseline schedule and/or contemporaneous schedule updates

either do not exist or are flawed to the extent that they are not reliable to support a delay analysis.

Implementation of the collapsed as-built delay analysis involves identifying project delays or changes, and then subtracting activities representing these delays or changes from the as-built construction schedule. The resulting "collapsed as-built" schedule demonstrates when a project would have been completed but for the delays or changes; demonstrating the effect of the delays or changes on a project's completion date.

The SCL Protocol is justifiably cautious about recommending the CAB approach. On anything but the most simple, intuitive and linear of projects, the layers of assumptions and subjective logic required to establish the as-built.

Table 2.3 - Strengths and weaknesses of the CAB technique

Strengths	Weaknesses
• Relies on as-built programme • Based on simple, easy to understand principles • Can isolate impact of employer's delay events from contractor's delay event (when iterative applications are applied) • Only relies on as-built • Does not require progress updates • Does not require a baseline programme	• Reconstructing sufficiently detailed as-built is laborious • Constructing as-built logic is subjective • Does not calculate delay based on contractor's contemporaneous intentions, 'at the time' • Unable to distinguish pacing activities from critical delays • Can identify as-built periods of compensable delay • Cannot identify as-built (contemporaneous) critical path • Requires many subjective assumptions when creating the CAB as-built model for analysis, in content and level of detail, as well as logic and durations of the as-built activities

Source: (Keane & Caletka, 2008)

d). TIA technique

Keane and Caletka (2008) describe TIA as an evolution of the impacted as-planned (IAP) method. There are many names used in the construction industry for the TIA approach, probably because there are as many ways to apply the technique. The main difference between the IAP and TIA method is the use of 'multiple base' programmes in the TIA, as opposed to a 'single base' (i.e. the baseline) in the IAP. The SCL Protocol states that the TIA method is the 'preferred technique to resolve complex disputes related to delay and compensation for that delay'.

Table 2.4 - Strengths and weaknesses of the TIA technique.

Strengths	Weaknesses
• Easy to understand • Can be carried out contemporaneously • Can identify approximate concurrency • Considers dynamic critical path • Does not require as-built programme • Relies on contemporaneous intentions (accounts for changes to logic and duration of remaining activities from time to time)	• Produces theoretical results based on a hypothetical question • Cannot identify actual concurrent delay • Labour intensive • Technically complex • Requires frequently prepared progress schedules

Source: (Keane & Caletka, 2008)

2.7 Elements of Time Extension Claim

Extension of time claims is unsuccessful when the contractor fails to adequately demonstrate its case through its submission of detailed particulars (Badman, 2007). He has listed out eight essential elements that must be addressed in a time claim. They are:

a. The event

Identify the event: the circumstance which gives rise to change causing delay.

b. Liability for the event

Once an event has been identified the next step is to determine liability for the event. If responsibility rests with the employer or it is a neutral event, such as force majeure or exceptionally adverse climatic conditions, the contractor may be entitled to an extension of time. However, this is dependent upon the terms and conditions of the particular contract. In circumstances where the contractor is responsible for the event then the consequences remain with the contractor.

c. Contractual entitlement

Typically, construction contracts contain provisions entitling the contractor to an extension of time on the occurrence of a particular event provided the progress of the works or time for completion is delayed as a consequence.

For example FIDIC 1987 provides for an entitlement for extension of time in the event of: late drawings (Clause 6.4).

d. Contractual compliance

Generally within an extension of time clause, the contractor will be obligated to submit notice(s) and detailed particulars within a specified time frame. However currently in ICTAD specifications, noticing is not compulsory for the entitlement of the time claim.

For example, Clause 44.2 of FIDIC1987 provides: "Provided that the engineer is not bound to make any determination unless the contractor has (a) within 28 days after such an event has first arisen, notified the engineer with a copy to the employer, and (b) within 28 days, or such other reasonable time as may be agreed by the engineer, after such notification submitted to the engineer detailed particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time."

e. Cause and effect

A common mistake made by many contractors when attempting to demonstrate the cause and effect of an event is that they merely list in chronological order the pertinent exchanges of correspondence between the parties. To demonstrate cause

and effect, a story should be prepared based on the facts describing the effect(s) of the event upon the works. This should include details of the planned works affected, referring to the planned sequence, durations, and methodology; the status of the works in relation to that planned at the time of the event; and, description of the changes to that plan as a consequence of the event.

f. Analysis of delay

Conduct a delay analysis to demonstrate the effect of the event on the contractor's programme. There are a number of internationally recognized delay analysis methods. Ultimately, the choice of delay analysis methodology will be dependent upon such matters as level of records available; the robustness of the baseline programme and any updates; time available; degree of accuracy; and, level of proof required.

g. Statement of claim

Every extension of time claim must contain a succinct statement of what the contractor is claiming.

h. Substantiation

Extract and provide documentary evidence (letters, method statements, instructions, progress reports and photos, minutes of meetings, programmes and schedules), statements of fact and expert witness statements (if required) in support of the assertions made within the claim submission.

According to Badman (2007) adopting these eight elements as a check list will give a good starting point for drafting any extension of time claim, in spite of each construction project being unique.

2.8 Record keeping for Contemporaneous Delay Analysis

No matter what project controls are put in place, unfortunately delay and disruption especially on large or complex projects are almost inevitable. As Levin (1988) states, ‘The basis of most construction claims is a delay’. Delay is the situation where the works take longer time than originally intended. Delays can be approval delays,

information delays or work undertaken later than originally planned (Williams, 2003). The variable which is affected by the event is time-related. Disruption by contrast does not refer to the timing of the works but to the situation where the works are made more difficult by some act of hindrance or prevention by the employer. Delays might be due to changes in the initial design, alterations to the specification and unforeseen circumstances such as unexpected ground conditions, poor weather or poor design which is only discovered during construction. Other delays are frequently caused by supply chain problems, for example suppliers not delivering components to site on time, or specialist manufacturers having problems with their off-site production processes. Delays and disruption can also be caused by people issues, for example individuals or organizations not responding to requested information within an appropriate time or individuals not agreeing on technical or management issues for an unreasonable period of time. Change management principles have been developed to help manage delay as it happens and in so doing reduce the likelihood of disagreements regarding culpability for such delays and disruption. However, many projects still end up in disputes.

The records kept on construction projects will be the main source of information on which claims for time or additional payments will be established by the contractor or assessed by the engineer or contract administrator.

The importance of producing adequate delay documentation has been recognized for many years, and good record-keeping is crucial in helping to avoid or resolve claims (Jergeas & Hartman, 1994). There is a multitude of different types of records including correspondence, meeting minutes, delivery notes, progress records, site diaries, day work sheets, photographs and invoices (Carmichaeli & Murray, 2006). Updated programmes can also record progress. The purpose of keeping records is to enable the assessment of progress, to confirm work has been carried out and to record resource use and expenditure for payment.

The quality and quantity with which records are kept varies widely between different organizations. Many have different procedures for keeping records and on many jobs quality procedures for record-keeping are not implemented effectively. Recent studies show that producing ‘inadequate records’ is among the principal generic

causes identified as leading to delays in substantiation/assessment of EOT claims (Kumaraswamy & Yogeswaran, 2003). Courts and boards of contract appeals stress the importance of contemporaneous records in proving delay and other claims and often the outcome of such cases hinges on such documentation (Bramble & Callahan, 2000).

However the production of information is often of insufficient quality to enable an effective investigation into issues of delay and disruption to be undertaken in retrospect, as Major and Ranson (1980) observe:

> 'It is all too common, when seeking to establish what actually happened on a project, to find that even a considerable amount of investigation will produce only an incomplete picture. It will often be necessary to analyze minutes of progress meetings, valuations, diaries, and various charts and programmes which neither individually nor collectively enable an actual progress chart to be produced or a detailed history of the project to be written. This is a common and substantial area of failure in site and head office management.'

2.8.1 Electronic records

In developed countries many projects are moving towards web-based document management systems, which allow for real-time collaboration between all parties. This also allows the web-based server document control application to act as a central filing system available to all project participants who are granted access. It is recommended that parties save, back up and archive all documents which are made available to them for future reference. Once access is denied, or restrictions are placed on a party's access to the web-based document portal, gaining access to historical records will be difficult.

Many standard forms require contractors to provide notice of an intention to make a claim for time and/or money within a reasonable time after the event which gave rise to the claim. These notice requirements are often linked to a requirement to keep contemporaneous records which can be inspected by the employer's representative from time to time. When contractors fail to comply with these provisions, their

entitlement is often limited. The records required in the course of developing a properly substantiated claim for time and/or money would include those listed below.

a). Programme/Progress Information

- Baseline Programme setting out the order, sequence, timing and dependencies
- Method Statement (i.e. supplemental information supporting programme)
- Intended resources and time to achieve the programme (i.e. supplemental information supporting programme)
- Revised programmes indicating contemporaneous intentions and any changes in resources and timing to achieve them
- Time Impact Evaluations measuring the potential impact of proposed changes prior to carrying out the changed work
- Progress programmes monitored and updated during the progress of the Works
- Daily Meetings – minutes
- Weekly Progress/Design Status Meetings – minutes
- Monthly Meetings – minutes
- Special Meetings – minutes
- Early Warning Meetings – minutes

b). The Contractor's Daily Reports

- Identification of all contractor activities in progress or being delayed and the cause of such delays referenced, where possible, to the Programme (task IDs).
- Identification of all contractors' plant and equipment on site with hours worked, idle or down time and repair time given separately.
- Work performed to date giving the location, description and by whom and referenced, where possible, to the Programme (task IDs).

- Test results or inspections with references to any particular specification or code requirements. List of deficiencies along with the corrective action required.
- Photographs.

c). Communications

- Letters (with or without attachments)
- Transmittals (with or without attachments)
- Faxes
- E-mails
- Requests for Information
- Contractor Submittals
- Certificates

d). Cost Information

- Job Cost Report (all costs coded to the project from accounting systems)
- Labour Returns (timesheets, daily allocation records)
- Plant Returns (daily allocation reports, hire records, daily inspection reports)
- Subcontractor allocation reports
- Cost Management Documents – including Payment Vouchers, Invoices,
- Purchase Orders
- Change Orders, Estimates, Negotiations

d). Contract Documents

- Conditions
- Specifications
- Employer's requirements

- Drawings
- Instructed Variations

2.9 Selecting a Delay Analysis Technique for the Analysis

A fair and effective evaluation of delay impact is possible if the most appropriate delay analysis technique is selected that provides a reliable solution with the information available and within the time and cost allocated for this purpose. However, the transient nature of construction projects not often allowing scheduling data being well documented as well as time and budget limitations lead a number of researchers to suggest that the choice of a simpler method may be sensible. As planned vs. as-built and collapsed as-built methods are efficient in some situations. The impact as-planned method falls behind these three as it has so many critical flaws.

The reliability of delay analysis depends on the selection of a suitable analysis method and on the availability of scheduling data. An analyst should meticulously review the data obtained from the project records because none of the methods yields reliable results if the information used is invalid. It is necessary to be very familiar with the capabilities of the software used in project scheduling and progress control in order to be able to generate legitimate schedules for the analysis. The other controversial issues such as the treatment of concurrent delays and the ownership of float should be clearly specified in the contract. Project participants should settle these issues early in the project so as to maintain proper scheduling administration. The best practice is to be prepared for delay management throughout the project by adopting these recommendations as a routine procedure. Since time impact analysis is by far the most effective method in proving time-based claims for the reasons discussed in this paper, ideally speaking, all project managers should engage in practices that will generate adequate information to allow the use of time-impact analysis in case a time-based claim needs to be proven. However, given the different circumstances in different projects, it is not always possible to generate such information. In such cases, the recommendations made in this paper should allow a

claims analyst to pick the most effective delay analysis method that is compatible with the information at hand at the time of analysis.

Braimah & Ndekugri (2008) in their reports on an empirical study based on a survey of UK construction and consulting organizations has confirmed the above facts. In their initial analysis of the results shows that the top six factors influencing the selection of delay analysis technique are records availability, baseline programme availability, the amount in dispute, nature of baseline programme, updated programme availability, and the number of delaying events. There was a strong consensus, at 95% confidence level, among contractors and consultants in their rankings of the factors. As a preliminary step towards future development of a model to aid practitioners on delay analysis technique selection, factor analysis was used to reduce the factors into six group factors by determining the underlying features inter-relating the selection factors. These group factors (in order of importance) are project characteristics, contractual requirements, characteristics of baseline programme, cost proportionality, timing of the analysis and record availability.

2.10 Burning Issues in Delay Analysis

Following are number of problematic issues identified by Kean and Caletka (2008) which have arisen in connection with both programming and delay analysis.

- issues related to the ownership of float in construction programmes
- concurrency
- programme approvals
- mitigation
- acceleration
- pacing
- contractors' entitlement to early completion
- the assessment of disruption damages

Float is an integral part of CPM programming and delay analysis. The concept of float, which has given rise to much debate, increases the probability of critical delay

to the project. Even where it doesn't result in critical delay, float loss can cause financial loss to discrete task related resources. An issue of much debate for many years is 'who owns the float in a construction programme?'; the implication being that the owner of the float has exclusive use of it. There are various viewpoints on this matter.

Another common problematic issue which arises in the delay analysis is that of dealing with, and defining, concurrent events and concurrent delay. The uncertainty as to how concurrent delay should be managed or defined continues to cause difficulty to contract administrators, in particular in their task of assessing extensions of time and compensation events during the course of a project.

These issues impact both on the level of extension of time that might or might not be granted, and also on the amount of compensation, for example loss and/or expense, that might be due. When concurrent culpable delays are identified by the employer, contractors often argue that it was simply 'pacing the work.' Another area of potential difficulty is that of programme approvals and onerous specifications. Many of the major building and civil engineering forms of contract require the contractor to prepare and submit a construction programme. The content and standard of construction programming data that employers have required to be submitted by contractors in the past has varied quite considerably. However, in more recent times, with the advances in computer generated output and a growing awareness of the nature of construction planning, employers have been requesting ever increasing detailed and sophisticated programmes from contractors. In some forms of contract, it is a more common practice to require quite detailed and sophisticated programme requirements.

2.11 Delay Claim Life Cycle

Each and every delay claim has its own life cycle (Keane & Caletka, 2008). They have summarized the life cycle as follows:

- Baseline programme is established
- Project commences

- Deviation from baseline programme is identified (or projected)
- Delay occurrence/discovery
- Delay analysis
- Delay claim submission and presentation
- Delay claim response
- Negotiations (and award of appropriate extension of time)
- Revised baseline programme is established and agreed
- Dispute resolution procedures (if award is not agreed)
- Delay claim resolution

Delay claims are a very effective way to spend money and divert management resource from running a business. Resolution by way of a mutually acceptable extension of time should be sought at the earliest opportunity to avoid the dispute stepping up to the next, more formal process. There are many pitfalls on the path to a successful delay claim resolution as well as steps that can be taken to improve the outcome; for example, the agreeing of delay impacts contemporaneously (i.e. as they arise during the course of the project works) rather than adopting a 'wait and see' approach. Chapter 5 considers a number of problematic issues which arise in connection with both programming and delay analysis. These include problematic issues related to the ownership of float in construction programmes, concurrency, programme submission and approvals, acceleration, disruption and mitigation of delay.

Keane (1994) in his research has categorized life cycle of a delay claim in following five stages.

Stage I : Identification of Causative Events
Gather and research evidence Establish contractual/ legal basis for claim

Stage 2	:	Identification of linked effects Establish causal link Analyse evidence and present findings Collate supporting documentation
Stage 3	:	Evaluate effects and Quantify damage
Stage 4	:	Compile and Submit Claim
Stage 5	:	Negotiate settlement

2.12 Widely Accepted Guideline for Delay Analysis

There are two widely and forensically accepted guidelines in current practice.

a. The SCL delay and disruption protocol

Firstly, in the UK, the Society of Construction Law published its Delay and Disruption Protocol in October 2002. The aim of the SCL Protocol is stated as being to:

> 'provide useful guidance on some of the common issues that arise on construction contracts, where one party wishes to recover from another an extension of time and/or compensation for the additional time spent and the resources used to complete the project. The purpose of the Protocol is to provide a means by which the parties can resolve these matters and avoid unnecessary disputes'.

The SCL Protocol recognizes that the application of common sense and reality checks are required when applying delay analysis techniques (Keane & Caletka, 2008).

b. Recommended practice No. 29R-03 forensic schedule analysis

Recently the Association for the Advancement of Cost Engineering International (AACEI) published relevant guidance, similar to the SCL Protocol, in the form of its 'Recommended Practice' No. 29R-03 - *Forensic Schedule Analysis*(RP-FSA) which was issued on 1 July 2007 and officially launched on 15 July 2007. The RP-FSA is primarily focused on the terminology and the application of forensic analysis and is a much more a technical document. However, it acknowledges that the SCL Protocol

had a ‘wider scope’. The stated purpose of the AACEI’s Recommended Practice guide is ‘to provide a unifying technical reference for the forensic application of CPM scheduling’ and to ‘reduce the degree of subjectivity involved in the current state of the art’. Whereas the SCL Protocol provides guidance to contract administrator and forensic analysts alike, the RP-FSA has an expressed emphasis on ‘minimising procedural subjectivity’ in forensic scheduling.

2.13 Conclusion

An extensive review of technical, professional and academic literature was performed to establish what was already known and published in connection with the area of research in order to identify the problematic issues and difficulties associated with the delay analysis in the construction industry.

It was found that there are four main delay analysis techniques and many derivatives of the four categories are being practiced in the industry. Selection of the most suitable delay analysis for the situation depends on factors like availability of records, time of analysis and resources available for the analysis.

It was also found that there are eight essential elements of a time extension claim, namely, event, liability of the event, contractual entitlement, contractual compliance, cause and effect, analysis of delay, statement of claim and substantiation.

There were plethoras of research carried out worldwide to identify causes of project delays as well as their effects. However, there were only a very few researches on delay analysis. Most of the researches related to delays were of descriptive type researches that includes surveys and fact-finding enquiries of different kinds. The main characteristic of these methods were that the researcher had no control over the variables and only reported what has happened or what was happening. Most of the researchers had selected non probability sampling technique in selecting their sample.

Questionnaire survey and case studies were the most common methods used in data collection and some were more successful in adopting a mix method of both the questionnaire and case studies.

Therefore, it can be concluded that it is more appropriate to select a sample based on the non-probability sampling technique and to collect data using both the case studies and questionnaire survey for a research of this nature.

CHAPTER 3 : METHODOLOGY OF STUDY

3.1 Introduction

During the Literature Review in chapter two, an extensive search and review of existing technical, professional, and academic literature was undertaken which established, in particular, what is currently written and known about the problematic issues in construction delay analysis.

From this exercise several main areas of difficulty were identified, together with an indication of the potential gaps which may exist between such areas, and solutions currently available.

The main aim of this chapter is to investigate from an industrial practice perspective of what the principal problems and/or failures in the process of construction delay analysis are, and whether there exists scope for positive beneficial improvement, particularly by adopting predefined guidelines.

To achieve the above targets initially four projects were selected as case studies and extensive investigation done on area of delay analysis, granting extension of time and other areas related to time extension. Thereafter a questionnaire developed with the help of the findings of the case studies and literature review was implemented. The Survey was mainly aimed at identifying the current practices in delay analysis and problematic issues concerning the preparation of time claims. To achieve the main objective, survey was focused on following areas;

- Particulars of the construction programme.
- Level of record keeping at site.
- Identification of the nature and scope of computer usage by Contractors in the area of time management and analysis operations.
- Identification of the frequency of time extension claims being submitted, and an observation of the responses made.
- Assessment of the success or failure rate being recorded by Contractors.
- Awareness of delay analysis techniques among the contractors.

3.2. Sample Selection

Sampling is a procedure that uses a small number of units of a given population as a basis for drawing conclusions about the whole population. Sampling is often necessary because it would be practically impossible to conduct census to measure characteristics of all elements of population. (Zikmund, 2003)

According to Zikmund (2003) there are two major sampling methods namely probability and non probability sampling. Non probability techniques includes convenience sampling, judgment sampling, quota sampling and snow ball sampling and where as probability sampling technique includes random sampling, systematic sampling, stratified sampling and cluster sampling.

A simple rule of thumb is that the more homogeneous a population the samples can be smaller and vice-versa. Therefore, sample size is a judgment based on the amount of variability that is known to exist within the population (Holt, 1998).

From the literature review it was disclosed that most of the researchers who had investigated the aspects of construction delays were using non probability sampling techniques. Some had selected the sample considering the fact of easy accessibility. Few researches had selected their samples based on the findings of the previous researchers.

While interviewing the Engineer's representatives it was disclosed that the contractors with higher grades of ICTAD registration practices effective project management techniques than the contractors with lower grades. Giving due consideration for that fact and the conclusions arrived from the literature review, judgment sampling one of the non probability sampling techniques is used to select the sample. Accordingly contractors with ICTAD registration C1, C2, C3 and C4 were selected for review. All the contractors registered at the time of survey under the above four categories were selected for the survey. Table 3.1 shows the composition of the sample.

Table 3.1 -The composition of the sample

ICTAD Grade	Total No Participants
C1	12
C2	16
C3	20
C4	26
Total	74

3.3 Data Collection

Having selected the sample, method of collecting data had to be chosen. The following data collection methods were taken in to consideration:

- Case Study
- Personal Interview
- Questionnaire
- Observation

According to Taylor and Steele (1996) observation method can be very time consuming and resource intensive and is susceptible to observer bias, subjective bias on the part of the observer thus undermining the reliability and hence the validity of the data gathered. The Observation method considered not appropriate for this type of study.

Instead, combination of other three methods, case study, personal interview and questionnaire method was used. As an approach to the design of questionnaire and to have a clear picture of the industry practices, four projects were selected as case studies. Those projects were intensively examined by interviewing all the relevant stake holders, going through documents and by record analyzing and so on.

From the data derived from the case studies the Questionnaire was developed. Self completion Questionnaire is used as the major data colleting method of this research. The main advantages of this method being: -

- It was the least costly compared to the alternatives.
- The sample could be collected from a much wider area.
- The bias of the interviewer is removed.
- The respondent is not asked to give instant replies so that answers could be considered and records consulted before responding if necessary.

One of the main disadvantages of this type of self completion questionnaire is that it might not be answered in sequential order. However, in this case the data would not have been affected.

In order to ensure a high response rate as possible, most of the time questionnaires were sent through personal contacts to reach the correct person of the organization and followed up the process until the questionnaire was reached to the targeted person.

Each questionnaire carried a request for a telephone interview with a positive response rate of 76% of respondents willing to provide additional information.

3.4 Questionnaire Design

No survey can achieve success without a well-designed questionnaire. A well-designed questionnaire should meet the research objectives. To ensure those aspects following steps were adhered to develop the questionnaire.

1. Decide the information required.
2. Define the target respondents.
3. Choose the method(s) of reaching the target respondents.
4. Decide on question content.
5. Develop the question wording.
6. Put questions into a meaningful order and format.
7. Check the length of the questionnaire.

8. Pre-test the questionnaire.
9. Develop the final questionnaire.

Content of the questionnaire was developed mainly from the data, and facts disclosed from the four case studies and literature survey. Questionnaire was targeted towards very senior individuals within the organizations with many more important priorities on their hand far greater than completing a questionnaire. Therefore, it was essential that the questionnaire be as short as possible, easy to read and understand and capable of completion within a matter of minutes.

With that intention, numbers of questions were limited to 20 and elect for closed-ended questions requiring only a "tick in the appropriate box" response. The layout of the questions was carefully considered to prevent as far as possible confusion or ambiguity, and to ensure the offered alternative answers were clearly associated with the questions being asked. Purpose and usage of each and every question is discussed later in this section and the questionnaire is attached as Appendix - A.

Every attempt was made to construct the questions with the greatest clarity, neutrality, and to avoid the building in of any hidden bias. The reasonably balanced response rate suggests that no serious bias or distortion will seriously affect the finding as a result of those that did not return the questionnaire.

Once the questionnaire was finalized as to content and layout, ten draft copies were provided for pilot studies for ten Engineers of different capacity. The purpose of pre-testing the questionnaire was to determine:

- whether the questions as they were worded will achieve the desired results
- whether the questions have been placed in the best order
- whether the questions are understood by all respondents
- whether additional or specifying questions are needed or whether some questions should be eliminated
- whether the instructions to interviewers are adequate.

From this pilot survey it was disclosed that some wording of the questionnaire was difficult to understand. Those were simplified with the concurrence of the

participants. Order of the questions was also changed to have a better flow after the comments made by the respondents.

It was disclosed that the majority of the respondents of pilot study were unaware of the delay analysis techniques like Time Impact Analysis. In the initial questionnaire there was a question to indicate them the technique followed by them for the delay analysis. Under this situation it was revealed that correct answer was suspicious. Therefore, that question was replaced with more elaborative question indicating the procedures of delay analysis techniques to get the correct picture (Question No: 13 of the finalized questionnaire). Under tests a questionnaire took between 10 and 20 minutes to complete, where a response was made to each question. After the above amendments questionnaire was finalized (Appendix - A).

Purpose and usage of the questions are as follows:

*"**Q 01 -Details of the Organization."***

Purpose: To identify the respondent background

Usage: To compare the responses received based on their grading.

*"**Q 02 -On how many occasions are your construction programmes prepared using project management software?"***

Purpose: To establish incidence/frequency of using project management software in project planning

Usage: This information is contrasted with responses given to other questions while developing recommendations.

*"**Q 03 -What details do you normally include/show in your work programme?***

Purpose: To establish main component of the work programme currently in practice.

Usage: This information is used to identify the gap of information that is required to adopt a proper delay analysis technique.

"Q 04 -When do you normally update your Work programme?"

Purpose: To identify the industry practice on updating the programme.

Usage: Information is used to recommend improvements for delay analysis practices.

"Q 05 -What are the records maintained at site?"

Purpose: To identify the records maintained by the contractors.

Usage: To identify the gap of record requirement for a proper delay analysis technique.

"Q 06 -Are the contractor and consultant keeping records separately?"

Purpose: To identify the industry practice.

Usage: This information is contrasted with responses given to other questions when formulating recommendations.

"Q 07 -If yes, on how often are their discrepancies between Contractor's records and Consultant's records?"

Purpose: To study the gravity of the problem.

Usage: This information is contrasted with responses given to other questions when formulating recommendations.

"Q 08 -Are computers used by the company on construction site locations?"

Purpose: To identify exposure to computerisation on site.

Usage: Recommendations are developed to suit the site resource level.

"Q 09 -Where computers are used on site locations, please indicate the tasks they perform:"

Purpose: To identify in more detail the specific tasks most frequently performed on site where computer technology used.

Usage: This information is used to verify the type of problems being identified prior to make recommendations.

*"**Q 10 -How often has the need arisen to submit extension of time claims?"***

Purpose: To identify the frequency of claims.

Usage: To establish link with research problem and to compare with other findings.

*"**Q 11 -When do you normally submit time claims?"***

Purpose: To identify the frequency of claims.

Usage: Information used to develop recommendations

*"**Q 12 -Who prepare the time claims?"***

Purpose: To identify resource level of the organization.

Usage: This information is reviewed when solutions are being structured.

*"**Q 13 -Indicate the procedure/s you follow in proving delays"***

Purpose: To identify method currently practiced by the industry.

Usage: This information is used with responses given to other questions when formulating recommendations.

*"**Q 14 -Are you aware of the following delay analysis techniques?"***

Purpose: To check the awareness of basic delay analysis techniques.

Usage: This information is used with responses given to other questions when formulating recommendations.

*"**Q 15 -What are the Governing factor/s of selecting a particular Delay Analysis technique to a project?"***

Purpose: To identify the factors affecting in adopting a particular delay analysis technique.

Usage: This information is used with responses given to other questions when formulating recommendations.

"Q 16 -Where claims are submitted for an extension of time, on how many occasions are you granted with time extension to your satisfaction?"

Purpose: To identify the gravity of the problem in time extension claim.

Usage: This data is used to assist in validation of the problem chosen for research.

"Q 17 - If your extension of time claim (or claims) rejected either in part or in total, please indicate the reason(s) for rejection:"

Purpose: To identify frequency and predominance of the most common reasons for claim rejection.

Usage: This data is used to assist in validation of the problem chosen for research.

"Q 18 - Have Time Extension Claims lead to disputes which resort to Adjudication or Arbitration?"

Purpose: To identify frequency of disputes.

Usage: This data is used to assist in validation of the problem chosen for research.

"Q 19 - In your opinion please rank (1-4) the following barriers/bottlenecks of implementing an accurate delay analysis technique"

Purpose: To study the barriers for implementing a proper delay analysis technique.

Usage: To establish most common barriers in time claim management.

"Q 20 - Would you be prepared to answer a number of brief additional questions by Telephone interview?"

Purpose: To get the detail of the respondents.

Usage: To get clarifications for incomplete questionnaires and get additional data if required.

CHAPTER 4 : ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

In chapters two and three the principal problematic issues in the practice of construction delay analysis claims were identified, based on existing professional and technical literature, four case studies, followed by a survey of construction companies in Sri Lanka. This chapter will expand and contrast the findings of the above research, that is the existing and in some instances theoretical knowledge with the harsher realities of success or failure experienced in current practice.

The problematic issues were then further considered in order to isolate by deduction one particular problem for which a solution could be devised, and this in turn led to develop recommendations to improve delay analysis practices in the Sri Lankan construction industry.

4.2 Case Studies

Four projects were selected in different magnitude of contract prices ranging from rupees 0.5 billion to rupees two billion (Appendix - B). Three projects were completed projects and the remaining one was on going. Data accessibility was one of the major criteria in selecting those projects.

Descriptive and exploratory analysis was carried out for the above four projects. Documents of those projects were reviewed and several interviews were done for clarifications and to get views of the stake holders of the projects (list of Interviewees, Appendix - C). The facts disclosed from the case studies were used to develop the questionnaire along with the conclusions of the literature review. However facts of these case studies were not generalized. Instead wider survey was carried out in the form of self explanatory questionnaire survey and taken up for the detailed analysis. Facts disclosed in the case studies are as follows.

Project P-01

This was a construction of a ten storied building complex. Initial contract period was 2 years and finally taken 3 years to complete. The contractor had submitted three EOT claims and got the time extension for the extended year with the cost of preliminaries and the price fluctuation claim for the extended period.

When examined the contractor's claim and the Engineer's approval, it was revealed that the claim was a list of delay events indicating the number of delayed days and adding up to get the total delay. And the Engineer's approval had followed the same pattern. There was no reference to the critical path or the construction programme. Contractor has only submitted few copies of minutes of the meeting and instruction of the Engineer to justify the dates quoted in the claim. Main reasons quoted in the claim were the variations and late approval by the Employer.

From the interviews it was found that the neither contractor's staff nor the Engineer's staff knew delay analysis techniques like impacted as-planned, Time impact analysis, Collapsed as-built and As-planned vs As-built. After briefly explaining about the techniques they admitted that they had not maintained proper records, had no expertise knowledge to follow one of the above delay analysis technique. Project manager of the contractor went on saying that their company was not prepared to spent time and money on those kinds of advance techniques.

Project P-02

This was a building construction project. Initial contract period was two years and contractor had taken additional one year and three months to complete the project. This contract included only the civil works. For other services like electrical and mechanical works, employer had assigned separate contractors. Contractor had submitted one EOT claim after the lapse of initial contract period and was awarded the total extended period requested including his claim for the additional cost incurred during the extended period. In this project contractor had taken good effort to substantiate his claim and recorded his intention to claim in events when there was a likely possibility of delaying the projects. Engineer's project manager and

Employer's representative mentioned the contractor's timely warning helped them to minimize the delay.

Main reason quoted in the EOT claim was the delay to meet the deadline by the other contractors assigned by the Employer, thereby contractor for civil works had deprived of completing works on time. This was a straight forward reason for the eligibility of extension of time as per the conditions of that particular contract. The contractor had also quoted few other reasons like delay in issuing details, variations, restriction of working hours, adverse weather conditions and change of scope of work. Contractor had mentioned in his claim that delay caused by the above reasons were concurrent delays and the project completion was depend on the completion of Employer's direct works. However contractor had failed to justify this fact using the construction programme.

In this site all the records had been computerized. In some situations contractor was using those records to calculate his profit or loss in particular work items and to establish work norms to be used in their future works.

Project P-03

This was a construction of a 10 storied building in the premises of a government hospital. Initial contract period was two years and finally it had taken five years and ten months to complete the project. As this had taken more than the double the initial contract period this project was thoroughly examined in the sense of time extension.

EOT claims of the contractor had been prepared by the contractor's project staff. Proper delay analysis technique had not been followed in preparing the claim. Contractor's staff was unaware of any of the advance delay analysis technique.

Contractor had submitted nine EOT claims and the Engineer has taken only eight of them for the consideration. One claim had been rejected on the ground of not submitting supporting details. Contractor had got the extension for the total delayed period of the project along with the addition cost incurred during such extended period. Total additional cost due the time extension was nearly 20% of the initial contract price. Prime reason for the delay was the non-payment of interim payments to the contractor. There was a situation that interim payments were delayed by six

months and even contract had given notice for termination on that ground. When interviewed the projected engineer of the Employer it was revealed that though allocation had been made to the project, sometimes money was not there for the payments. Variations of the contract were cited as another major reason for the delay.

Project Manager of the contractor was of the view that the initial contract period set for this contract was unrealistic and unachievable in the prevailed conditions. He further mentioned that there were time restrictions, traffic restrictions and noise restriction as the site was located in the heart of that hospital. When raised this issue from the Engineer's representative, he mentioned that contract period was set mainly considering the urgent need of the Employer and further said other factors were not evaluated in detail while setting the contract period.

When examined the project files, several instructions from the engineer to update the programme and keep proper records at site were found. Engineer's representative confirmed that the contractor's record keeping at site was poor and granting time extension was very difficult in the absence of the contemporaneous records. In this contract it was not compulsory to give prior notice of delay events to be eligible for the time extension as in the project P-01. Therefore, contractor had taken lethargic approach in prior noticing of delay events.

Project P-04

This is an ongoing project and has completed 40% of the works at the time of evaluation. Initial contract period is two years. Contractor has submitted one EOT claim prepared by the claim consultant hired for the purpose of preparing EOT claims and other related claims.

Contractor had claimed 136 days time extension for the reasons of encountering unexpected poor soil conditions and to insert permanent casing which was not in the original scope of work. Contractor had used the As Planned vs As Built technique to prove his claim. However Engineer had approved only 58 days for the contractors claim. Thereafter contractor had conveyed his dis-satisfaction for the awarding of the claim. Engineer had cited insufficient support documentation and failing to demonstrate the cause and effect as reasons for rejection of portion of the claim.

4.2.1 General comments made by the interviewees

It was revealed that it is compulsory to submit a work programme in almost in every contract. Interviewees mentioned that the content of the programme and how it should be prepared were not emphasized in contracts. Under this situation contractors were submitting programmes ranging from just excel sheets to complex programmes prepared by project management software.

Two interviewees representing public sector Employer expressed their view on delays of some projects run by the Government funds. They mentioned that one of the major reasons for the delays were the cash flow issues. Sometimes contractors' payments were delayed by several months and projects were dragging on several years. According to them there were situations where the projects were delayed by more than the initial contract period.

Participants of those who represent the contractor expressed dissatisfaction over the record keeping practices at some of their sites where the contractor and the Engineer keeping site records separately and further mentioned this issue had lead to disputes. They were of the view that these kinds of disputes could have been averted if both the parties agreed to a common format and keep the contemporaneous records jointly. According to them contractors with higher grade of ICTAD registration tend to practice effective project management than the contractor's with lower grades. They further mentioned some consultants are reluctant to accept photographs as one of the tool in substantiating claims.

Engineer's representations' main concern of EOT claims were contractor's failure to give notice on time to be eligible for the claim, insufficient supporting documentation and failing to demonstrate cause and effect. They further mentioned in some situations record keeping at sites was very poor and contractors failed to submit the records on time. Under those circumstances they mentioned that they were forced to keep separate records by their own. There were of the view that most of the contractors they were dealing with were unfamiliar with the delay analysis techniques like impacted as-planned, time impact analysis, collapsed as-built and as-planned vs as-built. They further mentioned that some contractors are undertaking

contracts exceeding their capacities and thereby fails to provide necessary resources and labour on time resulting delays to the projects.

4.3 Questionnaire survey

As described in Section 3.3, a sample of 74 contractors were selected for the survey. Personal contacts were used to make sure that the Questionnaires were reached to the suitable individuals of the organization. The Questionnaires were sent through email, by post and by hand. Figure 4.1 shows the sample distribution.

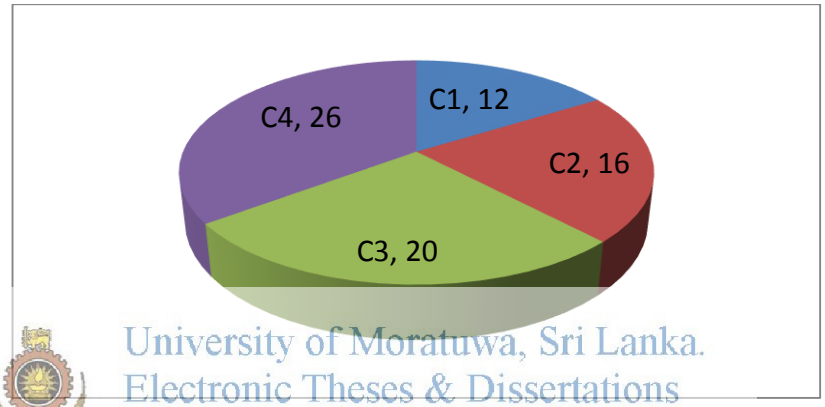

Figure 4.1 - Sample Distribution

The survey was targeted to achieve the following:

- Identification of current methodology followed by the contractors in preparing time extension claims.
- Finding out the frequency of time extension claims being submitted and whether the contractors are being awarded the extension to their likings.
- Identification of record maintaining levels at sites.
- Identification of computer usage level at sites.
- Identification of barriers of time extension claims.

The responses were also received through email, by post and by hand. Fifty One responses were received. When analyzing the responses, it was found that five questionnaires were not fully completed. Since they were not fully completed, it was

assumed that respondents had not taken good care to fill the questionnaire and their responses cannot be accurate. Therefore, those partly filled questionnaires were not taken in to the analysis and only the 46 completed responses were taken in to analysis. Table 4.1 summarizes the responses of the sample selected.

Table 4.1 – Response Rate

ICTAD Grade	No of Questionnaires sent	No of Questionnaires Returned	Response Rate
C1	12	8	67%
C2	16	10	63%
C3	20	12	60%
C4	26	16	62%
Total	74	46	62%

The response rate of contractors with higher grades of ICTAD registration were higher compared to the lower grades. It shows that contractors with higher grades are more interested towards research and Development activities than those who are having lower grades.

4.4 Analysis of Survey Responses

4.4.1 Submission of time extension Claims and their awarding

It was revealed that 98% of contractors have experienced submitting extension of time claims on one or more occasions where 68% of them experienced 25% or more of their projects were unable to complete within the originally specified time targets. Table 4.2 and Figure 4.2 illustrate the above scenario. Therefore, it is obvious that time extension claims becomes an integral part of the construction management.

Table 4.2 -Frequency of submitting time extension claims

Frequency	No of Respondents	% of Respondent
Not at all	1	2%
01% to 25%	14	30%
26% to 50%	15	33%
51% to 75%	10	22%
76 % to 100%	6	13%

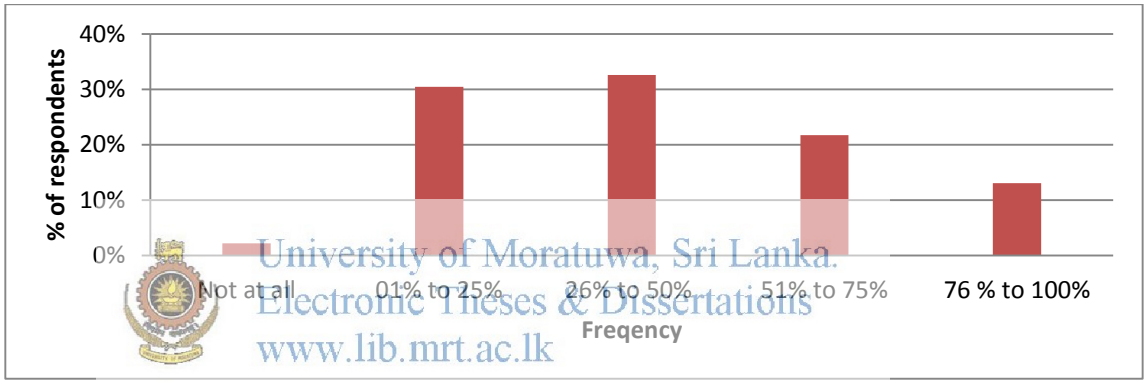

Figure 4.2 - Frequency of submitting time extension claims

It is evident from the responses that having submitted time claims 59% of contractors were being awarded with 50% or lesser satisfaction rate. Only 21% of contractors have the experience of satisfactory awardings for more than 75% of their projects. Therefore, it can be concluded that there is a high risk of rejection or awardings with un-satisfaction for time extension claims in Sri Lankan Construction industry. Sri Lankan construction industry seems, lacking a good accepted practice or guide lines for time extension claims. Figure 4.3 graphically demonstrate the above scenario.

Table 4.3 - Satisfaction rate of time extension awardings

Frequency	No of Respondents	% of Respondents
Not at all	3	7%
0-25%	6	13%
26%-50%	18	39%
51%-75%	9	20%
Over 76%	10	21%

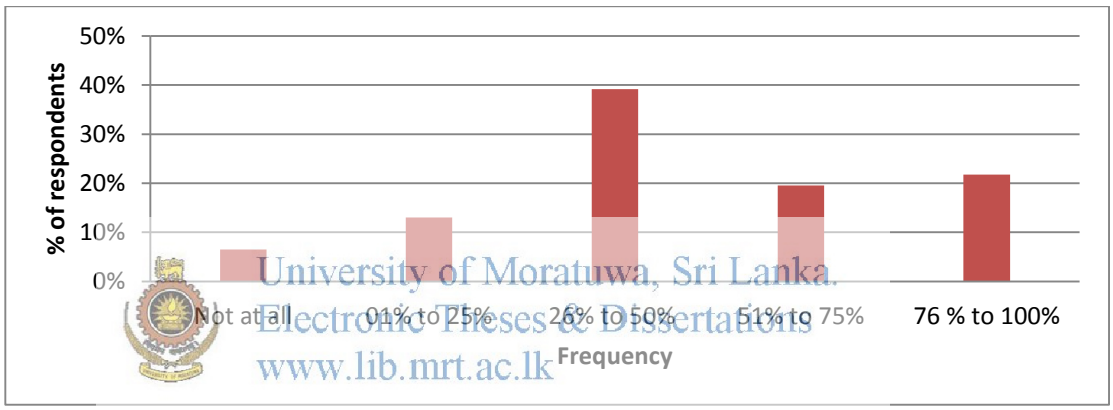

Figure 4.3 - Satisfaction rate of time extension awardings

It was observed the highest number (38% of incidents) of claims being rejected for failing to provide sufficient support documentation. Claims were also rejected because of Contractors' failure to demonstrate the cause and effect (29%).

Another major reason given for claim rejection is the claim was not being specific. This however is a growing area for concern and indicate that there is potentially a serious problem in preparation of time extension claims. Table 4.4 and Figure 4.4 show that on what ground EOT claims were rejected and on what extent they were rejected.

Table 4.4 - Main reasons for Rejection of Time Extension Claims

Reason	No of incidents	% of incidents
Insufficient support documentation	25	38%
Cause and effect not demonstrated	19	29%
Claim not specific	8	12%
No reasons given	6	9%
No contractual entitlement	3	5%
Insufficient/incorrect notice	2	3%
Claim content disputed	2	3%
Other	0	0%

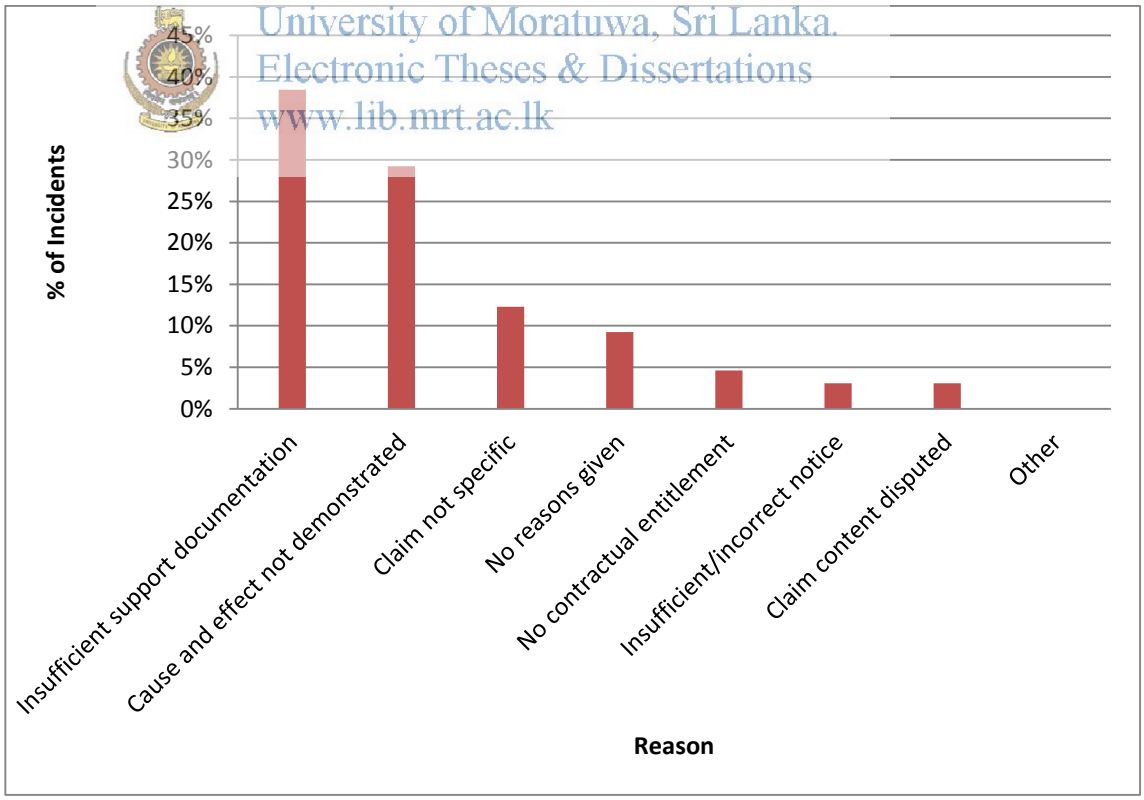

Figure 4.4 - Reasons for Rejection of Time Extension Claims

22% of respondents are having bitter experience of going for Alternate Dispute Resolution (ADR) mechanism for the time extension claims. This shows the gravity of the problem of not having a proper set of guidelines for such claims. Figure 4.5 graphically illustrate the situation.

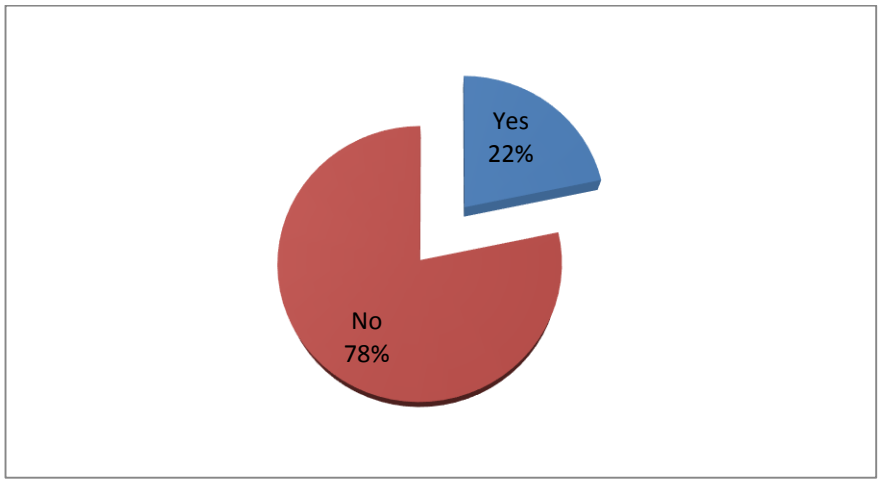

Figure 4.5 - Going for ADR for Time extension claims

4.4.2 Construction programme

During the interviews it was revealed that construction programme is compulsory in modern day contracts. Level of the construction programme was investigated through the questionnaire.

22% of contractors were using the project management software like MS Project and Primavera for the preparation of construction programmes in all of their projects. In overall 83% of the contractors had this practice in 50% or more of their projects. It is a good trend and managing time extension claims are much easier with the construction programmes of this nature. Comprehensive detail is shown in the Table 4.5.

Table 4.5 -Use of Project Management Software for the preparation of Construction Programme

% of Using PM software for construction programme	No of Respondents	% of Respondent
Not at all	0	0%
01% to 25%	2	4%
26% to 50%	6	13%
51% to 75%	10	22%
76 % to 99%	18	39%
100%	10	22%

During the interviews it was revealed the construction programme is a prerequisite in current construction contracts. It was observed 76% of respondents show the critical path in their work programme. Other 24% seems to have a construction programme with no sense. A few respondents (9%) do not even show activity links, which is a primary requirement of a work programme. Therefore, it is evident that some contractors do not pay due attention to the construction programme. Thus proving delays for them would be a nightmare without a proper construction programme. Table 4.6 and Figure 4.6 illustrate the components included in contractors' work programme and their frequency.

Table 4.6 -Details normally included/shown in the work programme

Details included	No of Respondents	% of respondents
Activity Links	42	91%
Critical Paths	35	76%
Resources	10	22%
Material	8	17%
other	0	0%

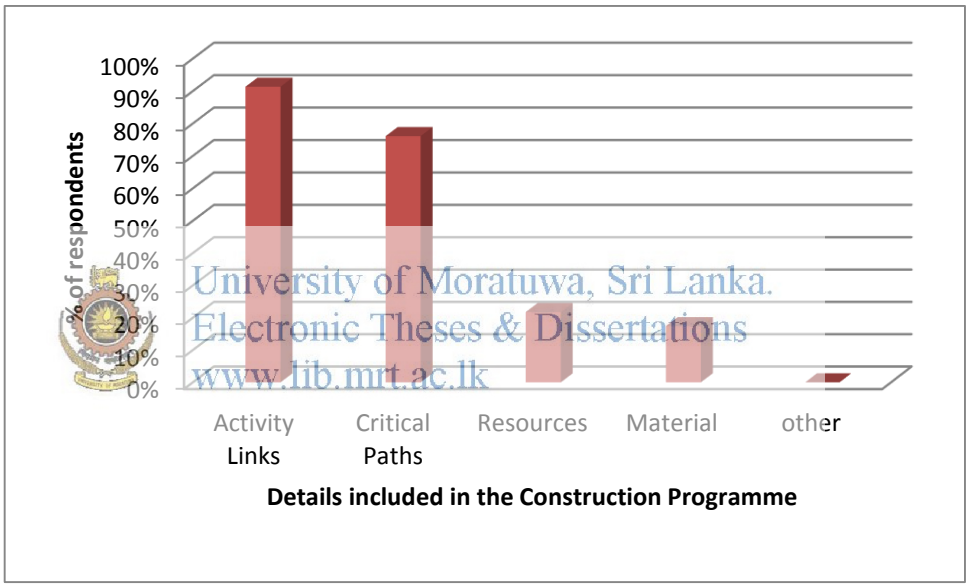

Figure 4.6 -Details normally included/shown in the work programme

Results show that 33% update their work programme monthly while 22% update it after a delay event. Table 4.7 and Figure 4.7 show how the respondents update their work programme. Programmes are updated to achieve the following main objectives.

- communicate actual project status from time to time;
- keep the programme relevant as a useful management tool;
- record actual performance of all parties alike;
- record changes to the original plan; and
- support forensic or prospective delay analysis.

For an accurate delay analysis updated programme is a must. Therefore, maintaining an up to date construction programme should be encouraged.

Table 4.7 -Updating of Work Programme

Interval	No of Respondents	% of Respondents
Monthly	15	33%
On Engineer's request	11	24%
After a Delay event	10	22%
Weekly	5	11%
other	5	11%

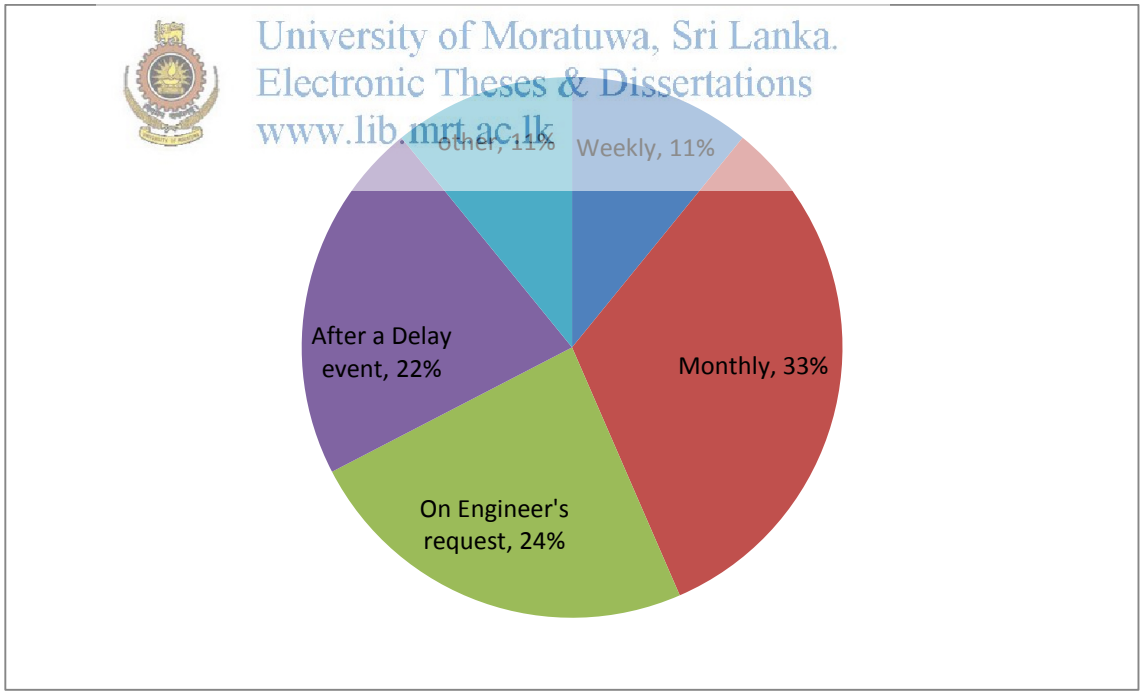

Figure 4.7 - Updating of work programme

4.4.3 Record keeping at site

When good record keeping procedures are established and maintained, stake holders of the projects are often able to access key information quickly and in a timely manner to respond to crises and manage problems at the time they arise. This reduces the disputes in delay analysis as well. As described above most common reason why many potentially valid claims are rejected is the claimant's failure to maintain adequate records, either of events, or of cost, or of both. Figure 4.8 graphically shows the records maintained by the respondents at their sites.

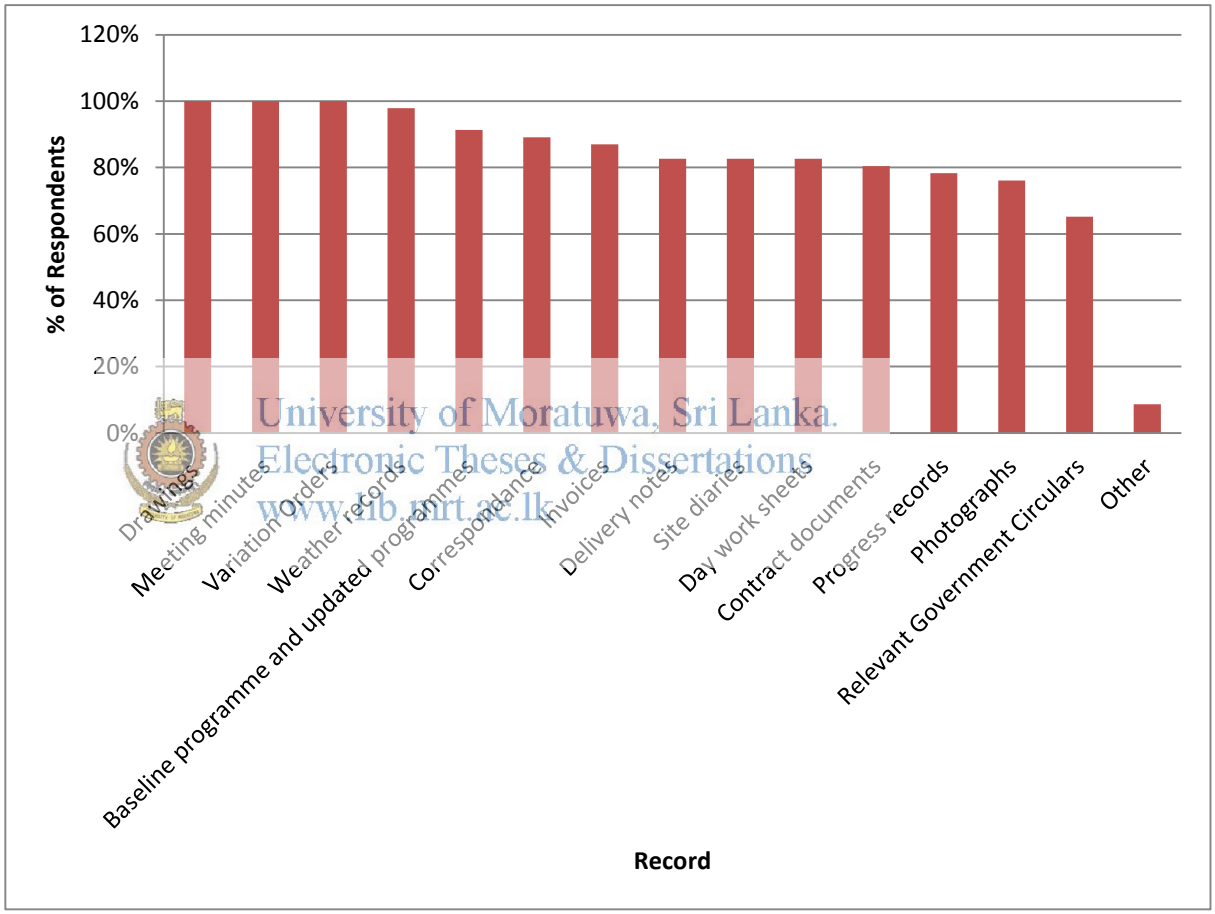

Figure 4.8 -Records Maintained at site

It was revealed that 91% were keeping baseline and updated work programme at site which is basic tool for monitoring progress and analysing delays. In the selected sample priority list of records kept at site are shown in Table 4.8.

It shows that construction programme was given fifth priority by the contractors (91%), which is key element in time extension claims. Furthermore, progress

records, one of the key records required for time management are further down the priority list with only 78% of the contractors maintaining progress records. Photographs were also got a lesser priority (76%). This can be considered as the confirmation of the fact disclosed by the interviewees representing the contractors that photographs are not widely accepted by some consultants in substantiating their claims. To succeed in an application for extension of time one fundamental requirement is for the claiming Contractor to produce adequate documentation and records of a supportive nature sufficient to persuade the assessor of the claim. Thus failure to do so not only reduces his chance considerably of pursuing successfully a claimed entitlement, but also of placing him in breach of contract in completing the project on time.

Table 4.8 -Priority list of records

Priority	Record Type	% of respondents
1	Drawings	100%
2	Meeting minutes	100%
3	Variation Orders	100%
4	Weather records	98%
5	Baseline programme and updated programmes	91%
6	Correspondence	89%
7	Invoices	87%
8	Delivery notes	83%
9	Site diaries	83%
10	Day work sheets	83%
11	Contract documents	80%
12	Progress records	78%
13	Photographs	76%
14	Relevant Government Circulars	65%
15	Other	9%

It was also observed that 39% of respondents had experience in keeping separate records by the Consultant and the Contractor. One of the ideas expressed in the interviews was that separate records were kept due to the contractors' failure to submit the timely records. This situation is demonstrated in Figure 4.9.

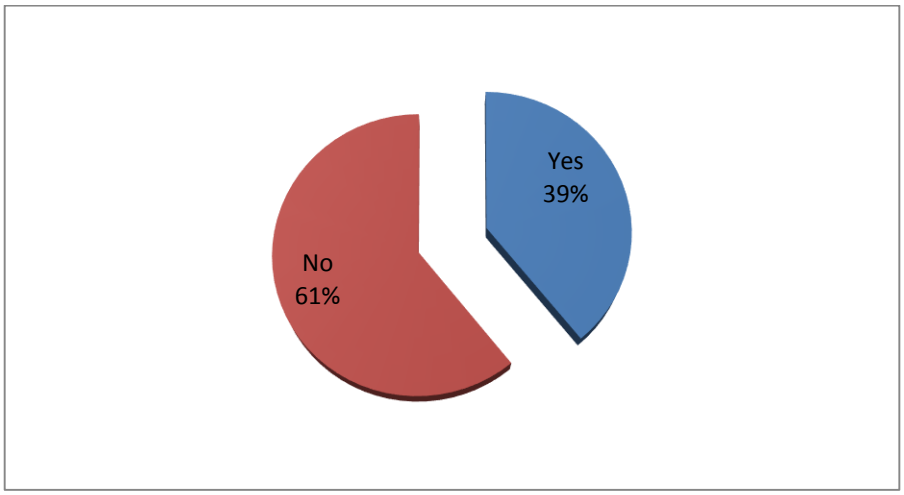

Figure 4.9 - keeping records separately by the Consultant and the Contractor

Furthermore, 94% of respondents those who keep records separately had discripencies either in minor of major nature between the records. This not only leads to disputes but also damages goodwill of the two parties.

Table 4.9- Discrepancies between Contractor's records and Consultant's records

Level of Discrepancy	**No of Respondents**	**% of Respondents**
Not at all	1	6%
01% to 25%	2	11%
26% to 50%	4	22%
51% to 75%	6	33%
76 % to 99%	3	17%
100%	2	11%

4.4.4 Usage of computers at site

Through the years, technology has become a big part of the society. Indeed, it has helped make lives easier and more convenient. Moreover, construction industry has also benefited from it since it has made work more efficient and productive. Due to this compute usage, the construction industry is capable of providing accurate, reliable and timely information to all participants on a construction project even at a different location that it is needed. Thus computerization can help immensely towards betterment of the time claims.

It is important though that there are necessary back up files made from all the data that is stored in the computers. Proper network security should be utilised to prevent unauthorised individuals from gaining access and using the information for their own good.

From the sample it is seen that some 83% contractors are using computers at 50% or more of their construction site locations. This of course indicates that nearly half of the construction sites are using computers. It is good to see that all the contractors are using computers at least one of their sites. Table 4.10 summarizes the use of computers at construction sites.

Table 4.10 -Using of Computers at site

Site Distribution	No of Respondents	% of respondents
Not at all	0	0%
01% to 25%	2	4%
26% to 50%	6	13%
51% to 75%	16	35%
over 75%	22	48%

Of those Contractors who use computers on site it was perhaps not surprising to find that 100% of them use for programming while 98% for progress monitoring and 87%

for word processing. It implies that manual methods of preparing construction methods are obsolete. Priorities of tasks performed using the computers are listed in Table 4.11.

This also indicates that 98% of construction contracts have progress monitored by computer aided methods. This is a good trend and use of computer aided method for progress monitoring is very much useful in proving delay claims. In addition it was also identified that the failure to employ computing technology fully in essential areas of project management, namely construction planning, monitoring and controlling with obvious benefits prevents to undertake retrospective time analysis of delay claims.

Table 4.11 - Priorities of Tasks performed using Computers

Priority	Task	No of Respondents	% of respondents
1	Contract Programming	46	100%
2	Progress Monitoring	45	98%
3	Word Processing	40	87%
4	Labour Records	32	70%
5	Cost Management	28	61%
6	Material Records	28	61%
7	Drawing Register	26	57%
8	Instruction Register	23	50%
9	Plant Records	22	48%
10	Cost Value Reconciliation	18	39%
11	Other	6	13%

4.4.5 Preparation of time extension claims

Any time extension claim must be entirely on its own merit, well analyzed and emphasized, properly documented, fully substantiated to minimized disputes.

Majority of Contractors' (76%) time claims were prepared by the respective project staff while 13% of the Contactors were having in house expertise for the time claim management. Very few Contractors (11%) were getting the service of external consultants to prepare their time claims. Table 4.12 shows sample distribution on preparation of EOT claims.

Table 4.12- Preparation of time extension claims

Time Claim Prepared by:	**No of Respondents**	**% of Respondents**
Project Staff	35	76%
In house expertise solely assigned to work on time and money claims.	6	13%
External Consultant	5	11%

As shown in the Figure 4.10, majority of time claims were prepared by the project staff. There are both advantages and disadvantages in preparing the time claim by the project staff themselves. Project staff knows every bit of the event as they are closely dealing with it and thereby it is beneficial in substantiating the claim. While interviewing the contractors' staff, they disclosed that there is a risk of preparing incomplete time claims by the project staff due to the lack of expertise knowledge of the subject and failure to allocate required resources and time.

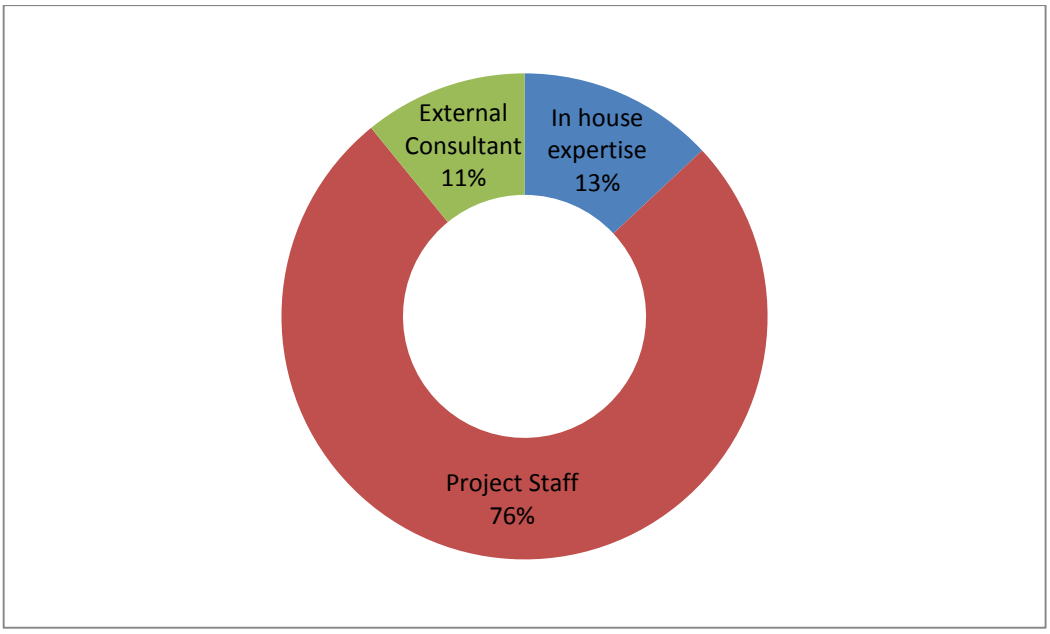

Figure 4.10- Preparation of time extension claims

Review of the literature suggests that the appropriate delay analysis technique should be decided by circumstances surrounding the claim situation. Therefore, knowledge and understanding of the delay analysis techniques and their relative importance is imperative in deciding the technique ideal for the situation.

It is surprised to note that majority of contractors (43%) are unaware of any of the four main delay analysis techniques. Time impact analysis is the least known (11%) technique. Table 4.13 illustrates the knowledge on delay analysis of the respondents.

Table 4.13 - Awareness of delay analysis technique

Technique	**No of Respondents**	**% of respondents**
None	20	43%
As-planned versus as-built	12	26%
Collapsed as-built	9	20%
Impacted as-planned	8	17%
Time impact analysis	5	11%

While interviewing the consultant's representatives it was disclosed that contractors were unfamiliar with delay analysis techniques. Therefore, question no 13 of the questionnaire was set to identify the procedures they were following in analyzing delays and technique involved was indentified.

From the survey, steps followed by the contractors for the purpose of delay analysis were indentified with a view of identifying the delay analysis technique they were following and tabulated in Table 4.14. Results revealed that 43% of contractors were submitting global claims without substantiating the claim resulting higher rejection or dissatisfaction rate. Others knowingly or unknowingly were using one of the four main techniques with least being using time impact analysis.

Table 4.14 – Techniques used in delay analyzing

Technique	**No of Respondents**	**% of Respondents**
Global Claims	19	41%
As-planned vs As-Built	11	24%
Collapsed as built	7	15%
Impacted as planned	5	11%
Time Impact Analysis	4	9%

A fair and effective evaluation of delay impact is possible if the most appropriate delay analysis method is selected that provides a reliable solution. The reliability of delay analysis depends on the selection of a suitable analysis method. It was revealed from the survey that majority of contractors (33%) selected the analysis method familiar to them without assessing whether it suits or not for the circumstances. Other major constraint (28%) seen by the contractor in selecting the method of analysis is the availability of records. Factors affecting the selection of the delay analysis technique is tabulated in Table 4.15 and graphically illustrated in Figure 4.11.

Table 4.15 - Governing factor/s of selecting a particular Delay Analysis technique

Factor	**No of Respondents**	**% of Respondents**
Being the familiar technique	15	33%
Availability of records	13	28%
Characteristics of baseline programme	9	20%
Characteristics of the project	8	17%
Cost of the technique	6	13%
Timing of analysis	6	13%
Other	6	13%
Contractual requirement	4	9%

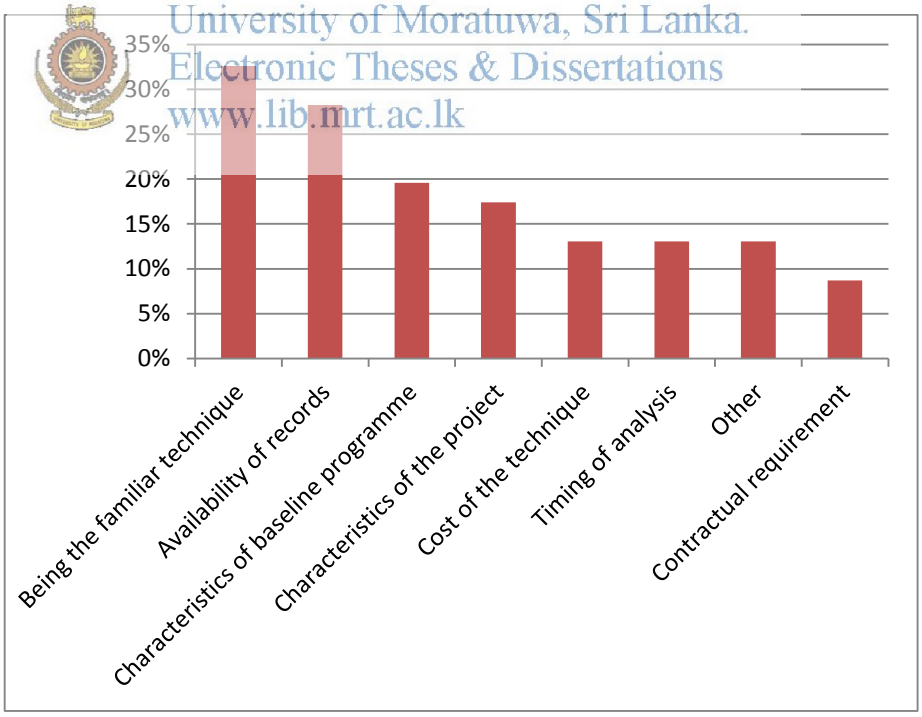

Figure 4.11- Governing factor/s of selecting a particular Delay Analysis technique

In the questionnaire survey contractors were requested to rank the following barriers in selecting an accurate delay analysis technique as per their opinion.

a Contract specifies a particular method

b Not maintaining adequate records to adopt a proper analysis technique

c Not having the expertise

d Inability to spend time/money on advance technique.

To convert the above data "Calculation of Rank Order", one of the data transformation process was used to change the data from their original form to a format that better supports data analysis to achieve research objectives.

In the process data transformation was performed by multiplying the frequency time the rank to develop a new scale that represents the summarized rank ordering. This was to identify the contractors' priority of concerns in adopting an advance method for delay analysis and was taken in to account while developing recommendations.

Table 4.16 – Rank order frequency for barriers

	Rank			
Barrier	1	2	3	4
a	2	8	12	24
b	23	13	8	2
c	18	14	8	6
d	11	16	14	5

Table 4.16 shows the frequencies of these rankings. To calculate the summary rank ordering, the destination with the first (highest) preference was given the lowest number(1) and the least preferred reason (lowest preference) was given the highest number(4).

The summarized rank ordering was obtained with the following calculations.

(a): (2x1) + (8x2) + (12x3) + (24x4) = 150

(b): (23x1) +(13x2) + (8x3) + (2x4) = 81

(c): (18x1) + (14x2) + (8x3) + (6x4) = 94

(d): (11x1) + (16x2) + (14x3) +(5x4) = 105

The lowest total score indicates the first (highest) preference ranking. The result show the following ranking ordering.

1. Not maintaining adequate records to adopt a proper analysis technique
2. Not having expertise knowledge
3. Inability to spend time/money on advance technique.
4. Contract specifies a particular method

Results show that the contractors themselves accept the fact that they are not maintaining enough records for implementing a proper delay analysis technique in the first place. Secondly they are not having the knowledge of delay analysis techniques and thirdly they are reluctant to spent time and money to an advance technique.

4.5 Discussion

Construction delay claims, or disputes related to schedule impacts, are one of the most common types of disputes in the construction industry. Yet, delay claims have become the least understood and frequently complex disputes in the construction field.

It was observed that there is a very high incidence (98%) of Contractors submitting extension of time claims on one or more occasions. Review of existing literature and research findings indicated that whilst the incidence of time extension claims is increasing, Contractors are failing to gather, analyse and present data as evidence to such an extent that there is a high rejection rate of claims made, and a consequent

significant dissatisfaction rate amongst Contractors with awards being made. This fact was further established form the case studies as well. It was disclosed in the project P03 one EOT claim had totally been rejected due to this reason.

The current difficulties experienced by Contractors in managing information on site locations, combined with the low investment in, and usage of Information Technology, forms a major contribution to the problems arising in the preparation and presentation of time extension claims. 22% respondents had bitter experience of going for ADR related to time extension claims. Differences of opinion about entitlements to extensions of time are regular causes of disputes in the construction industry. This shows that EOT claims can leads to disputes which may eventually damage the goodwill of the stakeholders.

However satisfaction rate for the awarding of time extension claims were very low. Nearly 60% of claims were being awarded with 50% or lesser satisfaction rate. From the survey findings it is concluded that there are several problems currently experienced by contractors in the area of time claims. The responsibility and burden of proving the time claim lies with the contractor. From the survey it was established that the major cause (38% of incidents) of disproving was the contractors' failure to submit the necessary supporting documentation to substantiate the. Due to the dynamic and often complex nature of a construction project, the simple 'short-cut' method of delay analysis has proved to be inappropriate for anything other than providing a relatively informed feel for what happened.

Second major reason (29% of incidents) is claim contractor's failure to demonstrate cause and effect of the delay event. A further reason given for claim rejection was the claims not being specific and being "too global".

To succeed in an application for extension of time one fundamental requirement is for the claiming Contractor to produce adequate documentation and records of a supportive nature sufficient to persuade the assessor of the claim that an award is due.

It was disclosed that some contractors were not paying due attention to the construction programme. 24% of the programmes were without the critical path.

Thus proving delays for them had become very difficult. An accepted programme should include key elements including well described activities, milestones, details and dates of any information required from the Employer or Engineer, Critical Path etc. Without these key elements of construction programme substantiating time claims will be impossible and claims are highly liable for rejection or awarding with dissatisfaction.

The major cause for failing time claims is the inadequate supporting documentation. However it was noted that almost all the contractors were maintaining the minutes of the meetings and variation orders. However "progress records", one of the most important records required for proving delays were being maintained by only 78% of the contractors. Therefore, it is obvious Sri Lankan construction industry is lacking good practice of proper record maintaining at sites. The records kept on construction projects will be the main source of information on which claims for time or additional payments will be established by the contractor or assessed by the engineer.

There is a multitude of different types of records including construction programme, correspondence, meeting minutes, delivery notes, progress records, site diaries, day work sheets, photographs and other contractual documents. The purpose of keeping records is to enable the assessment of progress, to confirm work has been carried out and to record resource use and expenditure for payment. The records that are of particular importance in the assessment of delay and disruption are daily logs, progress reports, job meeting minutes, programme updates and revisions. Such documents enable the continuing effect of problems to be communicated to all parties involved. Therefore, evidence for these records is essential to substantiate a claim effectively.

Another important fact noted in record keeping was the keeping records separated by the Contractor and the Engineer. 39% of the contractors were experiencing this situation and 94% of them had discrepancies of two types of records either in minor or major nature. This could have been averted if a single set of records were maintained with the concurrence of both parties.

Construction is an information intensive industry, and as such, the successful and timely completion of a project depends on the accuracy and timeliness of that information. In addition, some project participants may be in physically different locations, further complicating the accessibility and transmission of critical project information. In general, the construction industry has been reluctant to embrace the benefits of IT. It is found that 83% of contractors using computers in 50% or more of their site. It is good to see that all those who are working with computers are using computer in preparing construction programme. However material records and labour records were kept 61% and 70% of contractors using computers. Therefore, it is a challenge to be taken up of computerisation implementation for site use, data collection, storage, processing and retrieval. Formal scheduling procedures have become much more common with the advent of computers on construction sites and easy-to-use software programs. Sharing schedule information via the Internet will also provide a greater incentive to use formal scheduling methods.

Delay analysis has evolved from crude hand-drawn charts in the early years of CPM to sophisticated modeling of impacts and delays using computers and state-of-the-art software. However, more recently, that very software has received criticism for allowing shrewd manipulation of the programme and analysis to favour a particular party. Sri Lankan construction industry still not developed to an extent. It was also revealed that in 76% of situations time claims were prepared by the project staff. However, knowledge on basic delay analysis techniques like Impacted As-Planned, Collapsed As-Built, As-Planned versus As-Built and Time Impact Analysis of those staff was very poor. Widely known delay analysis technique was As-planned vs As-Built and was aware by only 26% of the contractors. It was noted that the selection of a particular schedule analysis methodology depends on the project facts, the nature of the events being analyzed, the nature and extent of available as-built information, and the available progress data, and may vary from project to project. Each of the above-referenced schedule analysis methodologies has inherent advantages and disadvantages.

Furthermore, most of the contractors identified “Not maintaining adequate records to adopt a complex analysis technique” is the main bottleneck for implementing a proper delay analysis technique.

CHAPTER 05: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The literature review and interviews revealed that construction claims are common, are on the increase, and the time extension requests are amongst the most frequent made. The fact is same with the Sri Lankan Construction industry as well. It was evident from the questionnaire survey that 98% of respondents have experienced time overruns.

Furthermore, satisfaction rate over the awarding of the time extensions is very poor. It was disclosed that 59% of such awarding has been made with 50% or lesser satisfaction rate. Further, it was revealed that there is a very high incidence of rejection of time extension claims due to insufficient supporting documentation and non demonstration of cause and effect of delaying events. Therefore, it is obvious that Sri Lanka construction industry is lacking good widely accepted practices in time extension claims.

It is often complained that there is a lack of good record keeping and a lack of uniformity of approach to record keeping in the construction industry. It was disclosed that not having proper records to substantiate the claim is the main reason for rejection of time claims. Thirty Eight percent of time claims had been rejected or awarded with lesser satisfaction on this ground. It was also noted that in some construction sites, records were being maintained separately by the Engineer and the contractor, and 96% such situations had discrepancies. Therefore, by having a proper record keeping process in place agreed by all the stake holders will immensely improve the construction delay analysis.

There is a high tendency in the industry to prepare the construction programme using project management software. However, very little effort is being taken to include the essential components to the programme. In most of the situations, construction programme is submitted for the sake of submitting a programme and as a contractual requirement only. It was found that 24% of the contractors had failed to include the critical path in their construction programme. This indicates the highly unsatisfactory situation in the Sri Lankan Construction industry related to the preparation of

construction programme. The importance of the construction programme in substantiating time claims is very much unfamiliar. It was broadly concluded that Contractors lack comprehensive understanding of the basis of time delay claims. They also suffer a significant degree of record management failure which results in claims being ill prepared, poorly substantiated and weakly presented.

It was also revealed that a large percentage of construction sites (83% of contractors use computers in 50% or more of their sites) enjoy the benefit of computing technology on site locations. This is a good tendency for the betterment of the construction industry to use IT to generate, maintain and store essential job specific records to substantiate time claims and to maintain and monitor of construction programme.

It was alarming to find that considerable portion of contractors were unaware of the main delay analysis techniques. 43% of the contractors were not familiar with any of the delay analysis techniques. This could be one of the main reasons for non-submission of proper time extension claims.

Ranking order of the barriers/bottlenecks of implementing an accurate delay analysis technique as identified by the Contractors was formed to be as follows.

1. Not maintaining adequate records to adopt a proper analysis technique
2. Not having expertise knowledge
3. Inability to spend time/money on advance technique.
4. Contract specifies a particular method

5.2 Recommendations

Based on the findings and conclusions presented, the following recommendations are suggested:

5.2.1 Record keeping at site

As the site records play a pivotal role in delay analysis it is recommended to have a more elaborate record keeping clause in the conditions of contract in place. There by record keeping process can be streamlined and disputes can be minimized on records.

It is also recommended to maintain records jointly with the agreement of the Contractor and Consultant in formats agreed upon at the inception of the project.

In the meantime, it is necessary to take initiatives to move towards web-based document management systems for record keeping in construction sites, which allow for real-time collaboration between all parties. As the most construction sites are already having computers, implementation cost would be minimal. This can firstly be implemented in mega projects. This also allows the web-based server document control application to act as a central filing system available to all project participants who are granted access. It is recommended that parties save, back up and archive all documents which are made available to them for future reference. Once access is denied, or restrictions are placed on a party's access to the web-based document portal, gaining access to historical records will be difficult.

5.2.2 Preparation of construction programme

It is recommend to include specific clauses in the conditions of contract to have well prepared construction programme. Currently, most of the contracts only specify that the contractor should submit a work programme without elaborating the required element and the format. For the sake of that clause some contractors submit programmes even without a critical path. Therefore, that existing clause should be strengthened by specifying to have a programme (using commercially available critical path method project planning software) showing the manner and sequence in which the Contractor plans to carry out the works with all other necessary elements. Both the Contractor and the Engineer should have a copy of the software package used to prepare the project programme. Thereby construction programme can be

made more suitable and user-friendly to use as a tool for the analysis and management of time claims.

5.2.3 Recording delay events

It is recommended to prepare 'event analysis sheet' for each potential delay event. For this purpose the format proposed by Kean and Caletka (2008) is recommended and given in Appendix - D. The event analysis sheet will assist in gathering all relevant information, documents and changes which will definitely be helpful in substantiating the time claims. On the other hand disagreement between the contractor and the engineer will be minimal as the parties are well aware and agreed upon on the delay events.

Furthermore, it is recommended to maintain a delay register to record the details of all the delay issues identified at site. Proposed format by Kean and Caletka (2008) is recommended and is shown in Appendix - E. This is to capture all those delays, no matter how small, which could have contributed to the cause of the critical delay incurred. Delay registers can include additional information from the event analysis sheet, and can be as complex or simple as required. These formats can be included in the ICTAD publication ICTAD/CM/01 "Guidelines for Effective Construction Management". With these records delay analysis can be easily done and disputes can be minimized.

5.2.4 Issuance of notice for delay events

FIDIC 1999 specify that the contractor shall submit notice to the Engineer of his intension to claim extension of time and/or cost within reasonable time after the event which gave rise to the claim. The service of a notice provides an opportunity for the Engineer and the Employer to consider alternatives in light of the cost and time. Under the FIDIC conditions of contract this early notice is a must for the entitlement of a claim. However in ICTAD condition of contracts, which is widely used in the Sri Lankan construction contracts, serving notice is not a must to have an entitlement to extension of time. Therefore, contractors take this lightly and they even pay very little attention to keep the records related to the delay events.

Therefore, it is recommended to revise the clause making issuance of notice compulsory for the entitlement of the time claim.

5.2.5 Awareness of delay analysis techniques

Many contractors were unaware of the widely used delay analysis techniques. Due to this unawareness they submit global claims without substantiating the cause and effect and these claims are highly liable for rejection. Therefore, it is a timely need to make awareness of delay analysis techniques among the Sri Lankan construction contractors. Workshops and seminars can be used for the purpose and bodies like ICTAD, the Institute of Engineers, Sri Lanka (IESL) and the National Construction Association of Sri Lanka (NCASL) can play pivotal role in this regard.

5.2.6 Introduction of a check list for a time extension claim

It is recommended having a check list while submitting a time extension claim comprising following eight essential elements.

1. The event
2. Liability for the event
3. Contractual entitlement
4. Contractual compliance
5. Cause and effect
6. Delay analysis
7. Statement of claim
8. Substantiation

Thereby proper time extension claim can be established and rejection rate of time extension claims can be minimized.

5.3 Recommendations for Further Studies

This research is mainly concentrated on problems arising under time claims management. In the process it was disclosed that considerable portion of projects are experiencing time overruns in Sri Lankan construction industry. Therefore, it is worth to research on quantifying time overruns in monetary terms.

While interviewing professionals representing the contractors, they expressed their dissatisfaction over the original contract periods of some projects. When the originally defined contract period is unrealistic time overruns are inevitable. Since further research is proposed to have a well defined guide lines to define a realistic original contract period of project depending on the complexity of the project.

Apart from those another significant area requiring academic investigation is the web base record management system for the Sri Lankan construction industry with a view to managing records effectively.

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