APPORTIONING LIABILITY IN CONSTRUCTION DELAY CLAIMS: AN EVALUATION OF CONTEMPORARY PRACTICES IN THE U.A.E. AND A PROPOSAL FOR IMPROVEMENTS

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Submitted as a partial fulfilment of the requirements of the Degree of Doctor of Philosophy

VOLUME 1 OF 2

November 2012

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ACKNOWLEDGEMENTS

For their support given to complete this research, I am indebted to many individuals. First and foremost, my sincere thanks go to my Supervisor, Dr. Monty Sutrisna, for his continuous guidance and encouragement given throughout the research. Without his kind support I would not have completed it. I am also grateful to my local Supervisor, Dr. I. Samaratunga whose guidance was always available when I needed it. Thanks are also due to many of my colleagues at work, both former and present, for the most valuable peer-discussions we had with regard to many contemporary issues that we experienced in the local environment of delay claims. A 'thank you' is also due to the participants in the interviews, surveys, and the members of the expert panel for their precious time spent amidst busy schedules and their valuable contributions made towards the data collection and validation of the research outcome. Last but not least, I am much grateful to my beloved wife and son for their encouragement, patience and support given to complete this arduous journey.

ABBREVIATIONS

AACEI	The Association for the Advancement of Cost Engineering (formerly American Association of Cost Engineers) International
AHP	Analytical Hierarchy Process
CIArb.	The Chartered Institute of Arbitrators
CPM	Critical Path Method
DM	Decision Maker
EOT	Extension of Time
ICE	The Institute of Civil Engineers
JCT	The Joint Contracts Tribunal
LD	Liquidated Damages
MDA	Method of Delay Analysis
NEC	New Engineering Contract
QLDC	Qualitative Data Collection
QNDC	Quantitative Data Collection
RICS	The Royal Institution of Chartered Surveyors
RP-FSA	Recommended Practice on Forensic Schedule Analysis
SAW	Simple Additive Weighting method
SCL	The Society of Construction Law
SPSS	Statistical Package for the Social Sciences

[Where the word 'engineer(s)' is used in the text, it is synonymous with 'consultant(s)' of the employers/developers]

DEDICATION

To my mother, my inspiration.

ABSTRACT

Various theories, concepts and methodologies exist for apportioning liabilities in construction delay claims. Yet, there is no much consensus among the practitioners towards them. Often, the implementation of these theories, concepts and methodologies in a project is based on Decision Makers' (DMs) individual judgments. Individual judgments are generally intuitive and subjective. That brings scepticism on the outcome yielded by either party's approaches or methods. This would most possibly result in further escalation of dispute. This research was inspired by the findings of initial surveys and peer discussions which indicated this situation as a major problem area in delay claims resolution, requiring improvements to the contemporary practices. Thus, the principal aim of this research is set out 'to investigate the problems involved in the contemporary practices of apportioning liability in construction delay claims and propose a Framework for Improvements'. This 'Framework of Improvements' is expected to enable consensus and uniformity among the DMs for appropriate application of essential theory, concepts and delay analysis methodology in order to minimise/ reduce the negative impacts of such problematic issues and enhance efficiency and fairness in delay claims resolution process. The research objectives were set out in order to fulfil this aim. Accordingly, the research undertook to investigate the perceptions, approaches and methods adopted by the practitioners in carrying out apportioning liabilities, and the problem issues that may stem from such practices. This inquiry was carried out implementing mixed methods approach which was consistent with the philosophical stand of the research. Thus, both semi-structured interviews (qualitative strand) and in-depth surveys (quantitative strand) were extensively used for the necessary data collection. The analysed findings and the merged results of this inquiry and the findings of a comprehensive literature review enabled developing the intended 'Framework of Improvements'. As the main outcome of the study, this Framework consists of (1) improvements to be adopted through changes to contract documentation and procedures and (2) improvements (through a Model) to the process of selection of a most appropriate method of delay analysis under objective circumstances of a construction project. These components of the Framework have been subject to necessary validation. Thus, if consciously implemented, it has the potential to bring forth substantial corporate benefits to both employers and contractors, by eliminating waste of time and money in unnecessary disputes in delay claims resolution process. The research has also contributed to the domain knowledge by providing a comprehensive data base as to the current practices and established a knowledge base of essential theory, legal position and practice in delay claims resolution; this can be used as a repository by practitioners and potential researchers. At the conclusion, while accomplishing the research objectives and the aim, the study has identified the potential limitations of the research and recommended areas for further research.

CHAPTER ONE

1.0 Introduction

1.1 Research Background

In construction, projects risk is inherent. It can be managed, minimised, shared, transferred, or accepted but cannot be ignored (Latham Report, 1994). Largely, this risk takes the form of 'delays' (Keane and Caletka, 2008). Thus 'delays' in construction and resulting claims for them also cannot be ignored, but require conscious resolution through establishing liabilities and fair apportioning of same.

The findings of a Pilot Study and peer discussions carried out indicated such conscious resolution of delay claims in the local settings (i.e. generally the UAE construction industry) was not as smooth as one would have expected. Findings of that Pilot Study and peer discussions indicated that establishing a fair apportioning of liabilities had possibly been affected by the existence of certain problematic situations. Broadly considered, such problematic situations prevail over both stages of apportioning liabilities in delay claims, namely, in the initial stage of establishing the entitlement (or other party's liability) and then in the phase of quantification of such entitlement or liability. This situation revealed a desperate requirement of improvements to problem areas in the contemporary practices of delay claims resolution. It has been the main rationale for this study.

On the other hand, the literature review (in Chapters 4, 5, 6 & 7) undertaken in this study has revealed that there is a dearth of in-depth research work in this area that can be used as a repository by the practitioners and potential researchers. A conspicuous lack is particularly observed of comprehensive studies undertaken to examine the problems affecting delay claims resolution process in the regional and local settings. It is found that certain studies in the Middle East region did examine the factors that lead to construction delay claims. However, they were not dealing in-depth with or comprehensively focused on the specific phenomena studied in this research. For example, Zaneldin (2005) studied construction claims in the UAE but it was limited to the types, causes and frequency of construction claims in the Dubai and Abu Dhabi Emirates. Further, Sweis *et al.* (2007) carried out research in Jordan, but that also mainly focused on the types of causes for delay claims. Also, a study was carried out by Enshassi *et al.* (2008) on problems associated with the claim management in Palestine but it was mainly from the contractor's perspective. There are also some other studies related to construction claims in the regional context, but a clear need exists to examine the delay-claims phenomena in-depth and more comprehensively in order to develop possible improvements to make the resolution process more efficient, consensual and less contentious, minimising the negative effects of its problems.

It is the foregoing background and the need to explore and identify such problem areas to develop possible improvements that mainly inspired and underpinned this research study. In order to fulfil this need, the principal aim of this research is set out 'to investigate the problems involved in the contemporary practices of apportioning liability in construction delay claims and propose a Framework for Improvements'. The research objectives described below are intended to fulfil this aim.

1.2 Statement of Research Problem

A '*delay*' arises out of the performance time limitations provided in a contract. In any contract it is a basic contractual duty on the parties not to delay performance. However, delays are inherent in construction projects and resulting disputes are a regular phenomenon throughout the global construction industry. Thus, they remain a major breeding source of claims and disputes. The UAE construction industry is not an exception to this.

Delay claims resolution has an essential role for conclusion of projects. Its process is centred on the apportioning liabilities between the claiming party and the defending party. This process consists of two phases of causation: (1) establishing each party's potential liability for the claimed occurrence, and (2) determining the quantum of the 'effect' flowing from that liability. The degree of success of the process depends on the extent of acceptability by the parties of the outcome of this apportioning.

Thus, for the success of delay claims resolution the parties' accord or the agreement for the approaches and methods used in both phases is of vital necessity. If such unanimity is explicitly present in the contract prior to happening of the claimed occurrence the resolution process is straightforward, and would be just a matter of implementing the pre-agreed approaches and methods.

However, in most of the projects these approaches and methods are left to be decided until delay claims start emerging. This situation makes things more complicated for the Decision

Makers (DM) of both claiming and defending parties. Various theories, concepts and methodologies exist for apportioning liabilities of a delaying event. Yet, there is a clear lack of consensus and uniformity between the DMs for appropriate application of them. Mostly, the application of them in a project is based on DMs' individual perceptions and judgments. Individual judgments are generally intuitive and subjective. That usually brings scepticism between the parties. Consequently, a fair resolution is fettered by such mutual scepticism on the outcomes yielded by either party's approaches or methods. Thus, this would pose major challenges to fair apportioning of liabilities and successful delay claims resolution, and most possibly leads towards further escalation of dispute.

In essence, therefore, the problem situation in the contemporary practices can be identified as arising from lack of consensus and uniformity between the DMs for appropriate application of essential theory, concepts and delay analysis methodology.

1.3 Research Propositions

Cooper and Schindler (1998) argue that while a research proposition is a statement about the concepts that could be judged for validity, it becomes a hypothesis when formulated for empirical testing. However, the current research, which takes mostly an inductive approach, is not meant for testing a previous theory or existing model but is mostly of descriptive and exploratory nature (for investigating the current practices) with the intention of conceptually sophisticating those practices, and therefore, it is decided to use research propositions in this study.

Accordingly, the following propositions were initially developed from peer discussions, the researcher's working environment and reflection on empirical experience in claims management. Subsequently, they were further informed by the literature review and the findings of the Pilot Study, at the early stages of the research project. These propositions are as follows:

1. The tacit or explicit awareness of essential theory, concepts, legal position and Methods of Delay Analysis (MDA) applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers);
2. In delay claims resolution, claimants and defenders (or assessors) generally utilise different MDAs which yield vastly contrasting outcomes between such methods, and thereby mutual disagreement, scepticism and distrust;

3. Generally, there is no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution;
4. Usually, there is significant amount of undue pressure and interference from employer-organisations over the engineers (consultants) when determining the entitlement to extension of time;
5. The problem situations in the contemporary practices can be reduced by developing a suitable framework for improving consensus and uniformity among the DMs for appropriate application of essential theory, concepts and delay analysis methodology.

In the forthcoming Chapters, necessary statistical tests will be used to confirm or reject these propositions and then to form necessary conclusions.

1.4 Aim and Objectives

Research Aim

This research study has been set out towards first investigating the current practices adopted in apportioning liabilities in delay claims resolution, and identifying possible problematic situations associated with such practices. On the findings of this investigation, the research needs developing a reliable mechanism that can be used to eliminate or at least to reduce the negative effects of such problematic situations.

Thus, the principal aim of this research study is,

> ***'To develop a Framework of Improvements through investigating the problems involved in the contemporary practices of apportioning liability in construction delay claims'.***

In order to achieve this principal aim the following main objectives need to be satisfied:

i. To investigate current practices in the local setting in relation to awareness, experience, and approaches as to theoretical, legal and methodological issues related to delay claims resolution process;
ii. To identify potential problematic issues in these practices which may obstruct efficiency and fairness in delay claims resolution process;
iii. Incorporating existing body of knowledge into contemporary practices and views, to develop a robust Framework of Improvements in order to minimise/ reduce the negative effects of such problematic issues.

In line with this Aim and the overall objectives, the topic of this research study is

"Apportioning Liability in Construction Delay Claims: An Evaluation of Contemporary Practices in the U.A.E. and a Proposal for Improvements"

1.5 Research Questions

Maxwell (2005, p5) points out that the research questions are the heart or the hub which connects goals, conceptual framework, methods and validity of research design. The research propositions, aim and objectives set out above have largely informed the defining of central research questions.

These propositions, aim and objectives developed the need to investigate how things happen in the domain of delay claims resolution and to explore what particular problems affect that process preventing the claims being settled in fair, equitable, and efficient manner, and also any improvements that can be proposed to avoid such problems. This need was substantial and broader, and could be fulfilled through finding answers to certain research questions only. In the formation of research questions the empirical work environment also played a pivotal role. Such role is reckoned pursuant to the suggestion that *"research question can be formulated based on theories, past research, previous experience, or the practical need to make data driven decisions in a work environment"* (Onwuegbuzie and Leech, 2006a, p.480).

Creswell and Plano Clark (2011) suggest that qualitative research questions focus and narrow the qualitative purpose statement and are stated as questions, not hypotheses. As Taylor *et al.* (2008) suggested hypotheses are specific statements and that many such statements may be needed to cover the entire range of inquiry contained within one research question and therefore, for a succinct expression of the core focus of a research project research questions are much more appropriate.

The research questions provide a definition of the research focus and *'are the springboard for the entire research effort'* (Taylor *et al.* 2008, p.8). Thus, the choices of strategy, methods and data types depend primarily on the information needs which are, in turn, driven by the research questions that the research seeks to answer. The primary place of research question in the whole research methodology process is demonstrated in the Fig.1.1

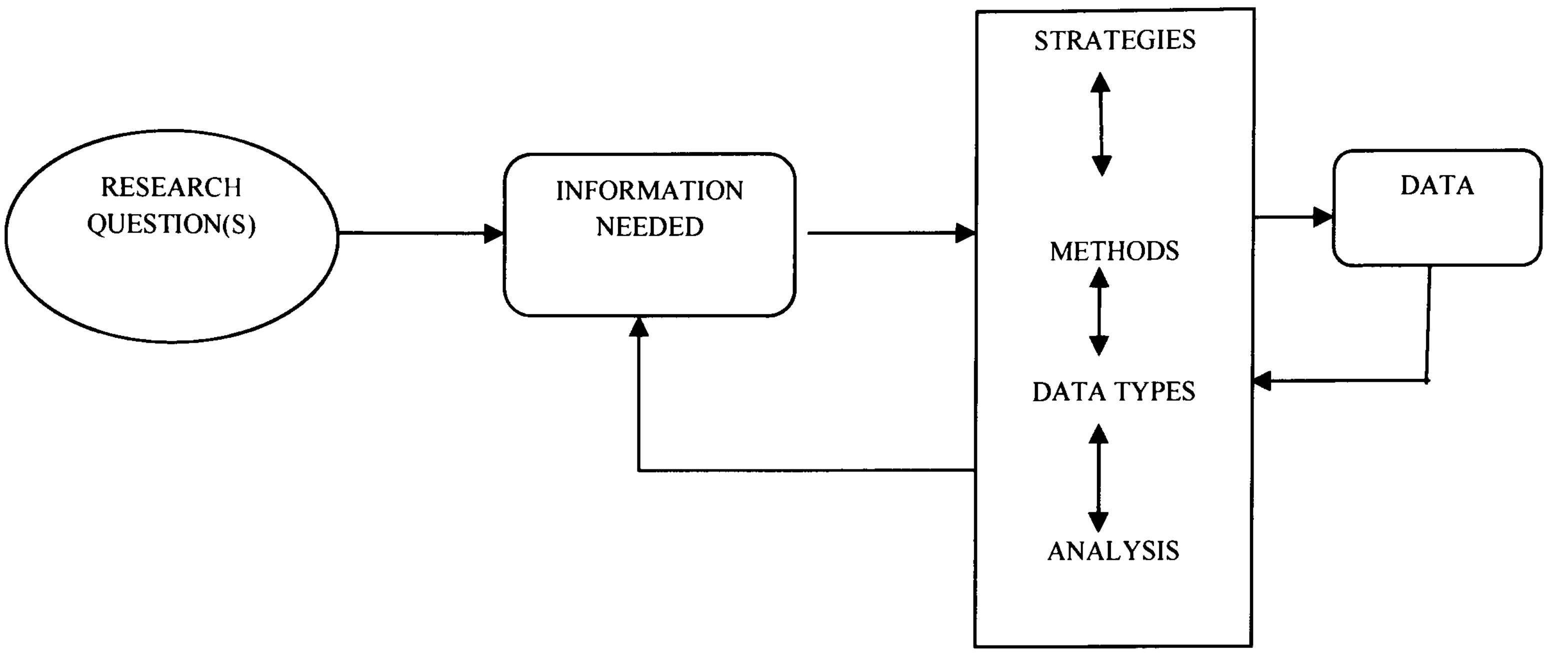


Figure 1.1 Methodology in the context of information & data.
Source: Taylor *et al.* (2008)

Greene *et al.(*1989) identified five general purposes of mixed-methods studies: (1) *Triangulation* i.e. seeking convergence and corroboration of findings from different methods that study the same phenomenon; (2) *Complementarity* i.e. seeking elaboration, illustration, enhancement, and clarification of the results from one method with results from other method; (3) *initiation* i.e. discovering paradoxes and contradictions that lead to a re-framing of the research question; (4) *development* i.e. using the results from one method to help inform the other method and (5) *expansion* i.e. seeking to expand the breadth and range of the investigation by using different methods for different inquiry components. Greene *et al.* (1989) suggest that every mixed methods study can be classified as having one or more of these five purposes. Accordingly, the current purposes can be classified as 'Triangulation' and 'Complementarity'.

Onwuegbuzie and Leech (2006a, p.480) argue *'if the purpose of the research is triangulation, then both the quantitative and qualitative set of research questions should lead most likely to an investigation of the same outcome or phenomenon'*. This suggestion is viewed as fully applicable to the set of research questions formed. Further, Onwuegbuzie and Leech (2006a) argue that researchers typically develop at least one qualitative research question and one quantitative research question in mixed methods research studies.

Relying on these arguments, the current study has used Mixed Methods requiring both qualitative and quantitative approaches in data collection, in order to address the research questions. Thus, these '*mixed methods research questions are questions that embed both a quantitative research question and a qualitative research question within the same question.*

That is, mixed methods research questions combine or mix both the quantitative and qualitative research questions' (Onwuegbuzie and Leech, 2006a, p.483).

Accordingly, the following research questions have embedded within both quantitative *(descriptive, co-relational or comparative type)* and qualitative *(exploratory type)* questions requiring to be answered concurrently in 'convergent design' approach of Mixed Methods. Thus, there are three central research questions in this study:

1. How convergent are the practitioners' perceptions and implementation of the theory and the methods of analysis applicable to the apportioning of liabilities in delay claims resolution?
2. What are the potential problematic situations arising from these perceptions and methods?
3. How can such problematic situations be dealt with through improvements to current practices?

This type of research questions will mainly have to focus on *"how things happen, rather than whether there is a particular relationship or how much it is explained by other variables"* (Maxwell, 2005, p75). Therefore, they are primarily 'process questions' and different from 'variance questions' which imply a search for a difference and for the particular variables that explain the difference (Maxwell, 2005).

These central questions have generated a series of sub-questions for which the answers are sought through an in-depth survey and semi-structured interviews.

1.6 Research Methodology

Having considered the ontological and epistemological positions, 'Critical Realism' has been acknowledged as a third way between positivism and constructivism, and the most appropriate paradigm for the current research study.

Once this philosophical position was established, the next question was how the inquirer (knower) should go about finding out whatever he believes can be known? In other words, it was the issue of selecting the appropriate *method of inquiry*.

The philosophical position of Critical Realism takes a 'subjectivist' standpoint to reckon the personal and social worlds. It does reckon a hard and objective reality existing outside to the individual cognition but does not assume that there is one objective reality experienced the same way by everyone. Instead, it considers the objective world is observed by participants differently with multiple meanings and points of view. These varying subjective meanings constructed by the participants (i.e. practitioners) are to be compared through dialectical interchange in order to distil a consensus construction that is more informed and sophisticated than any of the predecessor construction. This requires a *method of inquiry* of research that would focus on different issues in different ways to understand from the inside rather than the outside (Anti-positivism); it will treat human beings as possessing free will to act voluntarily (Voluntarism).

On the other hand, attending merely to the entities that may be measured or quantified or to individual subjective meanings only would produce a limited view of the situation. Therefore, it is required to transcend the purported irreconcilable objectivist/subjectivist, ontological/epistemological dichotomies between the realist (empirical-analytic) and relativist (naturalist, interpretive, constructivist) paradigms.

In line with this position, mixed method approach is selected as would be appropriate to consider both quantitative and qualitative approaches and methods. The emergence of mixed methods is a 'third paradigm' being distinct from the positive perspective of quantitative research on the one hand, and the constructivist perspective of qualitative research on the other (Tashakkori and Teddlie, 1998). A main advantage of employing mixed method is cited as permitting triangulation. Also one important benefit of this method is in the reduction of inappropriate certainty (Robson, 2002). Using a single method and finding a pretty clear-cut result may delude investigators into believing that they have found the 'right' answer. Using other, additional methods may point to differing answers which remove specious certainty. The fact that current research is in an applied field like 'construction delay claims resolution' also requires treating the reality as multiple, complex, constructed and stratified. This situation requires a higher 'rigor' in the research findings, and mixed method can facilitate that. In other words 'mixed method' approach would be a well suited companion for the research's theoretical perspective based on Critical Realism.

Data Collection and Analysis

In line with the mixed methods approach as the method of inquiry, the main forms of data collection are considered as semi-structured interviews and in-depth surveys, and, also, where necessary, case studies.

Analysis of the collected data is a process of inspecting, cleaning, transforming, and modelling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. With this goal in mind, the following approaches have been adopted in the process of data analysis.

Interview Data Analysis

With regard to the interview transcripts the following measures were adopted:

- All interview transcripts were coded according to themes and subthemes based on the tree codes;
- If a need for a new codes emerged the coding frame was changed and the transcripts were reviewed according to the new structure; Emerging themes were then conceptualised into broad themes;
- Extensive and varied raw text data were condensed to a summary format;
- Similarities and differences across varied raw text data were explored;
- The summary findings derived from the analysed data were linked to research propositions, aim and objectives and checked for corroboration with the findings of literature reviewed;
- The trustworthiness of findings have been assessed mainly by a range of techniques such as checking transcripts against audio records (using NVivo 8) and through triangulation of findings with survey findings.

The outcome of this analysis is the triangulated findings which form a core of the proposed framework of improvements.

In-Depth Survey Data Analysis

The data collected through the questionnaire were subjected to analysis through necessary statistical testing. The summary findings derived from the analysed data were linked to the research aim and objectives and, checked for corroboration with the findings of the literature reviewed.

All the variables in the questionnaire have been measured with either nominal or ordinal scale of measurement. For certain questions, nominal scale has been used to categorise the cases, and for others ordinal scale has been used to categorised and arranged them in a hierarchical order (for example, from the 'lowest' to 'highest'). Interval or ratio scales were not used to measure any of the variables. Thus, non-parametric methods were considered as appropriate for studying these categorical data, while noting that the parametric statistics are meant for analyzing interval/ratio scaled variables only (Israel, 2008).

Merged- Results

Having adopted Mixed Methods approach and Methodologic Triangulation, the individual results of the qualitative and quantitative strands were to be compared and appropriately combined. For this, the Convergent Parallel Design approach suggested by Creswell and Plano Clark (2011) was adopted in the current study. In the triangulation process, the summarised findings and results of both qualitative and quantitative strands were compared, interpreted and merged by a discussion (a discussion relating qualitatively derived themes to quantitative variables in corroboration with the literature reviewed), specifying how the qualitative findings either confirm or disconfirm the quantitative results and to see in what ways and to what extent they confirm the research propositions and answer the research questions for fulfilling the research objectives.

1.7 Research Scope

The main focus of this research is on apportionment of liabilities in delay claims. Yet, the purpose of inquiry takes the mode of 'problem' as well (Lincoln and Guba, 1985). Accordingly, the purpose of the inquiry of 'problem' (or the state-of-affair) is firstly to find out *"in the sense of accumulating sufficient knowledge to lead to understanding or explanation"* (Lincoln and Guba, 1985, p.226-227)) how fairly and equitably the apportionment of liabilities in delay claims is conceptually perceived and practiced in action, in this case, in the setting of the UAE/Dubai construction industry, and to identify possible factors hindering the aspired fairness and equity in outcome of delay claims resolution. Based upon these findings, it then intends to offer refinements or improvements to such problematic practices, as necessary. For this purpose the research aims at developing a 'Framework of Improvements' to contract documentation, claims administration, and also to delay analysis methodology in order to facilitate less contentious, more transparent and fairer outcomes in the apportionment of liabilities.

The research scope is limited to local settings of the UAE/Dubai construction industry. (Dubai has the most developed construction industry of all seven emirates which constitute the state of UAE.). The terrains of inquiry and research boundaries are kept within apportionment of liability in the claims for 'time' or extension of time. Thus, the procedures involving prolongation 'cost' claims are purposely excluded from the scope of the research. This is because only after the resolution of apportionment of liability in 'time' that the issue of 'compensability' would be relevant for such prolonged time. On the other hand, the research scope also excluded the issues related to 'disruption'. This is because, although the claims for 'disruption' may involve delays to *progress* of works, they are independent from prolongation claims, and not necessarily connected to delays to *completion* of works; therefore, they are considered to be outside this research inquiry.

There is a strict confidentiality policy adopted in the majority of construction projects in the UAE. This is the norm in almost all the government owned projects. This restricts disclosing any particular details (names, values etc.) of the projects or their stakeholders in the process of data collection. In line with this situation, an undertaking was given to the interviewees and the survey participants to protect confidentiality and anonymity for their 'right to privacy', and that undertaking has been strictly adhered to in the reporting of findings and results of the research.

1.8 Contribution to Knowledge

The major contributions of originality from this research study to the existing domain knowledge can be outlined as follows:

- Developing and presenting a 'Framework' of best practice improvements to contract documentation and contemporary practices in order to minimise/ reduce the negative effects of identified problematic issues that exist in the local practices of delay claims resolution;
- Developing and presenting a user-friendly, robust decision-making Model to enable practitioners (Decision Makers) to objectively and reliably select the optimum Method of Delay Analysis (MDA) appropriate to a given set of project-specific circumstances; as there is no universally acceptable MDA in industry, this would enable practitioners to defend the selected MDA on a stronger basis of objectivity if challenged against the outcome of the delay analysis.
- Building a comprehensive data base through semi-structured interviews and an in-depth survey as to current practices of delay claims resolution adopted in the local settings, which can be used by potential researchers;

- Establishing a wide knowledge base of essential theory and practice in delay claims resolution, including latest case law in the UK and US jurisdictions, which can be used as a repository by the practitioners and potential researchers;
- A comprehensive summary of primary methods of delay analysis, their mechanisms, strengths and weaknesses which can be used by practitioners as a basis of reference and check-list;

1.9 Structure of the Thesis

The main text of this thesis is subdivided into twelve chapters. Chapter 1 is a general 'Introduction' of the research. It has explained the research background, stated the research problem which is the focus of the study, and set out research propositions, main aim and principal objectives that would achieve the aim, and the central research questions to which the answers to be found through the study. It has summarised the research methodology to be adopted and its application at various stages. It has identified the scope and general boundaries of the research and then summarised the research's contribution to the existing knowledge. Further, it has graphically illustrated the thesis structure and outlined it.

Chapter 2 consists of a detailed discussion on the overall research methodology applied. It discusses the philosophical position of the research, establishment of the applicable inquiry strategy, knowledge acquisition techniques, sampling method, designing of the semi-structured interviews and survey questionnaire.

Chapter 3 explains the methods of data collection through the interviews and the in-depth survey, and the analysis procedure of the collected data. This has been followed by an overview of the statistical measures adopted in the data analysis and a discussion on the data reliability and validation.

Chapters 4, 5, 6 & 7 consist of a comprehensive review of the domain literature. The knowledge acquired through this review has provided necessary conceptualisation and the main basis for designing knowledge acquisition instruments (i.e. interviews and survey questionnaire) and the final outcome of the research, namely, the suggested Framework of Improvements.

Chapter 4 discusses the applicable theory, concepts and legal position as to apportioning liabilities in construction delays. This discussion mainly covers issues related to concurrent delays and 'float' ownership.

Chapter 5 extensively discusses the theories related to 'criticality' in forensic scheduling and their impact on delay analysis outcome. This discussion also covers related issues like 'pacing delays' and entitlement after contract completion date.

Chapter 6 presents a comprehensive review of literature related to the methodology of delay analysis (MDA) that is used for quantifying the apportioned liabilities. This discussion covers primary MDAs, their mechanism, strengths and weaknesses in the application under various project circumstances. Further, it discusses the 'factors' identified in various literature sources for selection of a most appropriate MDA under project-specific circumstances. It has emphasised the fact that the industry generally accepts that there is no single analysis methodology universally available and applicable to all situations of claims resolution.

Chapter 7 reviews mainly the literature regarding essential procedural issues like application of conditions precedent, prevention principle and the importance of updating the CPM programme. The discussion entails many case authorities in several jurisdictions. Also, the chapter has discussed issues related to claims submission, their assessment and awarding (or settlement) process.

Chapter 8 presents the outcome of the merged results of the qualitative and the quantitative strands which have been discussed in detail in the Appendix A- 'Interview Results' and Appendix B- 'Survey Results', respectively. The merging of the results of the two strands has been done using a triangulation approach and in the form of a discussion. The conclusions of the merged results have established the degree of convergence or divergence between the findings of the two strands, and with the findings of the literature review.

Chapter 9 presents a 'Framework' of best practice improvements to certain problematic issues identified through the data collected from the interviews and the in-depth survey. The 'Framework' consists of two main components:

1. The improvements to be adopted through changes to contract documentation and procedures; and

2. The improvements to the process of selection of a MDA (i.e. the optimum and most appropriate MDA under specific circumstances of a construction project).

The main aim of this first component of the 'Framework' is to add a contractual 'certainty' to some of the common problem issues which may otherwise contribute to further escalation of disputes in delay claims. The suggested improvements are based on the best practice approaches identified through the knowledge acquired from literature review and the findings of the research inquiry.

Chapter 10 presents a Model for selecting optimum MDA; it is the second component of the 'Framework' mentioned above. It discusses in detail of the scale of the existing problem and the need for a solution, selection of decision making method and technique, the application of the technique, the elements of the developed Model. With the aid of a real-life case-study, a step-by-step presentation of the application of the Model is also included.

Chapter 11 presents evaluation of the 'Framework' of improvements submitted in Chapters 9 & 10. This evaluation has been carried out through a process of reliability and validation. The Chapter submits a detailed account of the process and the test results of reliability and validation.

Chapter 12 submits the conclusions and recommendations arising from the research study. The research findings and outcome is summarised and compared with the research objectives to assess how they are accomplished through various stages of the research in order to fulfil the main research aim. The discussion also entails a review of the research propositions to see how they have been confirmed or rejected by the research findings. The Chapter also discusses limitations of research contribution and recommendations for future research based on the potentials revealed through the study.

1.10 Summary

The findings of a Pilot Study and initial peer discussions indicated that establishing a fair apportioning of liabilities had possibly been affected by the existence of certain problematic situations. Such problematic situations are found in both stages of apportioning liabilities in delay claims, namely, in the initial stage of establishing the entitlement (or other party's liability) and then in the phase of quantification of such entitlement or liability. Thus, there has been a clear need to explore the current practices in delay claims resolution, to identify specific problematic situations arising from such practices, and to provide possible improvements. This research has been inspired by that need. It is believed that the outcome of the research has fulfilled this need, at least to a substantial extent.

This Chapter has presented a general introduction to the overall thesis. In this introduction it has described the background for the need for this study and set out the necessary research propositions, central research questions, main aim of the research and the objectives which are to be satisfied in order to answer the research questions and achieve the main aim.

It has also outlined the research methodology for this study, which has been discussed in detail in Chapters 2 and 3. It also discusses the scope and limitations within which this research study has been undertaken, and then outlined the main contribution to knowledge made by the study.

The Figure 1.2 below has graphically presented the entire structure of the thesis as it evolves in the forthcoming Chapters.

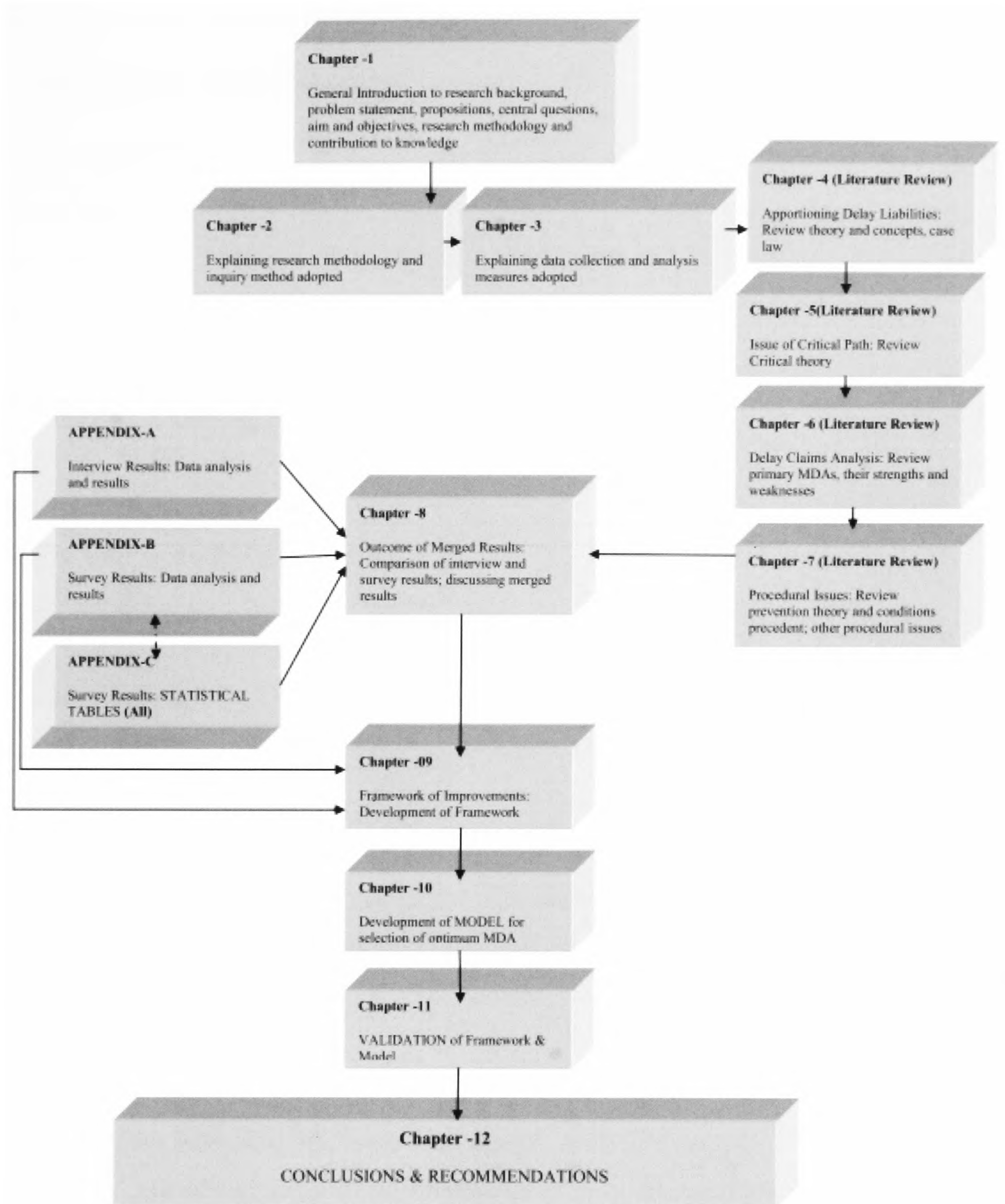


Figure1.2 Structure of the thesis.

CHAPTER TWO

2.0 Research Methodology

2.1 Introduction

Research methodology affords the procedural framework for carrying out the research and a way to systematically solve the research problem (Remenyi *et al*, 1998; Bryman and Bell, 2003). Thus, this Chapter presents the research methodology adopted in this study.

A methodology is defined as developing, either implicitly or explicitly, within a particular paradigm and embodying the philosophical assumptions and principles of the paradigm (Mingers and Brocklesby, 1997). Accordingly, the Chapter begins with discussing the ontological and epistemological stance followed by methodological elements as influenced by the philosophical position in this study.

This is followed by a discussion as to developing the specific inquiry strategy. Qualitative, Quantitative and Mixed Methods strategies of inquiry are discussed emphasizing the need of corroboration of the data rendering less biased and more accurate conclusions (Reams and Twale, 2008). The selection of appropriate inquiry strategy is underpinned by the fact that the current research is in an applied field like 'construction delay claims resolution' and hence was found in line with the view of the reality as multiple, complex, constructed and stratified. To satisfy the needs of this research, a combination of survey and interview has been selected as the most appropriate approach.

Next, the sampling procedures for both in-depth survey and interviews are explained through the selection of appropriate sampling method and validating the adequacy of sampling frame. This is followed by explaining the template design for the interviews and the questionnaire design for the in-depth survey.

The data collection procedures for both interviews (qualitative strand) and in-depth survey (quantitative strand) will be discussed in detail, in the forthcoming Chapter 3.

2.2 Paradigms and Methodology

Denzin and Lincoln (1994) define a paradigm as a basic set of beliefs that guides action. Paradigms deal with first principles, or ultimates. Guba and Lincoln (1994) argue that these beliefs are basic in the sense that they must be accepted simply on faith (however well argued), and there is no way to establish their ultimate truth-fullness.

Each paradigm can generally be perceived encompassing three elements, namely ontology, epistemology and methodology; ontology raises questions about the nature of reality while epistemology asks 'how do we know the world'; methodology concerns on how we gain knowledge within the context of the 'selected' nature of reality (Denzin and Lincoln, 1994).

Guba and Lincoln (1994) conceptualized four basic paradigms as belief systems based on the philosophical assumptions of ontology and epistemology to see the world and how it should be studied and understood. These basic paradigms are identified as Positivism, Post-positivism, Critical Theory *et al.* and Constructivism.

Mingers and Brocklesby (1997) distinguish three main paradigms each of which has been referred to by a variety of names: Empirical–Analytic (Positivist, Objectivist, Functionalist, Hard), Interpretive (Subjectivist, Constructivist, Soft), and Critical (critical systems); they defined a methodology as developing, either implicitly or explicitly, within a particular paradigm and embodying the philosophical assumptions and principles of the paradigm; on the other hand, a technique is defined as a specific activity that has a clear and well defined purpose within the context of a methodology (for example a statistical analysis). In the following discussion, the foregoing views have been considered as essential guidance for discussing the philosophical position of this research study.

2.2.1 Ontological Position

With regard to ontological position, Critical Realism finds a 'middle position' in the continuum, between Realism (objectivist) and Relativism (subjectivist); ontologically, it takes the position that the objective world is independent of human beings, existed before humans and would exist with or without them, but at the same time acknowledges that knowing of the objective world cannot be without human perception, experience and abilities. Crotty (1998) argued that it became a world of meaning only when meaning-making beings made sense of it; in this line of thought, the existence of a material world without mind is conceivable but the meaning of it without a mind is not. Thus, this world can be characterized as objective in the sense that it is independent of the observer (humans), but our observations and descriptions of it are not. According to Bhaskar (1978), Critical Realism has a stratified rather than flat ontology: the empirical and the actual or the real. Mingers and Brocklesby (1997) suggest that from the material world, through the process of evolution, linguistically–endowed humans have developed, capable of communication and self reflection; and this has led to the social and personal worlds. Ontologically, this personal world is subjective in that it is generated by, and only accessible to, the individual subjects; it's a world of our own individual thoughts, emotions, experiences and beliefs; the social world is the one that we share as members of particular social systems. Easton (2009) argues that the difference between critical realists and social constructionists lies in the acceptance of the possibility of knowing reality in the former case, and its rejection in the latter, who, in general, concentrate on uncovering the constructions that social actors make.

Positivism, Post-positivism and Critical Theory *et al.* ontologically take the objectivist (Realism) position, more or less on one end of the continuum, when compared with Critical Realism.

Positivism is commonly called "naive Realism" by its critics. It identifies with an apprehendable reality which is assumed to exist, driven by immutable natural laws and mechanisms. Knowledge of the "way things are" is conventionally summarised in the form of time-and-context-free generalizations, some of which take the form of cause-effect laws. The basic posture of the paradigm is argued to be both reductionist and deterministic.

In Post-positivism reality is assumed to exist, but to be only imperfectly apprehendable because of basically flawed human intellectual mechanisms and fundamentally intractable nature of phenomena (Guba and Lincoln, 1994). It preserves the basic assumptions of Positivism: ontological Realism, objective truth, use of experimental methodology.

Critical Theory *et al.* are treated as "Historical Realism" and reality is assumed to be apprehendable but over time shaped by a congeries of social, political, cultural, economic, ethnic and gender factors and crystallized into a series of structures that are now (as its critics considered, 'inappropriately') taken as "real", that is natural and immutable (Guba and Lincoln, 1994).

Compared with Critical Realism, on the other end of the continuum is Constructivism. It is based on "Relativism", that is when realities are apprehendable in the form of multiple, intangible mental constructions, socially and experiential constructions are not more or less "true", in any absolute sense, but simply more or less informed and/ or sophisticated. Constructions are alterable, as are their associated "realities" (Guba and Lincoln, 1994). Thus, Constructivism differentiates from other three paradigms as it is guided by 'Relativism' while the others are by various forms of 'Realism'.

2.2.2 Epistemological Position

In epistemological analysis, Critical Realism finds epistemological relationship to the material world as one of observation rather than participation as in social activity or experience as of a personal feeling. As Mingers and Brocklesby (1997) argue, however, in our personal world we do not observe it but experience it. We can aim to express our subjectivity to others and, in turn, appreciate theirs. Then our epistemological relationship to the social world is one of inter-subjectivity; on one hand it is a human construction, but then it goes beyond and pre-exists any particular individual. Thus, a reality derived by one person's observations and perceptions influenced by his or her socialization, upbringing, education, training and so on can be different from others (Fellows and Liu, 1997). Similarly, what one sees depends upon both what he looks at and what his visual/ conceptual experience is (Kuhn, 1996).

Compared with Critical Realism, Positivism, which is an objectivist approach maintaining a dichotomy between the 'object' (the observer) and the 'subject' (the observed), assumes the investigator and the investigated 'object' are to be detached, independent entities, and the investigator to be capable of studying the object without influencing it or being influenced by it (Guba and Lincoln, 1994). Inquiry takes place as through a one-way mirror. Replicable findings are, in fact, "true". In Post-positivism, though such dichotomy between 'object' and 'subject' is largely abandoned, objectivity remains a "regulatory ideal"; replicated findings are probably true but always subject to falsification. Constructivism and Critical Theory *et al.* have transactional and subjectivist approach and assume that the investigator and investigated 'object' are to be interactively linked, with the values of the investigator (and of situated 'others') inevitably influencing the inquiry. Findings are, therefore, value mediated. In this posture the traditional distinction between ontology and epistemology is challenged. What can be known is inextricably intertwined with the interaction between a particular investigator and a particular object or group (Guba and Lincoln, 1994). Accordingly, Constructivism and Critical Theory *et al.* are different from other two paradigms in their approach to the subjectivist - objectivist dichotomy.

2.2.3 Methodological Position

In methodological analysis, Critical Realism appears to be in line with multi-methods approaches. Maxwell and Mittapalli (2010, p.146) argue *"...Realism can constitute a productive stance for Mixed Methods research and can facilitate a more effective collaboration between qualitative and quantitative researchers".* Mingers and Brocklesby (1997, p.489) contend *"in dealing with the richness of the real world, it is desirable to go beyond using a single (or, on occasions, more than one) methodology to generally combining several methodologies, in whole or in part..."* They say adopting a particular approach is like viewing the world through a particular instrument such as a telescope, x-ray machine or an electron microscope. Although they may be pointing at the same place or thing, each instrument produces a totally different and seemingly incompatible representation. Thus, by using only a single approach one would get only a limited view of the situation (or the problem).

When compared with Critical Realism, Positivism, Post-positivism, Critical Theory *et al.* and Constructivism attend merely to the entities that may be measured or quantified or to individual subjective meanings only, and maintain irreconcilable objectivist/subjectivist, ontological/epistemological dichotomies between the Realist (Empirical-Analytic) and Relativist (Naturalist, Interpretive, Constructivist) paradigms.

Positivism takes an experimental and manipulative approach with carefully controlled (manipulated) conditions to prevent outcomes from being improperly influenced. This approach thus focuses on verification of hypotheses and uses chiefly quantitative methods. Although this is the general approach, there may also be circumstances where positivists use social statistics including secondary data for analysis. Post-positivism emphasizes on and has mainly invested in 'Critical Multiplism' (a refurbished version of triangulation) focusing on falsification (rather than verifying) of hypotheses. In Critical Theory *et al.* the transactional nature of inquiry requires a dialogue between the investigator and the subject of inquiry. That dialogue must be dialectical in nature to transform ignorance and misapprehensions (accepting historically mediated structures as immutable) into more informed consciousness (Guba and Lincoln, 1994). This approach aims at the reconstruction of previously held constructions. As for Constructivism the variable and personal (intra-mental) nature of social constructions suggest that individual constructions can be elicited and refined only through interaction between and among investigator and respondents. These varying constructions are interpreted using conventional hermeneutical techniques and are compared and contrasted through a dialectical interchange. The final aim of this approach is to distil a consensus construction that is more informed and sophisticated than any of the predecessor construction (Guba and Lincoln, 1994). Except for that, this also aims at the reconstruction of previously held constructions, similar to Critical Theory paradigm.

2.3 Research Issues in Perspective

All of the above paradigms, as sets of basic beliefs, are not open to proof in any conventional sense and there is no way to elevate one over another on the basis of ultimate, foundational criteria. Guba and Lincoln (1994) argue that any given paradigm represents simply the most informed and sophisticated view that its proponents have been able to devise, given the way they have chosen to respond to the three defining questions appear below:

- **(i)** Ontological question: what's the form and nature of reality and, therefore, what is there that can be known about it?
- **(ii)** Epistemological question: what is the nature of the relationship between the inquirer (knower) and what can be known?
- **(iii)** Methodological question: the question here is how can the inquirer (knower) go about finding out whatever he believes can be known?

In terms of these three defining questions, it is required to examine the issues in the research area, <u>from the Critical Realism perspective</u> as the current philosophical position.

2.3.1 Ontological Assumptions

The question here is what's the form and nature of reality and, therefore, what is there that can be known about it?

Central to successful resolution of delay based claims is the fair and equitable apportioning of parties' liabilities. Therefore, parties primarily desire that the 'apportioning of liabilities' is carried out fairly and equitably. However, whether these aspirations of parties are met or not will largely depend on ***how*** the apportioning of liabilities is carried out by the practitioners on both sides.

One may perceive that the apportioning of liability is dominated by subjective meanings or notions ascribed by the practitioners to delaying events and similar phenomena. These meanings and notions are constructed realities rather than objective realities. However, accepting the critical realist view that the existence of a material world without mind is conceivable, the current position is to recognize the tangible entities such as projects, activities, (delaying) events, damages and losses, project duration, terms and conditions of contract which generate the respective rights and obligations of parties and the claims (when such rights are violated and obligations are breached), and so on witnessed in the projects are objective reality that exists independent of the practitioners subjective meanings and notions.

It is perceived in the development of research study, the more such constructed notions (subjective) are in harmony with and grasped not too far from these tangible (objective) realities, the higher the chances of successful resolution of delay claims. This supports the position that the practitioners' perceptions, experiences, attitudes, judgments and so on embedded in delay claims resolution are not objective phenomena but are meaningful constructed realities only; however, without those tangible entities (objective realities) of projects, activities, (delaying) events, damages and losses, project duration, terms and conditions of contract, claims and so on, these 'meanings' would not have been 'meaningfully' made, sensed or derived from on their own.

Therefore, ontologically, the research takes the position that those tangible entities (objective world) are independent of individuals, but making sense of them cannot be without human perception, experience and abilities. Accordingly, while accepting the objective existence of projects, activities, (delaying) events, damages and losses, project duration, terms and conditions of contract, claims and so on, the practices of apportionment of liability in delay claims and the problematic situations deriving from such practices can be perceived only through the individual practitioners' subjective experience, tacit or explicit awareness, and interpretation of what they have implemented in practice. As Crotty (1998) suggests their meaning is not discovered, but constructed. As this obtained perception is built around individual cognition, its 'existence' or 'being' is primarily idealist and relative.

Critical Realism ably accommodates the co-existence of the intransitive domain of objective entities like projects, activities, (delaying) events, and so on, with their being of objects of transitive domain of practitioners' perception, experience, multiple view points, judgments and meanings derived from them. Mingers and Brocklesby (1997) point out that Critical Realism depicts the co-existence of 'intransitive objects of knowledge' (entities that exist independent of our experience of them) and 'transitive objects' (our experiences, theories and descriptions that are used in the production of knowledge); thus, Critical Realism acknowledges the conjoint existence of the objective and subjective dimensions.

Also the research inquiry intends to capture information from multiple approaches and methods of practitioners who may construct meaning in different ways even for the same occurrence (pluralism); each of these approaches and methods, though they can be divergent and mutually conflicting, may still be meaningful as they can be fair and equitable under different circumstances, providing they are implemented aptly and pertinently. For example, a judgment to use a particular method of delay analysis (MDA) may be inconsistent with the terms of one particular contract, but it may be consistent with those of another contract.

In the current research, these multiple constructed realities can be studied holistically only. Inquiry into such multiple meanings and viewpoints will inevitably be divergent, comprehensive, variable, and dynamic so that prediction and control are unlikely outcomes although some level of understanding can be achieved. Ontologically, Critical Realism accommodates existence of such multiple subjective meanings within its 'personal world' and 'social world'.

2.3.2 Epistemological Assumptions

The question here is what's the nature of the relationship between the inquirer (knower) and what can be known?

Patton (2002) argues that in practice human interventions are often quite comprehensive, variable, and dynamic, and this creates considerable difficulty for controlled experimental designs that need specifiable, unchanging treatments to relate specifiable predetermined outcomes.

Qualitative data can provide rich insight into human behaviour (Denzin and Lincoln, 1994). In the current research settings, epistemologically, the subjective meanings ascribed by human experience are prominent as they are informed by the practitioners (respondents/interviewees) and their activities. That can be understood only through acceptance of subjective relationship with the human actors. In the current research the thing that can be known is firstly the manner that the contemporary practices in local industry deal with the 'apportionment of liabilities' in delay claims. This is to be known primarily in order to identify any problematic situation(s) that stems from such practices which is the next thing that can be known. Thereafter, in order to know the necessary 'improvements' required for any existing 'problems' in practices, the 'views' of the practitioners who experience the problematic situation(s) are to be captured by the researcher (knower). This knowledge can be captured only through the interaction between the researcher and the responding practitioners. For that, the 'knower' and the 'object to be known' have to be interactively linked.

Thus, the inquiry process cannot be routed through a one-way mirror. Critical Realism accepts the epistemological relationship to deal with the human factor is not of objectivity. Groff (2004) identified that 'check on Relativism' was one of the several key epistemic principles of Critical Realism. Archer, Bhaskar *et al.* (1998) suggest that Critical Realism claims to be able to combine and reconcile ontological Realism, epistemological Relativism and judgmental reality. Similarly, Robson (2002) points out that it seeks to achieve a détente between the different paradigms of a post-positivist approach within the empirical tradition on one hand, and less thoroughgoing versions found in some constructionist approach on the other.

Thus, Critical Realism provides an apt approach for research in applied fields like construction delay claims resolution, where the reality is multiple, complex, constructed and stratified.

2.3.3 Methodological Assumptions

The question here is how can the inquirer (knower) go about finding out whatever he believes can be known?

Guba and Lincoln (1994) argue that the answer that can be given to this question is constrained by the answers already given to the first two questions. Accordingly, the methodological question cannot be reduced to a question of methods; methods must be fitted to a predetermined methodology (Denzin and Lincoln, 1994). Burrell and Morgan (1979) suggest that, if the researcher takes an 'objectivist' standpoint to reckon the social world as a hard and objective reality existing outside to the individual cognition (Realism) then his method of inquiry of research would be seeking to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements (Positivism); he will treat human beings as product of their environment (determinism) and his research methodology would be aiming to search for universal laws which explain and govern the reality that is being observed (nomothetic methodology). Nevertheless, many scholars may not agree to such limitation as to the issue of methodology. Crotty (1998) argues that the distinction between qualitative research and quantitative research occurs at the level of methods and not at the level of epistemology or theoretical perspective.

However, as discussed above, the philosophical position of Critical Realism applicable to the current research takes a 'subjectivist' standpoint to reckon the personal and social worlds. It does reckon a hard and objective reality existing outside to the individual cognition but does not assume that there is one objective reality experienced the same way by everyone. Instead, it considers the objective world is observed by participants differently with multiple meanings and points of view.

These varying subjective meanings constructed by the participants (i.e. practitioners) are to be compared through dialectical interchange in order to distil a consensus construction. This requires a method of inquiry of research that would focus on different issues in different ways to understand from the inside rather than the outside (anti-positivism); it will treat human beings as possessing free will to act voluntarily (voluntarism).

On the other hand, attending merely to the entities that may be measured and quantified or only to individual subjective meanings would produce a limited view of the situation. Therefore, it is required to transcend the purported irreconcilable objectivist/subjectivist, ontological/ epistemological dichotomies between the realist (empirical-analytic) and relativist (naturalist, interpretive, constructivist) paradigms.

2.4 Inquiry Strategy and Method Selection

Having established the philosophical position for methodology, it required developing the specific strategy of inquiry. Creswell (2009, p11) identified *"strategies of inquiry are types of qualitative, quantitative and Mixed Methods designs or models that provide specific direction for procedures in a research design"*. They were also called 'approaches to inquiry' (Creswell, 2009) or 'research methodologies' (Mertens, 1998). Each of these research designs involves the intersection of philosophy, strategies of inquiry and specific methods. Creswell (2009) presented an overview of these strategies and the research methods as shown in Tables 2.1 and 2.2 below:

Table: 2. 1 Alternative Inquiry Strategies

QUANTITATIVE	QUALITATIVE	MIXED METHODS
Experimental designs	Narrative research	Sequential
Non-experimental designs, such as Surveys	Phenomenology	Concurrent
	Ethnographies	Transformative
	Grounded theory studies	
	Case study	

Table: 2. 2 Outline of Quantitative, Mixed and Qualitative Approaches

QUANTITATIVE →	MIXED	← QUALITATIVE
Pre-determined	Both pre-determined and emerging methods	Emerging methods
Instrument based questions	Both open- and closed-ended questions	Open-ended questions
Performance data, attitude data, observational data	Multiple forms of data drawing on all possibilities	Interview data, observation data, document data, and audio-visual data
Statistical analysis	Statistical and text analysis	Text and image analysis
Statistical interpretation	Across databases interpretation	Themes, patterns, interpretations.

These three approaches are not as discrete as they first appear (Creswell, 2009). It is suggested that qualitative and quantitative approaches should not be viewed as polar opposites or dichotomies; instead they represent different ends on a continuum (Newman & Benz, 1998). It is argued "*a study tends to be more qualitative than quantitative or vice versa. Mixed Methods research resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches*" (Creswell, 2009, p3).

The qualitative form of inquiry supports a way of looking at research that honours an inductive style, a focus on individual meaning, and the importance of rendering the complexity of a situation. Qualitative data provide detailed understanding of a problem as that understanding arises out of studying few individuals and exploring their perspectives in depth.

The quantitative researchers have assumptions about testing theories deductively, building in protection against bias, controlling for alternative explanations, and being able to generalize and replicate the findings. Quantitative data provide a more general understanding of a problem, and that understanding arises from examining a large number of people and assessing response to a few variables.

Thus, qualitative and quantitative research approaches provide different pictures or perspectives and each has its limitations. If the study is limited to a few individuals qualitatively, then the ability to generalize the results to many is lost. If the study is to quantitatively examine many, then the understanding of any individual is diminished. Accordingly, one type of evidence may not present the full picture or would not be adequate to address the problem. Also, if there are contradictory results of each method, that would not be known by relying only on one method and one type of data alone.

2.4.1 Mixed Methods Approach

On the other hand, Mixed Methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches and the mixing of both approaches concurrently or sequentially so that the overall strength of a study is greater than either qualitative or quantitative research (Creswell and Plano Clark, 2007). Further, it is suggested that research problems suited for Mixed Methods are those in which:

- One data source may be insufficient;
- Results need to be explained;
- Exploratory findings need to be generalised;
- A second method needed to enhance a primary method; and
- A theoretical stance needs to be employed and an overall research objective can be best addressed with multiple phases or projects (Creswell and Plano Clark, 2011).

As mixed or multi methods were selected, it would be appropriate to consider both quantitative and qualitative approaches and methods. Tashakkori and Teddlie (1998) saw the emergence of Mixed Methods as a third approach being distinct from the positivist perspective of quantitative research on the one hand, and the constructivist perspective of qualitative research on the other. Thus, the role of Mixed Methods approach in the current research inquiry appears to have some resemblance with the role of Critical Realism which has found itself 'in between' Positivism and Constructivism.

A main advantage of employing mixed methods approach is its ability of permitting triangulation. Triangulation seeks convergence, corroboration, and correspondence of results from the different methods. Robson (2002) suggests that multiple methods can also be used in complementary fashion to enhance interpretability. For example, in a primarily quantitative study, the interpretation of statistical analyses may be enhanced by a qualitative narrative account. Likewise, where narrative account is the primary study, quantitative statistical analyses would provide the basis of required measuring and quantification for the data analysis and research findings. Creswell and Plano Clark (2011, p 45) *"believe that multiple paradigms can be used in Mixed Methods study and that they best relate to type of Mixed Methods designs"*. Thus, it may also be acknowledged that the validity of using mixed or multi methods is not limited to any conventionally specific ontological and epistemological perspective.

2.4.2 Mixed Methods - Theoretical Perspective

Generally, the proponents of Critical Realism are for Mixed Methods or multi-methodology as the answer for the question of methodology. Gorard and Smith (2006, p 61) argued *"qualitative or quantitative represents only one, perhaps not very useful, way of classifying methods"*. However, unlike single method representations, "*the* *essence of multi-methodology is to utilize more than one methodology, or part thereof, possibly from different paradigms, within a single intervention"* (Mingers and Brocklesby, 1997, p 491). On the Mixed Methods, Robson (2002) claims that one important benefit of multiple methods is in the reduction of inappropriate certainty. Reams and Twale (2008) argue that mixed methods are necessary to uncover information and perspective, increase corroboration of the data, and render less biased and more accurate conclusions. According to these suggestions, using a single method and finding a pretty clear-cut result may delude investigations into believing that they have found the 'right' answer. Using other additional methods may point to differing answers which remove specious certainty. The fact that current research is in an applied field like 'construction delay claims resolution' also requires treating the reality as multiple, complex, constructed and stratified. This situation requires a higher 'rigor' in the research findings. Being the apt selection for such reality, Critical Realism approach would also 'lead' to use Mixed Methods studies where both quantitative and qualitative approaches can be adopted for method of inquiry.

In other words Mixed Methods approach seems to be a well suited companion for the research's theoretical perspective based on Critical Realism. In this event, the aim is to use the methods in a more integrated way and therefore, the different methods are combined in sequential or concurrent manner. Mixed Methods approach also finds common grounds with Critical Realism, as the use (sequential or concurrent) of qualitative strand (constructivist) and quantitative strand (post-positivist) reflects the use of multiple worldviews in the design. As suggested by Cohen *et al.* (2011, p22) *"mixed methods research recognizes, and works with, the fact that the world is not an either/or world, but a mixed world".*

According to the foregoing, the Mixed Methods approach was selected as the most suitable for the current research. Thus, the methods that were to be combined in the current inquiry were mainly semi-structured interviews (with content analysis of transcripts), a Pilot Study and an in-depth survey-questionnaire. To an extent, for validation purposes, case-study approach was also utilised. Thus, this approach was expected to provide not only a basis for triangulation but also a source to look at the same things from different points of view of conceptualizing the problem situation(s) while offering a more comprehensive analysis with multiple viewpoints.

2.4.3 Application of Mixed Methods Design

Creswell and Plano Clark (2011) identify six prototypical versions of major Mixed Methods research designs as summarised below:

(a) *Convergent parallel design* which is based on concurrent quantitative and qualitative data collection, separate quantitative and qualitative analyses, and the merging of two data sets;

(b) *Explanatory sequential design* which implements methods sequentially, starting with quantitative data collection and analysis in phase 1 followed by qualitative data collection and analysis in phase 2 which builds on phase 1;

(c) *Exploratory sequential design* which implements methods sequentially, starting with qualitative data collection and analysis in phase 1 followed by quantitative data collection and analysis in phase 2 which builds on phase 1;

(d) *Embedded design* which follows both the concurrent or sequential collection of supporting data with separate data analysis and the use of the supporting data before, during, or after the major data collection procedures;

(e) *Transformative design*, which frames concurrent or sequential collection and analysis of quantitative and qualitative data sets within a transformative, theoretical framework that guides the methods decisions; and

(f) *Multiphase design* which combines the concurrent or sequential collection of quantitative and qualitative data sets over multiple phases of a programme of study.

Creswell and Plano Clark (2011, p77) suggest that the Convergent Parallel Design approach *"is probably the most common approach used across disciplines"*. Morse (1991, p.122) pointed out that the purpose of the Convergent Design was *"to obtain different but complementary data on the same topic"*. Having considered these suggestions and the current need for triangulating the qualitative and quantitative methods used in the Mixed Methods, directly comparing and contrasting their results for corroboration and validation purposes, the 'convergent design' approach was selected as the most appropriate amongst the options to obtain most rational results. Accordingly, qualitative and quantitative data were collected in a somewhat parallel manner exploring the contemporary practices adopted and their problematic situations in delay claims processes, generally using common themes and topics. The rationale for collecting both qualitative and quantitative data is to merge the two forms of data to bring a more complete understanding and a greater insight into the phenomena being studied than would be obtained by either form separately and alone.

The current study was started with a Pilot Study (ref. Appendix-A) which revealed the existing need for exploring the contemporary practices and identifying their potential problem-situations; the initial template design for the semi-structured interviews was informed by these (quantitative) revelations of the Pilot Study and the findings of literature review; then the initial template for interview structure was used to build the in-depth survey-questionnaire; due to the time available for the inquiry and other prevailing constraints in the local industry (for example, exodus of expert-resources to other markets in the region due to the economic crisis in Dubai), without waiting for all the interviews were completed, transcribed, data analysed and findings were made, the in-depth survey-questionnaire had to be developed based on the initial template for interviews and sent out to the potential respondents. This was complying with the convergent design approach adopted, and as Tashakkori and Teddlie (1998) point out when concurrent mixed analyses are employed, the analytical strands do not occur in any chronological order. While the in-depth survey-questionnaire had the role of the interfacing instrument to implement the quantitative strand covering a larger sample gathered, the general structure and the themes/sub-themes of both interviews and the survey-questionnaire were more or less similar.

In the process, qualitative results and the quantitative results were summarised by merging in a discussion form (a discussion relating qualitatively derived themes to quantitative variables). Finally, the merged results were compared and interpreted to see in what ways and to what extent the quantitative findings would be able to expand on the qualitative findings and how the merged results answered the research questions.

Creswell and Plano Clark (2011, p 90) note that ' *In the instrument-development variant, the initial qualitative phase plays a secondary role, often for the purpose of gathering information to build a quantitative instrument that is needed for the prioritized quantitative phase*'. As the major component of outcome of this study is a

Model with a mathematical approach which is akin to *a quantitative instrument* this approach is adopted in the current research as well.

Figure 2.1 below illustrates the prototype version of Convergent Parallel Design.

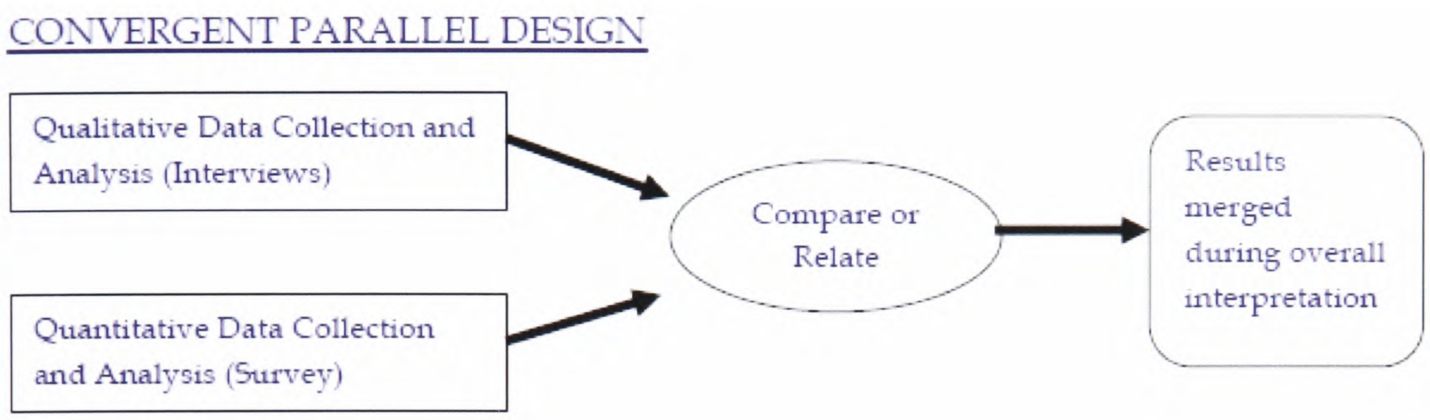


Figure 2. 1 Convergent Parallel Design
(Source: Creswell and Plano Clark, 2011, p. 69)

2.5 Sampling

2.5.1 Selection of a Sampling Method

A sample implies a subset of the entire population of interest (Taylor, *et al,* 2008). Hubbard (2010) suggests that sampling is observing just some of the things in a population to learn something about all of the things in a population. Thus, a sampling frame was devised from the essential elements of a population involved in construction delay claims in order to investigate, observe and know about the contemporary practices and problems in delay claims resolution process. As no such standard sampling frame was available in the local industry, it was envisaged that those practitioners (who are actually involved in delay claims resolution) to be found from the sectors of contractors, consultants/project administrators, developers, independent claims consultants and construction lawyers would closely correspond to the sampling frame of the targeted population of the practitioners. In this approach, bias in selection of sampling frame was avoided as these sectors normally covered the targeted population in construction industry of any given country/region.

Generally, a probability-base sampling is a method of selection where all of the items in the population have a calculable probability of being selected. With probability sampling the chance or probability of each case being selected from the population is known and is usually equal for all cases (Saunders *et al,* 2009). If this approaches to be taken, first a population of interest has to be decided. In the context of current research, this would have been all the practitioners involved in delay claims resolution in the UAE construction industry, a listing of all the units of the population of all such practitioners.

However, it was obvious that a specific sampling frame of practitioners with regular involvement in delay claims could not be expected under the local circumstances. There was no such known industry listing, membership register or a directory of such practitioners to be found, and therefore, it was irrational to have any expectation to having a random sampling of delay claims practitioners.

In this situation, probability sampling methods such as Random Sampling, Systematic Sampling, Stratified Sampling, and Multi-stage Sampling had to be excluded from consideration and only non-probability based approach for sampling had to be relied on as a practical alternative.

The broader needs associated with the aim and objectives of this research were not to generalize but rather providing a rich, contextualized understanding of the contemporary practices in the local settings and ensuing problems in delay claims resolution. Thus, the selection of sampling technique was considered to be in harmony with the research interests which lay in getting broad spectrum of the practitioners' perceptions, experience and judgments, and not merely identifying the proportionate average. It also complied with the main intention which was not sampling the 'people' but their 'ideas' to discover and understand the widest variation. After all, the principal need here is to collect data to describe and explain the key themes that can be observed and not just obtaining a statistically representative sample which allows generalizing in a statistical sense to a population as in the case of probability sampling.

This need of the data collection was considered opposed to an objective to generalise the findings (quantitative and/or qualitative) to the population (which the sample was drawn from) and making necessary inferences. Onwuegbuzie and Collins (2007, p287) argued "*If the goal is not to generalize to a population but to obtain insight into a phenomenon, individuals, or events (as will often be the case in the qualitative* *component of a mixed methods study), then the researcher purposefully selects individuals, groups, and settings for this phase that maximize understanding of the underlying phenomenon. Thus, many mixed methods studies utilize some form of purposeful sampling".*

Accordingly, a Purposive Sampling (where the selection is based on a specific purpose) strategy like Homogeneous Sampling which chooses *"settings, groups, and/or individuals based on similar or specific characteristics"* (Onwuegbuzie and Collins, 2007, p287) seemed to be a more appropriate approach for the current study enabling to collect data to describe and explain the key themes that can be observed. Accordingly, the final sample size may not be determined, although a minimum size may be identified. More critical was sampling across a wide homogeneous area of the population of claims practitioners engaged in contracting, developing and consulting entities in order to maximise the chance of identifying the diversity.

As already mentioned, there was no standing list or directory of practitioners involved particularly in delay claims in the local industry. In such situations invoking Snowball Sampling was considered to be appropriate as it allowed to reach the population concerned (i.e. practitioners) who could be inaccessible or hard to find. The RICS and CIArb. Membership data bases related to the UAE members as well as personal contacts of certain respondents were used to spread a widest net to include diversity. It is appreciated that Snowball Sampling may not adequately lead to representative sampling, but it is considered to be one of the best available under the circumstances when used with Heterogeneity Sampling discussed above.

2.5.2 Adequacy of Sampling

With regard to the adequacy of sampling population, sampling theorem was considered for guidance. It was important for the research inquiry, how large 'n' needed to be before the sampling distribution could be regarded as a normal distribution. Taylor *et al.* (2008) suggest that in general, it is safe to apply the theorem for samples of size $n > 30$, but for many populations encountered in practice, the approximation is good for $n>15$.

As a generally accepted rule of thumb for any type of population distribution, Bernstein and Bernstein (1999, p108) argued *"if $n \geq 30$, then the sample size is* *sufficiently large to apply the central limit theorem with reasonable accuracy"*. This is because even if the distribution of the individual observations is not normal, distribution of the sample means will be normally distributed if the sample size is ≥30. The central limit theorem shows that even when a population is non-normally distributed, the distribution of the "sample means" will be normally distributed when the sample size is 30 or more.

Further, Saunders *et al.* (2009) argue that statisticians have also shown that a sample size of 30 or more will usually result in a sampling distribution for the mean that is very close to a normal distribution. They also refer to Stutely's (2003) advice of a minimum number of 30 for a statistical analysis provides a useful rule of thumb for the smallest number in each category within the overall sample.

Referring to sample size in non-experimental relational designs, Robson (2002) suggested the 'rule of thumb', which was proposed by Menters (1998), of fifteen participants per variable.

Alternatively, in order to establish the sample size the following two equations were also considered:

$$SS = \frac{Z^2 \times P \times (1 - P)}{C^2} \quad \text{..............................(1)}$$

Where:

SS= Sample size

Z= Z value (e.g. value= 1.96 for 95% confidence level)

P= percentage picking a choice, expressed as a decimal (0.50) used for sample size needed).

C= margin of error (considered 10%).

$$SS = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.10^2} = 96 \text{ respondents.}$$

The correction for an assumed finite population was calculated using equation (2) below:

$$SSnew = \frac{SS}{1 \cdot \frac{SS-1}{POP}} \quad \text{..............................(2)}$$

(A relatively higher rate of margin of error (10%) was applied in view of the uncertainty of the potential respondents' actual involvement in delay claims, as there was no registry or other records available for the number of practitioners engaged in the field. It was also assumed 500 was a reasonable assumption for the theoretical population of this field which is highly specific, yet a relatively new entrant, among the other more general disciplines in the local industry).

Where POP (theoretical population of delay claims practitioners [assumed]) = 500

$$\text{SSnew} = 96 \Big/ 1+\frac{96-1}{500} = \mathbf{80.67} \approx \mathbf{80} \text{ respondents.}$$

In the selected sampling approach for in-depth survey-questionnaire the achieved number of eligible respondents is 74 (which has an estimated margin of error 11.4% at 95% Confidence Level) and that seems to be reasonably near to this number.

Referring to sampling for interviews, Polkinghorne (1989) recommends that researchers interview from 5 to 25 individuals who have all experienced the phenomenon. Creswell (1998) recommended ≤ 10 interviewees for phenomenological studies, as cited by Onwuegbuzie and Collins (2007).

Therefore, in so far as the level of response received for the interviews (10 nos.) and in-depth survey-questionnaire (74 nos.) is concerned, it is considered to be within the acceptable numbers.

2.6 The Interviews

Taylor *et al.* (2008) suggest that in survey strategy the most commonly used combination is the questionnaire-interview duo. Following this suggestion, initially, interviews were carried out with selected experts/practitioners. Instead of being fully-structured or fully-unstructured, these interviews were formulated in semi-structured frame taking account of the exploratory purposes of the research questions and objectives. Creswell (2007, p133) said "*The questions are a narrowing of the central questions and sub questions in the research study*". In designing the interviews, emphasis was also given to the use of these semi-structured interviews as part of the Mixed Methods research and as a means to validate findings from the in-depth survey-questionnaire (Bryman, 2006).

These interviewees, a total of 10, were purposively selected mainly using 'snowballing' technique and in line with the Purposive Sampling strategy as described earlier. All of these interviewees were experts in delay claims resolution, representing both sides of the barrier i.e. contractors and employers organisations, and therefore, 10 individuals were a sufficient number. Almost all of them were claims and delay analysts, except for one case of a practicing construction lawyer.

2.6.1 Template Design

The development of the interview design was based on the 'themes' informed by the literature review, key research questions, research propositions, and mainly in line with the research objectives set out. Accordingly, the main purposes that influenced the interview design were:

- To gain factual and grounded understanding of how the apportioning of liabilities of parties is carried out from practitioners' perceptions, approaches and experience, in the resolution of delay claims, and
- To investigate any problem situations encountered by practitioners in the process of such apportioning of liabilities and resolution of delay claims, how and why such problems occur, and what measures can be suggested to overcome their negative effects.

In order to thematically analyse the 'qualitative' data collected through the interviews, full transcripts were used. Template analysis involved the development of a coding 'template'. This summarised the identified themes, and organised them in a meaningful manner. In this case a hierarchical coding, which had broad themes with successively narrower, more specific ones, was used. Analysis was conducted as studying through the data (transcripts) and coding the segments having relevance to the research questions and interview purposes. Once a final version was defined, and all transcripts were coded to it, the further developed template served as the basis for the interpretation or illumination of the data set.

An initial template was built up considering the first two interview transcripts using NVivo software (version 8). This initial template contained 6 'Themes', 37 'Codes' and 46 'Sub-Codes' which eventually refined and developed at the data analysis stage into 6 'Themes', 29 'Codes' and 41 'Sub-Codes'. The coding in NVivo was stored in the 'nodes'. In the fully developed NVivo coding system, these "*nodes become points at which concepts potentially branch out into a network of sub-concepts or dimensions.*"(Bazeley, 2007, p.83).

Figure 2.2 below shows the strategy used in data collection/analysis through these semi-structured interviews.

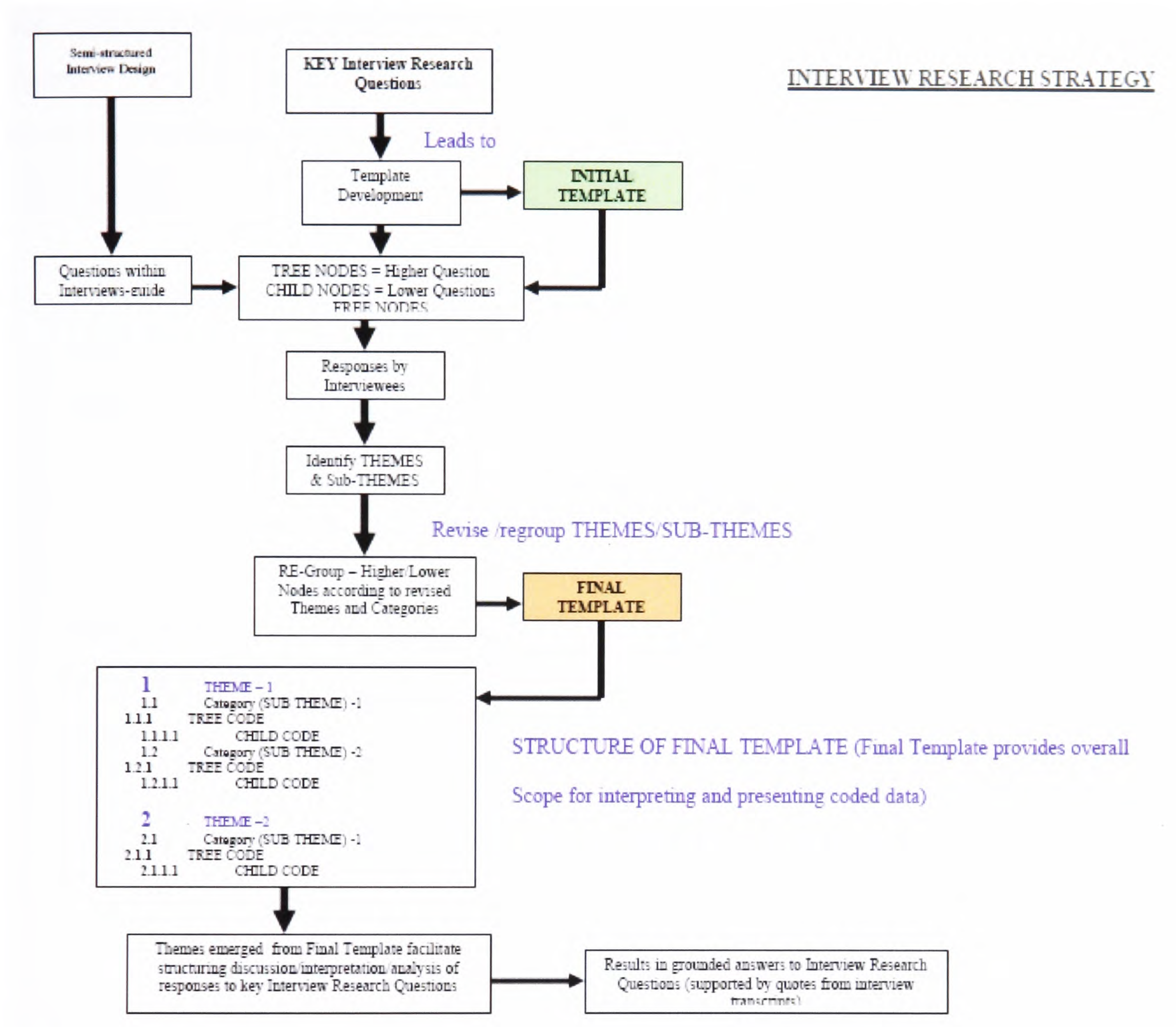


Figure 2. 2 Interview Research Strategy

2.7 The Survey

Surveys can be categorised as analytic or descriptive (Taylor *et al,* 2008; Gill and Johnson, 1997). Analytic surveys are concerned to explore associations between variables, whereas descriptive surveys are concerned with fact finding. In the current research both types of surveys were engaged. For the purpose of using survey strategy, a survey design provides *"a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population*" (Creswell, 2009, p145), and it also enables variations (among individuals and organisations) to be investigated while offering the prospect of allowing the researcher to make generalization (Taylor *et al,* 2008). It is submitted that a questionnaire is probably the single most common research methodological tool that is relatively well understood by most researchers (Adejimi, *et al*, 2010).

In any case, being for an investigative and observational study the survey-questionnaire was designed to observe individuals and measure variables of interest. With regard to the approach to sampling adopted in the data collection, it was in line with the Purposive Sampling strategy as described earlier.

2.7.1 Survey-questionnaire Design

The in-depth survey-questionnaire was basically developed and informed by the initial template design prepared for the interviews. As 'Convergent Design' approach was selected for data collection and analysis as mentioned earlier, the questions were created almost similar to and parallel with the semi-structured questions posed to the Interviewees. This was required mainly for the best merging of separately analysed information of the two databases in the Mixed Methods approach. However, it is noted that certain variants had to be allowed since quantitative priority existed in certain themed areas.

The survey-questionnaire was devised for three main purposes.

- For descriptive purposes, the questions were formed with the intention of fact finding mostly involving demographic data (e.g. respondents and organisational characteristics).
- Certain questions were devised with explanatory purpose to probe relationships between variables and to identify correlations (for example, probing a relationship/ association between rankings attributed by the Contracting and Consulting Groups).
- The third category of questions was with concept-forming purpose. These questions were designed to capture how the practitioners perceive certain phenomena underlying the contemporary practices in delay claims resolution (for example, perceived significance of the 'factors' used in the Model for selecting optimum delay analysis method).

It was recognised that question format, as an important aspect of survey-questionnaire design, had implications in the subsequent data analysis. Thus, a high attention was given to the need of how the data would be analysed at the designing of the survey-questionnaire. The following formats were mainly used in the survey-questionnaire design:

1. Prescribed nominal scale categories – for capturing data that are non-quantitative;
2. Prescribed ordinal scale categories – for capturing data that are semi-quantitative, placing different categories of variables in order;
3. Placing variables in ranking order – for ranking criteria and attributes in order of importance or frequency;

(For 'Template' used for this survey-questionnaire, please see Appendix-E)

2.8 Summary

This Chapter has outlined the research methodology adopted in this study. At the beginning it has discussed the selection and validating the applicable ontological, epistemological and methodological elements of the appropriate philosophical position for this study, followed by a discussion as to developing the specific inquiry strategy.

Accordingly, the philosophical position for the research study is based on Critical Realism; as for the inquiry strategy, Qualitative, Quantitative and Mixed Methods strategies of inquiry have been discussed emphasizing the need of corroboration of the data rendering less biased and more accurate conclusions. The selection of appropriate inquiry strategy is underpinned by that the current research is in an applied field and hence requires treating the reality as multiple, complex, constructed and stratified. To satisfy these needs, Mixed Methods approach is selected with survey-interview duo as the most appropriate combination of inquiry techniques. The sampling procedure for both in-depth survey and interviews is explained through the selection of appropriate sampling method and validating the adequacy of the sampling frame. This is followed by explaining the template design for the interviews and the questionnaire design for the in-depth survey.

The next Chapter will discuss the data collection procedures for both interviews (qualitative strand) and in-depth survey (quantitative strand) adopted in the study.

CHAPTER THREE

3.0 Methods of Data Collection and Analysis

3.1 Introduction

The previous Chapter 2 presented a discussion on the research methodology adopted in the study which detailed the research philosophy, inquiry strategy, sampling procedure and the design of interview and survey instruments. This Chapter 3 has discussed on the data collection procedures for both interviews (qualitative strand) and in-depth survey (quantitative strand). The measures adopted for data representation are discussed and explained in detail, along with the statistical measures and techniques used for analyzing the data collected. Finally, it presents the approaches adopted for reliability and validation of the findings and results of the research inquiry.

3.2 Data Collection Procedure

Creswell and Plano Clark (2011) recommended five common procedures for both Qualitative Data Collection (QLDC) and Quantitative Data Collection (QNDC) in Mixed Methods: (1) Sampling procedure (2) Obtaining permissions (3) Collecting information (4) Recording the data, and (5) Administering the procedures. These procedures were adopted in the study as follows:

(1) *Sampling procedure*: As for the QLDC and QNDC the participants who can provide the necessary information were *purposefully* selected with possible maximal variation of perception, experience and expertise in order to provide a complex picture of the phenomena explored in the study. (The adopted sampling approach has been described before).

(2) *Obtaining permissions*: the necessary permission for using the data collected was sought and obtained from each participant while giving a firm written undertaking to protect the confidentiality of the information in its use in the academic study in line with the research ethics and the Data Protection Act.

(3) *Collecting information*: Both semi-structured and open-ended (optional) questions were used in the interviews and the in-depth survey-questionnaire. The form of QLDC was basically in text data (transcripts produced from the tape-recorded interviews) , while the QNDC was through the respondents'

answers to the in-depth survey-questionnaire which were generally secured using a scale ('Likert Scale') in order to convert into numerical values.

(4) *Recording the data* in QLDC was done through audio-tape recording and transcribing later on. The data in QNDC were secured through using an on-line instrument (i.e. 'SurveyMonkey-Pro' software) and recorded/organised in computer based files.

(5) Administering the procedures basically involved agreeing on the timing and venue for each Interviewee and collecting necessary e-mail addresses and contact numbers of the participants of in-depth survey-questionnaire. Also in both QLDC and QNDC preparation of written confidentiality undertakings to each individual participant was an essential procedure as the ethical issues were given very high priority in data collection procedure.

3.3 Data Capture (Interviews)

Although these interviews were semi-structured in nature, generally, the interviewees were allowed to address the questions and express opinions using their own words and concepts. Mostly, the interviewees were allowed in an inductive style to express on themes that were important to them even they were peripheral and secondary to the research. The main purpose of these somewhat long interviews (average 90-100 minutes) was to capture these expert practitioners' perceptions and experience with a broader perspective having a focus on individual meaning, and the importance of rendering the complexity of a situation. On the other hand, the data captured through these interviews permitted the expected triangulation as the main advantage of employing Mixed Methods as the research inquiry strategy. Consequently, in a complementary fashion these data would enhance interpretability of statistical analysis of the data collected through the survey-questionnaire.

3.4 Data Capture (Survey)

Taylor *et al.* (2008) suggest four main methods for data capturing in surveys, namely,

- use of postal services;
- use of the Internet;
- in person; and
- Use of the telephone.

For the survey-questionnaire, the 'postal services' approach was not considered mainly due to the poor response rate which is around 10% as suggested in the literature (Taylor *et al,* 2008). 'In person' (or person-to-person) approach was also ruled out as impractical in view of the time constraints and travelling involved, as a relatively large number of respondents was targeted at the beginning. 'Use of the telephone' for conducting this type of survey (comprising 30 simple to complex questions) was also not considered appropriate mainly since the respondents could have been deprived of visual access to the survey-questionnaire and also constrained in answering complex questions which would require more time to think leisurely before responding. On the other hand, Internet based approach was expected to provide much better response, particularly contacting on a personal basis through personal e-mail addresses of potential respondents and the readily available facility for such on-line surveys through dedicated survey-software (for the current survey, 'SurveyMonkey-Pro' software was used). Also in this mode the respondents were given more time to think in order to give balanced and well considered response to many complex questions asked in the document. Therefore, the Internet based approach was selected to distribute the survey-questionnaire to the respondents and necessary data collection.

Initially, a Pilot Survey was carried out in order to investigate the need for carrying out this research study; then the survey-questionnaire was developed basically in line with the initial template-design for interviews and used in the main survey process. A modest Preliminary Survey was also carried out at the early stages prior to sending out the in-depth survey-questionnaire, for feedback on aspects such as layout of questions, clarity and appropriateness of wording, adequacy of the questions in conveying the desired meaning, and time needed to complete. In addition, the questionnaire itself was included with relevant questions to establish Face Validity and Content Validity of the instrument. A further survey to establish the ability and validity of the proposed Model was also carried out at a later stage.

Following the Pilot Survey and the interviews, the in-depth survey-questionnaire described before was conducted. Initially, 520 potential respondents across the industry in Dubai/UAE were earmarked through 'Snowballing' technique for this web-linked survey-questionnaire. However, over 200 e-mails returned, undelivered, reducing the potential responses to around 300. Of these, there were only 74 respondents who were genuinely eligible (in terms of actual involvement in delay claims resolution) to take part in the survey. This was also with varying levels of missing cases against some 'questions' in the survey-questionnaire, although for any one 'question' the number of responses remained >30. Thus, considering the 74 eligible responses, the response rate is just around 25%. This seems to be a somewhat anticipated response rate considering the vast number of employees who were laid off in the local construction industry since the 'economic crisis' started in 2008- 4th Quarter.

3.5 Data Analysis

The data analysis in the study was carried out separately, first analyzing the qualitative data using qualitative methods and then the quantitative data using quantitative methods. The information secured from both methods was then analysed using Mixed Methods analysis techniques at the third phase.

Figure 3.1 below illustrates the general procedure adopted in the current study.

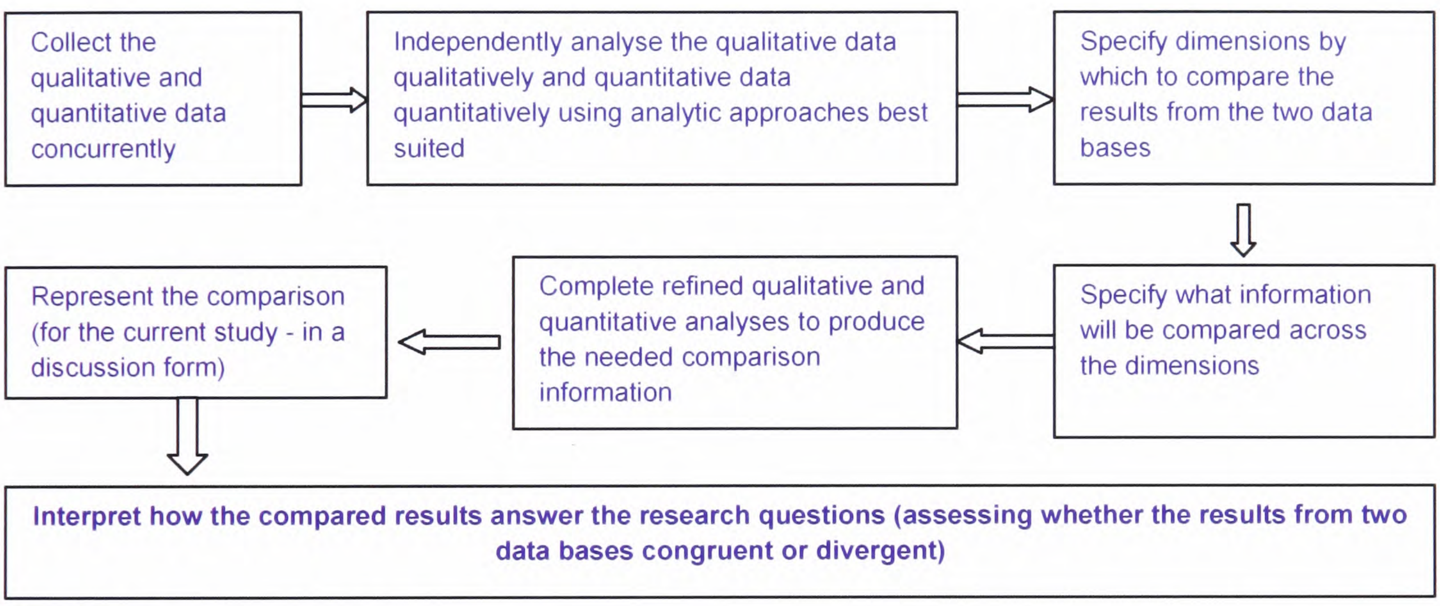


Figure 3. 1 Data Analysis Process

(Source: Creswell and Plano Clark, 2011)

Creswell and Plano Clark (2011) recommend six general steps for both qualitative and quantitative data analysis procedures: (a) Preparing the data analysis (b) Exploring the data (c) Analyzing the data (d) Representing the data analysis, (e) Interpreting the results and (f) Validating the data.

These general steps were followed in the study as follows:

(a) Preparing the data analysis

As to the qualitative data preparation it was mainly the transcribing the audio–tape recorded interviews using NVivo 8 software, and checking the transcripts against the audio-tracks for accuracy. Quantitative data preparation started with exporting the raw data gathered from the participants to each of the questions in the in-depth survey-questionnaire onto Excel spreadsheets using 'SurveyMonkey-Pro' software. These raw data were then cleaned for possible errors and converted into necessary numeric values.

(b) Exploring the data

For exploring qualitative data, it was mainly a task of reading through the long transcripts to develop a general understanding of the database, preparing Memos and developing 'Free Nodes' and from there hierarchical 'Tree Nodes' towards principal and secondary Themes; All these were carried out using the facilities in NVivo8 Software.With regard to the quantitative data, it required visually inspecting the data and conducting a descriptive analysis to determine the general trends in the data using the SPSS software.

(c) Analyzing the data

This step consisted of examining the database to address the research questions and relevant hypotheses. Generally, in the convergent design of Mixed Methods the data analysis occurs at three distinct points: with each database independently, when the comparison or transformation of the data occurs, and after the comparison or transformation is completed. (Creswell and Plano Clark, 2011).

Creswell (2007, p.148) defined qualitative analysis as "*preparing and organizing the data (i.e. text data as in transcripts, or image data as in photographs) for analysis, then reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, Tables, or a discussion. Across many books on qualitative research, this is the general process that researchers use*". Defining 'coding', Onwuegbuzie and Combs (2010, p.409) pointed out "*Coding is a strategy that is used to find themes and patterns in qualitative data*".

Following these definitions, as to the qualitative data analysis in this study the core feature was the coding process. The built –up 'Tree Nodes' and 'Free Nodes' were used in this for grouping the transcript texts (phrases, sentences and paragraphs), assigning a label to each unit, towards principal and secondary 'Themes'. These 'Themes' or 'Perspectives' would be *'the findings, or results, that provide answers to the qualitative research questions'* (Creswell and Plano Clark, 2011, p.208).

For quantitative data analysis, the data were analysed using the appropriate statistical tests; the selection of the tests depended on the research questions being addressed and the types of the data scale (mostly nominal or ordinal in the present case), comparison or relationships between the groups etc. The quantitative data analysis proceeded from descriptive analysis to inferential analysis. Descriptive analyses are used to organize and summarize data for the purpose of enhancing understanding, and the inferential analyses are the techniques used to make predictions or judgments about a population based on the characteristics of a sample obtained from the population (Onwuegbuzie and Combs, 2010). Where the descriptive analyses are pertinent, either single-quantity-based statistics (e.g. measures for central tendency) or exploratory-based statistics (e.g. exploratory factor analysis, correspondence analysis and so on) are used yielding descriptive statistics. Where the inferential analyses are pertinent either parametric analysis or non-parametric analysis is used. It is noted that in the current research non-parametric analysis was pertinent due to the type of scaling of data (which were nominal and ordinal, and not interval/ ratio type). Therefore, basically non-parametric tests (e.g. for measuring association, population tests, etc.) were used. Inferential statistics strand would generate indices of statistical significance (‘***p***’ values, i.e. probability of observed finding under the null-hypothesis) for hypotheses testing. In all these statistical tests SPSS version 18 software was used throughout.

After the analysis of both qualitative and quantitative data, the convergent or divergent results or findings were summarised, compared (side-by-side), discussed and interpreted and finally merged to see how the quantitative results build or expand on the qualitative findings, and how merged results answer the research questions and objectives.

(d) Representing the data analysis

Reporting the qualitative results was mainly done through discussion of the evidence for the themes or codes and figures or Tables where necessary. For the statistical results of quantitative data analysis in the study, they were represented in summary form in statements, Tables and figures at descriptive or inferential questions level. Where hypotheses were tested whether the results of the test were statistically significant, effect size and confidence intervals were reported as necessary. Where the results were to be presented in visual form, graphs or charts were used.

As the analyzing was conducted in order to merge the results by comparing the two data sets, side-by-side comparison or a discussion form for merged data was used. Consequently, quantitative results and qualitative findings were presented together and compared in the form of a discussion or in a summary Table. The presentation then became the merged results. Creswell and Plano Clark (2011) identify that one popular approach is to present quantitative results followed by qualitative findings in the form of quotes in a results or discussion section; a comment then follows specifying how the qualitative quotes either confirm or disconfirm the quantitative results. In the current presentation this format was adopted.

(e) Interpreting the results

After establishing the findings or results, they were interpreted for the meaning of such results. Generally, this was done by interpreting the extent to which the two databases converge, whether inconsistencies, contradictions, differences or similarities found, and what conclusions could be drawn from those differences or similarities.

Creswell and Plano Clark (2011) suggest that interpretation of results in Mixed Methods involves looking across the quantitative results and qualitative findings and making an assessment of how the information addresses the research question. Thus, the role here was to interpret how the combined or merged results of the two strands answered the research questions and contributed to the research objectives.

3.6 Statistical Measures

The selection of the appropriate statistical measures was done taking account of certain assumptions. It is noted that the assumptions of symmetrical data, measurement of data on interval/ratio scale, large sample size and random selection of sample from population concerned would require using 'parametric' testing measure. On the other hand, if the data do not meet such assumptions about population or when data measured are at a qualitative level then using 'non-parametric' measures is more appropriate as non-parametric tests (i.e. distribution free tests) do not have any assumptions of the population from which the samples are drawn (Israel, 2008).

Siegel and Castellan (1956, p32) point out "*Data measured by either nominal or ordinal scales must be analysed by non-parametric methods*". They insist that where the data are inherently in ranks (ordinal) or simply classificatory and categorical (nominal) no parametric technique applies to such data, and there may be no alternative to using non-parametric statistical tests.

In summary, it can be said that parametric statistics test hypotheses which are based on the assumption that the samples come from populations which are normally distributed, and also parametric statistical tests assume that there is homogeneity of variance (variances within groups are the same). For parametric tests, the level of measurement is to be at least 'interval'. The hypotheses tested by nonparametric statistical procedures do not require normal distribution or variance assumptions about the populations from which the samples were drawn; the level of measurement is to be 'ordinal' or 'nominal'.

Except for the obviously nominal scale questions where the data were classified but had no order, most of the data from the survey were collected using a Likert scale. Thus, it is pertinent to mention here that there is a certain debate over the Likert type scales whether they should be used as 'interval' or 'ordinal' data. While some articles (e.g., Coombs, 1960; Jacobson, 2004; Jamieson, 2004; Knapp, 1990; Kuzon, Urbanchek and McCabe, 1996) argue that Likert scales should be treated as ordinal scales, others (e.g., Baggaley and Hull, 1983; Maurer and Pierce, 1998; and Vickers, 1999) treat and analyse them as interval scales. Nevertheless, for this study it is considered as 'ordinal' mainly due to that although the Likert scales are able to show one value is greater or better than another in a ranking order, they do not show an equal, regular distance between each value, the distances between the values are arbitrary, and therefore, it cannot be known how much is greater or better as in the case of an 'interval' scale. In the ordinal scale (when compared with the interval scale), *"there is still an absence of metric, a measure using calibrated or equal intervals"* (Cohen *et al,* 2011, p603). Thus, the nature of the data collected in this research was of nominal and ordinal scale and not interval or ratio scale. Cohen *et al.* (2011, p 606) argued *"nominal and ordinal data are considered to be non-parametric, whilst interval and ratio data are considered to be parametric"*. Therefore, the appropriate statistical measures for this study were considered to be 'non-parametric'.

In the current study, both descriptive and inferential statistics were used to analyse results and draw conclusions. The descriptive statistics involved frequencies and percentages for analyzing mainly the data related to the characteristics of the organizations (for example, the size or nature of business) and the respondents (for example, their experience, type of the job and so on). They were used to describe and present data where the concern was simply with reporting what was found without attempting to infer or predict population parameters. In this instance, mainly frequency and percentage Tables were used.

Where the concern was to use information from the sample data to infer independence, association, relationship etc. between the categorical variables based on probability, inferential statistics were used. The following non-parametric inferential tests were used in the analysis and interpreting of sample data:

As it was mainly intended to see if there were a relationship between the practitioners belonging to contracting group and the consulting group, the selection of statistical measures had to consider 'bivariate data'.

A *chi-square* test, which is a test of independence (also known as *Chi-square test of association*), was selected to see whether there was a relationship or association between the two categorical variables (i.e. the two groups). A null hypothesis, stating that there was ***no*** statistically significant difference between the practitioners of the two groups with reference to certain phenomena, was generally tested. The level of significance (α) which is needed for supporting or not supporting the null hypothesis was usually set to 0.05.

The null hypothesis H_0 tested is that '*the two groups differ with respect to some characteristics and, therefore, with respect to the relative frequency with which group members fall in several categories; i.e. there is a bivariable interaction*' (Siegel and Castellan, 1956, p111). The focus of the test is whether the differences in proportions exceed those expected as chance or random deviations from proportionality (Siegel and Castellan, 1956); for example, it was tested whether the contractors' Group differ from the Consultants' Group in their agreement or disagreement with some concepts related to concurrent delays (ref. Question no.8 of the questionnaire).

The null hypothesis H_0 is tested by using the formula:

$$X^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(n_{ij} - E_{ij})^2}{E_{ij}}$$

Where,

n_{ij} = the observed number of cases categorized in the i^{th} row of the j^{th} column

E_{ij} = the expected number of cases in the i^{th} row of the j^{th} Colum

When H_0 is true; $E_{ij} = \frac{R_i C_j}{N}$

r = number of rows

c= number of columns

df= (r-1)(c-1)

If the observed and the expected frequencies are in close agreement the differences $(n_{ij} - E_{ij})^2$ will be small and value of x^2 will be small. When obtained x^2 is smaller than the critical x^2 value for a particular level of significance, at a particular df, the null hypothesis (that the two variables are independent of each other) will not be rejected. On the other hand, the larger the value of x^2 the more likely it is that the two groups differ with respect to the classifications (Siegel and Castellan, 1956).

It is suggested that establishing that a correlation exists between two variables may be the ultimate aim of a research study (Siegel and Castellan, 1956). Thus, the following non-parametric measures of correlation and statistical tests were used to determine the probability associated with the occurrence of a correlation as well as the "significance" of the observed association between the two sets of scores of the Groups as to various perceptions and approaches related to delay analysis resolution.

Spearman rank-order correlation coefficient 'r_s' is used to measure the *association* between two variables or as a measure of degree of relationship between two ordinal variables. In simple words, Spearman's rho measures the degree of agreement between 2 sets of ordinal data (Israel, 2011).

For Spearman's rho (r_s) the value range is '-1' to '+1'; a value of '-1' is a perfect negative relationship, while the value of '+1' is a perfect positive relationship; value of '0' indicates no relationship at all. A positive sign means if a respondent is ranked high in one attribute he/she will be ranked high in the other attributes also; a negative sign indicates the opposite. Also, if a respondent is ranked low in both attributes then also there is a positive *association.* (As the test is not influenced by outliers or extreme scores it does not pose any threat to the findings of the study).

The null hypothesis that there is no agreement between the ranks assigned by the groups on 'n' objects (i.e. the two variables under study are not associated [i.e. are independent] in the population and the observed value of 'r_s' differs from zero only by chance) is tested by the following formulas:

$$r_s = \frac{\Sigma x^2 + \Sigma y^2 - \Sigma d^2}{2\sqrt{\Sigma x^2 \Sigma y^2}}$$

Or

$$r_s = 1 - \frac{6\sum_{i=1}^{N} d_i^2}{N^3 - N}$$

Where 'N' = the number of objects ranked,

x_i and y_i are the ranks allotted by the respondents on the attributes,

$d_i = x_i - y_i$

Where it involves a large proportion of tied ranks a correction factor will be incorporated in computation of 'r_s' with $T_x = \sum_{i=1}^{g} (t_i^3 - t_i)$ where g is the number of groupings of different tied ranks and t_i is the number of tied ranks in the ith grouping.

While Spearman rank-order correlation coefficient 'r_s' is concerned with measures of the correlation between *two sets* of rankings of N objects, where the requirement is to consider measure of the relation or association among *several* rankings of N objects, *Kendall Coefficient of Concordance W* is used. For example, it may be used to measure the association among the rankings (***k***) allotted separately by the Contracting Group, the Consulting Group and both groups together as to the 'significance' of the *criteria* (Question no.28) or the 'importance' of the *factors* (Question no.29) considered for selection of an optimum delay analysis method. [In this instance the sets of rankings k = *3,* and N= number of criteria or factors in the ranking].

The computation of 'W' starts with data arranged into k X N Table with each row representing the ranks assigned by a particular group/judge etc. to the N objects. Then it requires to find the sum of ranks R_i in each column of the Table and divide each by k to find the average rank $\bar{R}_i$. Then the sum of $\bar{R}_i$ is divided by k to obtain the mean value of the $\bar{R}_i$s. Each of the $\bar{R}_i$ may then be expressed as a deviation from the grand mean. Siegel and Castellan (1956) argued that the larger these deviations, the greater the degree of association amongst the ***k*** sets of ranks. So the sum of squares of these deviations is found and the value of 'W' is computed with the following formula:

$$W = \frac{\sum_{i=1}^{N} (\bar{R}_i - \bar{R})^2}{N(N^2 - 1)/12}$$

Where 'k' = the number of sets of ranking,

'N' = the number of objects (criteria, factors etc.) being ranked,

$\bar{R}_i$ = average of the ranks assigned to i^{th} objects or subjects

$\bar{R}$= average (or grand mean) of the ranks assigned across all objects or subjects,

$N(N^2$-1)/12 = Maximum possible sum of the squared deviations, i.e. the numerator which would occur if there were perfect agreement among the ***k*** rankings, and the average rankings were 1,2,….,*N*

Siegel and Castellan (1956) also proposed a simpler and quicker formula substituting the above yielding the same result:

$$W = \frac{12\Sigma R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1)}$$

Where ΣR_i^2 is the sum of the squared sums of ranks for each of the *N* objects or individuals being ranked.

For a large proportion of ties observations correction factor is applied similar to the one applied for *Spearman's rho.* In that case, the W is computed with the formula:

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

'*W*' value varies between '0' and '+1'. As the ranks cannot all disagree completely, '*W*' cannot be negative. As $0 \leq W \leq 1$, only one-tailed tests concerning *W* are appropriate.

Siegel and Castellan's (1956) Table T (see Appendix – D for a copy) is used where *k* is between 3 and 20 and N is between 3 and 7. If W is equal to or greater than that shown in Table T for a particular level of significance, then H_0 may be rejected at that level of significance. However, when *N* is larger than 7, Table T cannot be used and the following formula is used along with the observed *W* to find out x^2 :

$X^2 = k(N-1)W$

If the value of x^2 equals or exceeds that shown in Siegel and Castellan's (1956) Table C (see Appendix – D for a copy) for a particular level of significance and a particular value of *df*= *N*-1, then the null hypothesis that the ***k*** rankings are unrelated (or independent) may be rejected at that level of significance. Siegel and Castellan's (1956) emphasized that a high or significant value of W would show only the level of 'agreement' between the respondents on their ordering of objects, but it does not mean whether that agreement is correct or wrong.

3.7 Data Reliability and Validation

Cohen *et al.* (2011, p179) argue *"threats to validity and reliability can never be eased completely; rather the effects of these threats can be attenuated by attention to validity and reliability throughout a piece of research"*. Thus, the reliability and validity of the data collected through both interviews and in-depth survey became an important key to the effectiveness of the research.

'Validity' consists of internal validity and external validity. Internal validity deals with the issue whether the identified inputs within their attributes actually produced the expected output. Onwuegbuzie and Leech (2006b, p234) defined internal validity as the *"truth value, applicability, consistency, neutrality, dependability, and or credibility of interpretations and conclusions within the underlying setting or group"*. On the other hand, the external validity addresses the ability to generalize the research findings beyond the research sample or setting under which the research undertaken.

3.7.1 Interview Data

As the interview data are generally qualitative, the validation of them requires to be adhered to principles different from those applicable to quantitative data (Lincoln and Guba, 1985; Bogdan and Biklen, 1992). However, as suggested by Hammersley and Atkinson (1983) 'validity' of qualitative data attaches to accounts, not to data or methods. Cohen *et al.*, (2011) suggest that the overwhelming feature of qualitative research is its concern with the phenomenon or situation in question and not generalisability, and therefore issues like random sampling, replicability, alpha coefficient reliability, isolation and control of variables and predictability do not matter much in qualitative research. Maxwell (1992, 1996) suggested that understanding is a more suitable term than 'validity' in qualitative research.

Face Validity and Content Validity were used in the study as qualitative measures of validity as to the semi-structured questions posed to the interviewees. Face and Content validity were secured particularly through extensive peer discussions as to establishing the following:

- ease of use and clarity of the questions,
- relevance and breadth with regard to the domain being studied,
- adequacy and representativeness of the themes / sub-themes

The assessments received through these peer discussions with regard to the above aspects were highly affirmative and any further proposals received were also evaluated and used appropriately to further improve the questions to be posed.

3.7.2 Survey Data

In order to report the credibility of the results of research inquiry as to the survey instrument, reliability and validation were necessary evaluation criteria. While the 'reliability' refers to the consistency of the results obtained, the validity refers to the degree that an instrument actually measures what is designed or intended to measure (Netemeyer *et al.*, 2003; Nunnaly, 1978; Burton and Mazerolle, 2011).

As for the Inter-Rater Reliability of the data collected from the in-depth survey (questionnaire), Intra-Class Correlation Coefficient (ICC) was used to see the correlation between the ratings given by one Group and those given by the other Group. In order to assess the inter-rater agreement it was required to correlate the two Groups' ("Judges") ratings. As the ordinal data were mostly with ratings (using Likert scale) they were converted to rankings (as they were utilized in Spearman's rho (r_s) and Kendall's coefficient of concordance W) . In measuring the Intra-Class Correlation Coefficient (ICC), Cronbach's Alpha was used as the reliability statistics along with single measure and average measure for ICC, at 95% Confidence Interval.

The summarised results (which are extracted from Table 11.1 of Chapter 11) indicate that with reference to the ratings obtained from the two Groups of practitioners for the respective data, generally, the Intra-Class Correlation Coefficient (or Inter-Rater Reliability) at 95% Confidence Interval is 0.89 ($P<.001$, $N=201$, $df=200$) with Cronbach's α 0.94.

A reliability coefficient of 0.70 or higher is considered acceptable for consistency estimates of Inter-Rater Reliability (Barrett, 2001). As indicated in these summarised results, these ratings are well above this acceptable margin.

In addition to the Intra-Class Correlation Coefficient, the questionnaire (Q#.31) inquired from each respondent their ratings as to the questionnaire's (i) clarity, readability, and ease of use, and (ii) accuracy, relevance and the sufficiency of coverage (breadth) of the issues inquired.

The elements under (i) are generally to establish the 'Face Validity' and those under (ii) are for 'Content Validity' (Burton *et al.*, 2011) of the survey instrument.

These ratings were required on a 5 points scale. (1= very low, 2=low, 3= medium, 4= high and 5= very high). The summarised SPSS results (see Appendix - C Tables Q#.31.1 to Q#.31.7 for calculations) indicated that a combined total of 'high' and 'very high' ratings over 90% for all the elements, except for the 'ease of use' for which the ratings of 'low' and 'medium' were 14% and 60% respectively, while that of 'high' was 27% (there were no 'very high' ratings). Thus, the feeling of nearly 75% overall majority was that the level of answering these questions was not an easy task. This may be explained as most of the questions in the questionnaire were complex and required in-depth knowledge and consideration to answer. These results were also confirming the feedback received through a peer discussion/ a modest preliminary survey that was carried out prior to sending out the in-depth survey-questionnaire on aspects such as lay-out of the questions, clarity and appropriateness of wording, adequacy of the questions in conveying the desired meaning, and the time needed to complete.

3.7.3 Respondent-Bias

<u>Response Bias</u>

The risk of response bias, which could possibly affect the survey and interview results, was also considered during the inquiry stage. This was a potential risk of compromising the data validity as suggested by Fellows and Liu (1997) data collection through surveys has been very prone to bias and distortion. In order to ensure avoiding or minimising the negative effects of such bias some measures were consciously adopted. Some of these measures were:

- Selection of the interviewees and the survey-respondents was strictly on the basis of the practitioners' actual involvement in delay claims resolution process (albeit their disciplines may be different).
- The wording of the questions was ensured not to be loaded in some way to favour one response over another. Wherever the opinion or rating was required from a survey-respondent the question was presented with an opportunity to state 'other' perceived alternative, if there is any. However, this option was almost not used by the survey-respondents. As to the interviewees, most of

them expanded the responses to many peripheral issues beyond the questions asked and this provided balance responses avoiding bias and one-sided replies.

- There were no questions that led any group or individual to present them in a favourable light, so they would be reluctant to admit to unsavoury attitudes.
- A firm undertaking was given to the interviewees and the survey-respondents to protect utmost confidentiality as to their privacy and all the data collected. This measure also aimed at capturing opinions, experience and suggestions from the participants without bias or fear.

Non- Response Bias

- This issue was reckoned in that it may create bias in the sample when the subjects do not answer specific questions. For example, in the in-depth survey questionnaire there were questions required to be answered in order to establish whether the respondent was actually involved in delay claims resolution. Some respondents had avoided answering these questions. In such cases, to accept their other responses could have compromised the validity of bona fide responses of who actually demonstrated their involvement in the delay claims. In order to avoid this type of bias, respondents who did not answer to such questions (for example, question as to experience in claims – Question no.5) were excluded from further consideration.
- Although this measure reduced the size of the sample for the in-depth survey, the valid number of respondents was within satisfactory levels (74 nos. with 11.4% margin of error, at 95% confidence level).

3.7.4 Mixed Methods Results

Creswell and Plano Clark (2011) defined validity in mixed methods research as employing strategies that address potential issues in data collection, data analysis and the interpretations that might compromise the merging (or connecting) of the two stands and the conclusions drawn for the combination.

Creswell and Plano Clark (2011) identify certain potential validity threats in carrying out Mixed Methods and the compromises and strategies that can be used to address such threats. Of those identified, the following are relevant to and strongly adhered in the current convergent design (see Table 3.1 below).

Table: 3. 1 Potential Validity Threats in Merging Data

Potential Validity Threat in Merging Data	Strategies for Minimizing the Threat
Data Collection Issues	
• Selecting inappropriate individuals for qualitative and quantitative data collection	• Draw samples from the same population to make data comparable; (only competent practitioners having hands-on experience in delay claims resolution have been selected)
• Collecting two types of data that do not address the same topics	• Address the same question (parallel) in both qualitative and quantitative data collection.
Data Analysis Issues	
• Using inadequate approaches to converge the data	• Develop a joint display of quantitative categorical data and qualitative themes
• Making illogical comparisons of the two results of analysis	• Find quotes that match the statistical results
• Utilizing inadequate data transformation approaches	• Keep the transformation straightforward (e.g. count codes or themes) and use procedures to enhance reliability and validity of transformed scores
• Using inappropriate statistics to analyse quantitised qualitative results	• Considered using non-parametric statistics , if needed
Interpretation Issues	
• Not resolving divergent findings	• Use strategies such as gathering more data, reanalyzing current data and evaluating the procedures
• Not discussing the research questions	• Address each question
• Giving more weight to one form of data than the other	• Use procedures to present both sets of results in an equal way (e.g. joint display) or provide rationale for why one form of data provided a better understanding of the problem.

3.8 Summary

This Chapter 3 has continued the Chapter 2 discussion on the research methodology adopted in the study. It has discussed on the data collection procedures for both interviews (qualitative strand) and in-depth survey (quantitative strand). The measures adopted for data representation are explained in detail, along with the statistical measures and techniques used for analyzing the data collected.

Finally, it has presented the approaches adopted for reliability and validation of the findings and results of the research inquiry. (A separate Chapter will address the issues of reliability and validation of the proposed Model).

CHAPTER FOUR

4.0 Apportioning Delay Liabilities

4.1 Introduction

As highlighted in Chapter 1, the delay claims resolution process is centred on the apportioning liabilities between the claiming party and the defending party. For a claimed delaying 'event', apportioning the liabilities consists of two phases of causation: (I) establishing each party's potential liability for the 'cause' of the claimed delaying event (or occurrence), and (2) determining the quantum of the 'effect' flowing from such delaying event. In the process of delay claims resolution a central role is undertaken by the delay analysts of contesting parties. As Keane and Caletka (2008) argued the main purposes of any delay analysis is establishing entitlement, causation and damages. Thus, the delay analysis is intrinsically based on essential theories and concepts involving apportioning liabilities and the analysis methodology (techniques). It is also affected by the standards of practices adopted in delay claims management. This Chapter presents an overview of the general literature related to the prevailing theories, concepts, and legal position on the apportioning of liabilities in delay claims and analysis. This review is based on published academic works, case law in the UK and the US jurisdictions, and other references involving the following areas:

> Categories of Delays, 'Concurrency', Approaches of apportioning liabilities, and 'Float Ownership'.

The next three Chapters will continue the literature review on the aspects of Issue of 'critical path', Pacing Delays, Entitlement after Completion Date, Delay Analysis Methods and their application, along with Prevention Principle and Conditions Precedent and the procedural issues in claims presentation, determination and awarding process.

The findings of this literature review have largely informed the conceptualisation of this study. They also provided the theoretical basis for designing the subsequent interviews and surveys, and the proposed Framework and recommendations for improving the delay claims resolution process.

Figure 4.1 below illustrates the conceptual framework built up on the literature review.

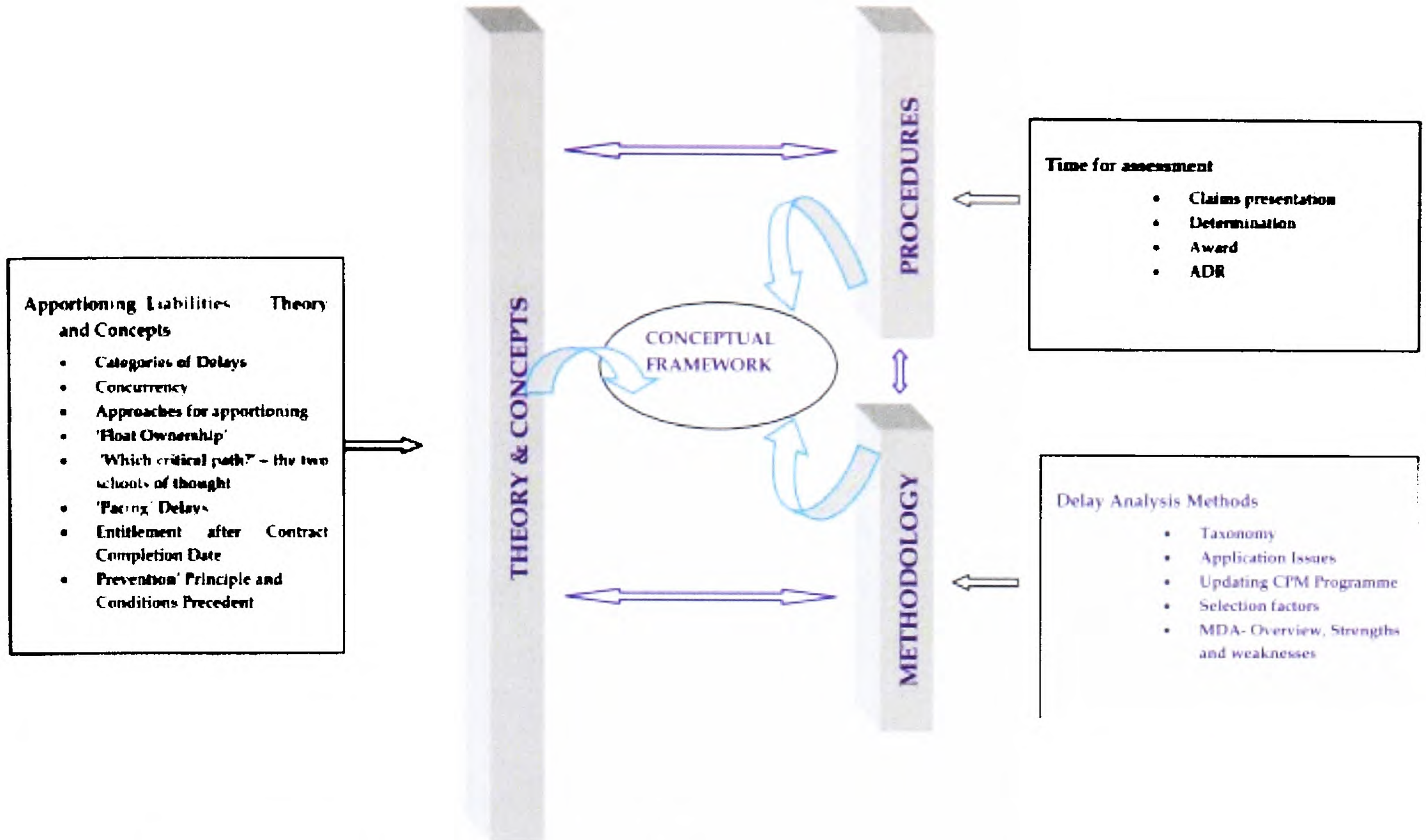


Figure 4. 1 Literature review –conceptualisation

4.2 Apportioning Liabilities – Theory and Concepts

4.2.1 Categories of Delay

As there may be various definitions for the concept of *delay* to mean many different things (Pickavance, 2005), it would be pertinent to look for a definition of the concept in the context of performance of contractual obligations. In a discussion of the effects of *Rainery v Miles [1981] AC1050*, Stannard (2007, p.7) submitted *"It is now clear that, whether time is of the essence or not, failure to perform on time by the promisor is a breach of contract for which damages can be obtained"*. Accordingly, 'construction delay' referred to in this study has taken that position as the basic legal definition.

On the other hand, as defined in the SCL Protocol (2002) there are two types of delays in context: the first is a 'delay to completion' which means a delay to the date when the contractor planned to complete its work, or a delay to the contract completion date; the second is a 'delay to progress' which means a delay which will merely cause delay to the contractor's progress without causing a contract completion date not to be met. In this research, the focus is on the first type i.e. 'delay to completion' which is generally associated with 'prolongation claims'. The second type, i.e. 'delay to progress' which is generally associated with 'disruption claims' is outside this study.

Generally the construction delays fall into two major categories: excusable and non-excusable (Alkass *et al.,* 1996; Finke, 1997). A general classification of these construction delays can be found in the literature (Alkass *et al.*, 1991, 1993, 1996; Wickwire *et al.,* 1988, 2003; Baram 1994; Reams, 1989, 1990; Kraiem and Diekmann, 1987) and accordingly, apportioning by responsibility can be characterised as:

- "Non-excusable" : This comprises delay which is the fault of the contractor or for which the contractor has assumed the risk, and therefore, entitled to neither an extension of time nor monetary compensation, but could be subject to LD or 'penalty' (as it is implemented in the UAE) as the case may be;
- "Excusable but non-compensable" which are typically outside the control of the parties (for example, 'acts of God'), and entitled to extension of time but no monetary compensation;
- "Excusable and Compensable" which are caused by the employer and or his representatives for which he has assumed the risk, and therefore the contractor is entitled to an extension of time and monetary compensation. (However, a delay can be compensable without prolonging the contract performance time)

Further, referring to *Essential Construction Co., Inc., and Himount Construction Ltd., Joint Venture. ASBCA No. 18706, 89-2 BCA 21,632 1t 108, 834,* Finke (1997, p.26) suggested *"given the contractor's burden of proof, delays not proven by the contractor to be excusable should, by default, be presumed to be nonexcusable."*

Arditi and Robinson (1995) and Stumpf (2000) identified the interrelationships between the types of delays mentioned above falling into one of the following three categories:

1. *Independent Delays*: which occur in isolation or without other simultaneous or consecutive delays. These are more straightforward for easily analysing the effects;
2. *Serial Delays*: Unlike the independent delays which are single, serial delays are sequences of consecutive, non-overlapping delays on a particular network path. Generally, the individual delays do not conflict and the appropriation of the overall project delay is relatively easy to calculate. However, as an extension to this general situation an initial delay may affect a delay in a succeeding activity ;

3. *Concurrent Delays*: For *True Concurrent delays*, delays occur at the same time on the same or parallel critical paths. In a purely 'true' concurrency, the delaying events start and finish at the same time, but that phenomenon is rare. However, for *'concurrent effects' of sequential delay events,* the delays are to occur on parallel critical paths only.

A more detailed review of 'True Concurrency' and 'Concurrent Effects' is undertaken below.

4.2.2 'Concurrency'

The Issue of a Definition: 'True Concurrency' and 'Concurrent Effects'

Any practicing delay analyst would agree that the concept of 'concurrent delays' has been the single most perplexed issue in determining the compensability. In fact, it is perhaps considered the most controversial subject in forensic schedule delay analysis (Livengood, 2007d).

The relevance of concurrent delays in delay analysis is wholly related to one issue: compensability. When all delays are critically affecting the time for completion, a party who needs to defend a claim would find the significance of a concurrent delay as it may permit him to offset the concurrent delay from the claimed party (Bramble and Callahan, 2000). In other words, its use is for the contracting parties trying to cancel out the compensability of one another.

The complexity of the concept is further confounded by the lack of or absence of a consensual definition among the experts and practitioners involved in delay claims. In the construction industry, in general, and in the scheduling profession, more specifically it is witnessed that the term 'concurrent delay' has numerous definitions. (Zack and Federico, 2011). Peters (2003, p. CDR 01.1) argued "*while most project participants toss the term concurrent delay about freely, it is rare that any two individuals can agree on what it actually means*". To make this point Peters (2003) cited some extracts from academic and professional work.

- Concurrent delay is experienced on a construction project when two separate delay events occur during the same time period. (Construction Claims Monthly, October 1993);
- It is important to note that to be considered concurrent delays, the delays need not actually take place at the same time (Ness, 2000);

- Concurrent delay is experienced on a project when two or more separate delay events occur during the same time period, and each independently affects the completion date (Reynolds and Revay, 2001.);
- Concurrent delay occurs when the results of two separate delay events overlap (Construction Claims Monthly. March, 2002).

According to Keane and Caletka (2008) a concurrent delay could be simply two or more events which cause delay running side by side. According to Marrin (2002) a concurrent delay is understood differently in different quarters and definitions are scarce, and defined it as a period of project over-run which is caused by two or more causes of delay which are of equal causative potency. Thus, the argument that there is no universally accepted definition of 'concurrent' delay stands firm.

Bramble and Callahan (2000, p. I1-78) defined that, in delay claims, concurrency may occur *"when there are two or more independent delays during the same period"* and they may also occur *"during any part of the project performance period, <u>not necessarily at the same time</u>"*. Therefore, *"a concurrent delay may occur during the same period as another delay but may also include any delays that contributed to the overall project delay, whether one delay overlaps with another <u>or not</u>"* . [Emphasis added]. Bramble and Callahan (2000) suggest the term '*offsetting*' rather than '*concurrent*' for delays that have the same effect on project completion but do not occur within the same time period. According to Bramble and Callahan (2000, p.I-17), much of the controversy surrounding the term concurrent delay is "*whether the events leading to delay must be <u>simultaneous</u> in occurrence or <u>merely offsetting</u> in effect*" [Emphasis added].

Tobin (2007) explained and differentiated the concepts of 'concurrency of causes' and 'concurrency of effects' of delays, throwing a further light on the above definitions. Tobin (2007, p.145) argued for the equal status between the concurrent effects of 'true concurrent' delays and those of sequential delays stating *" a true concurrency arises where the competing events cause a delay to progress on the critical path (or paths). The same is true for sequential causes of concurrent delay"*. The existence of such sequential causes of concurrent delay was accepted by HH Judge Seymour in *The Royal Brompton Hospital NHS Trust V Hammond And Others [2001] 76 Con L.R.*

148 when he considered an argument that two delays happening at *different times* were the concurrent delays.

Considering the perplexity of the issue, the SCL Protocol defines:

> *"True concurrent delay is the occurrence of two or more delay events at the same time, one an employer Risk Event, the other a contractor Risk Event and the effects of which are felt at the same time. The term 'concurrent delay' is often used to describe the situation where 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. To avoid confusion, this is more correctly termed the 'concurrent effect' of sequential delay events"* (The SCL Protocol', 2002).

The above definition of the SCL Protocol seems corroborating with case authorities in the US courts. Bramble and Callahan (2000) pointed out, for example, in *Raymond Construction of Africa, Ltd. v United States, [1969] 411 F2.D 1227 Ct. CI.* the court determined that three consecutive delays were concurrent. (The three consecutive delays occurred in the procurement, delivery and operations of heavy equipment, with little, if any, overlap; the court apportioned responsibility for each delay among the three different parties who contributed to the overall project delay). Similarly, in *Williams Enterprises, Inc. v Strait Manufacturing & Welding, Inc., [1990] 728f. Supp.12 D.D.C.* the federal court determined consecutive delays as concurrent delays.

According to the foregoing, it may be considered that both 'true concurrency' (related to occurrence *of two or more delay events at the same time)* and 'concurrent effects' (related to *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)* have equal status and effectiveness in delay analysis. However, the delays occurring with concurrent effects of not so equal potency are dealt with differently in the forensic scheduling, at least by two schools of thought. More on this is discussed later in Chapter 5, under the issue of 'critical path' theory.

4.2.3 Approaches of apportioning liabilities

In the general rule for a claim for breach of contract, the objective of the court is to put the claimant on a position as far as in the same financial position he would have been, had the breach concerned not occurred. For this purpose, it would be necessary that: the loss claimed is one which ordinarily flows from the breach of contract in the usual course of events, which is the reasonable people in the positions of the parties would have foreseen as a probable result of that breach; if the damages are direct then they are compensable, but if they are indirect (consequential) they are compensable only if such special circumstances were within the parties' contemplation at the time of entering to the contract; to succeed, the claimant has to discharge the burden of proving of the existence and the actual amount of damages, and if the loss or damage caused by the breach cannot be isolated from that attributable to other factors, there would not be recoverable damages. Long (1988) submits that the success of the claim will often hinge on how well the contractor /claims expert/ attorney can calculate and prove the damages, having demonstrated the nature of the loss and the connection between the loss and the owner's action.

These general rules as to recovery of damages are almost similar in the UK and US legal systems. (For example, *Hadley v Baxendale [1854]9 Ex 341, 156 ER 145; Victoria Laundry (Windsor) Ltd v Newman Industries Ltd [1949]2 KB 528; U.S v J.H. Copeland & Sons,[1928] 568 F.2d 1159 ; S.J. Groves & Sons Co. v Warner Co., [1928]576 F.2d 524; Maxwell v Schaefer, 112 A.2d 69 [1955]; R.J. Lampus Co. v Neville Cement Products Corporation, [1977, 378 A.2d 288; Roanoke Hospital Association v Doyle & Russell, [1975] Inc., 214 S.E.1d 155;Rochey Bros., Inc. v Rhoades, [1975], 527 F.2d 891 ; S.J. Groves & Sons Co. v Warner Co., [1928], 576 F.2d 524).*

According to these general rules, the complexities involved in apportioning liabilities are to be addressed only through establishing causation (i.e. establishing the nexus between the cause of the delaying event and its liability, and the 'effects' flowing from that cause). However, in establishing causation, the impact analysis would possibly run into the difficulty that several delay events caused by more than one party are on contesting, parallel critical paths. This analysing task is made all the more difficult since the liability for causative events will lie partially with both the employer and the contractor, and possibly with some 'neutral' events as well which normally entitle a contractor to additional time, but not compensation (Keane and Caletka, 2008).

Thus, in the circumstances of a true concurrency of delays, separation of competing causes of a particular impact of delay is a difficult question, and hence an equitable apportioning of liabilities also becomes difficult.

The following approaches appear in many text books (for example *'Keating on Building Contracts')* as 'solution' to this difficult question.

- 'But-for' test;
- Dominant Cause approach
- 'First-in-line' approach
- Devlin Approach;
- Burden of Proof approach; and
- 'Malmaison' case approach

'But-for' test

Marrin (2002, p.10) pointed out *"On behalf of contractors, it is occasionally suggested that the correct approach in determining contractual delay claims is to apply the 'but for' test of causation. No doubt, this is because it is the test most favourable to the claimant".* This test is based on the question that 'but for the event, would the loss have been suffered?' If the answer was 'no', then the event was said to have caused the loss. However, as Davison (2003, pp.145-146) suggested *"It is a useful filter, but it can become difficult to obtain clear answers where there are many overlapping and competing issues to test".*

Atkinson (2007) pointed out that in a negative assertion of causation, the 'but-for' test is that if the damage would still have occurred after the removal of an event from the circumstances, then it can be concluded that that event is not the cause of the damage. However, " *in the case of concurrent events in which both independently cause the same damage, such as delay, ...the but-for test leads to a conclusion that neither of two events caused the damage contrary to common sense. The test does not deal adequately with issues of concurrency and indivisible damage"* (Atkinson, 2007, p.13). Thus, when it comes to deal with concurrent delays, particularly with 'true concurrency', where it is impossible to assign more causative responsibility to one cause over another, 'but-for' test proves its inadequacy. If two independent delays with same length occur at the same time with equal potency to delay the contract completion, then the application of this test will have to conclude neither event caused the loss in issue, and such conclusion does not make much sense.

The test is given an unsympathetic reception in the English courts (*Galoo Ltd V Bright Grahame Murray [1994] 1 WLR 1360, CA.; Turner Page Music Ltd V Torres Design Associates Ltd [1997] CILL 1263, QBD (OR)* and most unlikely to be applied to a contractual claim unless the wording of the contract clearly demands it (Marrin, 2002).

Dominant Cause Approach

As it was established, the claimant would succeed in his recovery of losses if he could establish that the cause of which the defendant was responsible is the dominant cause of the loss that was suffered by him. Which cause is dominant is a question of fact which is not solved by the mere point of order in time, but is to be decided by applying common sense standards. (*Leyland Shipping v Norwich Union Fire Insurance Society Ltd [1918] AC 350, HL; Galoo Ltd v Bright Grahame Murray [1994] 1 WLR 1360, CA).*

'Keating on Building Contracts' (p.195, 5th ed.; p.246, 7th ed.) summarised this approach as follows:

> *"If there are two causes, one the contractual responsibility of the Defendant and the other the contractual responsibility of the Plaintiff, the Plaintiff succeeds if he establishes that the cause for which the Defendant is responsible is the effective, dominant cause. Which cause is dominant is a question of fact, which is not solved by the mere point of order in time, but is to be decided by applying common sense standards".*

'Keating's support to this approach has been based on the analogy drawn with some insurance and shipping cases (*Leyland Shipping v Norwich Union Fire Insurance Society Ltd [1918] AC 350, HL; Yorkshire Dale Steamship Company Ltd v Minister Of War Transport [1942] AC 691, HL).* However, like in the case of 'but-for' test it would find its inadequacy in dealing with two independent delays with same length occur at the same time with equal potency to delay the contract completion.

Ndekugri (2007, p.14) suggested that two problems would associate with dominant cause approach: *"First, it breaks down if the events are of equal causative potency. Second, the implications for recovery of direct loss and/or expense could be unfair to one of the parties".*

According to Marrin (2002, p.11) *"In terms of judicial authority, however, the dominant cause approach has almost entirely escaped attention"*. Then, it was only in the '*Fairweather*' case it was taken up. In *H. Fairweather and Co. Ltd v London Borough of Wandsworth [1987] 38 BLR 106,* the arbitrator's award was the subject of an appeal by the contractor, *Fairweather*. The Judge in the case disagreed with the arbitrator's ruling that the extension of time should relate to the *dominant cause of delay*. In the judgment HH Judge Fox-Andrews said the following:

> *"'Dominant' has a number of meanings: 'ruling, prevailing, and most influential'. On the assumption that condition 23 is not solely concerned with liquidated and ascertained damages but also triggers and conditions a right for a contractor to recover direct loss and expense where applicable under condition 24 then an architect and in his turn an arbitrator has the task of allocating , when the facts require it, the extension of time to the various heads. I do not consider that the dominant test is correct".*

In this case the dominant cause of delay theory has been rejected by the court as an approach for apportioning.

On the other hand, in the Scottish case of *John Doyle Construction Ltd v Laing Management (Scotland) Ltd, [2004] BLR 295* it seemed the court favoured the dominant cause approach, but if that approach could not be applied then it also considered apportionment:

> *"[15]...the question of causation must be treated by the application of common sense to the logical principles of causation. In this connection it is frequently possible to say that an item of loss has been caused by a particular event notwithstanding that other events played a part in its occurrence. In such cases, if an event or events for which the employer is responsible can be described as the dominant cause of an item of loss, that will be sufficient to establish liability, notwithstanding the existence of other causes that are to some degree at least concurrent.."*

However, this approach in '*John Doyle*' also drew a lot of criticism. For example, Pickavance (2005, p. 650) argued *"It is a common mistake , but except in relation to contracts that expressly require that approach to the rationalisation of competing causes of delay for the purposes of extension of time, the 'dominant cause' theory has* *nothing to do with extensions of time and liquidated damages. It is a legal theory relevant to recovery of damages and not to relief from damages".*

First-in-line approach

This approach operates on the basis of 'all-or-nothing'. In Royal Brompton, the contractor was not entitled to an EOT because the Relevant Event occurred after the contractor delay (Brawn, 2012). Thus, in the process of implementation, it uses the first event found (for which the responsibility is with the contractor, or the employer) as the cause (the "first-in-line") but for which the whole delay would not have arisen. Hence the subsequent delays occurring even during the first delay should not take liability. The same approach is applied to any counter claims. However, the approach faces the same problem of inadequacy as the 'but-for' and 'dominant cause' approaches as described before, when dealing with concurrent delays.

Devlin Approach;

This approach is a slight refinement of the first-in-line approach, arising from a decision of HH Judge Devlin in the case of *Heskell v Continental Express Ltd [1950] 1 All E.R. 1033* (Anderson, 2008, p549). It was held that:

> *"... if a breach of contract is one of two causes of a loss, both causes cooperating and both of approximately equal efficacy, the breach is sufficient to carry judgment for the loss".*

For example, this approach may apply where two competing delays entitle the contractor EOT, one is excusable and compensable (say late instruction), and the other excusable only (say exceptionally inclement weather), then the existence of the excusable and compensable delay would prevail and entitle the contractor to both time and cost. (Notably, this particular approach has been rejected by *'John Doyle'* judgment).

Burden of Proof Approach

According to this approach, if part of damages is shown to be due to a breach of contract by the plaintiff, the claimant must show how much of the damage is caused otherwise than by his breach of contract, failing which he can recover nominal damages only. (*Government Of Ceylon v Chandris [1965] 3 ALL ER 48)*

Malmaison Approach

This is primarily based on the approach adopted in *Henry Boot Construction (UK) Ltd v Malmaison Hotel (Manchester) Ltd [1999] 70 Con L.R. 32* i.e. the 'Malmaison' case. It appears to apply only to the granting of extensions of time in circumstances where a concurrency of delays exist, one (or some) of which would entitle the contractor to an extension of time, and others where the contractor is in culpable delay. Lowsley and Linnett (2006, p.190) recognised *"the position set out is widely considered to be an accurate statement of how concurrency under JCT80 should be viewed".*

The approach was based on a pre-agreed commercial accord between the parties, that if there were two concurrent causes of delay, one of which was a relevant event and the other was not, then the contractor was entitled to an EOT for the period of delay caused by the relevant event, notwithstanding the concurrent effect of the non relevant event.

In the following paragraphs of the judgment, HH Judge Dyson also confirmed

> *"... if there are two concurrent causes of delay, one of which is a Relevant Event and the other is not, then the contractor is entitled to an extension of time for the period of delay caused by the Relevant Event notwithstanding the concurrent effect of the other event. Thus, to take a simple example, if no work is possible on a site for a week not only because of exceptionally inclement weather (a relevant event), but also because the contractor has a shortage of labour (not a relevant event), and if the failure to work during that week is likely to delay the works beyond the completion date by one week, then if he considers it fair and reasonable to do so, the architect is required to grant an extension of time of one week. He cannot refuse to do so on the grounds that the delay would have occurred in any event by reason of the shortage of labour".*

Thus, it seems the judgment considered only the concurrent causes occurring at the same time, and therefore, not the concurrent effects of the causes (events) occurring sequentially. In other words, the '*Malmaison*' considered the 'true' concurrency of delays only.

The *'Malmaison'* provided the basis for many subsequent judgments. It was supported by HH Judge Seymour Q.C in *the Royal Brompton Hospital NHS Trust V Hammond and Others [2001] 76 Con L.R. 148* stating:

> *"..if Taylor Woodrow was delayed in completing the works both by matters for which it bore the contractual risk and Relevant Events, within the meaning of that term in the Standard Form, in light of the authorities which I have referred, it would be entitled to extensions of time by reason of the occurrence of the Relevant events notwithstanding its own defaults".*

In fact, it may be inferred that the '*Malmaison*' decision is a rejection of 'Dominant Cause' approach. Accordingly, Burr and Palles-Clark (2005) argue that in dealing with competing employer and contractor delays, the main contenders are the 'Dominant Cause' approach and the '*Malmaison*' approach.

Divergent Remedies for Concurrent delays

One of the most significant problems that would be faced by the delay analyst is the lack of a consensual approach for remedying in concurrent delays through allocation of responsibilities. As various triers-of-fact approach the difficult issue of apportioning the responsibility in concurrent delay situations with a wide range of opinions, establishing a pattern of legal precedence for such apportioning has become quite difficult (Arditi and Robinson, 1995).

Like other types of delay, concurrent delays also require to be grilled through the normal 'chain of proof' (Duty-Breach-Cause-Effect-Damage) for damages. This chain of analysis anticipates that the claiming party will fulfill each of the parts (Davison, 2003). Accordingly, establishment of that necessary link between 'cause' and 'effect' is required for each concurrent delay, separately. This process generally starts with the apportioning the responsibility for each delay and then proceeds to assessing the 'criticality' of the effect of the delay.

Generally, whether a delay is excusable, compensable, non-compensable or non-excusable is a matter of contract (Bramble and Callahan, 2000). However, in a concurrent delay situation things would not be that straightforward. As the delays are complex the apportioning also becomes complicated. The literature available on the subject of concurrent delays shows divergent opinions amongst the experts on compensability based on various combinations of the above types of responsibilities. Peters (2003) submitted a matrix (see Table 4.1) illustrating this situation, which has been prepared on the basis of views submitted by some prominent experts on the subject.

Table 4.1 shows at least five different approaches just from nine experts. That generally reflects the scale of the problem. Thus, there seems to be hardly any convergent position between the experts' opinions on the remedies for concurrent delays. This situation underpins the need to have a consistent application of the theory of concurrent delay entailing a firm approach of assessment of excusability and compensability when the delay analysis requires dealing with a mixture of excusable, non-excusable and compensable delays.

Table: 4. 1 Variances of Remedies for Concurrent Delays

	EXCUSABLE concurrent with **NON-EXCUSABLE**	**EXCUSABLE** concurrent with **COMPENSABLE**	**COMPENSABLE** concurrent with **NON-EXCUSABLE**
Theories of Concurrent Delays Gui Ponce de Leon P.E.., 1987 AACE Transactions	**Excusable**	**Compensable**	**Excusable**
Delay Analysis: A Systematic Approach Joseph S. Reams, Cost engineering, Vol. 31, No.2, February, 1989	**Excusable**	**Excusable**	**N/A**
Construction Claims Monthly October, 1993, Volume 15, Number 10	**Non-excusable**	**Excusable**	**Non-excusable**
A Cost Effective Delay Analysis Technique Mireille Battikha & Sabah Alkass, P.E., 1994 AACE Transactions	**Excusable**	**Excusable**	**N/A**
Concurrent Delays in Construction Litigation Dr. David Arditi & Mark A. Robinson, P.E., Cost engineering, Vol. 37, No.7, July, 1995	**Non-excusable**	**Excusable**	**N/A**
The Five Commandments of Construction Project Delay Analysis, Hamed A. Al-Saggaf, CCE, Cost engineering, Vol. 40, No.4, April, 1998	**Non-excusable**	**Excusable**	**N/A**
Concurrent Delays – What Are They and How to Deal With Them? George E. Baram, P.E., CCE, 2000 AACE International Transactions	**Non-excusable**	**Excusable**	**Non-excusable**
Concurrent Delay: A Modest Proposal R.B. Reynolds & S.G. Revay, The Revay Report, Vol. 20, Number 2, June, 2001	**Excusable**	**Excusable**	**Excusable**
Construction Claims Monthly March, 2002, Volume 24, Number 3	**Non-excusable**	**Excusable**	**Non-excusable**

Source: Peters (2003)

Recognising this problem, Wilson (2004) observed that there was a clear discrepancy between the frequency with which parties allege that a concurrent delay situation exists and the very limited circumstances in which concurrent delay will be recognised at law. Thus, he suggested that this situation might be addressed by greater thought being given to the allocation of the risk of delay at the contract drafting stage.

In order to provide a means by which the parties can resolve these matters and avoid unnecessary disputes, the SCL Protocol (2002) proposed a scheme with some balanced and viable propositions. The review of SCL Protocol has indicated that it has taken firm positions on many of the controversial issues associated with 'concurrent delays.

SCL Protocol submits two fundamental principles as to the standards to establish right to time extension (in order to avoid LD) and recovery of compensable loss/damages (for the prolonged period) in a concurrent delay situation. As to the right to time extension in a 'true concurrency' situation it states "*Where contractor Delay to Completion occurs concurrently with Employer Delay to Completion, the contractor's concurrent delay should not reduce any EOT due*" (Section 1.4.1). Then, as to concurrent effects arising from sequential delays, it states "*Where Employer Risk Events and Contractor Risk Events occur sequentially but have concurrent effects, here again any Contractor Delay should not reduce the amount of EOT due to the contractor as a result of the Employer Delay*" (Section 1.4.7).

The above position appears to have corroborated with both pre-CPM and post-CPM era legal position in the US courts on the matter. Precedential case law in the US in pre-CPM scheduling era can be seen in the case of *Sun Shipbuilding Company v United States, [1932] 76 Ct.Cl. 154, 188* which held "*...the rule is well settled that where both parties are responsible for the delay in completion of the contract and it is impossible to ascertain the true balance by setting off one against the other, no damages can be assessed*". Similarly, in post-CPM scheduling era in *Blackhawk Heating & Plumbing Co.,Inc. GSBCA No. 2432, 76-1 BCA 11,649 At 55,577, 1976.* it was held" *...where two parties are delayed in the accomplishment of the construction objective neither party should be allowed to profit from the delays of the other*".

Further, the US legal position as to concurrency seems implicitly corroborated with *'Malmaison'* approach. For example, in *R.P. Wallace Inc. v United States [2005] 21(5) Const. L.J.378* it was held:

> "*Concurrent delay is not fatal to a contractor's claim for additional time due to excusable delay, but precludes the recovery of delay damages. 'If a period of delay can be attributed simultaneously to the actions of both the Government and the contractor', this court has stated, there are said to be concurrent delays, and the result is an excusable but not a compensable delay;*"

Thus, it appears that the US courts have generally followed a policy that where no apportionment is possible the 'losses lie where they fall'. In *Caldwell and Drake v Schmulbach, [1909] 175 F.429, 434 C.C.N.D.W. VA.* the court observed *"how impossible it would be for a court to attempt to determine and apportion the cause of delay between the owner and contractor, both of whom are in default"*. As Bidgood *et al.* (2008, p.5) said, this articulated the concept of concurrent delay as *"that multiple parties contributed to an unsegregable delay"*. However, the general approach seems currently settled at apportioning if the parties are able to properly to segregate each cause of delay, the effects of the delay and the damage that result (Tobin, 2007). Pickavance (2005, p.646) cited many US cases stating *"In the US, some recent decisions by the courts and tribunals have overcome this problem by separating the costs and apportioning them to the responsible parties"* The references are given to *Freeman Darling Inc., GSBCA No 7,112 89-2 BCA para 21,882; Utley-James Inc., GSBCA No. 5,370 85-1 BCA para 17,816, 14 Cl Ct 804 (1985); Titan Pacific Construction Corp, ASBCA No.24,148 et al, 87-1 BCA para 19,828; Cline Construction Co, ASBCA No. 288, 84-3 BCA para 17,594.*

It seems, in concurrent delays, the SCL Protocol has taken a unified approach considering the '*Malmaison*' and the US case authorities as it accepts the contractor 's right to EOT as well as recovery of cost of employer caused delays if <u>segregated</u> from the costs of its own delays. In this regard, the SCL Protocol states:

> *"If the contractor incurs additional costs that are caused both by employer Delay and contractor Delay, then the contractor should only recover compensation if it is able to separate the additional costs caused by the employer Delay from those caused by the contractor Delay."*(Section 1.10.1).

Accordingly, while the contractor's entitlement is accepted in principle, the burden of segregating the employer caused cost is still passed onto the contractor for any success of the claim. This approach has high impact on the delays in a 'True Concurrency' where segregation is a much heavier burden (due to costs being so intertwined) than in the case of <u>sequential</u> delays occurring on parallel critical paths and having 'Concurrent Effects'.

As the Protocol upholds the entitlement to EOT for concurrent effects, the employer is not able to recover his LD (or 'penalty' in the UAE context) for that 'offsetting' time and the contractor is precluded from recovering the costs of his own concurrent delays. This approach appears to be in accord with the legal axiom that no party should benefit from its own faults and consequently, each party's losses lie where they fall.

It is observed that while accepting the contractor 's entitlement to apportion when he is able to segregate the costs, the US courts have not precluded the employer's right to recover unliquidated damages stemming from the contractor's culpable concurrent delays. For example, in *Acme Process Equipment v United States, [1965] 171 Ct. Cl. 324, 347 F.2d 509* it was reasoned that the government was not deprived of an opportunity to prove and recover its actual damages caused by the contractor's delay and it lost only its right to recover *'an artificial measure of damages'* agreed between the parties for a situation in which the contractor alone is responsible for the delay. Thus, this approach of the US courts seems fair and equitable to both parties, while maintaining the principle that 'no party should benefit by its own fault'. In this instance, the SCL Protocol currently has no provision or is silent as for the employer's right to recover unliquidated damages for the concurrent delay period. Thus, in a future update of the Protocol, the SCL may also have to consider for allowing the employer's right to recover actual costs (or unliquidated damages) opposed to the contractor's right to recover his actual costs (segregated from own delay costs) in a 'concurrency'.

Another issue related to apportioning in concurrency is a mistaken belief that once an extension of time has been granted it carries an automatic entitlement to the recovery of loss and expense (Gibson, 2008). This notion of 'automatic entitlement' to cost is generally submitted regardless of whether the EOT concerned is arising from concurrent delay situation or independent delays. Considering this issue, in *H. Fairweather and Co. Ltd v London Borough of Wandsworth [1987] 38 BLR 106*, it was held that EOT should not create an automatic right to payment for prolongation costs. The SCL Protocol also submits *"Entitlement to an EOT does not automatically lead to entitlement to compensation (and vice versa)"* (Section 1.6.2). It categorically rejects, as a common misconception in the construction industry, that when the contractor is entitled to an EOT then he is also automatically entitled to be compensated for the additional time that it has taken to complete the contract (Section

1.6.3). Thus, this position of rejecting any automatic linkage between entitlement to an EOT and the entitlement to compensation for that prolonged time is much consistent with the common practice where the contractor is always required to claim its entitlement to an EOT under one provision and claim to compensation for that prolongation under another provision (for example, forms of JCT, FIDIC 4th edition and FIDIC 1999 series which require claims for 'time' and 'cost' be made under different clauses).

In line with the three scenarios of concurrent delays considered in the above Table 4.1, the SCL Protocol's principles can be viewed as follows:

- Whether the Excusable Delay and Non-Excusable delay are in 'True Concurrency' or having 'Concurrent Effects' the contractor is entitled to EOT (SCL Protocol Sections 1.4.1 and 1.4.7). Further, as to compensation, Section 1.10.1 says:

  > *"If the contractor incurs additional costs that are caused both by Employer Delay and contractor Delay, then the contractor should only recover compensation if it is able to separate the additional costs caused by the Employer Delay from those caused by the contractor Delay."*

- For the scenario "compensable concurrent with non-excusable" the SCL position is that remedy is to be "compensable" but subject to segregation of costs caused by employer delay); Failing which it is "Excusable" only;

  This position of SCL Protocol is complying with many US cases cited above which have decided along with similar principles as to the entitlement to segregated costs. In *Coffey Construction Company Inc. VABCA No 3361, 93-2 BCA 25, 788 [1993]* this principle was summarised as : *"The general rule is that, where both parties contribute to the delay neither can recover damages, unless there is in the proof a clear apportionment of the delay and expenses attributable to each party. Courts will deny recovery where the delays are concurrent and the contractor has not established its delay apart from that attributable to the government."* In *Blinderman 695f 2d 552 [1982],* US Court of Appeals for The Federal Circuit allowed the contractor an extension of time where an excusable/ compensable delay occurred concurrently with a non-excusable delay but denied him financial recompense unless he met the burden of separating costs of its own delay.

- For the scenario "excusable concurrent with compensable" the SCL position for remedy is both "excusable" and "compensable"; (as both delays are caused by employer).
- Section 1.4.8 exempts EOT or compensation when the employer's Risk Event is non-compensable (i.e. excusable only) and concurrent with non-excusable delay <u>after</u> the contract completion date. If they occur <u>before</u> the contract completion date the principles under section 1.4.1 and 1.4.7 apply and the remedy is "excusable" only.

Therefore, for the scenario "excusable concurrent with non-excusable" the SCL position is: if it occurs before the contract completion date it should be "excusable"; if it happens after that date then it is "non-excusable".

The above position of SCL Protocol is consistent with the judgment in *Balfour Beatty Building Ltd. v Chestermount Properties Ltd [1993] 62BLR1 QBD.* In this case, HH Judge Colman was to consider whether a time-dependent event could have been avoided if the contractor had not been in culpable delay. He considered an example of a storm (an excusable delay) that flooded the site during a period of the contractor's culpable delay (non-excusable delay) and interrupted progress of the works. He decided that the flooding would have been avoided altogether if the contractor had not delayed the completion date. Also in *John Doyle Construction Ltd v Laing Management (Scotland) Ltd, [2004] BLR 295* case (though it was in favour of 'dominant cause' approach), the HH Judge Drummond Young found that when an excusable-non compensable delay was concurrent with non-excusable delay *"it may be appropriate to deny him* [contractor] *any recovery for the period of delay during which he is in default".*

Nash (2002) expresses hope that, as the case law is not yet certain, the SCL Protocol can be adopted to provide clear rules with regard to concurrent delay. Likewise, it may be expected that the SCL Protocol's effort would be a long step towards promoting a unified position and consensus on these issues.

4.2.4 The issue of 'Float Ownership'

A general definition of 'float' in programming terms is the time difference between a sequence of activities and the critical path. Thus, an activity can be started later than its early start date if a 'float' is present, but still without prolonging the completion date of the project. Here, the concerned type is the 'Total Float' which is the amount of time a task may be delayed without affecting the project 'completion' date. It is calculated by the time difference between early dates and late dates of an activity. That apart, there are three other types of float: Free Float- the amount of time which a task may be delayed without impacting upon the early start date of any of its successor; Independent Float – the amount of time which a task may be lengthened or delayed without impacting upon the early start date of any of its successors or latest start time of any of its predecessors; Interfering Float – the amount of time that, if expended, would decrease the float available to its successors.

While a 'Positive' float is the period an activity can slip before it will affect the completion date a 'Negative' float is a measure of how much 'behind schedule' an activity is at a given point in time. A positive float of a task would become negative when the earliest date an activity can take place is after the latest date by which the activity should have taken place so as not to cause delay to completion, or when activities which are constrained by an intermediate contract milestone date go beyond that date. (Keane and Caletka, 2008).

The issue of float ownership has been a much debated one, especially when a contract is silent about it. "*Under the type of contract that is silent or ambiguous about float, uncertainty exists and disputes are likely to follow*" (SCL Protocol; Section 1.3.4).

For the employer, the importance of the 'float' is in using it for changes during the project period. In any case, proper management of critical activities is a must in order to complete the project within the scheduled time, just as important is the management of non-critical activities and their associate float-time (Peterman, 1978).

For the contractor, the float is a valuable resource as he uses its flexibility for planning his tasks of the project. The contractors argue that float ownership should be with the contractor. Their main argument is that since they prepare the programme with necessary construction logic and resource allocation they carry a great risk to complete within the fixed deadline of contract time, and if something unforeseeable happen they intend to rely on the 'float' included for such purposes. Therefore, they need the exclusive use of float, as they say. Further, if employer owns it and uses before the contractor incurs any delay, then the contractor has no opportunity to adjust the programme and consequently ends up paying Liquidated Damages.

A position favorable to contractors may assert that the impact of excusable delays is to be measured from the 'early dates' in the schedule, but the impact of inexcusable delays is to be measured from the 'late dates' (Guy Ponce, 1986). Conversely, an interpretation favorable to owners may assert that no time extensions are warranted (nor associated delay compensation, if applicable) until all float available in the schedule is consumed. In other words, available float is to operate as a 'bar' to time extensions. This position was accepted by several cases in the US jurisdiction (For example, *Blackhawk Heating & Plumbing Co., GSBCA No. 2432, 75-1 BCA 11,261 [1975], Chaney & James Construction Co., Inc., FAACAP No. 67-18, 66-2 BCA 10,271 [1967], Santa Fe, Inc., VABCA No.1946 [1984]).*

On the employer's side, the main assertion based on the belief that, as the pay-master of the project they have already purchased the 'float' as they pay for the site overheads based on the contract period, and accordingly, any float within that contract period is belonging to them alone.

In *Glenlion Construction Ltd v The Guinness Trust [1987] 39 BLR 89* the issue of 'project float' was in the focus. The contractor had a planned completion date earlier than the contract completion date. In this situation, two questions were to be resolved:

1. Whether the employer was obliged to facilitate an earlier completion than the specified contract completion date; and
2. Whether the contractor was entitled to time and cost compensation for the employer delay which prevented achieving the planned completion date, although the contract completion date was not delayed.

HH Judge Fox Andrews QC said that the contractor was entitled to complete on an earlier date, whether or not it produced a programme with an earlier date and whether or not he was contractually bound to produce a programme, but there was no obligation on the employer to facilitate an earlier completion, nor had the contractor any entitlement to compensation if that earlier date was not enabled. Thus, the answers to both questions were negative, and the contractor's claim for compensation was rejected.

Though the UK courts have not yet explicitly decided the issue of how float in a programme should be treated, it is recognised under the US law that float is an expiring resource available to all parties (Nash, 2002). For example, in *Gassman Corporation, ASBCA Nos. 44975 and 44976 [1999],* the contract contained a provision that the float was not time for the exclusive use or benefit of either party but must be used in the best interest of completing the project on time. Similarly, the provision developed by the US Army Corps of engineers specified " *....float available in the programme at any time should not be considered as for the exclusive use by either [C] or [D]...* ". (Pickavance, 2005, p. 595)

When a contract is silent about this issue, as a fair solution, the SCL Protocol has taken the position that "*it to be consistent with current judicial thinking, which is that an employer Delay has to be critical (to meeting the contract completion date) before an EOT will be due. It has the effect that float is not time for the exclusive use or benefit of either the employer or the contractor*" (Section 1.3.6). According to this position, whether the 'point of criticality' is applied at the contract completion date (as per Total Float Value theory) or at the predicted completion date (as per Longest Path theory), no residual float should exist before an EOT is due.

The SCL Protocol's position that the float is there to be used by whichever party needs it first is consistent with recent the UK case law, although these cases did not have any in-depth analysis on the issues of float and criticality (For example, *Henry Boot Construction (UK) Ltd V Malmaison Hotel (Manchester) Ltd [1999] 70 Con L.R. 32; Ascon Contracting Ltd V Alfred McAlpine Construction Isle Of Man Ltd [1999] 66 Con L. R. 119; The Royal Brompton Hospital NHS Trust V Hammond And Others [2001] 76 Con L.R. 148* and *Motherwell Bridge Construction Ltd v Micafil Vakuumtechnik [2002] 81 Con L.R. 44).*

The RP-FSA (2007, 2011) considers that 'Network Float' is a shared resource but the 'Project Float' is owned solely by the contractor. RP-FSA (2007, RP no.29R-03, p. 95; 2011, RP no.29R-03, p. 121) states "*Project float is the time between the last schedule activity on the baseline schedule and the contractual completion date where the* *contractual completion date is later than the scheduled completion date. In this case, in the absence of contrary contractual language, project float is owned solely by the contractor".* [Emphasis added]. According to RP-FSA's above position delays to early completion programmes would result in contractors being able to recover additional time related overheads prior to the contractual date for completion. This is, however, limited to situations where early completion programme is in issue, and would not affect RP-FSA's general position as to the criticality being measured against the Longest Path driven schedule completion date. As Keane and Caletka (2008) submit this also reflects a fundamental difference between the UK law (for example, the "*Glenlion*") and the US law (for example, *Metropolitan Paving Co* v *United States* 325 F2d 241 Ct. Cl. [1963]) on the subject of early completion programme. However, it is noticeable that at least one form of construction contract, i.e. the NEC family, has adopted a position similar to RP-FSA's position on this issue. Clause 63.3 of NEC 3 Engineering and Construction Contract states *"a delay to the completion date is assessed as the length of time that, due to the compensation event, planned completion is later than planned completion shown on the accepted programme . . ."* As Eggleston (2006, p.271) submits *"It indicates that the contractor's entitlement to an extension of time for completion is judged by reference to the date of planned completion on his* [contractor's] *accepted programme. Any assessed delay beyond that date caused by a compensation event is added to the formal contract time for completion by adjusting the stated completion date. Thus, if the contractor has terminal float in his programme he retains that float".*

According to the foregoing, there seems to be a fundamental difference between the SCL Protocol and the RP-FSA on this issue of 'project float' (Keane and Caletka, 2008). However, it is noted that Section 1.12.1 of SCL Protocol has accepted in principle of the contractor's entitlement to the costs directly caused by the employer delay, if he is prevented from completing the works by his planned completion date, *"provided also that at the time they enter into the contract, the employer is aware of the contractor's intention to complete the works prior to the contract completion date, and that intention is realistic and achievable".* Accordingly, unlike the RP-FSA which accepts the contractor's ownership to the 'project float' (or the 'terminal float' as per NEC3 form of contract), the SCL Protocol allows (without referring to 'ownership') the direct costs of employer delay ***only if*** those conditions (i.e. employer's awareness of the contractor's intention to early completion, and that intention is realistic and achievable) apply.

Lowe *et al.* (2007, p.6), however, submitted *"Like the standard forms mentioned in the Protocol, none of the most widely used standard form contracts in the USA for private projects contains a provision addressing which party owns the float on a project. By contrast, most public contracts for substantial projects in the USA contain a provision specifying that the project owns the float."* Thus, it seems though there is no universal position maintained in the US industry yet, at least in the public sector forms of contracts some position has been taken with regard to the issue with the aim of avoiding it becomes a source of disputes between the parties.

It seems, generally, the basis for SCL Protocol on the issue of 'float ownership' is formed by the legal position of the decision in the UK cases such as *Ascon Contracting Ltd v Alfred McAlpine Construction Isle of Man Ltd [1999] 66 Con LR 119 (QB, TCC), Henry Boot construction (UK) Ltd v Malmaison Hotel (Manchester) Ltd [1999] 70 Con L.R. 32, The Royal Brompton Hospital NHS Trust v Hammond and others [2001] 76 Con L.R. 148 Titan Pacific Construction Corp. v United States 17 CI. Ct. 630 [1989], and Motherwell Bridge Construction Ltd v Micafil Vakuumtechnik [2002] 81 Con L.R. 44.* Having considered all three positions of SCL Protocol, RP-FSA and NEC 3 form of contract, it appears the latter two are more in favour of the contractors; comparatively, the SCL Protocol takes a more pragmatic position without giving exclusive right to ownership of 'project float' or 'terminal float' to either party as the default rule in absence of an express provision in the contract to that effect. It appears also more equitable and fair, because in a situation of a greater excusable delay, if the float is owned by the contractor, the more the project is delayed the more 'float' will be *created* for the contractor. Against such situation, Winter and Calvey (2008, p. PS.03.1) argued *"Where is the incentive to mitigate delay? Is this fair to the owner to have to pay for delays and still deliver even more float to the contractor at the same time?"*

4.3 Findings

The following can be considered as the main findings from the foregoing literature review:

<u>Issues on 'concurrent' delays and apportioning delay liabilities:</u>

- There is still no universal position as to the definition of 'concurrent' delays, which is the most perplexed issue in delay analysis and apportioning liabilities;
- There is hardly any convergent position between the experts' opinions on the issues

associated with remedies for 'concurrent delays';

- The legal position is also not certain in essential issues like how to apportion liabilities in concurrent delays (for example the judgment in '*John Doyle*' followed 'Dominant Cause' approach whereas many other recent cases decided on 'Malmaison' approach);
- Where both parties are in concurrent delays, it may be appropriate to deny the employer any entitlement to liquidated damages and deny the contractor any entitlement to loss and expense. However, it may also be appropriate not denying employer's right to recover unliquidated damages stemming from the contractor's concurrent delays (*Acme Process Equipment v United States, [1965]),* while the contractor is allowed to recover prolongation cost to the extent he is able to segregate (SCL Protocol, 2002);
- The uncertainty as to definition of 'concurrent' delays and applicable approaches to apportioning delay liabilities may lead to disputes over the outcome of a delay analysis. For example, if the delay analysis follow 'Longest Path' approach to quantify delay impact, only the delays occurring <u>at the same time</u> would be considered as concurrent delays (Wickwire *et al.,* 2003) and that will exclude any entitlement to either party from the concurrent effects felt at the same time by the delays occurring sequentially;
- It appears that the principles of SCL Protocol are consistent with the general legal positions (though with some exceptions like Scottish cases of '*City Inn*' and '*John Doyle*') in the UK, and also corroborated with the general position taken by the American courts in most of the key issues of 'concurrency'.
- The following principles are proposed by the SCL Protocol with regard to 'concurrent' delays and apportioning delay liabilities:
    - Where contractor delay to completion (i.e. "non-excusable" delay) occurs concurrently with employer delay to completion (i.e. "excusable and compensable" delay), the contractor's concurrent delay should not reduce any EOT due;
    - Where employer risk events and contractor risk events occur sequentially but have concurrent effects, here again any contractor delay should not reduce the amount of EOT due to the contractor as a result of the contractor delay;
    - Where an excusable but non-compensable employer risk event occurs <u>after</u> the contract completion date while the contractor is in a culpable delay, no EOT or compensation is due;

- The argument that because the contractor is going to be on site after the contract completion date for his own delay anyway, he should not be entitled to an extension of time for employer caused delays (unless they are caused only by neutral causes) is rejected;
- The 'but-for', 'dominant cause', 'First-in-line', 'Devlin' and similar approaches are rejected for dealing with apportioning liabilities in concurrent delay situations;
- The entitlement to EOT is an estimated prolongation and may not exactly be tallying with the actual prolongation at the completion of project; however, the compensation must be on the basis of actual costs only;
- There is no automatic entitlement to 'cost' where the contractor is entitled to EOT; If the contractor incurs additional costs that are caused both by employer delay and contractor delay, then the contractor should only recover compensation if he is able to separate the additional costs caused by the employer delay from those caused by the contractor delay;

- It is also found that the foregoing proposed by the SCL Protocol may be considered as the most coherent and unified set of views currently available as to the issues of 'concurrency' and apportioning delay liabilities, and are the most consistent with the legal position developed in the UK and US jurisdictions.

Issue of 'Float Ownership':

- There is still no universal position as to who should own the 'Float', whether it is the contractor or the employer or should it be belonged to the project for consumption by either party on 'first come, first served' basis. There are arguments for all three positions;
- If 'project float' (or 'terminal float') is owned by the contractor as suggested by RP-FSA (or NEC 3) then the contractor is entitled to EOT for all delays caused by the employer to the 'planned completion date' in the programme which may be earlier than the contract completion date;
- If 'float' (i.e. without differentiating to 'network float' and 'project float' or 'terminal float') is owned by the project as suggested by SCL Protocol, there will be no entitlement to EOT or LD unless all the 'float' is consumed;
- Accordingly, as submitted by SCL Protocol, under the type of contract that is silent or ambiguous about float, uncertainty exists and disputes are likely to follow;
- The current UK and US legal positions are based on that an employer delay has to be critical (to meeting the completion date) before an EOT will be due (e.g. the

'Glenlion' in the UK and *'Gassman'* in the US); According to this position, whether the 'point of criticality' is applied at the contract completion date (as per Total Float Value theory) or at the predicted completion date (as per Longest Path theory), no residual float should exist before an EOT is due. Accordingly, this general judicial thinking is in favour of that float is not for the exclusive use or benefit of either the employer or the contractor;

- Therefore, the SCL Protocol's position that the 'float' is there to be used by whichever party needs it first is consistent with the general legal position of the UK and the US (though with some exceptions).

4.4 Summary

This Chapter has reviewed in detail the literature based on published academic works, case law in the UK and US jurisdictions, and other references involving the areas of Categories of Delays, 'Concurrency', Approaches of apportioning liabilities; and 'Float Ownership'.

The findings of this literature review have been presented at the end of the Chapter covering the issues on 'concurrent' delays and apportioning delay liabilities, and the issue of 'Float Ownership'. The content of these findings has largely contributed to the necessary conceptualisation, and informed the forming of the structure for the interviews and the surveys as well as the proposed framework of improvements.

The next three Chapters will continue the literature review on the aspects of issue of 'critical path', pacing delays, entitlement after completion date, delay analysis methods and their application, along with prevention principle and conditions precedent, the procedural issues in claims presentation, determination and awarding process.

CHAPTER FIVE

5.0 Issue of 'Critical Path'

5.1 Introduction

The previous Chapter 4 has reviewed the literature related to apportioning the delay liabilities in detail. Once the apportioning of responsibility for delays is established, the delay analysis proceeds to the next most important aspect in assessing compensability, namely the determination of 'criticality' of delay effects. This Chapter presents a review of the literature as to the determination of 'criticality' or, more precisely, the issue of determining the 'critical effects'. It is also inextricably linked with the issue of the definition of criticality in analysing concurrent delays (Peters, 2003).

This review is based on published academic works, case law in the UK and the US jurisdictions, and other references involving the following areas associated with the issue of 'critical path':

> The definition of criticality (according to the two prominent schools of thought), its impact on concurrent delays, 'pacing' delays and the issue of entitlement after contract completion date.

At the conclusion, the Chapter has presented the findings of the literature reviewed on these areas.

5.2 Theory of 'Criticality' – The two schools of thought

5.2.1 Theory of 'Criticality' in Forensic Scheduling

A CPM programme's critical path is the Longest Path of logically connected activities which, when the individual time durations of each activity are added, equals the overall duration of the project. However, at any given time there could also be multiple critical paths along with this longest critical path (Galloway, 1993; Wickwire *et al.*, 2003).

Peters (2003) emphasised the inextricable link with the issue of the definition of criticality in analysing concurrent delays. This is due to that *"the definition of 'criticality' can be set to either all activities on the Longest Path, or alternatively, all* *activities with a float value less than zero"* (Keane and Caletka, 2008, p.198). The RP-FSA (2007, 2009, and 2011) has recognised and explicitly differentiated the fundamental differences between these two schools of thought, namely 'Longest Path School' (which is also called 'Lowest Value School') and 'Total Float Value School' (which is also called 'Negative Float' Theory' or 'Zero Float School'), as to defining the critical path. Acknowledgement and understanding of these differences are fundamentally significant for determining the entitlement to compensability in concurrent delays.

While the Longest Path of a CPM programme is perfectly capable to predict the project duration and the project completion date at a given time (depending on the accuracy of the baseline programme and the as-built input), it will not reveal the existence of all the other subordinate critical paths at that time (which are also critical to the contract completion date). As the project progresses, the Longest Path may change and a previously subordinate critical path may become the Longest Path. Thus, where two causes of delay are of different causative potency and according to Longest Path theory the longer delay is then regarded as the effective cause and the shorter or the subordinate one as ineffective. In other words, the minor cause is treated as if it were not causative at all (Marrin, 2002). This is because under the Longest Path theory, if an activity has a float, with respect to the Longest Path, in excess of a given delay, it can absorb that delay and, thus, no time extension will be required. In other words, a 'float' will be created by the longest negative float (of the Longest Path) for absorbing any delays in the subordinate (critical) paths; the mere fact that an activity has a negative float will not be determinative of its criticality.

However, on the other hand, if the 'criticality' is defined by 'Total Float Value' theory (or the 'Negative Float' Theory) all activities that have negative float (i.e. one or more unit below zero total float) are considered 'critical' (Jentzen *et al.,* 1994; Peters, 2003).

Accordingly, depending on which of the above approaches is followed, a 'critical delay' could be a delay which has caused (or which can be shown to be likely to cause) a delay to either the contract completion date or the predicted (project) completion date. These two definitions for 'criticality' obviously generate different or opposite outcomes in the apportioning of liabilities and the recovery of damages/losses.

5.2.2 Impact on concurrent delays

Once a constraint is allowed on the scheduled completion date that will alter one of the basic theory rules of Critical Path Method (CPM) scheduling (O'Brian and Plotnick, 2005). In doing so the late finish of the last activity becomes equal to the early finish of the last activity, and accordingly, if that last activity is delayed beyond that late finish date, the calculation of the Total Float will be a negative value. (As defined by SCL Protocol [in Appendix-A to the Protocol], 'Total Float' is "*the amount of time that an activity may be delayed beyond its early start/early finish dates without delaying* <u>*the contract completion date*</u>"). Thus, when a project is behind schedule, the network model may display negative float values. As explained above, this results from the fact that the earliest possible dates of performance for the activities are later than the latest dates by which they must be performed in order for the overall network to complete by the constrained contract completion date. In other words, the negative value is a direct indication of how many work days the schedule activity is behind schedule (RP-FSA, 2007).

Now, there arises the important question of definition of criticality:

> Whether all activities having total float less than or equal to zero are critical, <u>**or**</u> only those having the maximum negative float are critical?

The answer to this question holds the essential difference between the two schools interpreting the criticality of activity paths carrying negative float value. As viewed above, the 'Total Float Value School' maintains that all activities with negative float are, by definition, critical assuming the definition of critical path is anything less than total float of one unit (RP-FSA, 2007). On its part, the 'Longest Path School' insists that only the activity path(s) that carries the lowest value (i.e. the maximum negative values) is critical.

In order to understand further the fundamental differences between these two theories, it would be pertinent to see how they apply in a concurrent delay situation possibly giving contrasting or opposing results as to the entitlement of the parties. For this, two scenarios are examined below with reference to a graphical presentation in Figure 5.1.

- **Scenario no.1:** Longest path delay (in Path 1) is caused by the employer with a compensable delay and subordinate path delay (in Path 2) is caused by a non-excusable contractor delay.

  Outcome under 'Longest Path Approach': the contractor may consume negative float (created by longest delay of Path 1) as long as the contractor's subordinate path (Path 2) finished earlier than the employer's longest delay. He is not in a critical delay relative to the Predicted Completion Date which is set by the Longest Path, and also is entitled to recovery of extended overhead expenses for the entire length of the Longest Path delay.

  Outcome under 'Total Float Approach': Concurrent effect of delays is considered and the contractor is granted extension of time only for the duration of the effect of subordinate delay;

  Employer loses right to LD (or 'penalty' in the UAE context) and contractor has to forego extended overheads unless he can segregate costs from those caused by employer delay. The contractor, however, is entitled to both time and money (in the form of extended overheads) for the remaining non-concurrent period. In this outcome the employer does not have to compensate for extended overhead costs for the entire Longest Path delay period of employer's compensable delay.

- **Scenario no.2:** Longest path delay (in Path 1) is caused by the contractor with a non-excusable contractor delay and Subordinate path delay (in Path 2) is caused by the employer with a compensable delay.

  Outcome under 'Longest Path Approach': the employer may consume negative float (created by longest delay of Path 1) as long as the employer's subordinate path (Path 2) finished earlier than the contractor's longest delay. He is not in a critical delay relative to the Predicted Completion Date which is set by the Longest Path, and also is entitled to recovery of LD (or 'penalty') for the entire length of the Longest Path delay.

  Outcome under 'Total Float Approach': Concurrent effect of delays is considered and the contractor is granted extension of time only for the duration of the effect of subordinate delay; employer loses right to LD (or

> 'penalty') and contractor has to forego extended overheads unless he can segregate costs from those caused by employer delay. The employer, however, is entitled to recover LD (or 'penalty') for the remaining non-concurrent period. In this outcome the contractor does not have to pay LD (or 'penalty') for the entire Longest Path delay period of contractor's non-excusable delay.

The foregoing illustrates that if the 'Longest Path Approach' is adopted the delays on the other subordinate paths (which are delaying the contract completion date to a lesser degree than the Longest Path delay) are considered *non-critical* relative to the (prevailing) Predicted Completion Date. In this instance, the effect of subordinate concurrent delay would not permit to offset the compensability of the longest delay. However, if the 'Total Float Approach' is the one adopted then all the delays (in the longest and the subordinate path) are considered *'critical'* against the (prevailing) Contract Completion Date. In this case, the subordinate delay would permit to offset the compensability of the longest delay to the net extent of the concurrency (subject to segregation of costs). As submitted in the RP-FSA (2007, 2009, 2011), which approach is correct depends on which principles are considered. However, in the absence of clear contract terms, the legal position on which approach or theory to be followed to define 'criticality' is not yet clear even in the US where CPM based forensic schedule analysis is almost mandatory in delay claims resolution and given higher prominence than in any other jurisdiction. A famous landmark case among the US case authorities in this regard is *Santa Fe, Inc., VABCA Nos. 1943-1946. [1984]*. In *'Santa Fe'* there was a Liquidated Damages (LDs) clause in the contract and as the contractor delayed, LDs were imposed. The contractor appealed for a remission of LDs and sought extension of time. A section of the *'Santa Fe'* contract entitled 'Adjustment of Contract Completion Time' which stated as follows:

> *"Actual delays in activities which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network will not be the basis for a change to the contract completion date"*

The above provision was obvious that the 'criticality' had to be determined by the impact on the 'extended and predicted' completion date and not on the contract completion date. By virtue of this provision, the contract required to use 'Longest Path' approach to measure criticality. The contractor (*Santa Fe*), however, argued that the Total Float approach applied and that but for the Longest Path delays incurred by him, there were subordinate delays incurred by the Government and those delays also delayed the project. The contractor maintained that impact of changes on the unchanged work could not be demonstrated by the CPM rules and the government's reliance on rules was not applicable or just because *"all uncompleted work becomes negative and therefore critical, once the scheduled completion date has been reached".* He also argued *"...any work sequence or CPM path which runs past its contractually required completion date to be critical and any delays on those work sequences to be on the critical path".*

However, rejecting the contractor's argument that changes issued after the scheduled completion date automatically entitled it to a time extension, the Board stated that delays that did not affect and extend the ***predicted*** contract completion date should not be the basis for a change to the contract completion date. The contractor's arguments for negative float activities were rejected on the view that *"there is still a critical path represented by the negative slack activities with the highest numerical designation (for example -180 days versus -50 days), The activity chain representing the highest negative slack (for example, the -180 days) represents the longest chain of activities through the project in terms of time"* (Wickwire *et al.*, 2003, p.376).

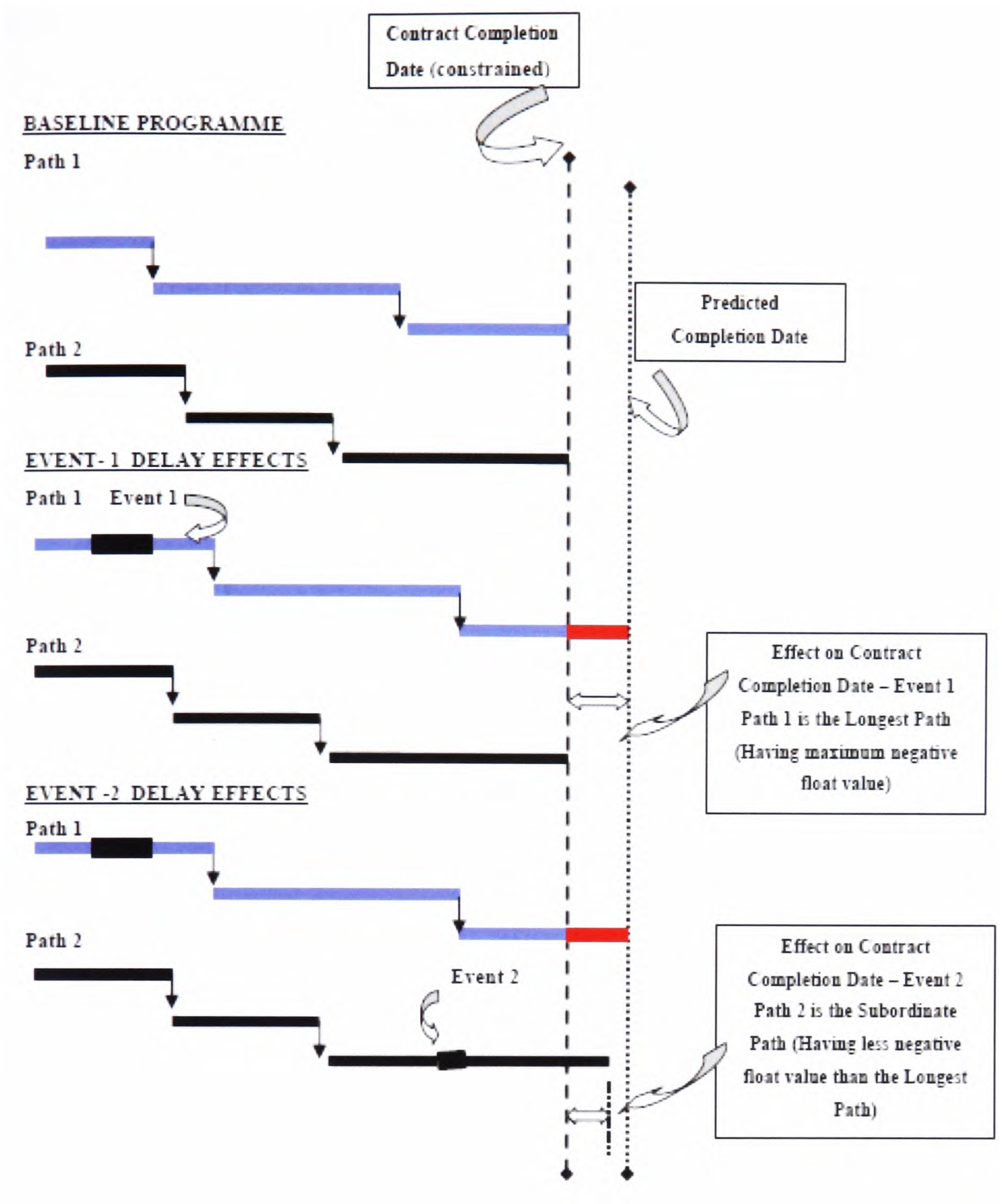


Figure 5. 1 Graphical Illustration of Delay Effects

So it seems the important issue is not when the change order was issued (whether before or after the contract completion date) but the impact that change had on the completion of the project. It could have been interesting how the '*Santa fe'* would have been decided if that specific provision was not present in the contract but the court did not make any comment on that aspect. Thus, Wickwire *et al.* (2003, p.377) suggested "*Santa Fe, Inc…may not apply to all cases because of the peculiar language in the Santa Fe contract requiring that the delay analysis show that the 'predicted' completion date was delayed*". In this context, however, there has been no suggestion from these learned authors or in any other published work what alternative method of delay analysis can be used if the contract is silent about the 'critical path' or, more particularly, if the contract requires the 'criticality' to be measured against the contract completion date, a situation which may conflict with the Longest Path theory and tend to be more in line with the Total Float theory. Thus, there seems to be a lacuna in this area and to fill that gap it may require a future research for developing suitable alternative analysis methods conducive to Total Float theory.

Bramble and Callahan (2000, p.11-88) explained the Total Float Value theory as follows:

> *"An activity that has used all its float and is thus late would be entitled to be used as an offset, regardless of the idiosyncrasies of the critical path, because it "affects" the project's completion date. This would permit a concurrent delay on an alternate path that is also late, but not on the critical path, to be used as an offset. In other words, in addition to the one critical path, any path with negative float may qualify as "critical" under this approach and be available to offset a claimed delay.....In the absence of delay to the one critical path, all other paths with negative float also would have caused delayed project completion".*

This position complies with another US case *Fischbach & Moore International Corp., ASBCA No. 18146, 77-1 BCA (CCH) 12,300 [1977]* which permitted simultaneous delays for a strike and subcontractor failure to offset the claimed delay, in view of even though the claimed delay was the most critical, other delays also had no float left and therefore were held critical. This judgment and the SCL Protocol principle with reference to float as it relates to extension of time are seemed mutually consistent.

Williamson (2005) views that tribunals [in the UK] will always be reluctant to conclude that there is concurrency and will confine such a conclusion to circumstances of 'true' concurrency. This seems to be the situation, considering the following paragraph stated by HH Judge Seymour Q.C. in the *The Royal Brompton Hospital NHS Trust V Hammond And Others (2001) 76 Con L.R. 148* case, which may be indicative that the UK courts still do not view beyond 'Longest Path' and hence are confined to 'True Concurrency':

> *"However, it is, I think, necessary to be clear what one means by events operating concurrently. It does not mean, in my judgment, a situation in which, work already being delayed, let it be supposed, because the contractor has had difficulty in obtaining sufficient labour, an event occurs which is a Relevant Event and which, had the contractor not been delayed, would have caused him to be delayed, but which in fact, by reason of the existing delay, made no difference. In such a situation although there is a Relevant Event, 'the completion of the Works is* [not] *likely to be delayed thereby beyond the Completion Date'."*

In this regard, the SCL Protocol submits that: "*Unless there is express provision to the contrary in the contract, where there is remaining float in the programme at the time of an Employer Risk Event, an EOT should be granted to the extent that the Employer Delay is predicted to reduce to below zero the total float on the activity paths affected by the Employer Delay*". (Section 1.3). [Emphasis added]. Also, in its definition to 'Delay to Completion', it says "*In common usage, the expression may mean either delay to the date when the contractor planned to complete its works, or a delay to the contract completion date. The Protocol uses the expressions Employer Delay to Completion and contractor Delay to Completion, both of which mean delay to a contract completion date.*." [Emphasis added]. Also, it maintains that "*...an EOT should only be granted to the extent that the Employer Delay is predicted to reduce to below zero the total float on the activity paths affected by the Employer Delay.*" [Emphasis added].

Accordingly, SCL Protocol has taken a position that, in absence of an express provision in the contract which may require otherwise, treating all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date. As the SCL Protocol defines the term 'Contract Completion Date as "*The date by which the contractor is contractually obliged to complete the works*" (Appendix-A to the Protocol, 2002), there seems no ambiguity in its position. These principles have been presented in the '***Figure 9:*** *Employer Risk Event on path 2 while contractor in unrecoverable critical delay on path 1*' of the SCL Protocol, which is reproduced below. It has clearly illustrated that the contractor's entitlement to EOT is based on the lesser or subordinate critical delay (on path 2) to Contract Completion Date.

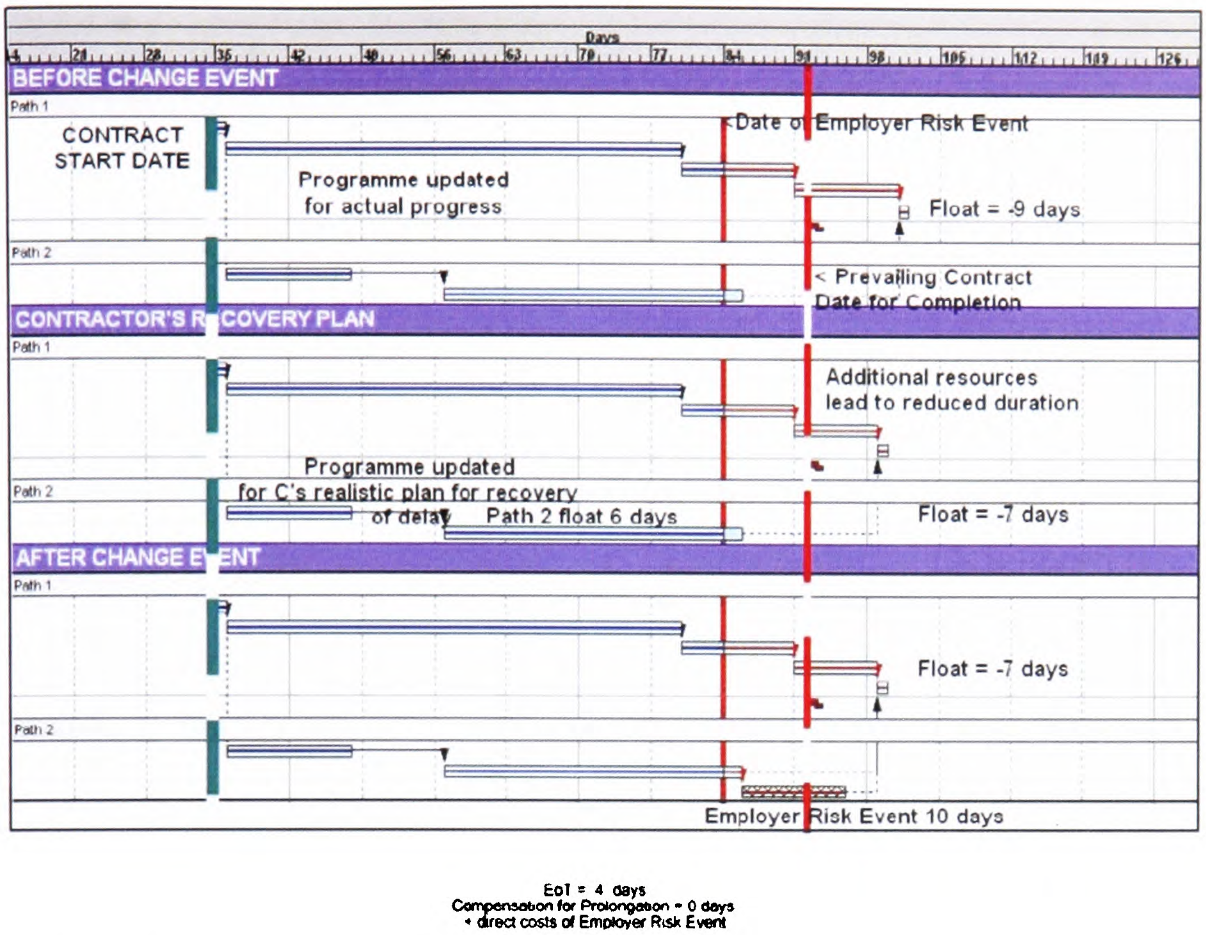


Figure 5. 2 SCL Protocol "Figure 9"

(Source – SCL Protocol, 2002)

However, contrary to the SCL Protocol, the RP-FSA (2007, 2009, and 2011) indicates the 'completion' is referring to scheduled completion, and not contractual completion. When the RP-FSA defines 'Critical' path, it refers to and means the 'Longest Path' to the 'predicted' completion date. This definition takes on a fundamental departure from the SCL Protocol (Keane and Caletka, 2008). However, RP-FSA (2007) accepts that *"the zero float school may have an arguable point if contractual considerations are brought into play, since all paths showing negative float are impacting (albeit not equally) the contractual completion date"* (2007, p87)

Thus, the foregoing discussion finds that in order to add certainty to the contract risk-distribution and for avoiding post-contract disputes the best solution is to conspicuously address the issue of 'criticality' in the contract itself. This is more important in the circumstances where the applicable terms define the 'criticality' of delays against a specific 'contract' completion date or against 'predicted' completion date. For example, assuming the contract requires dealing with EOT or LD issues against a specified contract completion date, in multiple critical paths situations the longest delay in one path will decide the criticality of the concurrent delay in a second path and will recognise this latter delay as critical only if it is equally potent or overtakes the former. Thus, using Longest Path approach under such circumstances seems to be causing understated or overstated results and most likely contradicts the contractual intention of the parties and also conflicts with the position that the contractor should not be deprived of its entitlement to EoT only because he is already in a culpable delay.

On the other hand, particularly in view of the above "Figure 9" and its supporting principles, the SCL Protocol owes to give further guidance as to the issue of 'criticality' in the perspective of the Longest Path and Total Float Value theory. This is particularly necessary as, referring to Time Impact Analysis, the "*Protocol recommends that this methodology be used wherever the circumstances permit, both for prospective and (where the necessary information is available) retrospective delay analysis*" (Section 3.2.11). Thus, such further guidance may have to identify such circumstances under which 'Time Impact Analysis' (which is generally used with Longest Path approach in the US) can be used along with the principles depicted in the Protocol's "Figure 9" above.

As Livengood and Peters (2008, p. CDR.06.14) argued, ensuring that the concurrency analysis is in harmony with the contract's definition of criticality is essential because "*Virtually all forensic delay methodologies provide for extensions of contract time on the critical path only*" and "*therefore, critical path definition is of utmost importance*".

5.3 'Pacing' Delays

As a connected issue to 'concurrency' and 'float', a 'pacing' delay can be found when a party makes efforts to get relieved from his obligation to a delay occurred stating that was a delay as a result of an expressed 'pacing'. The 'pacing' delays can be described as when one party (contractor or the employer) realises that there is or will be, on the critical path, a delay caused by the other party and decides to slow down (or decelerate) carrying out its obligations in an effort to keep pace with the other party's delay. Here the typical thinking of the 'pacing' party is "why should I hurry up and wait" when the other party's critical delay is ongoing.

RP-FSA (2007, p.84) defined a 'pacing' delay as:

> *"Concurrent delay occurs where another activity independent of the subject delay is also delaying the ultimate completion of the chain of activities. Pacing delay occurs when the delay in the independent activity is the result of a conscious and*

> *contemporaneous decision to pace progress against the subject delay. The quality that distinguishes pacing from concurrent delay is the fact that while the former is a result of conscious choice by the performing party to pace the work, in the latter case, work is involuntarily delayed by factors independent of any problems arising from the subject delay."*

Thus, typically 'pacing delays' occur in a period of concurrent delays. Hence, the difficulties normally inherent in concurrent delays, particularly in distinguishing the 'driving' activities in concurrent delays, are also common to 'pacing' delays. Accordingly, both the employers and contractors can argue that the delays caused by them were not to be considered relevant as the works were already in delays caused by the other party and there was no reason to hurry and wait.

Although it is not considered in depth in the UK courts, in the US, there have been several judgments given with reference to this concept. In the US case *John Driggs Company, Inc., END BCA No. 4926, 87-1 BCA 19833 [1987]*, the US Army Corps of engineers Board of Contract Appeals stated

> *"When a significant owner-caused construction delay.....occurs, the contractor is not necessarily required to conduct all of his or her other construction activities exactly according to the pre-delay schedule, and without regard to the changed circumstances resulting from the delay... The occurrence of a significant delay generally will affect related work, as the contractor's attention turns to overcoming the delay rather than slavishly following the now meaningless schedule".*

Similarly, in *Utley-James, Inc., GSBCA No. 5370, 85-1 BCA 17,816, aff'd, Utley-James Inc., v United States, 14 CL. Ct.804 [1988]*, the General Services Agency Board of Contract Appeals decided:

> *"Where the government causes delays to the critical path, it is permissible for the contractor to relax his or her performance of the work to the extent that it does not affect project completion".*

Referring to these US cases, Zack (1999, p.CDR.01.3) argued that this acknowledgement of the US legal system of the contractor's right to slow-down their works when faced with owner-caused delays is not illogical and the *"...courts appear to be simply acknowledging the fact that a contractor has the right to manage the project as he or she sees fit, in order to maximize his or her profit".*

In another Appeals Board decision in the US case *MCI Construction, Inc. 1996 DCCAB No D-294* it was stated,

> *"We agree with MCI that the delays attributed to MCI by the District were not critical path delays and generally come within the category of 'why hurry up and wait'".*

This case was a re-affirmation of a party's right to use a 'float' created by another party's delay when the Longest Path approach is used to decide 'criticality.

Yet, 'pacing delays' can be misused, abused and wrongfully applied as an excuse for failure to perform own obligations. However, a party which relies on 'pacing' argument with hindsight may be at risk when it cannot support that with contemporaneous records. Livengood and Peters (2008, p.CDR.06.15) argued *"Proof of pacing always falls to the party alleging the pacing. If a contractor alleges that it paced its performance to an owner's parent delay, the proof of such entitlement falls to the contractor. Conversely, if an owner claims that it issued a change order late because the contractor was itself late constructing an improperly designed condition that spotlighted the need for a change order, the proof of entitlement to pace falls to the owner".* Thus, where the contractor attempted to use 'pacing' delay argument, but could not prove with contemporaneous records that he could have completed the work but for the employer delay, had to do so at his own peril (*John Murphy Construction Co., AGBCA, No. 418 79-1 BCA 13,836 [1979]).* Though the main purpose of 'pacing' delay argument is that it can be used as a defense against offsetting compensability, attempting to use that argument (without the ability to prove it) may be construed as a self-admission of an own delay.

In a situation of an employer caused delay (i.e. excusable and compensable delay) the contractor would be entitled to compensation for the time difference between the actual project completion date and when the project would have been completed but-for the employer delay. Being in a 'pacing' delay running concurrent with such excusable delay, however, the contractor may expect to get compensation extended to part of the 'pacing' delay period as well, based on an argument that he is entitled to compensable delay from the time he should have (or would have) finished without the 'pacing' delay and up to the actual completion date.

Zack (1999) however, argued such claim recovery should be denied based on the following reasons:

- The contractor is entitled to compensation for the time between the actual completion date and when the project would have ended but-for the employer delay. However, to extend such compensation into the 'pacing' delay period means that the employer has to pay for hypothetical damages; the time involved in the 'pacing' delay is not easily calculated. *"If the contractor did not pace the owner's delay, who would say that, some other contractor-caused delays would not have arisen during the same period? ...To compensate the contractor for this type of delay is to compensate the contractor for a hypothetical delay or a delay that cannot be actually documented through a detailed schedule analysis"* (Zack, 1999, p. CDR.01.5);
- Considering the contractor's obligation to mitigate his damages, if he opts to decelerate he would have experienced some cost savings (i.e. lower production cost or decreased labor costs), and then to demand compensation for the pacing period would be a demand of 'over compensation';
- Pacing is a business decision (perhaps for own business needs) and a self-imposed delay;
- Pacing delay itself is a concurrent delay, and within the definition of 'concurrent delay' he is not entitled to compensable delay arising from a concurrent delay. (Note: However, this argument may not be sustained as the contractor's entitlement to 'segregated costs' in concurrent delays has been generally acceptable to both the UK and the US courts).

In order to rely on a 'pacing' delay the following is essential as described in RP-FSA (2009):

- If there has been no potential concurrent delays identified, 'pacing' argument is irrelevant;
- Existence of the Parent Delay:

  By definition, 'pacing' delay cannot exist by itself. It exists only in reaction to another delay and the parent delay must always precede the pacing delay. The existence of a parent delay is a mandatory requirement in legitimising a pacing delay;
- Showing of Contemporaneous Ability to Resume Normal Pace:

  Pacing is not realistic unless the party claiming it was pacing can show that it had the ability to resume progress at a normal, un-paced rate. Implicit in that party's ability to show that it could have completed the schedule activity on time if necessary is the fact that the party was able to reasonably determine or reliably approximate when the parent delay would end;

- Evidence of Contemporaneous Intent:

  The case can be further strengthened by showing that the pacing was a conscious and deliberate decision that was made at the time of pacing. Without a notice signifying contemporaneous intent to pace, the claimant can use pacing as a hindsight excuse for concurrent delay by offering after-the-fact testimony.

In fact, without the ability to show the contemporaneous ability and evidence of a conscious and deliberate decision at the start of the 'pacing', either side may throw its own 'pacing' delay claim at each other, leaving the position similar to asking which came first, the chicken or the egg.

5.4 Entitlement after Contract Completion Date

As the issue of the contractor's entitlement in concurrent delays occurring *before* the contract completion date is discussed in the foregoing, this section addresses that entitlement in concurrent delays occurring ***after*** the contract completion up to substantial completion date.

The decision made in *'Santa Fe'* case accepted the Longest Path approach and rejected the contractor's argument that changes issued after the scheduled completion date automatically entitled it to a time extension. This rejection was purely on the ground that a residual 'slack' (i.e. 'float') is generated by the Longest Path's maximum negative floats for the negative floats of the subordinate paths and as long as that longer negative 'slack' exists the effects of the subordinate paths would not impact the predicted completion date and hence they are treated as non-critical. On this basis, whether the change order is given before or after the contract completion date is *irrelevant*. The *'Santa Fe'* decision has been consistently followed by many cases in the US, which dictates that only delays that extend the longest critical path of a contractor delays will result in an entitlement to EOT after contract completion date. For example, in the case of *Electronic and Missile Facilities Inc., GSBCA No. 2787, 71-1 BCA 8785* case, following *'Santa Fe'* approach, the Board said,

> *"It is our view that where a change is ordered the extension of time is measured by the amount of delay attributable to the change, whether the change is ordered before or after the original contract completion date".*

Jentzen *et al.* (1994) submitted in this regard that in dealing with delays that occur after the expiration of the contract time *Santa Fe, Inc* offered a refinement to the law for holding that only those delays that cause an impact to the predicted completion date shall be considered for time extensions. The refinement referred to here is the consideration that delays which occur after the expiration of the contract time have *no* difference to those delays that occur before the expiration of the contract time. As '*Santa fe*' held "*the important issue is not when the change order was issued, but the impact that change had on the completion of the project*".

However, this position of *'Santa fe'* as to the entitlement to EOT seems to be contrasting with the SCL Protocol position on the matter. (It must be noted that *'Santa fe'* was decided mainly on the "*peculiar language in the Santa Fe contract requiring that the delay analysis show that the 'predicted' completion date was delayed*" (Wickwire *et al.* (2003, p.377). The SCL position which is illustrated in its "Figure 9" clearly shows that the contractor's entitlement for the excusable delays occurring after contract completion date (while he is in a culpable delay) is based on the negative float on a subordinate path (path 2), which is <u>shorter</u> than the prevailing longer delay on the Longest Path (Path 1). Accordingly, the Section 1.4.8 of the SCL Protocol submits

> *"Where an Employer Risk Event occurs after the contract completion date, in a situation where failure to complete by the contract completion date has been caused by contractor Delays, the principle set out in Section 1.4.7 above should apply, ... Where an EOT is due after the contract completion date, the Employer Risk Event does not exonerate the contractor for all its delays prior to the Employer Risk Event occurring. The effect of the Employer Risk Event should be assessed as described above and any EOT found due should simply be added to the contract completion date".*

Thus, the SCL Protocol accepts entitlement to net effects of an employer delay occurring after passing the contract completion date and while there is a contractor's culpable delay, and does not go by the *'Santa Fe'* decision and the 'residual float' created by the Longest Path for the subordinate paths (if the employer delay is occurring on a subordinate path) to deprive the contractor's right to EOT against the employer's change ('prevention') act. SCL Protocol further confirms

> "*Finally, the Protocol's position on concurrency prevents an Employer or CA taking advantage of a contractor's delay after the contract completion date to issue instructions and make changes without having to give an EOT. It cannot be correct that an Employer should be able to charge the contractor with LDs*

at a time when the contractor is carrying out extra work ordered by the Employer or CA". (Section 1.4.13).

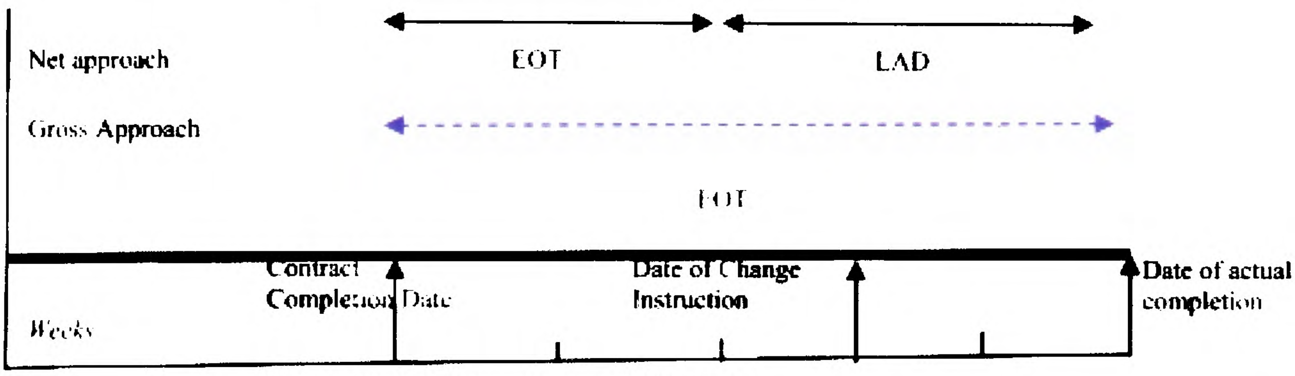
In its position as to the 'net effects', the SCL Protocol seems to have followed the *Balfour Beatty v Chestermount Properties [1993] 62 BLR 1* decision. In this case, unlike in the '*Santa Fe*' , the contractor's entitlement to EOT for the employer's changes instructed after passing contract completion date (while the contractor is also in a culpable delay) was not an issue in dispute. However, among the other issues, the concern was on the basis of the quantum of that EOT. The contractor's approach was 'gross' method of calculation and the employer's was the 'net' approach. The contractor argued that issuing a variation during a period of culpable delay was to make time at large, and the contractor was left to complete within a reasonable time only, and the employer would lose the right to deduct LD. HH Judge Colman looked at what he called the 'underlying realities' of the situation. It was held that the proper meaning of the contract was that it required EOT to be measured by reference to what had actually happened. Accordingly, it was decided that if an event had occurred which caused a particular period of delay that was the EOT which should be granted. Thus, the 'gross' approach was arbitrary and EOT based on that approach would have no relationship to the actual period of delay. Thus, only the net (the actual) excusable delay period was awarded and that period was simply added to the prevailing contract completion date. The contractor argued that if the 'net' approach was adopted the extended net period would expire even before the variation giving rise to the EOT had been instructed, and that was physically impossible and illogical. However, HH Judge Colman held that even if the net extension was to expire before the date of instruction of change it was the right approach. Accordingly, the contractor's expectation to get relieved from the whole of the LAD for his own culpable delay through receiving EOT up to the completion of the varied work was not allowed.

'Balfour Beatty' seems to have considered a decision of an earlier case *Amalgamated Building contractors Ltd v Waltham Holy Cross UDC [1952] ALL ER.* In the '*Amalgamated*' it was held that the contractor was to entitle the net excusable delay and no EOT for the earlier delays of the contractor's own. Likewise, in *McAlpine Humberoak v McDermott International [1992] 58 BLR 1at 55,* the Judge rejected the argument for 'gross' approach stating "*..if a contractor is already a year late through his culpable fault, it would be absurd that the employer should lose his claim for unliquidated damages just because, at the last moment, he orders an extra coat of paint".* Consequently, as SCL Protocol holds (see Section 1.4.8 quoted above), only the net EOT found is simply added to the contract completion date.

The net and gross approach as dealt with in '*Balfour Beatty*' is illustrated in the Figure 5.3 below (Note that the added net effect of EOT expires even before the date of instruction).

Based on the foregoing discussion, it appears that the contractor's entitlement in concurrent delays occurring after the contract completion date is intrinsically decided by the definition given to the issue of 'criticality' as discussed previously. Thus, if the criticality is decided by Longest Path approach, obviously, the entitlement in principle will have to be decided similar to the approach taken in the '*Santa fe*' and consequently will be dictated by only if such delays extend the longest critical path of a contractor delays.

Figure 5. 3 Net and Gross Approach



Source: Modified from Carnell (2005, Fig.4 :)

a) Actual excusable delay period 2 weeks started from end of 3rd week since contract completion date.
b). Contractor's culpable delay total 5 weeks since contract completion date.
C) Net Approach = EOT 2 weeks. LAD 3 weeks;
d) Gross Approach – EOT 5 weeks (up to end date of excusable delay period). LAD 'zero'

If the approach is similar to the principles depicted by "Figure 9" of the SCL Protocol, it will be decided complying with the 'preventive principle' and the limitation arising from Longest Path approach is irrelevant. In summary, however, whether the criticality is defined by the predicted completion date (Longest Path) or the contract completion date (Total Float Value theory) is a matter for the terms of the contract applicable to a given project. As Atkinson (2007, p.6) pointed out *"Liability in contract will depend upon the terms of the contract and the intention of the parties"*. Thus what is in the contract will finally decide which way to go with regard to the contractor's entitlement in concurrent delays occurring *after* the contract completion date.

5.5 Findings

The following are the main findings from the foregoing literature review:

Determination of 'criticality' of delay effect

- There is still no universal position as to the question of definition of criticality that whether all activities having total float less than or equal to zero are critical (Total

Float Theory), or only those having the maximum negative float are critical (Longest Path Theory);

- Even in the US legal system, which has considered the forensic analysis issues more in depth than any other legal system, the position seems to be varying (e.g. the *'Santa fe'* and *'Fischbach & Moore');* on the other hand, generally, the UK courts seem to have currently confined to 'true' concurrency concept, and therefore unable to view beyond the 'Longest Path' approach.
- These two definitions for 'criticality' obviously generate different or contrastive outcomes in the apportioning of liabilities and the recovery of damages/losses; thus, if the contract is silent about defining the 'criticality' that may lead to a dispute situation in the delay analysis and hence delay claims resolution;
- SCL Protocol has taken a position that, unless the terms of contract require otherwise, to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date.
- However, contrary to the SCL Protocol, when the RP-FSA (2007, 2009, and 2011) defines 'Critical' path, it refers to and means the 'Longest Path' to the 'predicted' completion date.
- Accordingly, whether to use the 'Longest Path Theory' or the 'Total Float Theory' is a matter for the terms of the contract; in order to add certainty to the contract risk-distribution and for avoiding post-contract disputes the best solution is to conspicuously address the issue of 'criticality' in the contract itself. This is more important where the applicable terms define the 'criticality' of delays against a specific 'contract' completion date or against 'predicted' completion date or otherwise.

'Pacing' Delays

- A 'pacing' delay can be found when a party makes efforts to get relieved from his obligation to a delay occurred stating that was a delay as a result of an expressed 'pacing'; it is a based on the thinking 'why to hurry and wait';
- In the US courts this concept has been given acceptance, though in the UK it seems not considered in depth.
- Pacing delays can be misused and wrongfully applied as a global excuse for a failure to perform;
- In order to prevent such abuse the following conditions can be applied:

- ➢ The claiming party has to show that it had the contemporaneous ability to resume progress at a normal, un-paced rate and it could have completed the schedule activity on time if necessary;
- ➢ The claiming party has to submit evidence of contemporaneous intent (e.g. giving 'notice' to that effect) for showing that the pacing was a conscious and deliberate decision that was made at the time of pacing.

<u>EOT after completion date</u>

- Where 'Longest Path' approach is used, there will be no automatic entitlement to EOT for an employer caused event on a subordinate path while the contractor is in a culpable delay on the Longest Path; accordingly, EOT is due only when the delay impact of the employer event exceeds the contractor's delay on the Longest Path;
- The SCL Protocol accepts entitlement to EOT for an employer delay occurring after passing the contract completion date and while there is a contractor's culpable delay ("Figure 9" of the SCL Protocol); however, the employer risk event does not exonerate the contractor for all its delays prior to the employer risk event occurring. The net effect of the employer risk event should simply be added to the contract completion date;
- Like in the case of other issues, there should be clear contract terms as to the party's intention on this issue. If the contract is silent then SCL position is fair and reasonable as it is reflecting the current legal position in the UK (*"Balfour Beatty v Chestermount"*); however, if the criticality is decided by Longest Path approach, the entitlement in principle will have to be decided similar to the approach taken in the '*Santa fe*' and consequently will be dictated by only if such delays extend the longest critical path of a contractor delays.

5.6 Summary

The foregoing has discussed in detail the literature based on published academic works, case law in the UK and US jurisdictions, and other references involving the areas of the definition of criticality (according to the two prevailing schools of thought), its impact on concurrent delays, 'pacing' delays, and the issue of entitlement after contract completion date. These areas are associated with the issue of 'critical path'.

The findings of this literature review have been presented at the end of the Chapter. The content of these findings has largely contributed to the necessary conceptualisation and informed the forming of the structure for the interviews and the surveys as well as the proposed Framework of improvements.

The next two Chapters will continue the literature review on the aspects of delay analysis methods and their application, the Prevention Principle and Conditions Precedent, and the procedural issues in claims presentation, determination and awarding process.

CHAPTER SIX

6.0 Delay Impact Analysis

6.1 Introduction

The previous two Chapters (Chapters 4 and 5) have reviewed the literature mainly related to the theory and concepts of the apportioning delay liabilities. This Chapter 6 presents a review of literature related to the methodology of delay analysis that is used for quantifying the apportioned liabilities.

It first presents an overview of five major Methods of Delay Analysis (MDAs), with a detailed account of their respective strengths and weaknesses. The MDAs reviewed are four primary methods, namely As-planned v As-built [APvAB], Impacted-As-Planned [IAP], Collapsed-As-Built [CAB] and Time Impact Analysis [TIA] followed by Global Claims method which is also popular among the contractors. The review of MDAs is followed by a review of the literature addressing the factors those are to be considered in the selection of an appropriate MDA under given circumstance of a Project.
The findings of the current review are outlined at the conclusion of the Chapter.

6.2 Methods of Delay Analysis

6.2.1 An Overview, Strengths and Weaknesses

For all delay analyses there are three primary reasons for their use: 1) Establishing a line of investigation; 2) Demonstrating entitlement, and 3) Presenting the case, one is seeking to prove (Farrow, 2001). According to Baram (2000), all delay analysis methods can be categorised as (i) 'forward approach' (e.g., Impacted-As-Planned, As-planned v As-built, Time Impact Analysis and various Window methods) or (ii) 'backward approach' (e.g., Collapsed-As-Built or 'But-for'). Most of these methodologies are variations on two methodologies of very different two principal schools of thought regarding forensic schedule analysis: methodologies that model actual project events through computer simulation, for example the Time Impact Analysis (TIA) method, and methods based on the observation of actual events, for example the As Planned vs. As-Built (APvAB) method (Livengood, 2007a).

Keane and Caletka (2008) identified 4 primary analysis methods with their more commonly applied secondary derivatives, as follows:

Table: 6. 1 Categories of MDAs

General Approach	Primary Method	Secondary Derivative Methods
Additive	**Impacted As-Planned**	Chronological Addition of Delays (one at a time): Gross Addition (all delays at once)
	Time Impact Analysis	Chronological Event Analysis; Watershed Analysis: Window Analysis; Contemporaneous Impact Analysis
Subtractive	**Collapsed As Built**	Chronological Insertion* *[sic]* of Delays (one at a time): Gross Insertion* *[sic]* (all delays at once); Windows Analysis (delays in each window)
Analytical	**As-Planned v As-Built**	Contemporaneous Float Mapping; As-Built Critical Path Deduction; Total Time Claim (gross difference); As-Planned vs Contemporaneous Updates; Gross Time Reconciliation (total time claim)

(Source: Keane and Caletka, 2008) *This must read as "Extraction" according to RP-FSA (2007)

These four primary methods are considered, generally, the mostly used MDAs in the delay claims resolution. The following discussion presents an overview, and strengths and weaknesses for using as suitable MDAs of these four methods, together with the 'Global claims' approach which is popular particularly among the local contractors.

Impacted As-Planned (or As Planned Impacted) - **IAP**

Some experts call this methodology as Time Impact Analysis (TIA), and that may mislead the reader into believing that actual events are fully considered though it is not the case (Livengood, 2007c). IAP is a 'what-if' methodology. The shortcomings of such methodology are many, which lead to disputes over its inadequacy to deal with delays in due manner. On this, Finke (1997, p27) argued that "*simply incorporating excusable delay after excusable delay into an as-planned schedule may ignore both the effects of nonexcusable delays and the contractor's obligation to reasonably reschedule work to mitigate the effects of excusable delays*".

Although the method may be used where the construction logic is not changed significantly, any variance between the critical paths of as-planned and actual schedules will cast doubt on the IAP. In *John Barker Construction Ltd. v London Portman Hotel Ltd. [1996] 83 BLR 31* the Judge expected the IAP programme analysis to be consistent with actual events. *In Henry*

Boot construction (UK) Ltd v Malmaison Hotel (Manchester) Ltd (1999) 70 Con L.R. 32 it was held that the IAP programme approach adopted by Henry Boot was not realistic and failed to provide an accurate and logical analysis of delay. In *Ascon Contracting Ltd v Alfred McAlpine Construction Isle of Man Ltd (1999) 66 Con L. R. 119(TCC)* HH Judge Hicks QC recognised that the logic of the programme may change as events unfold, and therefore, the causative analysis may no longer be valid for the resulting causes of delay to completion. In *Great Eastern Hotel Company v John Laing Construction Ltd. EWHC 181, TCC [2005]*, IAP was criticised for giving rise to a hypothetical answer. In this context Lucas (2002, p.30) observed *"The impacted as-planned approach which was widely used and accepted in the 1970s and early 1980s is seldom used at this time and almost universally rejected by the courts"*. Though this observation may be true, at least in the US courts (for example, *Gulf Contracting, ASBCA No. 37,939, 94-2 BCA Para26.726 [1994]*), it remains to be probably the most common analysis technique used by contractors on most projects (Livengood, 2007e). Thus, IAP continuously appears in text books and professional Protocols like SCL and RP-FSA as one of the primary MDAs in use.

Although it is not favoured, RP-FSA (2007) identifies this in its taxonomy as a 'Modelled/Additive/ Single Base (MIP 3.6)' method. SCL Protocol arguably suggests that together with APvAB method, this is *"the cheapest and the simplest method of analysis"* (2002, p.48). IAP takes the as-planned schedule and adds new activities which represents generally the other party's delays, contractor's or employer's (depending on who uses the method), to demonstrate why the project was delayed beyond the completion date (Zack, 2001).

The theory in IAP is that *"if you add all of the owner changes to the contractor's original plan, you'll end up with the earliest date the project could have been completed due to the added work"* (Fruchtman, 2000, p. CDR.06.3).

Generally, IAP is not considered for demonstrating concurrent delays, as *"in its minimum implementation, concurrency cannot be evaluated by this method"* (RP-FSA, 2007, p.61). However, RP-FSA (2007, 2009, and 2011) recognises that IAP can be used to identify a limited evaluation of concurrent delays (i.e. "approximate concurrency").

A brief overview of the RP-FSA (2007) suggested process is as follows:

1. Establish contractually complied as-planned schedule, which includes, at a minimum, original scope of planned activities, their relationships, durations, and any contractual milestones ;
2. Create one additive model by inserting all owner-caused impact events into the baseline (say EDE-IAP);
3. Create another additive model by inserting all contractor-caused and *force-majeure* caused impact events into the baseline (say CDE-IAP);
4. Compare the two resulting schedules. To the extent that the EDE-IAP and CDE-IAP net delay-effects beyond the baseline completion date overlap there is a concurrency.
5. If CDE-IAP result is greater than EDE-IAP result then there is no compensable delay; If EDE-IAP result is greater than CDE-IAP result then the difference between the two is the period of compensable delay (up to the extent it does not exceed the actual completion date).

The advantages and disadvantages of this MDA, as identified in RP-FSA (2007) are indicated in the Table 6.2 below:

Table: 6. 2 IAP method- Strengths and Weaknesses

Strengths & Advantages	Weaknesses & Disadvantages
Easy to understand	Because it does not rely on an as-built schedule it is perceived as an analysis based on a purely hypothetical model
Does not require as-built programme	Cannot, by itself. account for concurrent delays
Can be implemented relatively easily and quickly compared to other methods	-

Source: RP-FSA (2007)

Time Impact Analysis –TIA

RP-FSA (2007) identifies this in its taxonomy as a 'Modelled/Additive/ Multiple Base (MIP 3.7)' method. For many experts, the TIA is the most desirable approach to handle a delay claim, as long as data and source documents are available in the required format and at the required time frame (Baram, 1994). The SCL Protocol (2002, Section 4.8) also views *"It is also the best technique for determining the amount of EOT that a contractor should have been granted at the time an Employer Risk Event occurred"*. However, TIA has a limitation that it establishes only the projected, and not actual, delay to the project completion (Fruchtman, 2000). SCL Protocol (2002, Section 4.8) agrees that the amount of EOT may not precisely represent the actual delay (and it is based on the effect of delay events on the contractor's intentions for the future conduct of the work in the light of the actual progress achieved at the time of the event), but argues "*that does not mean that time impact analysis generates hypothetical results – it generates results showing entitlement*". Thus, TIA is to be understood as showing the estimated entitlement to EOT (based on the actual circumstances of the progress of works at the time of the occurrence of delay, whether the analysis is carried out prospectively or forensically) and not the actual entitlement. In fact, TIA is an evolution of the IAP method, and the difference between the two is the use of multiple base programme in TIA as opposed to a single base (i.e. single baseline) in the IAP (RP-FSA, 2007; Keane and Caletka, 2008).

Although TIA provides a systematic and objective MDA since it considers the effect of the delays in the context of time and CPM schedule, there are still a few downfalls. The method does not scrutinize delay type prior to the analysis, therefore further analysis to apportion entitlement is required; also the concurrent delays are not immediately addressed necessitating further analysis to address it. It may become too cumbersome if there is an overwhelming amount of delaying events (Alkass *et al.,* 1996).

The foregoing literature review finds that among the static and dynamic MDAs, TIA is considered by the courts and experts of a relatively higher objectivity and credibility than the other MDAs. However, TIA is also not for any blind-use. Like any other analysis technique, for its validation, certain preconditions should exist without which the outcome of the delay assessment by TIA will not produce valid basis for determining the criticality (or non-criticality) of a delay. The typical problem in the current practices amongst the analysts in Dubai (or elsewhere) is that ignorance or neglecting of these essential conditions and using TIA somewhat recklessly and blindly. The fundamentals of these essential conditions are well set out in the US legal cases such as the famous *'Fortec'* case, and others like *'Continental Consolidated Corp.'*, *'J.A. Jones Constr. Co.'* and also in *'Santa-fe'* (albeit in a different context).

In the decision of *Fortec Construction v United States (8 CL. Ct. 490 (1985)* the United States Claims Court recognized that control of a project, as well as the extension process, is lost if the parties do not update the CPM programme to properly reflect delays and time extensions. In this context, the *'Fortec'* found the following grounds to reject the delay analysis based on the CPM Longest Path approach:

> *"....The critical path changed from that depicted on the CPM diagram introduced into evidence. The Corps, however, refused to grant timely and adequate time extensions*

> *and to authorize revisions to the CPM to reflect the changed performance critical path. As a result, it is impossible to determine from the CPM diagram whether a particular activity was critical or noncritical, on schedule or behind schedule. Further the Corps failed to even consider several of Fortec's requests for additional compensation and time extensions until after the project was completed. Fortec could not update the CPM without receipt of modifications from the Corps adding the additional work, and then only with the concurrence of the Corps as to the time to be added...Accordingly, Fortec was unable to update the CPM during construction. This inability, caused by the Corp's failure to act in a timely fashion, should not now be used as a sword against Fortec.*
>
> *"Reliance upon an incomplete and inaccurate CPM to substantiate denial of time extensions is clearly improper... "*

This same issue of lack of updating the CPM programme of the actual status at the time of delaying event, and the failure to award EOT promptly and *immediately upon determining the extent of the delay* were the main reasons for the rejection of the delay analysis based on CPM Longest Path, in several other cases in the US courts. In *Continental Consolidated Corp., ENGBCA Nos. 2743, 2766, 67-2 BCA 6624(1967)* the Army Corps of Engineer's Board of Contract Appeals held that if the CPM is used to evaluate EOT it must reflect actual project conditions. In the "*Continental*" the contractor sought extra costs incurred due to suspensions of work and due to subsequent acceleration and the Government claimed that acceleration was justified, since the CPM revealed the project was behind schedule. The board rejected the Government's reliance on the CPM, stating that:

> *"It is essential that any changes in the work and time extensions due to the contractor be incorporated into the progress analysis <u>concurrently</u> with the performance of the changes or immediately after the delay and thus integrated into the periodic computer runs to reflect the effect on the critical path. Otherwise, the critical path chart produced by the computer will not reflect the current status of the work performed or the actual progress being attained.*

Since adequate time extensions were not granted immediately upon determining the extent of the delay and updated the programme accordingly, the Board found that the CPM's completion schedule was distorted and unreliable as a basis for denying time extensions.

Also in *J.A. Jones Constr.Co., ENGBCA Nos. 3035, 3222, 72-1 BCA 9261*, the Army Corps of engineers Board of Contract Appeals (ACEBCA) reiterated similar concerns that the CPM must reflect actual performance to be a reliable basis for evaluating EOT. On that ground, the board rejected the Government's reliance on the original, unadjusted CPM, stating that:

> *"The value and usefulness of the CPM... is dependent upon the Contracting Officer making prompt decisions when excusable delays are alleged by the contractor and upon the contractor promptly revising and updating the CPM chart to incorporate time extensions, whether they are tentative or finally determined, within a short time after occurrence of the delay".*

These US cases clearly indicate that failures in updating the CPM programme of the actual status at the time of delaying event, grant of adequate EOT for the contractor's entitlement and particularly prompt awarding of EOT and incorporating that in contemporaneous updating of the CPM programme can be fatal to the validity of using TIA in delay analysis.

The theory in TIA is *"revise the schedule after each update to reflect any changes and/or impacts to determine the effect on the projected project completion date"* (Fruchtman, 2000,p. CDR.06.3). Thus, for each change a 'fragnet' is developed to represent the change (event) and incorporated into the current schedule and calculated. This is done once prior to and then after incorporating the 'fragnet'. Any difference between the two calculations would determine whether there is any impact on the completion, attributable to the event.

Keane and Caletka (2008) summarised the steps of application of TIA. Accordingly, the following measures are applied once all delays are listed, liability assessed for each delay event, and progress data obtained for all activities in the programme at the point immediately prior to (or close as reasonably possible to) each subsequent delay commencement date:

1. Create a series of TIA base programmes using updated contemporaneous progress programmes closest to each commencement date;
2. Tabulate the data-dates and the projected completion date of each of the base programmes prior to inserting any of the delay events; copy, rename and save each of these base programmes for impacting;
3. Prepare 'fragnet' for each delay event; this can be a subset of activities for a 'fragnet' or a single activity; use actual durations if TIA is done retrospectively (for reducing theoretical nature), or estimated durations if done prospectively; identify predecessor

and successor activities in the baseline programme for relating the 'fragnet' or the single activity;

4. Insert each of the fragnets, one at a time, chronologically, into respective baseline programmes, separately for Employer Delay Events (EDE) and contractor Delay Events (CDE) or they can be considered in the same base calculation if chronologically appropriate;
5. If a CDE and EDE commence on the same date it requires creating three separate models on the same date to identify concurrent delays for impact of EDE impact, CDE impact and combined EDE and CDE impact;
6. The calculated change to the completion data (loss or gain) for each successive delay event is tabulated and inserted chronologically (according to date of impact) into a Table;
7. Cumulative loss, or gains, are determined for EDE, CDE and concurrent periods;
8. Any anomalous results are reviewed, identified and, where corrections are deemed necessary, the process is repeated as required.
9. TIA can also incorporate 'neutral' events (e.g. force majeure) and weather impacts; they are treated the same as concurrent delays in TIA model.

The advantages and disadvantages of this MDA, as identified in RP-FSA (2007) are indicated in the Table 6.3 below:

Although the method is based on the as-planned programme it attempts to avoid criticism pointed to IAP by correlating the planned programme with actual progress. TIA based analysis provides the consequences of an event on the assumption that future (remaining at the time of occurrence of the event) activities of the programme will proceed as-planned (as originally intended).

Table: 6. 3 TIA method- Strengths and Weaknesses

Strengths & Advantages	**Weaknesses & Disadvantages**
Easy to understand	Does not rely on as-built schedule (like CAB method), and therefore perceived as an analysis based on a hypothetical model
Does not require an as-built schedule	Cannot, by itself, account for concurrent delays
Can be implemented relatively easily and quickly compared to other methods	-

Source: RP-FSA (2007)

Collapse-As-Built or As-built –But-for **[CAB]**

RP-FSA (2007) identifies this MDA in its taxonomy as a 'Modelled/Subtractive/ Single Base (MIP 3.8)' method.

The theory in the CAB is that *"if you subtract the owner delays from the actual project duration, you would end up with how long the contractor would have actually taken to build the project but for the owner delay."* (Fruchtman, 2000, p. CDR.06.3).

Generally, CAB relies on a simulation of a 'what-if' scenario based on a CPM; it models not the intentions of the contractor, but rather his actual sequences and durations; it uses a 'deductive' approach, which is exactly the opposite philosophy of 'additive' approach that is relied on by IAP and TIA methods. (Keane and Caletka, 2008).

In its common form, CAB creates an 'as-built' schedule and identify 'actual delays' caused by one party, and then remove them from that 'as-built' schedule in order to 'collapse' the schedule. *"The argument is 'but-for these delays, this is when the project would have been completed'. The amount of delay and the resulting damage are then calculated"* (Zack, 2001, p.CD.04.1).

RP-FSA (2007) summarised the CAB as follows:

1. Excusable and Compensable Delay is established by the difference between the as-built completion date and the collapsed as-built completion date resulting from the extraction of all owner-caused delays;
2. Non-excusable and Non-compensable Delay is established by the difference between the as-built completion date and the collapsed as-built completion date resulting from the extraction of all contractor-caused delays;
3. For Excusable and Non-compensable Delays, CAB is not the best tool but it can be said that the difference between the as-built completion date and the collapsed as-built completion date resulting from the extraction of all owner-caused delays is at least the Excusable and Non-compensable Delay.

The advantages and disadvantages of this MDA, as identified in RP-FSA (2007) are indicated in the Table 6.4 below:

Table: 6. 4 CAB method- Strengths and Weaknesses

Strengths & Advantages	**Weaknesses & Disadvantages**
Easy to understand	Perceived to be purely and after-the-fact reconstruction of events that does not refer to schedule updates used during the project
Utilises only records of actual events	Relatively few practitioners with significant, hands –on experience in preparing this analysis
Proof of reasonableness of baseline schedule not necessary	Cannot by itself be used to identify the as-built critical path.
Can be implemented without any baseline or update schedules	-

Source: RP-FSA (2007)

Further limitations of CAB have been cited as that (i) constructing as-built logic is subjective (many subjective assumptions as to the activities' level of detail, logic, durations and so on); (ii) cannot identify as-built (contemporaneous) critical path; (iii) does not calculate delay based on contractor's contemporaneous intentions ('at the time'); (Keane and Caletka, 2008). Lovejoy (2004) viewed its inability to make allowance for mitigation of delays is also a drawback. Likewise, as discussed below, CAB method has been criticised by many experts in spite of its seemingly sound basis on 'actual' happenings of the project.

SCL Protocol (2002, Section 4.7) suggests *"similar to the as-planned versus as-built, the use of this technique is restricted by its inability to identify concurrency, resequencing, redistribution of resources or acceleration"*. (In this instance, however, SCL Protocol must have referred to the simpler and more conventional version of APvAB since its alternate form can deal with 'concurrency' as discussed below.) Fruchtman (2000) agreed that this method does not address concurrent delays and therefore is limited to calculating EOT but not compensability.

Zack (2001, CDR.04.5) contends that CAB schedules are "*deceptively simple*" and "*should not be relied on unless a great deal of independent research and analysis done*". Zack (2001) exclusively analysed the CAB method for its mechanism as well as the vulnerability of the technique in various aspects. The technique is grounded on a series of stated and unstated basic assumptions. Accordingly, a party defending against the outcome of an analysis based on CAB method would see its vulnerability in its implied factual basis, accuracy and correctness. Zack (2001) identifies this vulnerability in three types of possible challenges against this method:

1. Challenging stated and unstated basic assumptions; in this case the main challenge is centred on attacking the assumption that 'an as built critical path can be easily identified, reviewed and analyzed to ascertain delays'. The challenge is whether an as-built critical path can actually be calculated when all activities on an as-built schedule are completed. The vulnerability here is that in a CPM schedule the critical path is determined by a forward looking set of calculations only; by definition, then, an 'as-built' critical path cannot be calculated as all activities on an as-built schedule are completed, unless the activities are left unstatused. But the catch is if they are unstatused, the schedule is not an 'as-built' schedule. Thus one cannot objectively calculate an 'as-built' critical path from the activities of a completed as-built schedule;
2. Challenge theory - it is the questioning the theory concerning the but-for schedule to see if it has been accurately applied to the specific delay analysis.
3. Challenge analysis – it is through the analysis of the project documentation to challenge the technique to test the objectivity of the scheduler and the accuracy of the work.

Al-Saggaf (1998) also argues that the challenge to CAB is its approach to determining as-built critical path when no activities in the as-built schedule have floats at the actual completion because they are actual dates. Schumacher (1995) also agreed that the challenge in this 'but-for' method is the determination of the as-built critical path; he argued that since they are assigned with actual dates, no activities in the schedule have a 'float'. These arguments seem significantly valid against use of CAB. Although there has been at least one critical path that dictated the completion of the project it is difficult to identify it, especially in a delayed project there may be more than one critical path as the project nears completion. In this situation if one party uses but-for schedule, the other party may attempt to identify a different critical path going through activities unaffected by that party. Thus, in many cases the determination of the real as-built critical path will be in dispute. On another aspect, Alkass *et al.* (1996) state that although this technique seems to provide a sound MDA, the main problem is that it does not take into account any changes in the CPM schedule during the course of the project. Thus, all these arguments question the very basis and philosophy of the method, and therefore, may pose a formidable challenge to a party who desires to use CAB in delay analysis.

As-Planned versus As-Built [APvAB]

RP-FSA (2007) identifies this in its taxonomy as an 'Observational/Static/ Gross (MIP 3.1)' method. In its simplest form, APvAB compares the actual and planned durations of the project and claims the difference as an excusable/compensable delay. It does not even require CPM logic and can be used by plainly comparing a graphic comparison of as-planned schedule to the as-built schedule simply observing variances between start/finish dates of the various activities. In other words, it resembles a "total claim" (Zack, 2001), and therefore, the claimant is required to discharge a similar burden of proof as in the case of global claims. Accordingly, when its conventional version is used, to succeed, the contractor has to demonstrate that:

- The baseline programme was reasonable and realistic;
- There were no contractor's critical delays contributing to the duration overrun;
- The time overrun (difference between the duration of as planned and that of as built schedules) is entirely attributable to the delays of the employer or for which he assumes responsibility;
- To calculate the standalone impacts of each of these delay events is impossible or impractical as they are too complicated and intertwined to separate;

In any case, considering its limitation to deal with concurrency and dynamism of critical path, the results produced by this MDA may be contentious because an apportionment of delay liability may result in a flawed outcome if the effect of concurrent delays and changes in the critical path is overlooked (Alkass and Golanaraghi, 2012).

The theory in this MDA is that *"if you figure out what sequence of activities actually defined, the length of the project, you can then determine what and who caused the delays to the project completion"* (Fruchtman, 2000, p. CDR.06.3).

Amongst the deficiencies of the APvAB, Atkinson (2007) identified the following:

- Part of the delay may be due to inaccuracies of the timing of the activities, or the duration of the activities may be unrealistic or underestimated;
- Price to be paid for the work may be low and less than the actual cost of carrying out the planned work;
- Risk contingencies of time and or cost may be insufficient for the risk events that actually occurred.

- Though it is useful to show graphically the progress of the project, the method has little analytical value when used to make inferences as to the cause of delay to completion of the whole project.

However, as proposed in RP-FSA (2007), in a more sophisticated version APvAB can be used to establish better apportioning with concurrent liabilities. Keane and Caletka (2008) explained it in detail, in line with RP-FSA (2007), and a brief overview of the process is as follows:

1. Establish contractually complied as-planned schedule, which includes, at a minimum, original scope of planned activities, their relationships, durations, and any contractual milestones ;
2. Establish a proper as-built schedule (this can be either from the CPM updates or re-constructed with similar level of details of the baseline or as-planned schedule). The as-built schedule should corroborate with reliable project records and represent the original scope and the delaying events, in the same chronological order of occurrence. It shows actual start and finish dates of each activity, including disruptions and discontinuity;
3. Identify at least one reliable as-built critical path from the as-built schedule. This may be challenged for its subjectivity, unless monthly CPM updates were kept and relied upon throughout the project, or the critical path through the works is otherwise obvious and capable of being represented on a summary level programme;
4. Create 'as-built critical path liability Table' consists of all events along the as-built critical path indicating when each event was on the as-built critical path;
5. Comparing with as-planned schedule, establish the actual duration of each activity in which that was critical (e.g. if earned value shows only 4 days of work was accomplished in a 10 day period, there would have been a critical delay of 6 days);
6. Assign liability for each critical delay;
7. If more than one critical path identified, the above process to be repeated for each of them;
8. Compare the periods of delay assigned to each party, and establish any concurrent delays.

The advantages and disadvantages of this MDA, as identified in RP-FSA (2007) are indicated in the Table 6.5 below:

Table: 6. 5 APvAB method- Strengths and Weaknesses

Strengths & Advantages	**Weaknesses & Disadvantages**
Easy to understand	Not suitable for projects of extended duration
Based on as-built critical path	Not applicable to projects built in a manner significantly different than planned
Technically simple to perform	Not suitable for complicated projects with multiple planned critical paths
Can be performed with very rudimentary schedules	Less accurate at the analysis advances through the project
Closely related to actual events	Relatively time-consuming when implemented correctly

Source: RP-FSA (2007)

Further limitation of (the more sophisticated version of) APvAB has been cited as that constructing proper as-built programme could be resource intense and expensive (Keane and Caletka, 2008), as it generally requires a greater level of expertise to accurately perform (Fruchtman, 2000).

Global Claims

One definition for Global Claims is '*... where a global or composite sum ... is put forward as the measure of damage ... where there are two or more separate matters of claim ... and where it is said to be impractical or impossible to provide a breakdown ... of the sum* (Hudson's Building and engineering Contracts, 1995, at paragraph 8·200, pp.1086-1087).

Bramble and Callahan (2000, p. 12-12) described the principle of a Global Claim in terms of total cost approach as: "*the claimant does not attempt to tie particular costs to particular events; instead it seeks the difference between its actual costs of performance and its anticipated costs...*". According to Pickavance (2005) a total loss claim merely fails to distinguish between the losses that flow from those events for which liability is established and other matters.

The foregoing indicates that whether it is for 'time' or 'cost', the Global Claims are of a common characteristic which is lacking 'causation' to link the alleged cause and the claimed effect of time or cost.

Courts in both the UK and the US have long been sceptical about global claims, since they fail to link cause and effect directly (Lyden, 2008). In the US case *Bruno Law v United States (1971) 195 Ct Cl 370, US Ct of Claims* it is stated

"*... many of the incidents relied on by plaintiff were isolated and non-sequential and* *therefore could not possibly have caused any significant delay in the overall progress of the project. Furthermore, with respect to the great bulk of such incidents, plaintiff has failed to prove, or indeed even attempt to prove, the crucial factors of the specific extent of the alleged wrongful delay to the project operations caused thereby".*

In the UK case *McAlpine Humberoak Ltd v McDermott International Inc (1992) 28 Con LR 76, CA* the arguments for global claim went beyond common sense when it was suggested that a breakdown was unnecessary because, the global claim would remain unchanged if everything save one item was not proved. In *Wharf Properties Ltd v Eric Cumine Associates (No 2) (1991) 52 BLR 1, PC* the Privy Council held that an unparticularised claim was hopelessly embarrassing and should be struck out.

However in Mid *Glamorgan County Council v J Devonald Williams (1991) 8 Const LJ 61, QBD (OR)* considered a softer approach considering *J Crosby & Sons Ltd v Portland UDC (1967) 5 BLR 121, London Borough of Merton v Stanley Hugh Leach Ltd (1985) 32 BLR 51* and *"Wharf Properties"* and stipulated the principles to be applied to the pleading of complicated ('global') cases, as follows:

- A proper cause of action has to be pleaded; where specific events are relied upon for a money claim under the contract then any pre-conditions which are made applicable to such claim by the terms of the relevant contract will have to be satisfied in respect of each of the causative events relied upon; when it comes to quantum, whether time based or not, and whether claimed under the contract or by way of damages, then a proper nexus should be pleaded which relates each event relied upon to the money claimed;
- Where, however, a claim is made for extra costs incurred through delay as a result of various events whose consequences have a complex interaction that renders specific relation between event and time/money consequence impossible or impracticable, it is permissible to maintain a composite claim.

In *Skanska Construction UK Ltd v Egger (Barony) Ltd [2004] EWHC 1748 (TCC),* HH Judge Wilcox said that *"... courts have ... been cautious in permitting global claims to proceed. But in some circumstances a global or total cost claim may be the only practical way to present a claim".*

It seems the above concessions are not without 'conditions', and in *John Doyle Construction Ltd v Laing Management (Scotland) Ltd [2002] BLR 393 (Outer House)* HH Judge Lord Macfadyen set out the circumstances under which a global claim can be made. He said:

"In *some circumstances, relatively commonly in the context of construction contracts, a whole series of events occur which individually would form the basis of a claim for loss and expense. These events may inter-react with each other in very complex ways, so that it becomes very difficult, if not impossible, to identify what loss and expense each event has caused. The emergence of such a difficulty does not, however, absolve the pursuer from the need to aver and prove the causal connections between the events and the loss and expense. However, if all the events are events for which the defender is legally responsible, it is unnecessary to insist on proof of which loss has been caused by each event. ... it will suffice for the pursuer to aver and prove that he has suffered a global loss ...*"

"A global claim, as such, must therefore fail if any material contribution to the causation of the global loss is made by a factor or factors for which the defender bears no legal liability. ..."

"Advancing a claim for loss and expense in global form is therefore a risky enterprise. ... proof that an event played a material part in causing the global loss, combined with failure to prove that that event was one for which the defender was responsible, will undermine the logic of the global claim. ..."

However, this softening drew much criticism from many quarters. For example, Winter (2007, p4) argued that

"The temptation is obvious – a claimant can assert that everything was the responsibility of the defendant, so does not have to demonstrate cause and effect or break down the quantum of his claim, safe in the knowledge that, even if he does not succeed in showing that everything was the responsibility of the defendant, the court will help him out by doing an apportionment from his total claim. Is this a correct, or prudent, course of action?"

Bramble and Callahan (2000) submitted that the US courts may allow "total cost" approach (global approach) when it can be demonstrated the following five conditions exist:

1. There is no other way of estimating damages;
2. No underbid or errors in the bid took place;
3. Inefficiency by the party submitting the claim can be distinguished from the costs of delay due to improper acts of others;
4. The actual costs incurred by the contractor are reasonable;
5. The user of the total cost method has used a reasonable cost accounting system to

accumulate its job costs.

Lyden (2008) comprehensively discussed many case authorities of several jurisdictions (US, English, Irish, and Australian) and summarised these positions as follows:

- A trial court must use the total costs method with caution and as a last resort – *Servidone Construction Corporation v United States (1991) 931 F 2d 860, US Ct of Appeals (Fed Circuit)*
- A rolled-up award can only be made where the loss attributable to each event cannot in reality be separated and the other requirements for an award have been met for each head of claim *J Crosby & Sons Ltd v Portland UDC (1967) 5 BLR 121, QBD* and *London Borough of Merton v Stanley Hugh Leach Ltd* (1985) 32 BLR 51, Ch D
- Where it is not possible to disentangle the various elements of the claim, it is legitimate to make a global award of money *Insertco v Honeywell Control Systems, unreported (QBD (OR)), 1996.*
- Causation, i.e. linking any breaches of contract to the relief claimed, is largely a matter of inference *John Doyle Construction Ltd v Laing Management (Scotland) Ltd [2002] BLR 393 (Outer House); [2004] BLR 295 (Inner House);* and *London Underground Ltd v Citylink Telecommunications Ltd [2007] EWHC 1749 (TCC), [2007] BLR 391.*
- If the 'dominant cause' approach cannot be used to determine liability, apportionment of the loss may be possible *John Doyle Construction Ltd v Laing Management (Scotland) Ltd [2002] BLR 393 (Outer House);*
- Apportionment must be based on the evidence *Lichter v Mellon-Stuart Co 305 F 2d 216 (1962), US Federal Ct of Appeals (3rd Circuit);*
- The practical difficulties of doing an apportionment exercise should not prevent the contractor from recovering his relevant loss. *John Doyle Construction Ltd v Laing Management (Scotland) Ltd [2002] BLR 393 (Outer House); [2004] BLR 295 (Inner House);* and
- The difficulties and complications involved in calculating damages do not relieve the court (or other decision-maker) of its duty to assess the natural and probable financial loss to the plaintiff as best it can *Doran v Dublin Plant Hire Ltd [1990] 1 Ir 488, High Ct Ireland.*

According to the foregoing, it is evident that all these primary MDAs have their own strengths and weaknesses, at varying degrees of inherent subjectivity. This situation emphasises that there would not be any single MDA that could be suitable for all the circumstances requiring delay analysis.

6.3 Selection Factors

Ng, Skitmore *et al.* (2004) argue that the amount of delay that can be attributed to the employer or the contractor depends on what delay analysis technique employed. Bubshait and Cunningham (1998) pointed out that there would not be one single analysis method that suits every situation. SCL Protocol (2002) recognized the absence of such universally acceptable single method of analysis. After reviewing twenty research studies (published between 1987 and 2004) that discussed about various aspects, advantages and disadvantages of the APvAB, IAP, CAB and TIA methods, Arditi and Pattanakitchamroon (2006) concluded that no one method could be universally used over another in all situations. RP-FSA (2007, 2009, and 2011) points out that no forensic schedule analysis method is exact. Thus, the industry generally accepts that there is no single analysis methodology universally available and applicable to all situations of delay claims resolution.

Keane and Caletka (2008, p187) argued *"determining which technique is the most appropriate is the most subjective task and, even when agreement is reached between the parties, often the application of the same 'technique' varies to such an extent the neither party is willing to accept the other's conclusions"*. This complexity of the issue of selecting the optimum MDA is caused by many reasons. RP-FSA (2010) recognised three primary areas of reasons for that:

1. Each claim is unique in that each deals with a different project, different contract documents, different legal jurisdictions, different dispute resolution mechanisms, and different fact patterns among other project execution factors, as well as that each MDA is different and each has certain technical factors to consider, including advantages and disadvantages. Because of the uniqueness and the need to consider multiple variables it is impossible to recommend one method that is the "best" method, or to rank the methods in order of preference;
2. The selection of the analytical method should be based primarily on technical considerations related to the purpose, the timing, availability of data, and the nature and complexity of the delay and scheduling information;
3. There are a number of qualitative reasons, beyond technical schedule analysis reasons, that should be included in determining which forensic schedule analysis method is to be used for a particular claim.

These variables require to be dealt with by a consensual approach of the practitioners of the contesting parties in order to choose the right MDA. However, as emphasised by RP-FSA (2009, p.137) that does not normally happen *"because individuals generally work for one party to a dispute, there is often skepticism about the impartiality of the particular methodology chosen. Therefore, it is vitally important that all practitioners understand clearly what it takes to overcome this skepticism when choosing and using a particular delay evaluation method"*.

Therefore, the biggest obstacle for the delay analysis method used by either party would be if there is no credibility in it. Gothand (2003, p.18) emphasised this point stating that when a schedule impact is submitted for a claim the relationship between the claimant and defendant will be tested with credibility becoming the largest hurdle for the parties to overcome.

Commenting on how the practitioners wrong application of MDAs results in dispute situations, Zartab (1996, pp. 23-27) submitted *"Many analysts use faulty techniques to quantify"* and *"Much delay-related litigation could be avoided if the proper technique were used to analyse delay"*;

Nevertheless, entities like SCL Protocol, RP-FSA as well as several academic studies have made continuous efforts to identify the 'factors' which can be used to make a selection of MDA on more objective basis in order to resolve this issue of mutual scepticism.

RP-FSA (2009) categorised its suggested 'factors' as outlined below:

Technical considerations

Purpose of Analysis, Source Data Availability and Reliability, Complexity of the Dispute

Legal considerations

Contractual Requirements, Forum for Resolution and Audience, Legal or Procedural Requirements

Practical considerations

Size of the Dispute, Budget for Forensic Schedule Analysis, Time Allowed for Forensic Schedule Analysis, Expertise of the Forensic Schedule Analyst and Resources Available, Custom and Usage of Methods on the Project or the Case.

Arditi and Pattanakitchamroon (2006) compared four primary MDAs (APvAB, IAP, CAB and TIA) for their relative suitability and selection under four main criteria as listed below:

1. Availability of Information

    Type of Schedule

        Updated Schedule, Adjusted Schedule

    Type of Information

        No CPM, No CPM but progress record, CPM approved/not, updated CPM approved/ updated

2. Time of analysis

    Foresight, Real time, Hindsight during performance period, Hindsight, after project completion

3. Capabilities

    Float consumption/ Critical Path, Time extension, Compensation, Concurrent delay, Resequencing, Dynamic nature of CPM, Acceleration, Hindsight during performance period, Hindsight after project completion

4. Time-cost –effort, Type of analysis, Level of effort.

Braimah and Ndekugri (2007), having compiled from various published works, presented eighteen 'factors' that influence selection of methods of delay analysis. These 'factors' were grouped into 6 'Group Factors' as follows:

Group Factor 1- Project Characteristics:

Complexity of the project; The amount in dispute; Size of project; Duration of the project; Nature of the delaying events; The number of delaying events; The other party to the claim.

Group Factor 2- Requirements of the contract:

Updated programme availability; Applicable legislation; Form of Contract; Dispute resolution forum.

Group Factor 3- Characteristics of Baseline Programme:

Nature of baseline programme; Baseline programme availability.

Group Factor4- Cost proportionality:

Cost of using the technique; Skills of the analyst.

Group Factor 5- Timing of analysis:

Reason for the delay analysis; Time of the delay

Group Factor 6- Records Availability.

The factors described by Arditi and Pattanakitchamroon (2006) under four main criteria, the eighteen factors submitted by Braimah and Ndekugri (2007) and the RP-FSA's eleven factors are somewhat overlapping but generally convergent. Together, they can be regarded as a comprehensive basis for the hierarchical structure of the proposed Model described in Chapter 10. A comparison of these 'factors' is presented in Table 6.6 below.

Table: 6. 6 Comparison of Selection Factors

Factors identified in literature review (RP-FSA, 2009)	**Factors identified in literature review (Braimah and Ndekugri, 2007)**	**Factors identified in literature review (Arditi and Pattanakitchamroon (2006)**
Purpose of analysis	Reason for the delay analysis	**Capabilities** Float consumption/ Critical Path, Time extension, Compensation, Concurrent delay, Resequencing, Dynamic nature of CPM, Acceleration, Hindsight during performance period, Hindsight after project completion, Type of analysis,
Source data availability and reliability	Updated programme availability; records availability; nature of baseline programme; baseline programme availability	**Availability of Information** Type of Schedule, Updated Schedule, Adjusted Schedule, Type of Information, No CPM, No CPM but progress record, CPM approved/not, updated CPM approved/ updated
Complexity of the dispute	-	**Type of analysis,**
Contractual requirements	form of contract	
Forum for resolution and audience	Dispute resolution forum; the other party to the claim	
Legal or procedural requirements	Applicable legislation;	-
Size of the dispute	The amount in dispute; nature of the delaying events; the number of delaying events	-
Budget for forensic schedule analysis	Cost of using the technique	-
Time allowed for forensic schedule analysis		**Time-cost –effort,**
Expertise of the forensic schedule analyst and resources available	Skills of the analyst.	**Level of effort,**
Custom and usage of methods on the project or the case		-
-	Time of the delay; size of project; duration of the project; complexity of the project	**Time of analysis** Foresight, Real time, Hindsight during performance period, Hindsight, after project completion

6.4 Findings

The following are the main findings from the foregoing literature review:

Methods of Delay Analysis

- Generally the four primary methods of delay analysis are identified as (1) As-Planned v As-Built [APvAB], (2) Impacted As-Planned [IAP], (3) Collapsed As Built [CAB] and (4) Time Impact Analysis [TIA]. Global Claims is also considered as a popular method among the contractors;
- Each MDA has been identified with respective capabilities and characteristics of strengths/advantages and weaknesses/disadvantages, which are generally varying; Thus, selection of a particular MDA is governed by these varying capabilities and characteristics;
- According to these characteristics, generally APvAB and IAP methods are simpler to perform and more economical than the CAB and TIA. However, they are unsuitable for complicated projects and the results of delay analyses are less accurate, and lack objectivity. On the other hand, CAB and TIA methods are more sophisticated and more recognized for their results of relatively higher objectivity; However, generally they are more complicated, more time consuming need high expertise and hence less economical to be used in small projects but more suitable for complicated and large projects. Nevertheless, CAB can be used only retrospectively, and more vulnerable to be challenged for 'subjectivity' than TIA. As to Global Claims, it does not rely on any delay analysis as by nature it is a 'total claim' method which maintains all delays are coming from the other party alone and unable to establish causation of each delay event separately; its use is not encouraged and highly constrained.
- It is universally recognized in the industry, therefore, that no one method can be universally used over another for all situations and no forensic schedule analysis method is exact;
- Failures in updating the CPM programme of the actual status at the time of delaying event, grant of adequate EOT for the contractor's entitlement and particularly prompt awarding of EOT and incorporating that in contemporaneous updating of the CPM programme can be fatal to MDAs (e.g. TIA) which rely on the as-built programme in delay analysis.

Selection Factors

- The amount of delay that can be attributed to the employer or the contractor depends on what delay analysis technique employed;

- There would not be one single analysis method that suits every situation; no forensic schedule analysis method is exact; the industry generally accepts that there is no single analysis methodology universally available and applicable to all situations of claims resolution;
- Determining which technique is the most appropriate is a subjective task and, even when agreement is reached between the parties, often the application of the same 'technique' varies to such an extent the neither party is willing to accept the other's conclusions;
- Each claim is unique in that each deals with a different project, different contract documents, different legal jurisdictions, different dispute resolution mechanisms, and different fact patterns among other project execution factors, as well as that each MDA is different and each has certain technical factors to consider, including advantages and disadvantages;
- Individuals generally work for one party to a dispute, there is often scepticism about the impartiality of the particular methodology chosen;
- The biggest obstacle for the delay analysis method used by either party would be if there is no credibility in it;
- Much delay-related litigation could be avoided if the proper technique were used to analyse delay;
- The factors described by Arditi and Pattanakitchamroon (2006) under four main criteria, the eighteen factors submitted by Braimah and Ndekugri (2007) and the RP-FSA's eleven factors can be regarded as a comprehensive basis for the hierarchical structure of the proposed Model described in Chapter 10. In application, these 'selection factors' are intrinsically driven by the unique characteristics of strengths and weaknesses of the MDAs reviewed.

6.5 Summary

The foregoing has discussed in detail the literature based on published academic works, case law in the UK and US jurisdictions, and other references related to the methodology that is used for quantifying the apportioned liabilities, in terms of delay impact analysis based on five prominent MDAs. The review has also identified from the literature those 'factors' which are to be considered in the selection of appropriate MDA under given circumstances of a Project.

The findings of this literature review have been presented at the end of the Chapter. The content of these findings has largely contributed to the necessary conceptualisation and informed the forming of the structure for the interviews and the surveys as well as the proposed framework of improvements.

Particularly the literature reviewed as to 'selection factors' of a suitable MDA has mainly informed the developed Model's Level 2 "Criteria" and Level 3 "Attributes". These 'selection factors' are intrinsically driven by capabilities and characteristics, which are varying and unique to each of these MDAs reviewed.

The next Chapter addresses some essential aspects of procedural issues covering conditions precedent and prevention principle, significance and issues related to the CPM programme, claims presentation, determination and awarding process.

CHAPTER SEVEN

7.0 Procedural Issues

7.1 Introduction

This Chapter addresses some issues important to claims resolution procedures. In the UAE almost all the major forms of contracts carry provisions to bar EOT (and cost) claims unless the contractors fully comply with certain conditions precedent. However, in terms of the UAE Federal Law the court's position whether to hold conditions precedent over the prevention principle is not very clear. In this context, the Chapter has discussed the legal positions in the UK, the US and Australian jurisdictions, as they show more certainty on this issue. Next, it has discussed some issues related to the CPM programme, particularly the legal significance of its as-built updates, and consequences of its deficiencies. This is followed by a discussion on claims presentation by the contractors, the process of their assessment by the consultants and the employers' awarding of EOT. The findings of the current review are outlined at the conclusion of the Chapter.

7.2 'Prevention' Principle and Conditions Precedent

The submission of the Notice and or 'particulars' within a prescribed time and a manner is a condition precedent in most of the bespoke contract forms in use in the local industry. Thus, the conflict between the 'prevention principle' and conditions precedent is having a direct bearing on the issues related to delay claims resolution process in the UAE industry.

These conditions precedent are, in most of the time, similar to such conditions appear in the FIDIC 1999 scheme of forms of contract (Red, Yellow and Silver books of FIDIC 1999 series). For example, Clause 8.4 of the FIDIC 1999 (Red Book) states that EOT will be awarded only if the contractor complied with Clause 20.1.Clause 20.1 states in clear language that if the contractor fails to give notice within 28 days then the time for completion *"shall not be extended, the contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim"*. To compare, a typical clause in those bespoke contract forms is as follows:

> "44.4 ***Failure to Provide Notification and Detailed Particulars***
>
> *If the contractor fails to comply with any of the provisions of Sub-Clause 44.2 or (as the case may be) Sub-clause 44.3, the Time for Completion of the Works shall not be extended and the Employer shall be discharged from all liability in connection with any such event, circumstance or claim to which Sub-clauses 44.2 and 44.3 apply"*

In the UAE jurisdiction, however, there is no published case law upholding these conditions precedent. It is submitted that the UAE law may or may not provide relief to the contractors claims where delays are purely caused by the other side although the contractors have failed to comply with such conditions precedent. However, one may note that the UAE Federal Law No. 5 of 1985, Article 287 states

> *"If a person proves that the damage has resulted from a foreign cause beyond his control, i.e. by an act of God, a sudden accident, a force majeure, an act of a third party, or <u>an act of the injured</u>, he shall not be liable for damages <u>unless the law or the agreement requires otherwise</u>*". (Emphasis added).

This seems to go along with the principle very well established at common law that *"no person can take advantage of the non-fulfilment of a condition the performance of which has been hindered by him..."* (*Roberts v The Bury Improvement Commissioners [1870]*) and the wording of this Article '*unless ... the agreement requires otherwise*' may uphold a position in favour of a condition precedent which is set out in very clear and plain language in the agreed contract. On the other hand, it is submitted that Article 487 of the same Federal Law No. 5 could possibly be relied on for defeating a time-barring effect of a condition precedent. Article 487 states that

> *"Pleading for non-hearing of a lawsuit for lapse of time may not be waived before the right to such pleading has been proved. Also, non-hearing of a lawsuit may not be agreed upon after a period that varies from the period determined by law"*.

Thus, a contractor seems to have the right to claim against an employer beyond the time-bar (arising from a condition precedent) in the agreement but before the expiration of the period prescribed by law. Further it is submitted that UAE law does not permit parties to exclude liability for breach of contract entirely as the Article 296 of the Federal Law No. 5 states:

> *"Any condition purporting to provide exemption from liability for a harmful act shall be void."*

Accordingly, it may be argued that an act of prevention is a breach of a fundamental implied term of the contract, and an employer would not be able to rely on a condition precedent to exempt from his liability for such act of prevention. Moreover, this whole area of the UAE law shows no published precedence, and therefore, the status of condition precedent and the prevention principle seems yet to be tested in the local settings.

For such uncertainty in the local legal position, it is pertinent to see how this issue has been determined in other jurisdictions where generally best industry standards prevail (for example English, Scottish, and Australian jurisprudence). In the Scottish, English and Australian jurisdictions the legal position on the issue seems to be having some certainty, at least for now, though they have differences. In the Australian case, the *'Gaymark'* [1999], it was decided in favour of the prevention principle whereas the Scottish case *City Inn Ltd v Shepherd Construction Ltd. 2003 S.L.T. 885; 2003 S.C.L.R. 795; [2003] B.L.R. 468; 2003 G.W.D. 18-549; IH (2 Div)* upheld the condition precedent approach rejecting contractors arguments based on prevention principle. However, before '*Gaymark*' there were other cases which supported time-bar provisions against prevention principle (For example, *Turner Page Music Ltd v Torres Design Associates Ltd [1997] CILL 1263, QBD (OR); Decor Ceilings Pty Ltd v Cox Constructions Pty Ltd (No 2) [2005] SASC 483, [2006] CILL 2311, Supreme Ct Sth Aus).*

Lal (2002) argued that the English courts should be persuaded by the Scottish case of *'City Inn'* which favoured and construed notice requirements as a condition precedent to defeat the prevention principle. His main points in favour of this Scottish decision were based upon the issues of express risk allocation giving effect to the intention of the parties, and the need for financial and contractual certainty, especially in modern procurement routes such as project finance arrangement. As the construction contracts seek to allocate risk, a greater need for financial and contractual certainty is involved when limited recourse is involved. Lal (2002) argued that it would be unfair and may encourage poor project management to allow the contractor to simply miss notice requirements and assert his rights to EOTs at times (only) suitable to him, and especially in the context of construction contracts in project finance arrangements, the notice requirements should defeat the prevention principle.

Another implication of this issue is how a late 'notice' and 'particulars' may affect the delay claims resolution process itself. Lal (2002) argued that if compliance with condition precedent is defeated by prevention principle and give the contractors flexibility to stockpile or issue EoT claims at stages close to completion that would make it much harder to resolve the disputes; it is because while the data required to resolve such disputes may be fading memories, EoT claims near to completion invariably lead to 'commercial negotiations' to resolve disputes rather than resolution by objective data or contemporaneous records. Giving such 'flexibility' would produce opposite results to good practice encouraged by SCL Protocol (Section 3.5.5.) to resolve dispute. After all, SCL Protocol promotes claims applications for EOT be made and dealt with as close in time as possible to the delay event that gives rise to application, In context, the rationale in having a notice clause is to get an early warning to alert the parties to such changes unforeseen when the works were originally planned, and to enable the parties to assess its effects and make provision for them. Therefore, a failure to comply with these requirements (deliberate or otherwise) would deprive the parties of this opportunity and is likely to have opposite consequences to those which might have been intended in the conditions precedent agreed by the parties (Carnel, 2005).

Prior to *'Multiplex'* (2007) case the English law was in favour of prevention principle. The consequences of the prevention principle are that the employer cannot hold the contractor to a contractual completion date if the contractor is prevented from completing by that date by act or omission of the employer. In that instance, time becomes at large and the contractor's obligation to complete by the specified date is replaced by an (implied) obligation to complete within a reasonable time (*Holme v Guppy [1838] 3 M&W 387 and 150 ER 1195, Exchequer Pleas, At P 389 (Parke B); Peak Construction (Liverpool) Ltd v McKinney Foundations Ltd. [1970] 1 BLR 111; The Cape Hatteras [1982] ; British Steel Corporation v Cleveland Bridge and engineering Company Ltd [1984] 1 All ER504, QBD(Comct); Scott Lithgow Ltd v Secretary Of State For Defence [1989] 45 BLR 1, HL).*

Tobin (2007, p.148) pointed out that *"The consequences of imposing the prevention principle are that time is set at large and the liquidated damages provisions are unenforceable"*. In order to avoid the operation of the prevention principle, the employers include provisions for extensions of time in construction contracts. Thus, where the employer does not grant extension of time (for own causes) because of the contractor's failure to adhere to conditions precedent then the contractor's contractual obligation ceased to be valid and the time to complete will be at large or completion to be within a reasonable time. What is the reasonable time had to be decided at the time of the question arose, having regard to all relevant circumstances (*Shawton engineering Ltd v DGP International Ltd [2005] Ewca Civ 1359, [2006] BLR).*

Accordingly, in order to bind a contractor to the contract obligation to complete while EOT is being denied, very clear words would be required in such conditions precedent (*Percy Bilton Ltd v Greater London Council [1982] 20 BLR 1, HL.).*

Thus, the requirements to be present for a condition precedent are referred to as follows:

- The precise time within which the notice is to be served should be stated;
- In plain express language it must be stated that unless the notice is served within the prescribed time, the party required to give notice will lose its right to an EOT under the Contract. (*Bremer Handelgesellschaft Schaft MBH v Vanden Avenne Izegem Pvba [1978] 2 Lloyd's Rep 109, HL).*

However, even if the above 'conditions' for a condition precedent satisfied, still there was no certainty. (For example, *Koch v New Millennium Experience [1999]*).

The 2007 judgment of *Multiplex Constructions (UK) Ltd v Honeywell Control Systems Ltd; [2007] EWHC 447 (TCC); [2007] BLR. 195; 111 Con. L.R. 78; [2007] CILL. 2458; [2007] BUS. LR. D109* case appears to be the first English case explicitly decided in favour of notice requirements as a condition precedent. (In the *"Multiplex"* the Judge did not consider that *"Gaymark"* represented English law).

In the *"Multiplex"* it was argued by the subcontractor that the liquidated damages were not applicable due to the prevention principle applied and time was thus become at large. While rejecting this argument Jackson J said:

> "*Whatever may be the law of the Northern Territory of Australia, I have considerable doubt that Gaymark represents the law of England. Contractual terms requiring a contractor to give prompt notice of delay serve a valuable purpose; such notice enables matters to be investigated while they are still current. Furthermore, such notice sometimes gives the employer the opportunity to withdraw instructions ...*" and further,
>
> *"If Gaymark is good law, then a contractor could disregard with impunity any provision making proper notice a condition precedent. At his option the contractor could set time at large".*

This position taken in '*Multiplex*' can be compared with the position taken in *'City Inn'* which upheld the 'condition precedent' over 'prevention. In '*City Inn*' it was said that

> "... *if he* [the contractor] *wishes an extension of time, he must comply with the condition precedent that clause 13.8 provides for these specific circumstances ... But if the contractor fails to take the specified steps in clause 13.8.1, then, unless the architect waives the requirements of the clause under 13.8.4, the contractor will not be entitled to an extension of time on account of that particular instruction"* (Lord Jackson, in the Inner House).

Having regard to this present position in English law, it is now suggested to consider , the prevention principle as a rule of construction and not a rule of law, and can be excluded by express terms (like under FIDIC Clause 20.1); and to consider that "*the prevention principle does not apply, because the 'proximate cause' of the contractor's loss is not the employer but the contractor's own failure to operate the contractual machinery, so there is no 'act of prevention*" (Lal, 2007, p.15).

The 'Multiplex' seems to have generally settled the legal position of 'condition precedcent', at least for the English law. However, this position may not be considered finally and conclusively settled as it has been reported from a case as latest as in 2012 that requiring 'timely' submission of notice/ particulars be a condition precedent to claiming EOT cost could still be challenged [ref. *Walter Lilly & Company Limited v Giles Patrick Cyril Mackay, DMW Developments Limited.* [2012] EWHC 1773 (TCC), paragraphs 463-465].

7.3 Updating the CPM Programme

The prime importance of a baseline programme based on CPM schedule is beyond doubt and the decisiveness of its proper maintenance (updating) in delay claims analysis is much evident.

At least in the US industry, the use of CPM schedule is almost inevitable in every new construction project and courts and boards of appeals have underlined the importance of utilizing the CPM which has been recognized as the most accurate tool for performing an analysis of delays to a project (Baram, 1994; McCullough, 1999).

Briggs (2006) cited the judgment of *Balfour Beatty Construction Limited v The Mayor and Burgess of the London Borough of Lambeth [2002] BLR 288* to insist the importance of the programme to provide a basis for the analysis of delay in which, HH Judge Humphrey LLoyd QC observed

> *"It seems that BB had not prepared or maintained a proper programme during the execution of the works. By now, one would have thought that it was well understood that, on a contract of this kind, in order to attack, on the facts, a clause 24 certificate for non-completion (or an extension of time determined under clause 25), the foundation must be the original programme (if capable of justification and substantiation to show its validity and reliability as a contractual starting point) and its success will similarly depend on the soundness of its revisions on the occurrence of every event ..."*

Livengood (2007b, p.2) submitted "*the Baseline Schedule and the As-Built Schedule are the two most important schedules in a forensic analysis*". Updating of the programme is expected to be preceded by existence of a proper baseline CPM programme. Reams argued (1990, p12) "*Failure to recognise that the as planned schedule that was worked with was deficient in some regard may lead to the entire delay analysis being discredited*".

The quality of the baseline programme and its proper updates have also been considered as a decisive factor in the selection of optimum MDA as would be seen in the discussion under item 6.3 above. On this point, Fruchtman (2000, p. CDR-06.4) commented "*the selection of the best schedule analysis technique is dependent on numerous factors; however, the most important criteria should be the quality of the original schedule and how effectively it was used*".

Livengood (2007f) pointed out that both the TIA and the APvAB methods require actual dates; without knowing what actually happened, the value of either analysis is greatly diminished and this is well recognized by courts.

Updating the CPM programme is essential for more sophisticated MDAs like Time Impact Analysis (TIA), but not for simplistic methods like Impacted-As-Planned (IAP). In any case, the approved CPM programme to be used for the project is important only to the extent that it is a properly built realistic programme for monitoring and administering the project. If the programme is irreparably deficient for the purpose, there would not be any acceptance to the same only because it is the approved programme. For example, in *W.A. Stevenson Construction (Western) Ltd v. Metro Canada Ltd., [1987] 27 Constr. L. Rep. 113 (B.C.S,* *Ct.)* the British Columbia Supreme Court rejected the owner's argument that only the approved schedule could be used to measure delay, because the approved schedule did not comply with the contract, and was only a bar-chart that reflected the milestones. As a result the court permitted the contractor to use more detailed schedules which reflected the intended sequence and completion dates though they had not been approved by the employer. Zartab and Rasmussen (2001) found that a baseline schedule can have enormous financial consequences as it is frequently used to justify or deny time extensions and inefficiency losses. Therefore, the employers need to be more careful to accept only a baseline programme that is prepared to reflect realistic construction logic and comply with the contract requirements ensuring its expected role as a reliable, practical instrument for its purpose. However, the employer's approval alone has little significance in measuring or showing the cause of delay. When measuring or defining delay what mostly matters is the evidentiary aspects and the reliability of the schedule (Bramble and Callahan, 2000). On the other hand, *"Incomplete schedules do not afford an opportunity to evaluate how all activities interact to achieve project completion. All delays are measured by their effect on the entire project".* (Bramble and Callahan, 2000, p.11-23).

The importance of updating the baseline programme was the focus in the US case *Fortec Constructors v. United States, 8 Cl. Ct.490 [1985], Aff'd, 804 F.2d 141 (Fed.Cir.1986).* In the *'Fortec'* [1985] *"the Claims Court recognised that the control of the project, as well as the time extension process is lost if the parties do not properly update the critical path network to reflect delays and time extensions"* (Gassan, 1996, p.35). In *'Fortec'* it was found that the CPM schedule was only updated once and did not consider delays in the work performed before or after the update. It should have been properly updated mainly because of the dynamic nature of the critical path which changes as the project progresses. The court held in the '*Fortec*' that the CPM could not be used by the government to assert that a particular activity was critical or non-critical, or on or behind the schedule, and because of the changes in contract performance were not integrated in the CPM it was impossible to determine which activities were on the critical path. Accordingly, the court rejected the US government's attempt to rely on an incomplete CPM to deny recovery.

In another case of *Continental Consolidated Corp; ENGBCA Nos. 2743, 2766, 67-2 BCA, 6624 (1967); 68-1 BCA, 7003 [1968]* the contractors claimed for extra cost for suspension and acceleration directed by the government. The government argued that the ordering acceleration was required as the critical path method revealed that the project was behind schedule. However, the Board rejected this reliance on CPM stating:

> *"it is essential that any changes in the work and time extensions due to the contractor be incorporated into the progress analysis concurrently with the performance of the changes or immediately after the delay and thus integrated into the periodic computer runs to reflect the effect on the critical path. Otherwise, the critical path chart produced by the computer will not reflect the current status of the work performed or the actual progress being attained"*

Similarly, in *J.A. Jones Constr. Co., ENGBCA Nos. 3035, 3222,72-1 BCA 9261 [1972]* it was decided that the CPM schedule was distorted and unreliable as a basis for denying EOT, since adequate time extension were not granted immediately upon determining the extent of the delay.

Also, in *Haney v United States 230 Ct. Ci. 148, 676 F.2d 584 (1982)* and *Titan Pacific Construction Corp. v United States 17 Ci. Ct. 630 (1989),* the acceptance of CPM schedule was denied by the courts as reliance upon an incomplete and inaccurate CPM was improper and unacceptable.

Therefore, it is to be noted that in '*Fortec*', '*Continental Consolidated Corp*' and the other cases the method of delay analysis used the CPM and the main point found in these cases is that unless the CPM programme is fully updated in terms of the delays, gains, mitigation, acceleration and the contractor's entitlement to EOT as of the time of the occurrence of the delay event, such programmes cannot be relied on for credible results of the delay analysis. This is more relevant to the circumstances where a 'wait & see' policy is being practised by the employers/ engineers to delay an award of EOT, and consequently, as pointed out in these US cases, the CPM programme becomes obsolete to be used as the basis for delay analysis techniques.

In another aspect, the contractual status of the programme is also a significant issue in the delay claims resolution. Unless the terms of contract specifically make it a contractual document the programme merely represents the contractor's intention of how he expects to organise carrying out the works to comply with contract requirements. Without the programme being a contract document, the contractor's only obligation is to comply with the contract milestones and he is at liberty to arrange things during the contract period as long as he does not suspend or fail to proceed with the works as required by the contract. He can make changes to the sequences or the relationships or the durations of the activities of the programme in so far he is not failing to comply with the contract obligations to complete. However, though the engineer (acting on behalf of the Employer) is involved in giving 'consent' to this programme (as in the case of FIDIC 4th edition, Clause 14.1 or most of the bespoke forms of contract in the UAE which contain a similar Clause following FIDIC, requiring the contractor to submit a programme *'to the engineer for his consent'*), the engineer/ Employer may not be able to interfere with the programme unless the contractor fails to comply with the requirements of diligent performance and contract completion. According to the FIDIC's publication of 'Guide to the use of FIDIC-Fourth edition' (1989, p.63) "*The programme is the responsibility of the contractor and it is submitted to the engineer for constructive comment..*"; the FIDIC Guide does not explicitly state whether the giving 'consent' to the content of the Clause 14.1 Programme imposes a contractual obligation on the engineer/Employer, but it says, "*The engineer monitors the progress of the Works on behalf of the Employer but is not entitled to alter or interfere with the contractor's obligation to complete the Works safely, properly and on time*". (1989, p.63). Thus, a reasonable construction on Clause 14.1 wording may be that a non-contractual, a non-binding document is used to hold the employer contractually binding to the programme effects, although a non-scrupulous contractor can possibly manipulate 'changes' to his programme so that the employer would be exposed to independent or concurrent delays. Pickavance (2005, pp. 626-627) argued,

> "*...where the baseline for gauging whether C has suffered a delay to progress is merely non-contractually binding intention, it is arguably unreasonable to allocate to C the time-related risk of concurrent delays and thereby , in effect, raise that intention to an obligation to achieve performance under threat of liquidated damages. In other words, it might be said that most standard form contracts effectively give C, on the one hand, the "right" to incur its own culpable delay, but on the other hand, by virtue of the prevention principle, frame acts of prevention by D as "wrongs" (being breaches of contract, or at least, equivalent to breaches of contract) the "remedy" to C for which is an extension of time*".

Pickavance (2005, p.627) also described an alternate approach followed by the Australian standard forms of contract AS2124 and AS4000. Accordingly, AS2124 (Clause 35.5) states:

> "*where more than one event causes concurrent delays and the cause of at least one of those events, but not all of them, is not [a developer's time risk event] then to the*

extent that the delays are concurrent, [C] shall not be entitled to an extension of time for practical completion".

Thus, this alternate approach has denied entitlement to EOT in circumstances of concurrent delays, and put the contractor under an *"obligation to follow its existing programme unless there is "reasonable cause" to "depart" from it. As it plays a role in determining C's contractual obligations, the status of the programme is therefore under the AS forms elevated to that of a contract document. Because C has no right automatically to change its work plans, moreover, the AS contracts, to a degree, can be considered to frame any slower-than-planned working or culpable delay by C not as a "right" of C's but as a "wrong" in prima facie contravention of the contract"* (Pickavance, 2005, p.627).

This alternate approach of Australian standard forms of contract seems to have eliminated the undue benefits to the contractor when using the contractor's non-binding programme for contractually binding measures at least in the circumstances of 'concurrency'.

7.4 Claims Presentation

At the beginning of this Chapter it has been discussed how significant is the issue of conditions precedent and potential risk of forfeiting the right to claim EOT (and costs) if failed to comply with such conditions. Thus, in summary, it can be concluded that (regardless of how the UAE courts may decide between conditions precedent and the 'prevention principle') it is prudent for all contractors to comply with those conditions rather than risking potential deprivation of right to claim and long and costly legal battles. This is particularly essential as most of the bespoke contracts require full compliance with these conditions precedent for admission of delay claims for determination and that is possibly consistent with the UAE Federal Law No. 5 of 1985, Article 287 as discussed above.

Apart from the issue of compliance with conditions precedent, what can very often be fatal to a contractor's delay claim is his failure to establish 'causation' with necessary evidence. Thus, insisting the necessity of establishing the causation, Bramble and Callahan (2000, p.1-15) submitted *"contractors frequently fail to recover for alleged delay damages or requested time extensions because they fail to prove that the delayed activity was critical. Typically, that failure involves the inability to establish a causal link between an event and the overall project delay".*

Pickavance (2005) cited the following from Lloyd LJ's comments in *McAlpine Humberoak v McDermott (1992) 58 BLR 1* as to what should be contained in delay claims:

- Theoretical calculation, formulae, and rules of thumb do not provide proof of anything;
- Hypothetical assumptions and calculation might be satisfactory for preliminary issues of principle, but hard facts, visible and proved, are needed to substantiate claims for reimbursement; and
- Damage must be proved by hard evidence, whether measured in time or money.

Accordingly, it is clear that for the success in delay claims, any impressionistic estimates or similar methods cannot substitute the requirements based on objectivity and factual, hard evidence to prove causation.

In a study conducted in Hong Kong, Kumaraswamy and Yogeswaran (2003, p.30) found the following (see Table 7.1) as the reasons (in descending order of importance) for delays in the submission of delay claims.

Considering the Table 7.1, the majority of the reasons (i.e. no.2, 3, 4, 5,7,8,10,11, and 12) for delays in delay claims submission appear to emanate from lack of keeping necessary records. This seems to be, undoubtedly, one of the factors contributing to the late determination of the claims as well, as the burden of submission of sufficient particulars to enable the consultant to evaluate the claim is primarily on the claimant, i.e. the contractor.

Table: 7. 1 Reasons for delays in submitting the details of claims for EOT

S/N	Rank	Description
1	1	Overall delay cannot be ascertained/actual delay could not be determined until end of delay or construction
2	2	Focus on progress of work and not on claim/contractor's staff too busy on other tasks/lack of staff (in contractor's organisation) to deal with EOT claims
3	3e	General lack of details
4	3e	Lack of contractor's management resources
5	5	The effects are not known/could not foresee that an event would cause a delay until the delay occurred
6	6e	contractor does not want to cause friction or offend the employer
7	6e	Poor paperwork control by the contractor
8	6e	contractor wants to know exactly the amount of extension of time required such that their risk to liquidated damages can be removed
9	9e	Benefit of hindsight (choose events that attracts money)
10	9e	engineer requests excessive details
11	9e	Policy to submit global claims can cause delayed submissions
12	9e	Site staff inexperienced in contract procedures and task undertaken by head office expert who needs time to understand claim situation
13	9e	If the claim is related to inclement weather usually prompt action is taken

Source: Kumaraswamy and Yogeswaran (2003)

On the other hand, 'keeping records' seems to be a major reason associated with lack of causation and hard evidence to support/prove the claimed delays, and also in many standard forms 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 (Keane and Caletka, 2008). Similarly, based on FIDIC 4th edition clauses in verbatim, maintaining such contemporaneous records by contractors to support the time and cost claims is a standard provision in most of the bespoke forms of contract in the local industry. Thus, lack of keeping such records may jeopardise the whole process of the delay claims resolution.

7.5 Assessment and Awarding Process

It is noted that almost all the major bespoke contract forms in the UAE contain requirements of employer approval for awarding EOT to the contractor, in spite of the 'impartiality' in the determination of EOT expected from the consultant (engineer).

In their study conducted in Hong Kong, as for the reasons for delays in the assessment of delay claims, Kumaraswamy and Yogeswaran (2003, p.31) found *"it appears that the principal reasons for delays in assessments are related to lack of details and clarity in substantiation, and delays in submissions of details by the claimant"*. The study also found, *inter alia*, Employer's interference/politics, consultant's lack of resources, delay in approval (of EOT) by employer as some other factors contributing to the delay in assessment process. Thus, it appears that reasons are not one-sided for the delays in EOT claims assessment and settlement process.

Finke (1997) pointed out that in most construction projects the delays are often left unanalysed until the end of the job and Bramble and Callahan (2000, p.16-25) observed *"parties are often convincing themselves that it is to their advantage to delay the resolution of claims as long as possible"*. This may be due to a mistaken belief that matters might become clearer as the contract progresses or expecting that the contractor may catch up and eliminate the potential delay later.

It has been a common scene since the economic crisis started in the last quarter of 2008, that claims resolution process in many projects in the UAE is procrastinated by the employers, following a "wait & see" policy. McDonald (2000, p. 38) observed as a common situation that *"owners often try to wait until the end of the project to deal with the issue of time extensions. This is done in the mistaken belief that denying a time extension at the time of the occurrence provides the owner with one more bargaining point when wrapping up the project"*. As Bramble and Callahan (2000, p.16-25) argued *"an owner may wish to postpone resolution of claims to gain leverage by dragging its feet, with the idea that when the contractor reaches the negotiating Table it will be so eager for settlement that it will accept less. This approach assumes that time is generally on the side of the owner"*. The validity of this argument may be seen when a dispute is eventually resolved with a lesser value of the money to the contractor than it should have been, due to inflation during the procrastinated period and/or rare payment of interest charges, and even with forced 'discounts' secured from the helpless contractors in exchange of the 'settlement'. However, this kind of delay claims resolution is not based on fair grounds, (as the contractor is in a weaker bargaining position, for the employer has in his hand both the completed project and the money that has been claimed) but coercion when negotiation may favour one party and is detrimental to the other. Nevertheless, not all contractors are willing to subject to such compulsions. Thus, many disputes may advance to arbitration and even to litigation levels, as a result of such "wait &

see" policy. If that happens the cost of pursuing a claim through the legal system for several years can be many times the amount of the claim. Therefore, it would be advantageous to both parties to negotiate and settle the claims for time and its cost immediately (Bramble and Callahan, 2000).

Other main problems arising from such "wait & see" policy can be found in delay analysis process, when a more sophisticated MDA like TIA is to be used. As TIA's main operational basis is CPM Programme updates, the validity of such basis is crucial for the acceptance of the delay analysis outcome. As discussed before in Chapter 6, in many court cases in the US the delay analysis outcome (produced by TIA) was rejected as it was based on unreliable programme updates. In the cases like *Fortec Construction v United States (8 CL. Ct. 490 (1985), Continental Consolidated Corp., ENGBCA Nos. 2743, 2766, 67-2 BCA 6624(1967), J.A. Jones Constr.Co., ENGBCA Nos. 3035, 3222, 72-1 BCA 9261* and so on it was held that, *inter alia*, the failure for prompt awarding of EOT and incorporating that in contemporaneous updating of the CPM programme can be fatal to the validity of using TIA in delay analysis. In "*J.A. Jones Constr. Co*" case it was clearly decided that the CPM schedule was distorted and unreliable because adequate time extensions were not granted immediately upon determining the extent of the delay.

Thus, it can be seen that an immediate and direct consequence of the "wait & see" policy is the deprivation of using the best MDA like TIA for fair and efficient delay claims resolution.

In some forms of contract the terms provide that the contractor is only entitled to relief from LDs for excusable delays that actually cause delay to completion, and other forms are either silent of that or expressly allow such relief for the likely effects of delay. Accordingly, in the first category of forms of contract a "wait & see" policy may be permissible until the actual effects of the claimed delays are clear and visible, but not so where the second category of forms of contract apply. In this latter case, in order to reduce the unfair effects of a "wait & see" policy, the SCL Protocol (2002, Section 4.19, p.49) has suggested that when the delay analysis is carried out retrospectively,

> *"in deciding entitlement to EOT, the adjudicator, judge or arbitrator should so far as is practicable put him/herself in the position of the CA at the time the Employer Risk Event occurred. He/she should use the Updated Programme to establish the status of the works at that time. He/she should then determine what (if any) EOT entitlement could or should have been recognised by the CA at the time".*

In this suggestion the SCL Protocol has attempted to avoid validating "wait & see" policy and considered the triers-of-fact should so far as is practicable put themselves in the position of the CA at the time the delay event occurred. As Lowe *et al.* (2007) suggested this is a unique approach to deny an employer any undue benefits if he wants to wait until the end of a project to determine the contractor's entitlement to additional time.

In this instance RP-FSA(2007) has also maintained a similar line that the impact of potential causes of delay must be evaluated within the context of the schedule at the time when the circumstances happen.

7.6 Findings

The following are the main findings from the foregoing literature review:

<u>'Prevention' Principle and Conditions Precedent</u>

- The major bespoke forms of contract used in the UAE are having conditions precedent as to 'notice' and other requirements related to delay claims; these conditions are worded following FIDIC 1999 series of forms;
- The UAE law may or may not provide relief to the contractors claims where delays are purely caused by the other side although the contractors have failed to comply with such conditions precedent. However, the wording of UAE Federal Law No. 5 of 1985, Article 287 may be in favour of a Condition Precedent but it shows no known precedence and the issue may have to be tested yet, particularly when such other Articles like Article 487 as mentioned above imply survival of a claim until it is time barred by law; due to this uncertain situation, a more prudent way to deal with it is to comply with the conditions precedent in order to keep the right to claim alive;
- In the Scottish, English and Australian jurisdictions the legal position on the issue seems to be having some certainty, at least for now; thus recent English and Scottish law have decided in favour of conditions precedent although it may be inequitable for the employer to levy liquidated damages in the presence of an act of prevention, whereas current legal position in Australian courts seems to be for prevention principle and granting EOT even if the contractor has not given notice required by the contract;
- Failure to give 'notice' and 'particulars' complying with the conditions precedent may affect the delay claims resolution process itself; If contractor's compliance is defeated

by prevention principle and giving them the flexibility to stockpile or issue EoT claims at stages close to completion may make it much harder to resolve the disputes promptly.

Updating the CPM Programme

- At least in the US industry, the use of CPM schedule is almost inevitable in every new construction project and courts and boards of appeals have underlined the importance of utilizing the CPM in asserting or refuting a delay claim;
- Updating of the programme is expected to be preceded by existence of a proper baseline CPM programme;
- The Baseline Schedule and the As-Built Schedule are the two most important schedules in a forensic analysis;
- Failure to recognise that the as planned schedule that was worked with was deficient in some regard may lead to the entire delay analysis being discredited;
- Updating the CPM programme is essential for more sophisticated MDAs like Time Impact Analysis (TIA), but not for simplistic methods like Impacted-As-Planned (IAP);
- Both the TIA and the APvAB methods require actual dates; without knowing what actually happened, the value of either analysis is greatly diminished and this is well recognized by courts;
- If the programme is irreparably deficient for the purpose, there would not be any acceptance to the same for delay analysis only because it is the approved programme;
- Unless the CPM programme is fully updated in terms of the delays, gains, mitigation, acceleration and the contractor's entitlement to EOT as of the time of the occurrence of the delay event, such programmes cannot be relied on for credible results of the delay analysis but become obsolete to be used as the basis for delay analysis techniques;
- An alternative approach implemented by Australian Standard Form AS2124 is to deprive the contractor of any entitlement to EOT in concurrent delays situation if at least one of the delays is not a risk event of the employer (Developer). This seems reasonable as it puts the contractor under an obligation to follow its existing programme unless there is "reasonable cause" to "depart" from it. In a situation like Clause 14.1 of FIDIC 4th edition where the engineer/employer has to give 'consent' to the contractor's programme which is a non-contractual document and then to be

bound by it contractually though without having any say to its control, such alternate approach could be justifiable.

<u>Claims Presentation</u>

- Regardless of how the UAE courts may decide between conditions precedent and the 'prevention principle', it is prudent for all contractors to comply with those conditions rather than risking potential deprivation of right to claim and long, costly legal battles;
- Apart from the issue of compliance with conditions precedent, what can be mostly and very often fatal to a contractor's delay claims is his failure to establish 'causation' with necessary evidence;
- For the success in delay claims, any impressionistic estimates or similar methods cannot substitute the requirements based on objectivity and factual, hard evidence to prove causation;
- 'Keeping records' seems to be a major reason associated with lack of causation and hard evidence to support/prove the claimed delays;
- Lack of 'Keeping records' seems to be one of the major factors contributing to the late determination of the claims, as the burden of submission of sufficient particulars to enable the consultant to evaluate the claim is primarily on the contractor.

<u>Assessment and Awarding Process</u>

- Employers' interference/politics, consultant's lack of resources, delay in approval (of EOT) by employers are found to be among the factors delaying assessment of the delay claims and the EOT awarding;
- Employers may wish to postpone resolution of claims to gain leverage by dragging its feet, with the idea that when the contractor reaches the negotiating table it will be so eager for settlement that it will accept less;
- However, many disputes may advance to arbitration and even to litigation, as a result of such "wait & see" policy. If that happens "the cost of pursuing a claim through the legal system for several years can be many times the amount of the claim;
- A main problems arising from such "wait & see" policy can be found in delay analysis process, when a more sophisticated MDA like TIA is to be used but it cannot rely on a CPM programme which has become invalid due to employer's failure to promptly award EOT. This is often the case when the contract forms are either silent of or expressly allow relief from LDs for the <u>likely effects</u> of excusable delays.
- In order to reduce the unfair effects of a "wait & see" policy, the SCL Protocol has

suggested that when the delay analysis is carried out retrospectively, to decide entitlement to EOT in the position of the CA at the time the Employer Risk Event occurred.

7.7 Summary

This Chapter concludes the main literature review for this study which is carried through the three preceding Chapters 4, 5 and 6. The main findings of the overall literature review will be considered for their convergence or otherwise with the findings of the research inquiry results which would be dealt with next.

In this Chapter, the current legal positions in the UK, the US and Australian jurisdictions, as well as the possible position of the UAE legal system have been discussed in the context of 'prevention principle' and 'conditions precedent'. It has also discussed some issues related to the CPM programme, particularly the legal significance of its as-built updates, and consequences of its deficiencies. This is followed by a discussion on claims presentation by the contractors, the process of their assessment by the consultants and the employers' awarding of EOT. The findings of the current review are then outlined before conclusion of the Chapter.

CHAPTER EIGHT

8.0 Outcome of Merged Data Analysis and Discussion

8.1 Introduction

This Chapter 8 mainly presents the outcome of the merged results of the qualitative and the quantitative strands which were discussed separately in the Appendix A- 'Interview Results' and Appendix B- 'Survey Results'. The merging of the results of the two strands has been done using a triangulation approach and in the form of a discussion with necessary cross-referencing to the concerned Appendices and the findings of literature review. Triangulation seeks convergence, corroboration, and correspondence of results from the different methods. Thurmond (2001) identified five types of 'triangulation': Data Source Triangulation, Investigator Triangulation, Methodologic Triangulation, Theoretical Triangulation, and Data Analysis Triangulation. However, in the current study, which has mixed methods approach as its inquiry approach, the emphasis is basically on the Methodologic Triangulation which is also called Mixed-method or Methods Triangulation (Barbour, 1998; Greene and Caracelli, 1997; Green, 2007; Polit and Hungler, 1995).

It is suggested that researchers using between or across-method triangulation may employ qualitative and quantitative data collection methods in the same study (Boyd, 2000; Denzin, 1970; Kimchi *et al.*,1991; Mitchell, 1986). Lincoln and Guba (2000) argued that within the same paradigm, mixing data collection methods would be sensible. Thus, possibility of Methodologic Triangulation by combining qualitative and quantitative methods in a single study is accepted (Cobb, 2000; Lincoln and Guba, 2000; Mitchell, 1986). Accordingly, the currrent research has used a combination of interviews and an in-depth survey. In this blending, mainly it is expected to *"increase the ability to rule out rival explanations of observed change and reduce skepticism of change related findings"* (Hinds, 1989, p.442).
The Convergent Parallel Design approach suggested by Creswell and Plano Clark (2011) was discussed earlier in the Chapter 2 ('Research Methodology'), and adopted in the current study. Accordingly, qualitative and quantitative data collected from the interviews and survey questionnaire are to be merged in order to bring a more complete understanding and a greater insight into the phenomena being studied than would be obtained by either form separately and alone.

Creswell and Plano Clark (2011, p.223) suggested three options for merged data analysis comparisons in mixed methods studies: *"side-by-side comparisons in a discussion or summary Table, joint display comparisons in the results or interpretations, or data transformation in the results"*. Accordingly, for the current comparison of results, this first option for merging is selected. Thus, the comparison for merged data analysis presents the quantitative results and the qualitative findings in the form of a discussion. This discussion then becomes the vehicle for merging the results. One popular approach suggested by Creswell and Plano Clark (2011) is to first present the quantitative results followed by qualitative results in the form of quotes (or vice versa) in a results or discussion section. And then to comment how the qualitative results either confirm or disconfirm the quantitative results.

In Appendix A- 'Interview Results' and Appendix B- 'Survey Results', the data analyses of the interviews and the in-depth survey have been carried out, respectively. These Appendices also contain the summarised findings and results of the qualitative and quantitative strands. In the triangulation process, these summarised findings and results are compared, interpreted and merged by a discussion (a discussion relating qualitatively derived themes to quantitative variables in corroboration with the reviewed literature), specifying how the qualitative findings either confirm or disconfirm the quantitative results and to see in what ways and to what extent they confirm the research propositions, answer the research questions and finally accomplish the research objectives.

It is noted that while the in-depth survey questionnaire has the role of the interfacing instrument to implement the quantitative strand covering a larger sample gathered, the general structure and the themes of both interviews and the survey questionnaire are more or less similar. This has provided a common ground for the triangulation undertaken.

This Chapter consists of two main sections entitled *Comparisons of Results*, and *Conclusions of Merged Results*. The *Comparisons of Results* is carried out in a discussion under the headings of 'Awareness', 'Adopted Practices', 'Problematic Situations' and 'Suggested Improvements' which are framed in line with the main themes under which the inquiry was conducted.

It may be noted that the separate analyses carried out for 'Interview Results' and 'Survey Results' in Appendices A & B, respectively, contain further detailed discussions to supplement the merged results discussed in this Chapter; the Tables appear in this Chapter are also sourced from Appendices A, B, & C.

8.2 Comparison of Results

The dimensions by which to compare the results from the two data bases are broadly determined by the main themes addressed in the interviews. Using these broad dimensions, the findings of the data collected and analysed from the interviews and the in-depth survey will be discussed and compared with necessary cross-referencing to the Appendices. Thus, the comparison between the two strands will be mainly carried out under three main themes namely *'Awareness'*, *'Adopted Practices'*, and *'Problematic Situations'*. In the final outcome of this comparison, it is expected to reveal the general background of practices related to apportioning of liabilities in delay claims resolution, particularly in UAE/Dubai.

Following that comparison, a further theme of *'Suggested Improvements'* will address the various suggestions made, particularly by the interviewees, to introduce certain improvements. These suggestions were made with the intention to provide some solutions to the *'Problematic situations'* identified in the general background of practices. The final aim of these improvements is to minimise disputes and enhance efficiency in the process of apportioning liabilities in delay claims. These proposed improvements have been further discussed and appropriately used in the suggested best practice 'Framework of Improvemnents' presented in Chapter 9, as the main research outcome and in line with the principal research aim and the main objectives.

8.3 Awareness

The dimensions for comparison under this theme are

1. The level of awareness among the practitioners on delay claims theory and forensic scheduling which are essential for apportioning of liabilities in delay claims; and
2. The extent of convergence or divergence among the awareness of practitioners on these delay claims theories, concepts and methods.

8.3.1 Concurrent Delays – Applicability in Contracts (Apportioning time and cost)

It is noted in the literature review that when it comes to apportioning costs in concurrent delay situations, there are many schools of thought adopting various approaches (Arditi and Robinson, 1995; Livengood, 2007d; Peters, 2003). To examine this trend in the local settings, The Question no.9 of the survey questionnaire inquired the level of awareness of the two Groups (i.e. Contracting Group and Consulting Group) on how to apportion the time and cost in six possible scenarios of concurrent delays. The summary results of Tables B.19 to B.24 as appear below have shown the survey-respondents' perceived awareness of these scenarios.

Table: B. 19 Apportioning : Where one delay is caused by the employer and the other by the contractor

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	21	2	3	2	28
	% within Respondent Group	75.0%	7.1%	10.7%	7.1%	100.0%
Consulting Group	Count	6	7	23	1	37
	% within Respondent Group	16.2%	18.9%	62.2%	2.7%	100.0%
Total	Count	27	9	26	3	65
	% of Total	41.5%	13.8%	40.0%	4.6%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 26.08 > Critical x^2 = 16.27 at .001, *df*=3, p<.001; Symmetric Measures : *Phi* ϕ=.633, Cramer's V = .633

The above summary of results in Table B.19 (N=65) shows that "where one delay is caused by the employer and the other by the contractor", the majority of the Consulting Group (62%) perceived that the contractor was entitled to time and cost (the cost only if clearly segregated by the contractor) while the majority of the Contracting Group (75%) viewed that the entitlement was to 'time' only. The results of Chi-Square Test for Independence show that there is high, statistically significant association between the perceptions of the two Groups on these concepts (sample x^2 = 26.08> Critical x^2 = 16.27 at .001, *df*=3, p <.001). *Phi* ϕ (.633) and Cramer's V (.633) also show that the strength of this association between the variables is substantial. Thus, these results suggest that both Groups did not share a similar perception on the scenario concerned. To this extent, there is significant association between the Groups' perceptions.

Table: B. 20 Apportioning: Where two delays are caused by the employer

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	1	25	3	0	29
	% within Respondent Group	3.4%	86.2%	10.3%		100.0%
Consulting Group	Count	0	34	3	0	37
	% within Respondent Group		91.9%	8.1%		100.0%
Total	Count	1	59	6	0	66
	% of Total	1.5%	89.4%	9.1%	0	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 1.42 < Critical x^2 = 5.99 at .05, *df*=2, p=.491>.05; Symmetric Measures : *Phi* ϕ=.147, Cramer's V = .147

The summary of results in Table B.20 (N=66) above shows that "where two delays are caused by the employer", the vast majority of the Consulting Group (92%) and of the Contracting Group (86%) were in agreement as to the contractor's entitlement to both time and cost. The Chi-Square Test for Independence shows that there is no statistically significant association (differences) between the perceptions of the two Groups on this issue (sample x^2 = 1.42 < Critical x^2 = 5.99 at .05, *df*=2, p=.491>.05). *Phi* ϕ (.147) and Cramer's V (,147) also show that the strength of any association between the variables is very weak. Thus, these results may suggest that the vast majority of both Groups shared a similar perception on the scenario concerned. To this extent, there is no significant association (differences) between the Groups' perceptions.

Table: B. 21 Apportioning : Where two delays are caused by the contractor

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	0	0	0	29	29
	% within Respondent Group				100.0%	100.0%
Consulting Group	Count	1	0	0	36	37
	% within Respondent Group	2.7%			97.3%	100.0%
Total	Count	1	0	0	65	66
	% of Total	1.5%			98.5%	100.0%

Test statistics
Chi-Square Test for Independence: sample x^2 = 0.796 < Critical x^2 = 3.84 at .05, *df*=1, p=.372>.05; Symmetric Measures: *Phi* ф=-.110, Cramer's V = .110

A summary of results of the Table B.21 (N=66) shows that "where two delays are caused by the contractor", the vast majority of the Consulting Group (97%) and of the Contracting Group (100%) were in agreement as to the contractor's non-entitlement to either time or cost. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this matter (sample x^2 = 0.796 < Critical x^2 = 3.84 at .05, *df*=1, p=.372>.05). *Phi* ф (.110) and Cramer's V (.110) also show that the strength of any association between the variables is very weak. Thus, these results may suggest that the vast majority of both Groups share a similar perception on the matter and to this extent, there is no significant association (differences) of perceptions between the Groups.

Table: B. 22 Apportioning: Where two delays are caused by the neutral causes

Respondent Group		**Time Only**	**Both Time and Cost**	**Time, but the cost only if clearly segregated by the contractor**	**No time, No cost**	**Total**
Contracting Group	Count	26	0	1	1	28
	% within Respondent Group	92.9%		3.6%	3.6%	100.0%
Consulting Group	Count	31	4	2	0	37
	% within Respondent Group	83.8%	10.8%	5.4%	.0%	100.0%
Total	Count	57	4	3	1	65
	% of Total	87.7%	6.2%	4.6%	1.5%	100.0%

Test statistics
Chi-Square Test for Independence: sample x^2 = 4.61 < Critical x^2 = 7.82 at .05, *df*=3, p=.202 >.05; Symmetric Measures: *Phi* ф=-.266, Cramer's V = .266

A summary of results of Table B.22(N=65) shows that "where two delays are caused by neutral causes", the vast majority of the Consulting Group (84%) and of the

Contracting Group (93%) were in agreement to that the contractor's entitlement was to time only. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this (sample sample x^2 = 4.61 < Critical x^2 = 7.82 at .05, *df*=3, p=.202 >.05). *Phi* ϕ (.266) and Cramer's V (.266) also show that the strength of this association between the variables is weak. Thus, these results may suggest that the vast majority of both Groups shared similar perceptions and to this extent, there is no significant association (differences) of perceptions between the two Groups.

Table: B.23 - Apportioning : Where one delay is caused by the employer and other is by a neutral cause

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	16	8	4	0	28
	% within Respondent Group	57.1%	28.6%	14.3%	0%	100.0%
Consulting Group	Count	5	23	8	1	37
	% within Respondent Group	13.5%	62.2%	21.6%	2.7%	100.0%
Total	Count	21	31	12	1	65
	% of Total	32.3%	47.7%	18.5%	1.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 14.383 > Critical x^2 = 11.34 at .01, *df*=3, p=.002 <.01; Symmetric Measures: *Phi* ϕ=-.470, Cramer's V = .470

The Table B.23 (N=65) indicates that, in the case "where one delay is caused by the employer and other is by a neutral cause", the majority of the Consulting Group (62%) viewed the option 'Both time and cost' as the correct approach whereas the majority of the Contracting Group (57%) favoured 'Time Only' option. The Chi-Square Test for Independence shows that there is a statistically significant association between the perceptions of the two Groups (sample x^2 = 14.383 > Critical x^2 = 11.34 at .01, *df*=3, p=.002 <.01). *Phi* ϕ (.470) and Cramer's V (.470) also show that the strength of this association between the variables is moderate. Thus, these results suggest that both Groups did not share similar perception on this issue. To this extent, there is significant association (differences) between the Groups' perceptions.

Table: B. 24 Apportioning : Where one delay is caused by the contractor and other is by a neutral cause.

Respondent Group		Time Only	Cost Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Don't Know	Total
Contracting Group	Count	21	0	1	1	5	0	28
	% within Respondent Group	75.0%		3.6%	3.6%	17.9%		100.0%
Consulting Group	Count	29	1	2	2	2	1	37
	% within Respondent Group	78.4%	2.7%	5.4%	5.4%	5.4%	2.7%	100.0%
Total	Count	50	1	3	3	7	1	65
	% of Total	76.9%	1.5%	4.6%	4.6%	10.8%	1.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample $x^2 =$ 4.06 < Critical $x^2 =$ 11.07 at .05, *df*=5 p=.540 >.05; Symmetric Measures: *Phi* ϕ=-.250, Cramer's V = .250

The summary of results of Table B.24 (N=65) shows that, in the case "where one delay is caused by the contractor and other is by a neutral cause", the majority of the Consulting Group (78%) and of the Contracting Group (75%) were in agreement as to the contractor's entitlement to time only. The Chi-Square Test for Independence shows that there is no statistically significant association (difference) between the perceptions of the two Groups on this (sample $x^2 =$ 4.06 < Critical x^2 = 11.07 at .05, *df*=5 p=.540 >.05). *Phi* ϕ (.250) and Cramer's V (.250) also show that the strength of this association between the variables is weak. Thus, these results suggest that the majority of both Groups shared a similar perception and to this extent, there is no significant association (differences) of perceptions between the Groups as to the issue.

The foregoing indicates that, in more complicated aspects of apportioning in concurrent delays (ref. Tables B.19 and B.23 above), the survey results are consistent with the findings in literature review that there is hardly any convergent position between the experts' opinions on the issues associated with remedies for 'concurrent delays' (Peters, 2003; Livengood, 2007d; Keane and Caletka, 2008). However, on the other hand, the survey results show that there is a majority agreement between the two groups in less complicated aspects of apportioning in concurrent delays (ref. Tables

B.20, B.21, B.22 and B.24). Thus, to that extent there is a degree of divergence between the survey results and the literature review's findings in less complicated aspects of apportioning in concurrent delays.

On the basis of the above results, the common situation may be interpreted as the majority of the survey- respondents are for apportioning the time and cost in concurrent delays adopting a line similar to the principles of SCL Protocol (2002) discussed in the literature review. However, there were also divergent perceptions on more contentious and perplexed scenarios of concurrent delays, but these perceptions were represented only by a minority of the participants.

With the interviewees, the apportioning of the time and cost in concurrent delays was discussed particularly in the context of a contentious proposition that whenever the contractor gets extension of time, regardless of existence of a concurrent delay situation, he will automatically get cost as well (Gibson, 2008). For the majority (60%) of the interviewees (ref. Table A.2 below), who discussed this issue, the apportionment of costs in concurrent delays was essential as they thought an entitlement to 'time' would not automatically entitle to 'cost'.

Table: A. 2 Apportioning Time and Cost on 'concurrency'

THEORY/ CONCEPT

'Regardless of concurrency, whenever the contractor gets extension of time he will automatically get cost as well'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2		1	
3	1		
4		1	
5		1	
6			1
7		1	
8		1	
9		1	
10			1
TOTAL	2	6	2
%	20%	60%	20%

On the other hand, all the interviewees (100%) were in agreement that the contractor should not be deprived of his entitlement to EOT only because he was in a concurrent delay with the employer delay (ref. Table A.3 below).

Table: A. 3 Apportionment of Liability in 'concurrent delays'

THEORY/ CONCEPT

'The contractor should not be deprived of his right to time extension, even if he is in a delay concurrent with an excusable delays'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2	1		
3	1		
4	1		
5	1		
6	1		
7	1		
8	1		
9	1		
10	1		
TOTAL	10	0	0
%	100%	0%	0%

The general findings of the literature reviewed (ref. Chapter 4) on this issue were:

- There is hardly any convergent position between the experts' opinions on the issues associated with remedies for 'concurrent delays' (Arditi and Robinson, 1995; Peters, 2003, Wilson, 2004; SCL Protocol, 2002);
- The legal position is also not certain in essential issues like how to apportion liabilities in concurrent delays;
- The SCL Protocol may be considered as the most coherent and unified set of views currently available as to the issues of apportioning delay liabilities for recovery of time and cost, and they are consistent with the legal position developed in the UK and particularly in the US jurisdiction.
- The uncertainty as to definition of 'concurrent' delays and applicable approaches to apportioning delay liabilities may lead to disputes over the outcome of a delay analysis. For example, if the delay analysis follow 'Longest Path' approach to quantify delay impact, only the delays occurring at the same time would be considered as concurrent delays (Wickwire *et al.*, 2003; Peters, 2003; Keane and Caletka, 2008) and that will exclude any entitlement to either party from the concurrent effects felt at the same time by the delays occurring sequentially on multiple critical paths;

Accordingly, on the issue of 'Apportioning time and cost in concurrent delays' it may be reasonably said that the overall awareness of the majority of survey-respondents is generally complemented by the majority of the interviewees; however, the general finding of literature review that *'There is hardly any convergent position between the experts' opinions on the* *issues associated with remedies for 'concurrent delays'* seems not fully corroborated by the results of the interviews and the survey. Yet, that may be corroborated to the extent of existence of a dissenting minority which perceived differently to the majority consensus. In any case, the majority position of both interviewees and survey-respondents generally represented the principles of SCL Protocol (2002) considered in the literature review in Chapter 4.

8.3.2 Concurrent delays – 'True Concurrency' and 'Concurrent Effects'

The Question no. 8 of the survey questionnaire inquired whether the respondents tend to treat (i) only such effects of 'True Concurrency' (where delaying events should occur at the same time) as 'concurrent' and having merits to award extension of time (Wickwire *et al.,* 2003), **or** (ii) besides the 'True Concurrency', the 'Concurrent Effects' (where delaying events on multiple critical paths occur sequentially but their effects being felt at the same time) are also having similar merits to award extension of time (SCL Protocol, 2002; Bramble and Callahan, 2000; Tobin, 2007).

The issue is of a high importance to delay claims analysis and apportioning quantum, since it intrinsically relates to the theory of 'criticality' which has been discussed separately.

The summary of results in Table B.18 below has shown that the majority (overall 57%) of the two Groups considered that both 'True Concurrency' and 'Concurrent Effects' equally merit entitlement to extension of time; however, a substantial minority (overall 39%) believed only 'True Concurrency' should carry entitlement. A small percentage did not have any firm perception (overall 5%). No alternative approach was submitted although the survey-respondents were provided with an opportunity for that.

The Chi-Square Test for Independence (sample x^2 = 2.14 < Critical x^2 = 5.99 at .05, *df*=2, p=.343 > p=.05) show that there is no statistically significant association (difference) between the perceptions of the two Groups on these concepts. *Phi* ϕ (.186) and Cramer's V (.186) also show that the strength of any association between the variables is weak.

Table: B. 18 Perception on "True Concurrency' and 'Concurrent Effects'

Perception on 'Concurrent' Delays in the case of "True Concurrency" or Concurrency of Causes (i.e. delaying events occurring at the same time) and "Concurrency of effects" (i.e.delaying events start sequentially and at different times but their effects are felt at the same time)

Respondent Group		In both cases the effects of the delaying events are treated as 'concurrent' and equally potent to award extension of time.	Only such effects of 'True Concurrency' are treated as 'concurrent' and having merits to award extension of time.	Don't Know	Total
Contracting Group	Count	15	10	0	25
	% within Respondent Group	60.0%	40.0%	.0%	100.0%
Consulting Group	Count	20	14	3	37
	% within Respondent Group	54.1%	37.8%	8.1%	100.0%
Total	Count	35	24	3	62
	% of Total	56.5%	38.7%	4.8%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 2.14 < Critical x^2 = 5.99 at .05, *df*=2, p=.343>.05; Symmetric Measures : *Phi* ϕ=.186, Cramer's V = .186

The same question was submitted to the interviewees and found that the majority consensus among them was 70% (ref. Table A.4 below) in supporting the principle that both 'Concurrent Causes' and 'Concurrent Effects' are having equal potency for extension of time.

Table: A. 4 Perception on "True Concurrency' and 'Concurrent Effects'

THEORY/ CONCEPT

'Both 'concurrent causes' and 'concurrent effects' are having equal potency for extension of time

Response	Supportive	Non-supportive	Neutral or No Position
1		1	
2	1		
3			1
4	1		
5	1		
6			1
7	1		
8	1		
9	1		
10	1		
TOTAL	7	1	2
%	70%	10%	20%

The general findings of the literature reviewed (ref. Chapter 4) on this issue were:

- There is still no universal position as to the definition of 'concurrent' delays, which is the most perplexed issue in delay analysis and apportioning liabilities;

- The SCL Protocol's principles may be considered as the most coherent and unified set of views currently available as to the definition of 'concurrent' delays, and are consistent with the legal position developed in the UK and US jurisdictions.

Thus, on the issue of 'true concurrency' and 'concurrent effects' it may be reasonably said that the overall awareness of the majority of survey-respondents is generally complemented by the majority of the interviewees with high level of consensus; however, the general finding of literature review that '*There is still no universal position as to the definition of 'concurrent' delays*' (Peters, 2003; Livengood, 2007d; Keane and Caletka, 2008) may be corroborated only to the extent of existence of a dissenting minority which opposed to the majority consensus. Yet, the majority position of both interviewees and survey-respondents corroborated with the principles of SCL Protocol (2002) considered in the literature review (ref. Chapter 4).

8.3.3 Ownership of 'Float'

The varied positions taken as to float ownership may impact the outcome of delay analysis (Peterman, 1978; Guy Ponce, 1986; Nash, 2002; Eggleston, 2006; RP-FSA, 2007). Accordingly, in order to inquire how the survey-respondents perceive and practise as to the issue of 'who owns the float' a specific question was asked (i.e. Question #10). The Table B.25 below has shown that the majority of both Groups (overall 68%) agreed that if the contract is silent about it then 'float' should belong to the project (SCL Protocol, 2002; Pickavance, 2005; Winter and Calvey, 2008). Nevertheless, there was a minority holding that the 'float' should belong to the contractor (overall 26%) or the employer (overall 3%). Another small percentage did not have any firm perception (overall 3%). No alternative approach was submitted although the survey-respondents were provided with an opportunity for that. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this (sample x^2 = 3.41< Critical x^2 = 7.82 at .05, df=3 p=.333 >.05). *Phi* ϕ (.227) and Cramer's V (.227) also show that the strength of any association between the variables is weak. To this extent, there is no significant association (difference) between the Groups' perceptions as to the concept concerned. On the other hand the majority position (overall 68%) seems to be consistent with the SCL Protocol's position.

Table: B. 25 Who owns the 'float' if the contract is silent of it

Respondent Group		'Float' belongs to the contractor	'Float' belongs to the employer	'Float' belongs to the project (either party can consume it on first come, first served basis.)	Don't Know	Total
Contracting Group	Count	10	1	18	0	29
	% within Respondent Group	34.5%	3.4%	62.1%		100.0%
Consulting Group	Count	7	1	27	2	37
	% within Respondent Group	18.9%	2.7%	73.0%	5.4%	100.0%
Total	Count	17	2	45	2	66
	% of Total	25.8%	3.0%	68.2%	3.0%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 3.41< Critical x^2 = 7.82 at .05, *df*=3 p=.333 >.05; Symmetric Measures: *Phi* ϕ=-.227, Cramer's V = .227

As summarised in Table A.5 below, the vast majority of the interviewees (90%) were in favour of that 'it is belonged to the project' and can be used on first come first served basis.

Table: A. 5 Perception on 'Float' ownership

THEORY/ CONCEPT - 'The 'float' is belonged to the project'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2	1		
3	1		
4	1		
5	1		
6			1
7	1		
8	1		
9	1		
10	1		
TOTAL	**9**	**0**	**1**
%	**90%**	**0%**	**10%**

The general findings of the literature reviewed (ref. Chapter 4) on this issue were:

- There is still no universal position as to who should own the 'Float', whether it is the contractor or the employer or should it be belonged to the project for consumption by either party on 'first come, first served' basis. There are arguments for all three positions;

- The SCL Protocol's position that the 'float' is there to be used by whichever party needs it first is consistent with the general legal position of the UK and the US (though with some exceptions).

Accordingly, on the issue of 'ownership of the float' it may be reasonably said that the overall awareness of the majority of survey-respondents is generally complemented by the majority of the interviewees; however, the general finding of literature review that *'There is still no universal position as to who should own the 'Float'* may be corroborated only to the extent of existence of a dissenting minority which opposed to the majority consensus. Nevertheless, the majority position of both interviewees and survey-respondents corroborated with the principles of SCL Protocol (2002) considered in the literature review (ref. Chapter 4). The minority perception that 'ownership of the float' should be with contractors is to an extent similar to RP-FSA (2007) position that the contractors should own the project float.

8.3.4 Measuring 'Criticality' in Forensic Scheduling

The Question no.11 in the survey questionnaire inquired the respondents' perception and practice as to the issue of measuring 'criticality' for apportioning the liability. For this purpose, it asked whether 'criticality' of a delaying effect to be measured against the prevailing contract completion date (as adopted by 'Total Float' theory) or against the project (predicted) completion date (as followed by the 'Longest Path' theory), when the contract did not explicitly refer to which approach to be taken.

The summary of results of Table B.26 has indicated below that the majority of both Groups (overall 60%) were in agreement with the 'Total Float' theory, although a substantial minority (Overall 35%) took the 'Longest Path' theory as their approach. Another small percentage did not have any firm position (overall 5%); The majority position may be explained by the fact that almost all bespoke forms of contract used in the locality set out that the contractual 'Time for Completion', which is defined in the contract, has to be affected by a delay for either granting extension of time or levying 'penalty' (or Liquidated Damages); this implicitly requires the 'criticality' of a delaying event be measured against the prevailing contract completion date.

The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this issue (sample x^2 = 1.27

< Critical x^2 = 5.99 at .05, df=2 p=.531 >.05). *Phi* ϕ (.140) and Cramer's V (.140) also show that the strength of this association between the variables is quite weak.

Table: B. 26 Approach to measure the 'criticality' of a delay effect, if the contract is silent of it.

Respondent Group		**Criticality to be measured against prevailing contract completion date.**	**Criticality to be measured against the projected completion date (determined by the Longest Path).**	**Don't Know**	**Total**
Contracting Group	Count	19	8	1	28
	% within Respondent Group	67.9%	28.6%	3.6%	100.0%
Consulting Group	Count	20	15	2	37
	% within Respondent Group	54.1%	40.5%	5.4%	100.0%
Total	Count	39	23	3	65
	% of Total	60.0%	35.4%	4.6%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 1.27 < Critical x^2 = 5.99 at .05, df=2 p=.531 >.05; Symmetric Measures: *Phi* ϕ=-.140, Cramer's V = .140

For the interviewees a similar question was submitted in the context of the principles of the foregoing two theories, and as Table A.6 shows below the majority (80%) were supportive of 'Total Float' theory approach.

Table: A. 6 Measuring 'criticality' in Forensic Scheduling

THEORY/ CONCEPT

'If the contract explicitly or implicitly infers that the point of measuring criticality is the prevailing contract completion date and not the project completion date, then the Longest Path approach cannot be implemented under such situation'

Response	**Supportive**	**Non-supportive**	**Neutral or No Position**
1	1		
2	1		
3	1		
4	1		
5	1		
6		1	
7	1		
8	1		
9	1		
10			1
TOTAL	**8**	**0**	**0**
%	**80%**	**10%**	**10%**

In this case, in an extended discussion, most of the interviewees were supportive of that the criteria to measure fairness in apportioning liabilities had to be the agreed terms (intentions) of the parties but it was also said that such 'fairness' was sometimes compromised for employers' benefit, in the local practice. Accordingly, the decision to apply Longest Path (Wickwire *et al.,* 2003, RP-FSA 2007, 2009, 2011) or Total Float approach (Jentzen *et al.,* 1994; Peters, 2003; Bramble and Callahan, 2000; SCL Protocol, 2002; Keane and Caletka, 2008) should be consistent with the terms of contract (Wickwire *et al.,* 2003; RP-FSA, 2007), but there may be deviation from this in the local practices if such 'fairness' is compromised for bias towards employer's interests. This may be some explanation for the trend that exists among these practitioners for using this or that MDA upon personal desire, regardless of the terms of the contract/ project circumstances.

The general findings of the literature reviewed (ref. Chapter 5) on this issue were:

- There is still no universal position as to the question of definition of criticality that whether all activities having total float less than or equal to zero are critical (Total Float Theory), or only those having the maximum negative float are critical (Longest Path Theory);
- Which approach is correct in application depends on the contractual considerations or terms of the contract (Wickwire *et al.,*2003; RP-FSA, 2007);
- SCL Protocol appears to have taken a position that, unless the terms of contract require otherwise, to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date.

Accordingly, on the issue of Measuring 'Criticality' in Forensic Scheduling it may be reasonably said that the overall awareness of the majority of survey-respondents is generally complemented by the majority of the interviewees. In this case, the general finding of literature review that *'There is still no universal position as to the question of definition of criticality'* may be corroborated only to the extent of existence of a dissenting minority which opposed to the majority consensus. Yet, the majority position of both interviewees and survey-respondents corroborated with the principles of SCL Protocol (2002) considered in the literature review (ref. Chapter 5).

8.3.5 Entitlement to EoT after passing the contract completion date

This was a peripheral issue discussed with the interviewees, on the issue of Measuring 'Criticality' in Forensic Scheduling. As discussed in the literature review this issue is primarily related to the so-called 'residual float' in the Longest Path method which precludes an automatic entitlement to extension of time for the employer's delays occurring while the contractor is also in a delay after passing the contract completion date. Opposed to this, the 'Total Float' approach considers the 'criticality' is to be measured from the prevailing contract completion date, regardless of the so-called 'residual float', and therefore, the extent of delay occurring after prevailing contract completion date would give an automatic entitlement to extension of time on 'net' basis (i.e. day-for-day basis).

As indicated in Table A.6 above, the overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' school, except for one interviewee who supported the 'Longest Path' approach. In this instance, it may be reasonable to consider that the majority of the interviewees are inclined to comply with the most of the bespoke forms of contract in the UAE which require 'criticality' in forensic scheduling to be measured against the contract completion date, and are unlikely to favour the so-called 'residual float' concept. This position seems to be convergent with that of the majority of the survey-respondents, as the majority stand indicated in Table B.26 above has been compatible with it.

The general findings of the literature reviewed (ref. Chapter 5) on this issue were:

- The SCL Protocol (2002) accepts entitlement to EOT for an employer delay occurring after passing the contract completion date and while there is a contractor's culpable delay (ref. 'Figure 9' of the SCL Protocol, 2002); however, the employer risk event does not exonerate the contractor for all its delays prior to the employer risk event occurring. The net effect of the employer risk event should simply be added to the contract completion date;
- If the contract is silent, then SCL's position reflects the current legal position in the UK (*'Balfour Beatty v Chestermount'*);
- However, if the criticality is decided by Longest Path approach, the entitlement in principle will have to be decided similar to the approach taken in the US case *'Santa fe'*, and consequently, will be allowed only if

such delays extend the longest critical path of a contractor delays. Thus, the followers of 'Longest Path' theory are inclined to consider there should be no automatic entitlement to EOT for excusable delays after passing the contract completion date (Wickwire *et al.*,2003);

The position of the majority of the interviewees and the survey-respondents ~~is~~ appears to be in line with the literature that supports the 'entitlement to EoT after passing the contract completion date' (SCL Protocol, 2002). It is also found consistent with the majority position seen in the previous issues such as Measuring 'Criticality' in Forensic Scheduling.

8.3.6 Awareness and Effectiveness of MDAs

The Question no.12 in the survey questionnaire inquired the respondents' level of awareness on mostly used MDAs in the local practices. The MDAs referred to were As-planned v As-built [APvAB], Impacted-As-Planned [IAP], Collapsed-As-Built [CAB] and Time Impact Analysis [TIA] together with Global Claims method. Of these, the first four MDAs are identified as primary methods in many publications (Keane and Caletka, 2008; SCL Protocol, 2002; Arditi and Pattanakitchamroon, 2006). This Question was intrinsically associated with another Question (no.18) which inquired how they perceived the effectiveness of those MDAs in practice.

Table: B. 27 Level of Awareness on MDAs

	CONTRACTING GROUP		**CONSULTING GROUP**		**OVERALL**	
MDA	**Awareness Index (Weighted**	**Rank**	**Awareness Index (Weighted**	**Rank**	**Awareness Index (Weighted**	**Rank**
As-Planned vs As-Built	4.1	5	3.44	5	3.75	5
Impacted As-Planned	4	4	3.32	4	3.62	4
Collapsed As-Built	2.57	1	2.76	2	2.68	1
Time Impact Analysis	2.96	2	3.22	3	3.11	2
Global claims	3.82	3	2.75	1	3.22	3

Test statistics

Kendall's $W = 0.87 >$ Critical $W = 0.84$ (For $N=5$ and $k=3$, at significance level $\alpha = 0.01$, $df=4$)

The summary of results of Table B.27 above has indicated that in both Groups, the highest level of awareness was for the simplest methods, namely *As-Planned vs. As-*

Built and *Impacted-As-Planned.* To this extent, there was a concordance among the ranks assigned by the practitioners in the two Groups. Nevertheless, the Consulting Group showed a higher level of awareness than the Contracting Group as for the more sophisticated methods (i.e. *Time Impact Analysis* and *Collapsed-As-Built*). This may be explained as, generally, the consultants are inclined to rely on methods that are more robust in order to defend their findings/decisions in the claim resolution process.

From the test statistics (Kendall's W = 0.87 > Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) it can be concluded with considerable confidence that the agreement or concordance amongst the rankings of the respondents of the two Groups is higher than it would be by chance had the scores and their rankings been random or independent.

Thus, the overall results may infer that the general level of awareness on less sophisticated MDAs is high in both Groups, although the Consulting Group may show a superior awareness as to the more sophisticated MDAs.
Then, when inquired about the effectiveness of the MDAs in use (Question no.18), the rankings suggested that *Time Impact Analysis* was the highest effective MDA as perceived by both Groups. As indicated in Table B.30 below, for the Contracting Group the lowest effectiveness was with the Collapsed-As-Built and this may be explained by the relatively low use and knowledge of that method in the local industry. For the Consulting Group the lowest ranked was the Global Claims method, as it seems to be the most unsuccessful one to get an acceptance by the consultants

The test statistics (Kendall's W = 0.77 >; Critical W = 0.72; For N=5 and k=3, at significance level α= 0.05, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Thus, the two Groups perceived a higher effectiveness for the more sophisticated MDAs, in concordance.

Table: B. 30 Level of Perceived Effectiveness of Use of MDAs

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
MDA	**Effectiveness Index (Weighted Average)**	**Rank**	**Effectiveness Index (Weighted Average)**	**Rank**	**Effectiveness Index (Weighted Average)**	**Rank**
As-Planned vs. As-Built	2.97	3	2.44	2	2.96	3
Impacted As-Planned	3.14	4	3	4	3.14	4
Collapsed As-Built	2	1	2.44	2	2.28	2
Time Impact Analysis	3.57	5	3.72	5	3.67	5
Global claims	2.04	2	1.93	1	1.93	1

Test statistics

Kendall's W = 0.77 >; Critical W = 0.72 (For N=5 and k=3, at significance level α= 0.05, *df*=4)

On the other hand, as indicated in Table A.12 below, the majority of interviewees (60%) held that suitability or effectiveness of an MDA was dependent on the circumstances under which it was used. However, some considered Time Impact Analysis would give better accuracy of all MDAs in any circumstances, while one interviewee preferred less sophisticated methods like Impacted-As-Planned in view of the less time needed to get the results.

Table: A. 12 Suitability & Effectiveness of MDA

Response	Depends on circumstances it is used	Depends on use of 'Time Impact Analysis'	Depends on use of 'Impacted As Planned' method
1	1		
2		1	
3	1		
4	1		
5	1		
6			1
7	1		
8	1		
9		1	
10			1
TOTAL	**6**	**2**	**2**
%	**60%**	**20%**	**20%**

Thus, from these results, it is observed that the survey-respondents have taken firm positions as to their 'awareness' and perceived 'effectiveness' of the MDAs concerned, whereas the interviewees' perceptions on 'effectiveness' were more flexible. To this extent, the results of both strands appear to be divergent. Nevertheless, this divergence ought not to be viewed as weakening the credibility of results, but it appears to be confirming the general divergence of opinions on these issues among the practitioners. Accordingly, it has offered opportunity to have a deeper insight into the phenomenon under study which '*can be illuminative and important*' (Patton, 2002, p 556).

8.4 Adopted Practices

The dimensions for comparison under this theme are

a) The level of usage of methodology, records, technology and expertise among the practitioners from both Groups for claims submission and their evaluation;
b) Requirements of compliance with conditions precedent, and implementation of same;
c) Promptness in submission, evaluation and resolution of delay claims.

8.4.1 Use of MDAs

The Question no. 17 in the survey questionnaire inquired the respondents' frequency of use of the MDAs concerned. The summary of results of Table B.28 below has indicated that the *Impacted-As-Planned* is the mostly used method among the Contracting Group. This is consistent with the observations in literature review (Livengood, 2007e). The *Time Impact Analysis* is the most used one in the Consulting Group. Thus, there was a clear divergence among the practitioners in the two Groups with regard to their use of the MDAs.

Table: B. 28 Frequency of Use of MDAs

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
MDA	Frequency of Use Index (Weighted Average)	Rank	Frequency of Use Index (Weighted Average)	Rank	Frequency of Use Index (Weighted Average)	Rank
As-Planned vs. As-Built	3.9	4	2.96	3	3.45	4
Impacted As-Planned	4.11	5	3.14	4	3.61	5
Collapsed As-Built	1.74	1	2.46	2	2.11	1
Time Impact Analysis	2.96	2	3.76	5	3.38	3
Global claims	3.57	3	1.96	1	2.77	2

Test statistics

Kendall's W = 0.71 <; Critical W = 0.72 (For N=5 and k=3, at significance level α= 0.05, *df*=4)

It was further examined to see whether there was a 'correlation' between the rankings of each Group's 'Awareness' and the 'Use' of a particular MDA (see Table B.29 below).

Table: B. 29 Awareness vs Use (Spearman Rank Order Correlation)

	As-Planned vs. As-Built	Impacted-As-Planned	Collapsed-As-Built	Time Impact Analysis	Global Claims
Respondent Group	Awareness vs Use	Awareness vs Use	Awareness vs Use	Awareness vs Use	Awareness vs Use
Contractors' Group	.685**	.561**	.400*	.264**	.798**
Consultants' Group	0.215	.434**	.542**	.622**	-0.058

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

On the results obtained by using *Spearman Rank Order Correlation* (r_s), a statistically significant, strong, and positive association between most of the rankings was seen in both Groups. This would suggest that the use of the MDAs by the practitioners within the Groups is generally correlated to the level of awareness of the MDAs. Within the Contracting Group this association is more prominent in simpler MDAs (IAP and APvAB) and in the case of Consulting Group it is prominent in the more sophisticated MDAs (TIA) for which they showed a superior awareness.

Table: A. 10 Contractors' most preferred MDA

Response	'Impacted As Planned'	'Impacted As Planned' or Other
1	1	
2	1	
3	1	
4	1	
5	1	
6		1
7	1	
8	1	
9		1
10	1	
TOTAL	**8**	**2**
%	**80%**	**20%**

Table: A. 11 Consultants' most preferred MDA

Response	'Time Impact Analysis'	'Time Impact Analysis'or Other
1	1	
2	1	
3	1	
4	1	
5	1	
6		1
7		1
8	1	
9		1
10	1	
TOTAL	**7**	**3**
%	**70%**	**30%**

When inquired from the interviewees the majority of them agreed that the most preferred MDA for the contractors was *Impacted As Planned* whereas for the consultants it was the *Time Impact Analysis* method (ref. Table A.10 and A.11 above). However, some of them maintained that use of an MDA was dependent on the circumstances and accordingly the contractors or consultants would use either *Impacted As Planned* or *Time Impact Analysis* method. Interviewees' this position was consistent with the majority of interviewees' position which held that suitability or effectiveness of an MDA was dependent on the circumstances under which it was used. Almost all the interviewees personally preferred *Time Impact Analysis* for delay claims analysis, and that may be understandable as the majority of the interviewees served for developers' interests in their regular professional performance.

Accordingly, on the issue of 'frequency of use of the MDAs concerned' it may be reasonably said that the overall result of the survey-respondents is complemented by that of the interviewees, although there are some divergent positions among a minority who would think differently. These results largely confirm that the MDAs used by the practitioners of either side (i.e. contractor and employer sides) are not uniformed. This confirms the observations of literature review that the industry generally accepts that there is no single analysis methodology universally available and applicable to all situations of claims resolution (Arditi and Pattanakitchamroon, 2006; Keane and Caletka, 2008, RP-FSA, 2007). The results are also suggestive that the frequency of use of the MDAs by the practitioners within the two Groups is generally correlated to the level of awareness of the respective MDAs. In summary, the results confirm that in delay analysis, the practitioners of competing sides generally use divergent MDAs which may produce contrasting results, which could result in scepticism and disputes as observed in literature review (RP-FSA, 2007; Gothand, 2003; Zartab, 1996; Keane and Caletka, 2008).

8.4.2 Use of Programmes and As-Built Records

The Question no.15 inquired the survey-respondents' frequency of use of programmes and as-built records such as baseline CPM programme, consented programme, updates of the baseline programme and other contemporaneously kept records in delay claims preparation and evaluation of entitlement. The summary of results of Table B.32 below indicates that both Groups used CPM based baseline programmes (including the 'consented' programme) and ranked it's frequency of use with the highest score. Nevertheless, the Contracting Group considered updating the consented programme with as-built data was of the least importance. Otherwise, generally, the rankings of the two Groups for all types of records had a good concordance.

Table: B. 32 Frequency of Using Contemporaneous Records

Type of Records	CONTRACTING GROUP Use Index (Weighted	Rank	CONSULTING GROUP Use Index (Weighted	Rank	OVERALL Use Index (Weighted	Rank
CPM Baseline programme	4.25	5	4.75	5	4.50	5
CPM Baseline programme (Consented)	3.7	4	3.72	4	1.79	4
As-built programme updates	2.14	1	3.5	2	1.09	1
As-built programme updates (mutually agreed)	2.64	2	3.6	3	1.28	2
Site records, diaries and other contemporary records	3.46	3	3.45	1	1.64	3

Test statistics

Kendall's W = 0.87 >; Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4)

The test statistics (Kendall's W = 0.87 >; Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

For the majority of the interviewees (60%), the use of CPM Programme in projects was pretty high, but a minority (40%) was in the opinion that the rate of its use in projects was less than 50% (ref. Table A.8 below).

Table: A.8 Use of CPM Programme in projects

Response	High	Low
1	1	
2		1
3		1
4	1	
5	1	
6		1
7	1	
8	1	
9	1	
10		1
TOTAL	**6**	**4**
%	**60%**	**40%**

On the other hand, the majority (60%) of the interviewees observed that although the CPM Programmes were used in projects, their usage with as-built data in the delay claims resolution was not at an effective level. Another view expressed by some of the interviewees was that although submission of a CPM programme was a mandatory requirement in the contract, most of the time it was considered only as a cosmetic feature by most of the contractors without understanding the significance of it in project administration and claims management.

(ref. Table A.9 below).

Table: A. 9 Programme Updating

Response	Properly done	Irregular/Improperly done
1		1
2		1
3		1
4	1	
5	1	
6		1
7		1
8	1	
9	1	
10		1
TOTAL	**4**	**6**
%	**40%**	**60%**

Thus, there seems to be a general consensus among the practitioners that although the CPM baseline programme is given a priority to obtain 'consent' and that contractual need is complied with, such priority is not given by the contractors to update it with as-built information and use such objective data in delay claims preparation. This lack of motivation may be explained by the findings described earlier that *Impacted-As-Planned* was the contractors' most preferred MDA and it can be used without wanting any as-built data. On the other hand, priority given to as-built updates and records by the Consulting Groups can also be explained by the fact that The *Time Impact Analysis* is the most used MDA among the Consulting Group, which cannot be operative without such as-built updates/records.

Accordingly, on the issue of giving the highest priority to CPM based baseline programmes (including the 'consented' programme) it may be reasonably said that the overall result of the survey is complemented by that of the interviewees. However, on the importance of 'updating the consented programme with as-built data' a substantial divergence between the rankings of two Groups exists, which again is complemented by the interviewees' comments as to lack of understanding of the real use or significance of it by the contractors. In the literature review, it was observed that inadequate 'keeping records' to be a major reason associated with lack of causation and hard evidence to support/prove the claimed delays

(Keane and Caletka, 2008). Thus, this position may become fatal to the contractors' delay claims, and as discussed the issue is of prime importance and decisive to establish entitlement (Baram,1994; McCullough, 1999; Briggs, 2006; Livengood, 2007b).

8.4.3 Use of Software and Expertise

Additional questions (Questions nos. 13, 14 and 16) as to use of software and the expertise in delay claim preparation and evaluation were presented to the respondents of the survey. (There was no specific discussion in this regard with the interviewees). The results of Tables B.33 and B.34 below indicate that an overwhelming majority of the practitioners use sophisticated software like 'Primavera'. Further, Tables B.15, B.16, and B.17 below indicate the status with regard to deployment of resources and expertise. Accordingly, except for a very few companies, an overwhelming percentages of contractors and consultants employ only the in-house resources indicating non-reliance of outside expertise.

Table: B. 33 Frequency of Using Planning Software in Delay Analysis ("Primavera")

Respondent Group		Never	Seldom	Sometimes	Usually	Always	Total
Contracting Group	Count	1	0	1	6	21	29
	% within Respondent Group	3.4%	0%	3.4%	20.7%	72.4%	100.0%
Consulting Group	Count	0	3	2	9	17	31
	% within Respondent Group	0%	9.7%	6.5%	29.0%	54.8%	100.0%
Total	Count	1	3	3	15	38	60
	% within Respondent Groups	1.7%	5.0%	5.0%	25.0%	63.3%	100.0%

Table: B. 34 Frequency of Using Planning Software in Delay Analysis ("MS Project")

Respondent Group		Never	Seldom	Sometimes	Usually	Always	Total
Contracting Group	Count	14	2	5	1	2	24
	% within Respondent Group	58.3%	8.3%	20.8%	4.2%	8.3%	100.0%
Consulting Group	Count	10	2	10	4	0	26
	% within Respondent Group	38.5%	7.7%	38.5%	15.4%	0%	100.0%
Total	Count	24	4	15	5	2	50
	% within Respondent Group	48.0%	8.0%	30.0%	10.0%	4.0%	100.0%

~~On the other hand, t~~The summary of results in Tables B.16 and B.17 below reflect the general composition of deployment of such in-house resources. The ranking suggests that the mostly deployed categories in both Groups are the Quantity Surveyors and

Contracts Administrators. It appears the Lawyers are the least engaged by both Groups, while the engagement of Claims Specialists is also relatively low.

Table: B. 16 Resources Deployment (Contractors)

Resource	Never	Seldom	Some-times	Usually	Always	Total	'Normalized Weights"	Rank
Claims Specialists	13	3	7	3	2	28	2.21	3
Contracts Administrators	4	2	1	11	9	27	3.70	6
Quantity Surveyors	1	3	3	7	15	29	4.10	7
Planners	1	5	7	10	5	28	3.46	5
Engineers	4	8	11	4	1	28	2.64	4
Architects	15	6	4	1	1	27	1.78	2
Lawyers	17	7	3	0	0	27	1.48	1

Table: B. 17 Resources Deployment (Contsultants)

Resource	Never	Seldom	Some-times	Usually	Always	Total	'Normalized Weights"	Rank
Claims Specialists	3	5	6	6	10	30	3.5	2
Contracts Administrators	1	1	5	14	8	29	3.93	6.5
Quantity Surveyors	1	1	5	14	8	29	3.93	6.5
Planners	1	3	7	10	9	30	3.77	4
Engineers	2	1	5	11	10	29	3.90	5
Architects	1	3	7	12	6	29	3.66	3
Lawyers	10	7	10	2	0	29	2.14	1

8.4.4 Requirements and implementation of compliance with conditions precedent

For the Consulting Group the second most significant two factors contributing to escalation of disputes were the failures to submit delay claims 'notices' and their 'particulars' within the prescribed times. These two factors were also ranked with substantial importance for expediting/ making efficient the delay claims resolution process (ref. Tables B.40 and B.42 in the discussion under item 8.5 below. Such high significance attributed to these two factors may be explained by the fact that these requirements are set out as conditions precedent in most of the bespoke forms of contract; hence, failures of such conditions precedent leave no option to the consultant (engineer) except for refusal of admission of claims; in turn, such refusals, particularly where prevention by employer or his agents is the main or only cause of delay, would naturally generate disputes.

During the interviews, a discussion was extended to explore presence of conditions precedent in the contracts, particularly with regard to 'notice' and 'particulars' related to delay claims, and their implementation by the practitioners.

8.4.5 Presence of Conditions precedent

Almost all interviewees confirmed the invariable presence of conditions precedent in bespoke contract forms that were related to submitting 'Notices' and 'particulars' within a prescribed time and manner. The consequences for failure to comply with those requirements may lead to forfeiting/time barring the contractor's right to claim extension of time/cost.

8.4.6 Compliance with Conditions precedent

As indicated in Table A.13 below, the majority (80%) opinion of the interviewees confirmed a high rate of failure to comply by the contractors.

Table: A. 13 Contractors' compliance with Conditions Precedent

Response	Comply	Comply with 'Notice' requirement but fail in 'particulars'	Fail to comply
1	1		
2			1
3			1
4			1
5			1
6		1	
7			1
8			1
9			1
10			1
TOTAL	**1**	**1**	**8**
%	**10%**	**10%**	**80%**

8.4.7 Implementing Conditions precedent

This issue was discussed with the interviewees to inquire about the general practice of the employers in this regard. The interviewees confirmed that, although the failure rate was high to comply with conditions precedent, some employers were taking a lenient approach to use the failures as a negotiation tool in settling the claims, and, as discussed in the literature review (Chapter 7) that is probably because UAE Federal Law seems showing no publicly known position yet on this issue. However, some others strictly imposed the right to forfeit /bar the claims, citing the consequences set out in the contract for such failures. Most of the interviewees were in favour of holding the conditions precedent over the 'prevention principle'.

The literature reviewed in Chapter 7 indicated that the UAE law may or may not provide relief to the contractors claims where delays are purely caused by the other side although the contractors have failed to comply with such conditions precedent. In this instance, the wording of UAE Federal Law No. 5 of 1985, Article 287 may be in favour of Conditions Precedent but as there seems no known precedence the issue may have to be tested yet; due to this lack of certainty, a prudent way to deal with it is to comply with the conditions precedent in order to keep the right to claim alive.

The issues of conditions precedent related to 'notices' and 'particulars' in delay claims submission were given relatively high importance by the survey-respondents, particularly the Consulting Group, as significant contributory factors to escalate disputes. This is consistent with the importance attributed to these issues in the literature reviewed (Lal, 2002, 2007; Tobin 2007; Carnel, 2005), particularly within the uncertainty of the local legal position. The interviewees elaborated further how these conditions were practically implemented, referring to various scenarios in practice and generally complemented to the survey findings.

8.4.8 Promptness in Delay Claims Submission

The Question no. 24 in the survey questionnaire inquired the respondents' judgments on the promptness of the contractors delay claims submission, on the basis of certain 'propositions' related to potential scenarios. Table B.35 below indicates a summary of the respondents' perceived ratings of the contractors' promptness according to these propositions.

Table: B. 35 Promptness of Claims Submission

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
PROPOSITIONS "contractors submit their claims submissions with adequate details enabling consultants' assessment"	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	1.46	2	3.67	5	2.58	2
After the effects of ALL the claimed 'events' are ceased.	2	3	3.11	4	2.6	3
After the effects of the particular 'event' is ceased.	3.89	4	2.7	2	3.46	5
Contemporaneously and promptly.	4	5	2.89	3	3.04	4
Not determining at all.	1.35	1	2.23	1	1.79	1

Test statistics
Kendall's W = 0.56 <; Critical W = 0.72; (For N=5 and k=3, at significance

Accordingly, the results of the rankings of the two Groups stood quite contrasting as the Contracting Group maintained that these claims submissions were most likely made *'Contemporaneously and promptly'* whereas the other Group held they were mostly made *'long after the project is completed'*. However, considering other responses, it seems reasonable to consider that it is more likely than not that these submissions are made after the effects are ceased. So the two Groups were very divergent on this issue. The test statistics (Kendall's W = 0.56 <; Critical W = 0.72; For N=5 and k=3, at significance level $\alpha = 0.05$, $df=4$) show the rankings attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

When inquired, the general position of those interviewees who discussed this issue was that the claims submissions were not made until very late stages. Related to this issue, the interviewees observed that even these late submissions were of fundamental deficiencies, majority of which were in the failure to establish entitlement. The other deficiencies are related to non-submission of claims particulars until very late stages, quantum/ methodology issues and non-admission or denial of own concurrent delays. This position was compatible with the survey-respondents of the Consulting Group.
In Chapter 7, the literature reviewed indicated that lack of 'Keeping records' with hard evidence to prove causation is one of the major factors contributing to the late determination of the claims, as the burden of submission of sufficient particulars to enable the consultant to evaluate the claim is primarily on the contractor.

8.4.9 Promptness in Consultants' Assessment

The Question no. 25 in the survey questionnaire inquired the respondents' judgment on the promptness of the Consultants' Assessment of Delay Claims, in line with similar 'propositions' used in the Question no.24. As Table B.36 indicates below, highest ranked scenario by both Groups was that the consultants' assessment of the entitlement is made 'after the effects of ALL the claimed 'events' are ceased'.

Further, both Groups agreed that the "Not determining at all" was less likely to happen. The test statistics (Kendall's W = 0.87 >; Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Table: B. 36 Promptness of Claims Assessment

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
PROPOSITIONS "Consultants (assessers) determine claimed entitlement to extension of time":	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	2.08	2	2.96	4	2.53	2
After the effects of ALL the claimed 'events' are ceased.	4.04	5	3.48	5	3.75	5
After the effects of the particular 'event' is ceased.	3.16	4	2.81	3	2.98	4
Contemporaneously and promptly.	2.48	3	2.63	2	2.56	3
Not determining at all.	1.4	1	1.81	1	1.61	1

Test statistics

Kendall's W = 0.87 >; Critical W = 0.84 ; For N=5 and k=3, at significance level α= 0.01, *df*=4)

On the issue of the promptness in the consultants' (engineers) performance, the majority of the interviewees who discussed this issue agreed that the engineers' performance was not prompt due to various reasons like contractors' own delays in giving information, lack of consultants' resources, employer-delays to give approval, employers requiring further review on engineer's assessment and so on. This situation was prevailing even when there was a time prescribed (in some bespoke forms of contract) for the engineer to make his determination.

8.4.10 Promptness in Award of Entitlement

The results of the Question no. 26 in the survey questionnaire confirmed that almost all the bespoke forms of contracts in the UAE necessitated the employers' prior approval to engineer's grant of extension of time.

Table: B. 37 Promptness of Claims Assessment- Employer Approval

		In most of the projects in the UAE, the contract provisions require approval of the employer prior to awarding extension of time to the contractor?		
		YES	**NO**	**Total**
Contracting Group	Count	23	1	24
	% within Respondent Group	95.8%	4.2%	100.0%
Consulting Group	Count	24	3	27
	% within Respondent Group	88.9%	11.1%	100.0%
Total	Count	47	4	51
	% within Respondent Groups	92.2%	7.8%	100.0%

Thus, considering this 'constraint', the results of the respondents to Question no. 27 which inquired the employers' promptness in giving such 'prior approval' are indicated in Table B.38 below. Accordingly, it seems the results are contrasting, as the Contracting Group ranked such approval was available "long after the project is completed" but for the Consulting Group it came "after the effects of all the events" (or of the particular event) were ceased. Nevertheless, the summary results may suggest that, there is a consensus among both Groups that the employer's approval for extension of time award was made at least "after the effects of ALL the claimed events were ceased" as this scenario is ranked in the second highest position by both Groups.

Table: B. 38 Promptness of Award of Extension of Time

	CONTRACTING GROUP		**CONSULTING GROUP**		**OVERALL**	
PROPOSITIONS "Such employer approval is normally given":	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	3.96	5	2.88	3	3.43	5
After the effects of ALL the claimed 'events' are	2.88	4	3.13	4.5	3	4
After the effects of the particular 'event' is ceased.	2.64	3	3.13	4.5	2.88	3
Contemporaneously and promptly.	1.52	1	2.58	2	2.04	2
Not approving /awarding at all.	1.64	2	1.96	1	1.8	1

On the other hand, all the interviewees reckoned that there was invariably a strict requirement in bespoke contract forms that there should be an approval obtained from the employer prior to engineer's determination of extension of time. As indicated in Table A.14 below, the majority (70%) of the interviewees agreed that the employers' approval did not come promptly and the same interviewees confirmed that such employer-approval delays could be a major cause of dispute. There were different opinions amongst the interviewees as to the time taken by the employers to give such approval. Accordingly, in the absence of any contractually prescribed time for it, this approval would be available sometimes within three months (which was said to be a 'reasonable' time) or would be subject to a 'wait & see' policy by the employer (which might lead to a dispute situation and interference in engineer's impartiality).

Table: A. 14 Employer's Approval for EOT

Response	Reasonably Prompt and Contemporaneous	Inordinately Delayed	A source of problems
1	1		
2		1	1
3		1	1
4		1	1
5	1		
6		1	1
7		1	1
8		1	1
9		1	1
10	1		
TOTAL	**1**	**7**	**7**
%	**30%**	**70%**	**70%**

Except in the rankings for 'Promptness in contractors' Delay Claims Submissions' (ref. Table B.35 above), in all other issues, a substantial concordance between the rankings of the two Groups was indicated (ref Tables B.36 – B.38 above). The interviewees' statements appear to have been complementing the findings of the survey responses.

These merged results, thus, reveal that none of the parties, the contractors, the consultants and the employers, carry out their respective obligations with the promptness that is expected for an efficient delay claims resolution process. Accordingly, on the issue of 'promptness in delay claims submission and settlement' it may be reasonably said that the overall result of the survey-respondents is complemented by that of the interviewees.

8.5 Problematic Situations

The dimensions for comparison under this theme are

a) Problematic situations contributing to delay claims dispute escalation;

b) The factors obstructing use of an appropriate MDA;

8.5.1 Contribution to Dispute Escalation

With regard to problematic situations which may contribute towards escalating the existing delay claims disputes to more advanced levels, twelve such factors were identified mainly through the literature reviewe (Chapters 4 to 7). These were then presented to the survey-respondents through Question no. 21 for their perceived ranking of significance. These factors were:

a) Discrepancies and ambiguities within tender/contract documents.
b) Lack of risk distribution between the parties, in the contract.
c) Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.).
d) Failure of 'notification' of delay event within contractually prescribed time.
e) Failure of submission of 'particulars' of delay claim event within contractually prescribed time.
f) Global claims.
g) Contractor's failure to establish 'liability' for delay event based on contract provisions.
h) Contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.
i) Delay analysis method used by one party being disagreed/challenged by other party.
j) Absence of definition in the contract as to 'float ownership'.
k) Absence of definition of approach to be used at measuring 'criticality' of a delay.
l) Absence of definition in the contract as to approach for 'concurrent delay situations'.

The results of the Question no. 21 are indicated in Table B.40 below.

Table: B. 40 Problematic Situations Contributing to Dispute Escalation

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
Ref.	**Problematic Situation (for escalating disputes over delay claims)**	**Obstacle Index (Weighted**	**Rank**	**Obstacle Index (Weighted**	**Rank**	**Obstacle Index (Weighted**	**Rank**
a	Discrepancies and ambiguities within tender/contract documents.	3.73	5.5	3.07	2	3.39	5
b	Lack of risk distribution between the parties, in the Contract.	3.88	8	3.37	5	3.62	6
c	Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.).	3.27	4	3.29	4	3.28	4
d	Failure of 'notification' of delay event within contractually prescribed time.	3.73	5.5	3.71	10	3.72	7
e	Failure of submission of 'particulars' of delay claim event within contractually prescribed time.	3.85	7	3.75	11	3.8	9
f	Global claims.	4.31	12	4	12	4.15	12
g	Contractor's failure to establish 'liability' for delay event based on contract provisions.	4.24	11	3.61	8.5	3.91	11
h	contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.	4.08	10	3.43	7	3.74	8
i	Delay analysis method used by one party being disagreed/challenged by other party.	4.04	9	3.61	8.5	3.81	10
j	Absence of definition in the contract as to 'float ownership'.	2.77	1	3.04	1	2.91	1
k	Absence of definition of approach to be used at measuring 'criticality' of a delay.	2.84	2	3.14	3	3	2
l	Absence of definition in the contract as to approach for 'Concurrent delay situations'.	2.92	3	3.56	6	3.25	3

Test statistics

Kendall's W = 0.89; Sample $x^2 = 29.38$> Critical $x^2 = 24.72$; (For N=12 and k=3, at significance level $\alpha = 0.01$, *df*=11)

These results confirmed that for both Contracting Group and the Consulting Group the most contributing to dispute escalation was the 'Global Claims' (factor '*f*' above). For the Consulting Group the next two factors mostly contributing to escalation of disputes were the failure to comply with the prescribed time for submission of delay claims 'notices' (factor '*d*') and their 'particulars' (factor '*e*'). For the Contracting

Group the next two factors mostly contributing were the failure to establish 'liability' (factor *'g'*) and 'quantum' (factor *'h'*) which were closely followed by 'Delay analysis method used by one party being disagreed/challenged by other party' (factor *'i'*). As for the Consulting Group, these three factors stood the third most contributing factors to escalation of dispute. As for the remaining six factors, which are associated with contract documentation (factors *'a', 'b', 'c'),* and *'j', 'k',* and *'l')*), the two Groups attributed a relatively lower level of significance in the contribution to escalation of disputes.

Considering overall ranking of the results, the three most problematic situations were 'Global Claims' (factor *'f'*), failure to establish 'liability' (factor *'g')* and 'Delay analysis method used by one party being disagreed/challenged by other party' (factor *'i'*).

Generally, the survey results indicate with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent (Kendall's W = 0.89; Sample $x^2 = 29.38 >$ Critical $x^2 = 24.72$; (For N=12 and k=3, at significance level $\alpha = 0.01$, $df=11$).

During the interviews these factors and situations were discussed within the following 4 broad themes:

1. Disputes arising from analysis outcome (Factor ***'i')***
2. Deficiency in claims submissions (Factors ***'d', ' e', 'f', 'g', 'h')***
3. Non-availability of definitions (Factors ***'a', 'b', 'c', 'j', 'k', 'l')***
4. Employer's undue influence

8.5.2 Disputes arising from analysis outcome

This issue was discussed in relation to factor ***'i'*** above i.e. "Delay analysis method used by one party being disagreed/challenged by other party". It is observed that this factor was ranked overall at the third highest level of significance among the 12 'Problematic Situations' (ref. Table B.40 above).

According to most of the interviewees discussed this issue, the reasons for disputes are greatly related to issues of quantum which results from the 'methodology' at different levels of sophistication as used by either parties. It is pertinent to note that both

Groups of survey-respondents were in consensus that more sophisticated MDAs were the least vulnerable to challenges against the produced results (ref. Table B.31 below).

Some interviewees attributed this to use of less sophisticated MDA (due to lack of resources or ignorance), particularly within the contractors' side. For example, if a contractor uses a less sophisticated and more subjective MDA he would not consider own delays (as-built) occurred in concurrent with the excusable delays. In this case, if the consultant used a sophisticated MDA like Time Impact Analysis, which would track all as-built delays occurred chronologically, such concurrent delays would be revealed, and consequently that would affect the contractor's claimed recovery. This situation may lead to further disputes as the contractor's desired recovery is failed. Another issue cited was lack of transparency. In this instance, the contractors were kept from knowing how the outcome of the engineer's assessment was arrived, or what it was based on. Generally, the reasons for disputes arising from analysis outcomes are the mutual suspicions between the two sides due to use of different MDAs, ignorance and lack of expertise from contractor's side as to MDAs and the naturally resulting different quantifications of time/cost claims.

In the literature reviewed (Chapter 6) the problem situation was identified as

> "*.. Individuals generally work for one party to a dispute, there is often skepticism about the impartiality of the particular methodology chosen. Therefore, it is vitally important that all practitioners understand clearly what it takes to overcome this skepticism when choosing and using a particular delay evaluation method*". (RP-FSA, 2009, p.137).

Thus, the problem situations identified by the interviewees as to the disputes arising from analysis outcome have fairly complemented to the findings of the survey responses. They are also corroborated by the literature reviewed. Accordingly, this problematic situation is mainly caused by the use of different MDAs by the contractors and consultants which may produce contrasting outcomes based on their levels of sophistication. Other situations like lack of transparency, proper baseline programme and their as-built updates have also intrinsically contributed to this situation.

Table: B. 31 Level of Dispute Against the Use of MDAs

MDA	CONTRACTING GROUP Dispute Index (Weighted Average)	Rank	CONSULTING GROUP Dispute Index (Weighted Average)	Rank	OVERALL Dispute Index (Weighted Average)	Rank
As-Planned vs. As-Built	3.57	4	3	5	3.23	4
Impacted As-Planned	3.48	3	2.89	4	3.13	3
Collapsed As-Built	1.64	1	2.77	1	2.17	1
Time Impact Analysis	2.08	2	2.83	2	2.47	2
Global claims	4.28	5	2.88	3	3.57	5

Test statistics
Kendall's W = 0.87 >; Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4)

Generally, the survey results indicate with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent (Kendall's W = 0.87 >; Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4).

8.5.3 Deficiency in claims submissions

This issue is discussed in relation to the following factors which were inquired from the survey-respondents through Question no.21:

d) Failure of 'notification' of delay event within contractually prescribed time.
e) Failure of submission of 'particulars' of delay claim event within contractually prescribed time.
f) Global claims.
g) Contractor's failure to establish 'liability' for delay event based on contract provisions.
h) Contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.

In the summary results of Question no. 21, the survey-respondents have ranked these factors as follows (ref. Table B.40 above):

- Both Groups ranked the factor '*f*' Global Claims' submission as the most problematic factor contributing to deficiency in claims submissions.

- For the Contracting Group the second and third highest important factors of such contribution were the contractors' failure to establish 'liability' ***'g'*** and failure to establish 'quantum' for delay event ***'h'***, respectively.
- As for the Consulting Group, the second and third highest important factors were the contractors' failure to give 'particulars' ***'e'*** and 'notice' of delay within prescribed times ***'d'***, respectively.

For most of the interviewees discussed the issue, contractors' failure to establish entitlement or the 'liability' was the major cause for deficiency in claims submissions. This is essentially consistent with the survey-respondents' reckoning of 'Global Claims' (ref. Table B.40 above) as the most significant deficiency which often fails to establish individual 'liability' and respective 'quantum' of the event(s) through necessary causation, and therefore generally faces rejection. The survey-respondents also identified the issues of failure to establish liability, quantum as well as the failure to comply with conditions precedent (for 'notice' and 'particulars') among the top six overall ranks of problematic situations (ref. Table B.38 above). The other deficiencies discussed were related to non-submission of claims particulars until very late stages, quantum/ methodology issues and denial of own concurrent delays. These findings are corroborated with literature review when it was observed that the principal reasons for delay assessments were related to *"lack of details and clarity in substantiation, and delays in submissions of details by the claimant"* (Kumaraswamy and Yogeswaran, 2003, p.31)

When discussing the contractors' compliance with conditions precedent as to submission of particulars, some interviewees highlighted existence of some 'grey' areas in the requirements of such conditions. One interviewee noted that such grey areas created a questionable situation for the implementation of those conditions precedent. Having clarity and precision in the exactly specified requirements of the conditions precedent are decisive factors for strict implementation of such conditions. The 'grey area' cited by this interviewee was related to what level of information to be included in the detailed 'particulars' that a contractor should submit. When the submission of 'sufficient details' for a delay claim is a condition precedent, if the required type of detailed particulars are not precisely specified/defined in the contract documents it could always be a debating point between the claimant and the assessor, if the claim is to be ejected for non-compliance with the condition precedent. Thus, while the contractors' submissions are having own deficiencies, a potential problematic situation for conditions precedent in the (bespoke) contract documents may exist in such 'grey areas' lacking clarity in the contractual terms.

In the literature reviewed in Chapters 6 and 7, the inherent problems with the Global Claims and the importance of compliance with the conditions precedent were discussed in detail, and the above concerns are generally corroborated with those issues discussed.

Considering these merged results, it may reasonably be said that the results of the survey are generally complemented by that of the interviews, on the issue of deficiency in claims submissions and also consistent with the related issues discussed in the literature reviewed.

8.5.4 Non-availability of definitions

This issue was investigated in relation to the following factors which were inquired from the survey-respondents through Question no.21:

a) Discrepancies and ambiguities within tender/contract documents.
b) Lack of risk distribution between the parties, in the Contract.
c) Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.).
j) Absence of definition in the contract as to 'float ownership'.
k) Absence of definition of approach to be used at measuring 'criticality' of a delay.
l) Absence of definition in the contract as to approach for 'Concurrent delay situations'.

In the summary results of Question no. 21, the survey-respondents have ranked these factors as follows (ref. Table B.40 above):

For the Contracting Group, ***(b)***'Lack of risk distribution between the parties', ***(a)*** 'Discrepancies and ambiguities within tender/contract documents' and ***(c)*** 'Lack of clear mechanism in contract for delay claims presentation by contractors' were the more significant problem areas than ***(j)*** 'Absence of definition of 'float ownership', ***(k)*** 'Absence of definition of approach to be used at measuring 'criticality' of a delay' and ***(l)*** 'Absence of definition of approach for 'Concurrent delay situations'.

On the other hand, for the Consulting Group, ***(k)***'Absence of definition of approach for 'Concurrent delay situations', ***(b)*** 'Lack of risk distribution between the parties' and *(c)* 'Lack of clear mechanism in contract for delay claims presentation by contractors' were more important factors than the other three. Thus, for both Groups *(b)* 'Lack of risk distribution between the parties' and *(c)* 'Lack of clear mechanism in contract for delay claims presentation by contractors' were the most focused two factors. However, these rankings generally indicated a strong concordance in statistics tests (ref. Table B.40 above).

The two Groups of the survey-respondents indicated a strong concordance in their rankings of the 6 factors concerned. Although there were no specific and directly comparable response from the interviewees, their perceptions reflected on similar issues were generally corresponding to the survey findings on these factors (for example, providing 'definitions' in the contract documents as to many controversial issues was a prominent proposal in the improvements suggested by the interviewees).

8.5.5 Employer's Undue Influence

This issue was raised during the discussions with the interviewees (though no exclusive question in this regard was submitted to the survey-respondents) in order to explore their experience of it as a problematic issue.

The majority of the interviewees were in agreement that there were various forms of pressure exerted by employers on engineers, causing an undue influence over the engineer's impartiality set out in the contracts. According to these views, there are some consultants who would not give in to such 'pressure' but the general situation in the industry is the opposite of that. This phenomenon was mostly experienced with the public sector employers, and the majority of the interviewees (70%) agreed to it as indicated in Table A.15 below.

Table: A. 15 Employer's Influence on consultants

Response	**It is a norm**	**Only in exceptional cases**	**No influence**
1		1	
2	1		
3	1		
4	1		
5			1
6	1		
7	1		
8	1		
9	1		
10	1		1
TOTAL	7	**1**	**2**
%	**70%**	**10%**	**20%**

Among the various forms of undue influence on the consultants by the employers, the following have been cited as common:

- Possibility of losing future business relationship with major employers (in the UAE, almost all major employers are related to public sector in various forms) if an impartial determination is in favour of the contractors in a substantial loss;
- As the employer's prior approval is necessitated by the most bespoke contract forms, some employers refer the engineer's recommended /assessed outcome of entitlement to a third party for a further opinion. This seems to be a kind of 'arm-twisting' tactic forcing the engineer not to differ employer's aspirations. This may also be a procrastinating approach to delay the final resolution of claimed entitlement; (one interviewee suggested that to avoid abuse of this 'approval' requirement it was proper at least to limit that to a requirement of merely notifying the employer prior to issuing the engineer's determination.) These observed 'delay tactics' are corroborated with the observations made in literature review that in most construction projects the delays are often left unanalysed until the end of the job (Finke, 1997) and that some owners are with the idea that when the contractor reaches the negotiating table it will be so eager for settlement that it will accept less (Bramble and Callahan, 2000).

However, there were some divergent opinions also among the interviewees who maintained that in their experience there were no such pressure/influence from the employers, although the engineers may generally look at the 'things' in the employer's perspective and so on.

Thus, to a degree the interviewees' experience on this issue was divergent and to a degree contrasting. In their experience, the majority confirmed such influence was a norm than an exception, particularly from the employers of the public sector, while some interviewees denied a deliberate 'wait & see' policy by employers or any undue influence by the employer on the engineer. However, the majority opinion suggests that there is a greater possibility of this phenomenon and that has to be considered in the improvements required to the claim resolution process.

This issue was also inquired from the survey-respondents but in a different context. That inquiry was made in relation to "engineer's impartiality" in the delay claims resolution process, in both Question no.22 'Prevention Factors' and Question no.23 'Efficiency Factors'. As a 'Prevention Factor', the Contracting Group ranked the "engineer's impartiality" as the most important factor among 7 factors considered (ref. Table B.41 below); on the other hand, out of 11 such factors, it was ranked by both Groups as the most important factor in order to make the resolution process more efficient (ref. Table B.42 below). These results obviously imply this issue exists as a serious concern among both claims presenters and assessors. It is observed that the two Groups indicated a very strong concordance in their rankings in both instances.

Considering these merged results, it may reasonably be said that the results of the survey are generally complemented by those of the interviews, on the importance of this issue of assessor's (engineer/consultant) impartiality and his being free from undue influence from outside, in the delay claims resolution process.

Table: B. 41 Prevention Factors

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Prevention Factor**	**Prevention Index (Weighted Average)**	**Rank**	**Prevention Index (Weighted Average)**	**Rank**	**Prevention Index (Weighted Average)**	**Rank**
1	Allow sufficient time for consultants to complete the design and contract	4.31	5.5	4.65	7	4.48	5 5
2	Establish high level quality control mechanism within consultants team to minimize/eradicate conflicts, discrepencies and ambiguities within tender/contract documents	4.12	3	4.20	4.5	4.13	4
3	Clear distribution of risks between the parties, in the Contract.	4.31	5.5	3.40	1	3.86	3
4	Clear cut definition in the contract as to 'float ownership'.	3.32	2	3.58	2	3.45	1
5	Clear cut definition in the contract as to 'automatic entitlement to EoT for delays occurring after passing prevailing contract completion date'	3.27	1	4.20	4.5	3.73	2
6	Engineer's impartiality (against own failures or outside pressure)	4.63	7	3.84	3	4.22	7
7	Presence of a stipulated mechanism in the Contract to resolve delay claims at site level on day-to-day basis.	4.50	6	4.46	6	4.48	5.5

Test statistics

Kendall's W = 0.86 > Critical W = 0.74 (For N=7 and k=3, at significance level α= 0.01, *df*=6)

Generally, the survey results indicate with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent (Kendall's W = 0.86 > Critical W = 0.74 (For N=7 and k=3, at significance level α= 0.01, *df*=6).

Table: B. 42 Efficiency Factors

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Efficiency Factors**	**Importance Index (Weighted Average)**	**Rank**	**Importance Index (Weighted Average)**	**Rank**	**Importance Index (Weighted Average)**	**Rank**
1	Stipulation in the contract a clear mechanism for delay claims presentation by contractors (establishing 'liability' and quantum)	4.38	9	4.22	9	4.3	9
2	Stipulation in contract as to the basic and minimum required documents to be presented	4	6	3.74	1	3.87	5
3	Submission of 'notification' of delay claim event within contractually prescribed time	3.88	4.5	4.15	6.5	4.02	6
4	Submission of 'particulars' of delay claim event within contractually prescribed time	4.24	8	4.15	6.5	4.19	7
5	Clear cut definition in the contract for the approach as to 'concurrent delays'.	3.46	2	4.04	5	3.75	2.5
6	Clear cut definition in the contract for the approach as to 'float ownership'.	3.32	1	3.89	3.5	3.75	2.5
7	Clear cut definition in the contract for delay analysis methodology to be used in delay claims presentation and evaluation.	3.88	4.5	3.78	2	3.83	4
8	Clear cut definition in the contract for approach to be used at measuring 'criticality' of a delay (Zero Float or longest path)	3.54	3	3.89	3.5	3.72	1
9	Presentation and assessment of delay claims carried out on an analysis method mutually agreed on an objective basis.	4.19	7	4.22	8	4.21	8
10	Prompt and timely award of extension of time	4.69	10	4.33	10	4.51	10
11	Engineer's impartiality in apportioning liability	4.77	11	4.52	11	4.76	11

Test statistics

Kendall's W = 0.90; Sample x^2 = 26.95> Critical x^2 = 23.21; (For N=11 and k=3, at significance level α= 0.01, *df*=10)

Generally, the survey results indicate with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent (Kendall's W = 0.90; Sample x^2 = 26.95> Critical x^2 = 23.21; For N=11 and k=3, at significance level α= 0.01, *df*=10).

8.6 Conclusions of Merged Results

The comparison of results carried out in the foregoing discussion has indicated that the results of the qualitative strand (interviews) are generally complimenting the results of the quantitative strand (survey) on the issues discussed. At the outcome, the compared results of the two strands are consolidated, combining both types, into 'merged results'. In the final outcome, these merged results have revealed the general background of practices related to apportioning of liabilities in delay claims resolution, in the local construction industry. They have also been examined for their consistency or otherwise with the relevant literature reviewed earlier under Chapters 4,5,6 & 7.

The conclusions of these merged results are summarised below. While doing so, the extent of their confirmation or otherwise of the respective research propositions, whether the research objectives are fulfilled and how they (the merged results) have answered the research questions are also examined.

1. The compared results from the qualitative (interviews) and quantitative (in-depth survey) strands on the 'Awareness' on delay claims theory and forensic scheduling have found the following:
   a) On the issues of (i) apportioning time and cost in concurrent delays (ii) true concurrency' and 'concurrent effects, and (iii) 'ownership of the float' the overall awareness of the majority of survey-respondents of both Contracting and Consulting Groups was generally complemented by the majority of the interviewees. The perceptions of both interviewees and survey-respondents were generally corroborated by the literature reviewed and they were largely similar to the principles promoted by the SCL Protocol (2002) on these issues (ref. Chapter 4, 'Findings' under item 4.3). However, there were some divergent views among a minority of both survey-respondents and the interviewees who perceived differently, particularly on more contentious scenarios associated with these issues. This dissension was, though to a lesser degree than expected, consistent

with the general findings of literature review that confirmed lack of a universal position as to the apportioning and definitions of 'concurrent' delays' and 'who should own the float';

b) On the issue of measuring criticality in forensic scheduling the overall awareness of the majority of survey-respondents was generally complemented by the majority of the interviewees. However, there were some divergent views among a minority of the survey-respondents and the interviewees which were driven by their personal allegiance to this or that particular school ('Longest Path' or 'Total Float' school) on this issue. Generally, the majority results were corroborated with the findings of the literature reviewed, particularly the principles of SCL Protocol on measuring 'criticality' of delay effects (ref. Chapter 5, 'Findings' under item 5.5). Nevertheless, the presence of a substantial minority which held different perception to the majority confirmed the general findings of literature that there is no universal position as to the definition of 'criticality'.

c) A peripheral issue as to the 'automatic entitlement to extension of time for the employer's delays occurring while the contractor is also in a delay after passing the contract completion date' was discussed with the interviewees. The results indicated that the overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' school and consistent with the majority position seen in the previous issues such as 'Measuring 'Criticality'. They were also corroborating with the findings of the literature reviewed, particularly the principles of SCL Protocol on these issues (ref. Chapter 5, 'Findings' under item 5.5).

d) On the issue of awareness and effectiveness of MDAs the overall results may infer that the general level of awareness on less sophisticated MDAs was relatively high in both Groups, although the Consulting Group showed a superior awareness as to the more sophisticated MDAs. As to the 'effectiveness', the majority of survey-respondents of both Groups thought to rank the more sophisticated MDAs (like *Time Impact Analysis*) as the most effective. The majority of the interviewees' perceptions on 'suitability and effectiveness' were more flexible than those of the survey-respondents, and opined that such 'effectiveness' of a MDA was dependent on the circumstances under which it was used. To this extent, the results of both strands do not appear to be convergent.

- The above merged results indicate a greater consensus among the majority of the practitioners on the awareness on delay claims theory as to i) apportioning time and cost in concurrent delays (ii) true concurrency' and 'concurrent effects, and (iii) 'ownership of the float', (iv) measuring criticality, (v) automatic entitlement to extension of time for excusable delay after passing contract completion date, and (vii) effectiveness of various MDAs.

- However, the overall results also show a significant amount of dissension, albeit in a minority among practitioners, on essential theory, concepts, legal position and MDA applicable to delay claims resolution. The existence of such divergence is found to be consistent with the findings of literature review, though to a lesser degree than expected.
- Thus, to the extent of these overall merged results, the research proposition that *"The tacit or explicit awareness of essential theory, concepts, legal position and Methods of Delay Analysis (MDA) applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers)"* (Chapter 1) seems to have generally been confirmed by the presence of dissenting perceptions to the majority position on many issues as found in the results. However, it must also be appreciated that the survey-respondents and interviewees displayed a greater consensus in majority on the awareness on the same issues.

Having considered this situation, it may be reasonable to state that the merged results have only partially endorsed the above research proposition.

2. The compared results from the qualitative and quantitative strands on the practitioners' use of MDAs and contemporaneous records have revealed the following:
   a) On the issues of frequency of use of the MDAs the overall results of the majority of survey-respondents of both Groups were generally complemented by those of majority of the interviewees. Thus, the prevailing perception was that the most used MDAs by the consultants (engineers) were the more sophisticated (hence relatively more objective) ones whereas the contractors preferred to use less sophisticated and simpler methods (hence relatively more subjective and fitting to promote own case). This dichotomy of use of MDAs could be responsible for the opposing outcomes of delay analyses and the resulting distrust between the two parties in many occasions as discussed in the literature review (ref. Chapter 6, 'Findings' under item 6.4).
   b) With regard to survey results, it was also indicative that the frequency of use of the MDAs by the practitioners within the two Groups is generally correlated to their level of awareness of the respective MDAs. However, there were some divergent views

among a minority of both survey-respondents and the interviewees who perceived differently.

c) The survey results also confirmed that more sophisticated MDAs are the least vulnerable when challenged while simpler methods are weak to defend.

d) The overall result of the survey-respondents is complemented by that of the interviewees, when the majority of them attributed the highest priority to 'CPM based baseline programmes' among the records/information required for carrying out delay analyses. However, on the issue of 'updating the consented programme with as-built data', a substantial difference between the rankings of the two Groups was seen, which again was complemented by the interviewees' comments as to lack of understanding of the real use or significance of such 'updating' by the contractors.

- The above merged results may indicate a greater consensus among the practitioners on that there is a substantial difference in the use of their respectively preferred MDAs among the Contracting and Consulting Groups, although there was a minority who thought differently on the issue. There was also a correlation between the level of awareness and the frequency of use of MDAs within the two Groups. Also, a greater consensus prevailed over the highest significance attributed to CPM based baseline programmes'.
- The overall results also showed a substantial divergence among the practitioners on the issues of significance attributed to 'updating the consented programme with as-built data'.

- Thus, to the extent of these overall merged results, the following research proposition (Chapter 1) seem to have been generally confirmed by the research findings: '*In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust'.*

On the other hand, these merged results indicate that the existing dichotomy of use of MDAs is responsible for the opposing outcomes of delay analyses and the resulting distrust between the two parties. This seems to be a substantial problematic situation for an efficient delay claims resolution process. It also emphasizes the need of providing improvements to this situation. Thus, the undertaking of the research Model, which is presented in Chapter 10 as a potential improvement to minimize this problem, is vindicated by this practical need.

3. The additional questions (Questions nos. 13, 14 and 16) posed to the respondents of the survey (there was no specific discussion in this regard with the interviewees) revealed that an overwhelming majority of the practitioners use sophisticated software in delay analysis and with few exceptions an overwhelming majority of contractors and consultants employ only the in-house resources indicating non-reliance of outside expertise. Of these in-house resources, the mostly deployed categories in both Groups are the Quantity Surveyors and Contracts Administrators.

4. The compared results from the qualitative and quantitative strands on the 'factors which may contribute to escalate disputes' have indicated that a high importance was given by the survey-respondents, particularly by the Consulting Group to the issue of conditions precedent related to 'notices' and 'particulars' in delay claims submission. The interviewees elaborated further how these conditions precedent were present in almost all bespoke forms of contract in use in the local industry, and how they were practically implemented, referring to various scenarios of experience. These interview findings generally complemented to the survey findings and were consistent with the issues like 'legal uncertainty on prevention principle and conditions precedent' as discussed in the literature review (ref. Chapter 7, discussion under items 7.2 & 7.6).

5. On the issue of 'promptness in delay claims submission and settlement' the overall result of the survey-respondents was complemented by that of the interviewees. In both strands, the merged results firmly indicated that none of the parties, i.e. the contractors, the consultants and the employers, carried out their respective obligations with the promptness which should have been there for an efficient delay claims resolution process. To that extent of the overall results, the following research proposition has generally been confirmed: '*Generally, there is no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution*'.

6. Upon the inquiry of 'problematic situations', the results from the qualitative and quantitative strands revealed the following:

   On the 'problematic situations which may contribute towards escalating the existing disputes to more advanced levels', twelve such factors were identified and presented to the survey-respondents. Corresponding to these factors, the interviews conducted similar inquiries under 4 broad themes: (a) Disputes arising from analysis outcome; (b) Deficiency in claims submissions; (c) Non-availability of definitions; and (d) Employer's undue influence.

a) On the issue of 'disputes arising from analysis outcome' the overall results found that such disputes were a major problematic situation in delay claims resolution. The main cause of such disputes was identified as the use of different MDAs by the contractors and consultants who may produce vastly different outcomes based on their levels of objectivity and sophistication. The summary results for Question no.19 of the survey questionnaire (ref. Table B.31 above) also confirmed these findings that most of the disputes would arise from the use of less sophisticated MDAs. This situation was largely corroborated by the literature review as well. RP-FSA (2009) viewed that a main cause related to this problematic situation was the mutual scepticism between the parties about the impartiality of the particular MDA chosen. According to most of the interviewees discussed this issue, the reasons for disputes are greatly related to issues of quantum which results from the 'methodology' at different levels of sophistication as used by either parties. Thus, generally the results of these findings were complemented by those of the interviewees. This situation seems to have closely associated with the issues related to problematic situation discussed under item 2(a) above.
b) On the issue of 'deficiency in claims submissions' the survey-respondents ranked 'Global Claims' as the most significant deficiency encountered. As to the other factors such as the contractor's failure to establish 'liability' and 'quantum' of the claimed events and failure to comply with conditions precedent, the two Groups also showed a substantial concordance in the ranking. For most of the interviewees discussed the issue, contractors' failure to establish entitlement or the 'liability' was the major cause for deficiency in claims submissions. This position is essentially consistent with the survey-respondents' reckoning of 'Global Claims' and failure to establish 'liability' and respective 'quantum' of the event(s) through necessary causation as prime deficiencies. Thus, generally the results of the survey-respondents were complemented by those of the interviewees. These findings seem to be largely corroborated by the problems inherent with the Global Claims and the importance of compliance with the conditions precedent as discussed in the literature review (Chapters 6 and 7). As a peripheral issue, some interviewees pointed out certain 'grey' areas found in contract terms, particularly

in conditions precedent for submission of 'particulars', which created debatable situation for the implementation of those conditions.

c) On the issue of 'Non-availability of definitions', 6 factors were considered under Question no.21 (i.e. Discrepancies and ambiguities within tender/contract documents; Lack of risk distribution between the parties, in the Contract; Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.); Absence of definition in the contract as to 'float ownership'; Absence of definition of approach to be used at measuring 'criticality' of a delay; and Absence of definition in the contract as to approach for 'Concurrent delay situations').

   The two Groups of the survey-respondents indicated a strong concordance in their rankings of the 6 factors concerned. Although there were no specific and directly comparable response from the interviewees, generally their perceptions reflected on similar issues were corresponding to the survey findings on these factors (for example, providing 'definitions' in the contract documents as to many controversial issues was a prominent proposal in the improvements suggested by the interviewees.)

d) The issue of 'employers' undue influence upon the 'engineer's impartiality' was discussed with the interviewees in detail (though no exclusive question in this regard was submitted to the survey-respondents). The interviewees' experience on this issue was various and somewhat contrasting. The majority of interviewees confirmed such influence was a norm than an exception, particularly coming from the employers of the public sector. Yet, some other interviewees (a minority) denied a deliberate 'wait & see' policy or any undue influence by employers on the engineer. However, the majority opinion is to indicate that there is a greater possibility of existence of this phenomenon.

   On the other hand, a highest importance was attributed by the survey-respondents to 'engineer's impartiality' with reference to undue influences on the engineers (ref. summary results of Tables B.41 and B.42 above). This displayed a strong agreement among all the survey-respondents on the importance of 'engineer's impartiality' from an implied undue influence from employers.

   - The above results may indicate a greater consensus among the practitioners on factors governing the disputes arising from analysis outcome, deficiency in claims submissions, the issues requiring 'definitions' in the contract, and the impartiality of the engineer from undue influences.

- In spite of the divergent opinions existing to a lesser degree, the majority perception on the issue of 'impartiality of the engineer from undue influences' may still be indicative of the validity of the following research proposition: *'Usually, there is significant amount of undue pressure and interference from employer-organisations over the engineers (consultants) when determining the entitlement to extension of time'.*

7. In Chapter 1, three central research questions have been set out as follows:
   1) How convergent are the practitioners' perceptions and implementation of the theory and the methods of analysis applicable to the apportioning of liabilities in delay claims resolution?
   1) What are the potential problematic situations arising from the perceptions, and methods?
   2) How can such problematic situations be dealt with through improvements to current practices?

These central questions have generated a series of sub-questions which the answers are sought for, and the above merged results of the findings of both qualitative strand (interviews) and the quantitative strand (in-depth survey) have fairly and positively answered the question no. (1) and (2) above through their responses to those sub-questions. In other words, these findings have clearly established the extent of convergence or divergence between practitioners of competing parties as to the perceptions of essential theory, concepts and techniques, and their implementation in delay claims resolution. Further, these findings have revealed the potential problematic situations deriving from such perceptions, approaches and methods currently used by those practitioners. The third central research question is in fact dealt with through the 'Framework of Improvements' described in Chapters 9 and 10.

8.7 Summary

This Chapter 8 has primarily presented the outcome of the merged results of the qualitative and the quantitative strands which were discussed in the Appendix A- 'Interview Results' and Appendix B- 'Survey Results', respectively. The merging of the results of the two strands has been done using a triangulation approach and in the form of a discussion. As the mixed methods approach has been the inquiry strategy of this study, the Methodologic Triangulation which is also called Mixed Method or Methods Triangulation is selected as the appropriate method of triangulation. Accordingly, following the Convergent Parallel Design approach

(Creswell and Plano Clark, 2011) as discussed in Chapter 2, qualitative and quantitative data collected from the interviews and survey questionnaire are merged to bring a more complete understanding and a greater insight into the phenomena being studied. Thus, the summarised findings of the two strands of data (Appendix A- 'Interview Results' and Appendix B- 'Survey Results') are compared, interpreted and merged by a discussion (a discussion relating qualitatively derived themes to quantitative variables in corroboration with the literature reviewed), specifying how the qualitative findings either confirm or disconfirm the quantitative results and to see in what ways and to what extent they confirm the research propositions, fulfil the research objectives and answer the research questions. In many aspects, these results have also shown a substantial corroboration with the findings of literature review.

The results have been compared within common main themes of 'awareness', 'adopted practices', and 'problematic situations'.The overall outcome of the compared results are included in this Chapter under the section 'Conclusions of Meged Results'. In summary, the foregoing conclusions of the merged results have *generally* confirmed the following research propositions as to 'adopted practices':

1. *In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust;*
2. *Generally, there is no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution;*
3. *Usually, there is significant amount of undue pressure and interference from employer-organisations over the engineers' (consultants) when determining the entitlement to extension of time;*

However, the merged results have found somewhat differently on the research proposition as to 'Awareness':

- The overall merged results as to the awareness on delay claims theory indicated a greater consensus among the majority of the practitioners on the awareness on delay claims theory as to i) apportioning time and cost in concurrent delays (ii) true concurrency' and 'concurrent effects, and (iii) 'ownership of float', (iv) measuring criticality, (v) automatic entitlement to extension of time for excusable delay after passing contract completion date, and (vi) effectiveness of various MDAs. Notwithstanding, the overall results also showed existence of a significant amount of dissension from a minority to the majority of practitioners on the same issues. Thus, to the extent of this dissension, the research proposition that *'The tacit or explicit awareness of essential theory, concepts, legal position and Methods of Delay Analysis (MDA) applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers)'* seems to have only partially been confirmed.

The overall merged results show that the research inquiry has revealed the general background of practices related to apportioning of liabilities in delay claims resolution, in UAE/Dubai and potential problematic situations arising from such practices. Further, these results have offered some essential improvements in order to eliminate or at least to reduce the negative effects of such problematic situations. Also, the survey-respondents particularly provided essential data for developing a decision-making Model to enable practitioners (Decision Makers) to objectively and reliably select the optimum MDA appropriate to given circumstances of a project.

Accordingly, these merged results have, generally fulfilled the following research objectives set out in Chapter 1:

i. To investigate current practices in the local setting in relation to awareness, experience, and approaches as to ~~such of~~ theoretical, legal and methodology issues related to delay claims resolution process;

ii. To identify potential problematic situations in these practices which may obstruct efficiency and fairness in delay claims resolution process;

iii. Incorporating existing body of knowledge into contemporary practices and views, to develop a robust Framework of Improvements in order to minimise/ reduce the negative effects of such problematic issues.

Thus, to the above extent the research inquiry has found satisfactory answers to the following central research questions set out in Chapter 1:

1) How convergent are the practitioners' perceptions and implementation of the theory and the methods of analysis applicable to the apportioning of liabilities in delay claims resolution?
2) What are the potential problematic situations arising from the perceptions, and methods?

CHAPTER NINE

9.0 Framework of Improvements

9.1 Introduction

In line with the principal research aim set out in Chapter 1, it is required to develop a robust 'Framework of Improvements' for enabling consensus and uniformity among the Decision Makers for appropriate application of essential theory, concepts and delay analysis methodology in order to minimise/ reduce the negative impacts of identified problematic issues and enhance efficiency and fairness in delay claims resolution process.

Accordingly, this Chapter 9 prsents the intended 'Framework of Improvements' which is the main outcome of this research study.

Following the discussion as to identifying various 'problematic situations' experienced in delay claims resolution practices, the interviewees were requested to suggest any improvements/ solutions to those problematic situations which were discussed during the interviews. The intention of this request was to obtain their perceived improvements in order to be considered along with the findings of the literature review and the overall research inquiry for developing a Framework of best practice improvements in line with the research aim and objectives.

Accordingly, a series of improvements were suggested covering measures that can be adopted in pre and post-contract stages. Primarily they were related to stipulating clear definitions and risk distribution in the contract documents leading to certain changes in currently adopted practices as to apportioning liability in delay claims resolution.

These proposals for improvements were intrinsically related to the situations identified in Chapter 8 (ref. Item 8.5) and Appendix-A 'Interview Results' (ref. Items A.2.6 & A.2.7). They were generally related to the following specific situations:

1. Disputes arising from analysis outcome.
2. Deficiency in claims submissions.
3. Non-availability of definitions.
4. Employer's undue influence.

5. Insufficient time for pre-contract design and documentation.
6. Lack of promptness in assessment / settlement.
7. Dispute resolution.

The survey-respondents also consensually identified, through attributing a ranked importance, 5 factors which are *mostly* contributing to disputes in delay claims (ref. Table B.40 above), and 5 factors of *highest* 'importance' in reducing/preventing delay claims in construction projects (ref. Table B.41 above). Further, 4 factors were identified consensually as *most* important for enhancing efficiency in delay claims resolution (ref. Table B.42 above). By identifying these factors with their significance/importance in contribution to disputes escalation, as well as to prevention of disputes and enhancing efficiency of resolution process, the survey-respondents also made their contribution to such improvements.

These proposals for improvements are now supplemented by the best practices identified through the literature review carried out in Chapters 4-7, and developed into a 'Framework of Improvements' so that they can be adopted in the current practices of delay claims resolution.

In fact, the parameters or boundaries for the 'improvements' considered in this 'Framework' are structured according to the seven specific situations mentioned above. However, as said before, the theoretical and conceptual basis for these 'improvements' is mainly provided by the literature review and supplemented by the findings of the overall research inquiry.

This 'Framework of Improvements' consists of two principal components:

(1) The improvements to be adopted through changes to contract documentation and procedures which are presented through this Chapter 9; and

(2) The improvements to the process of selection of a MDA (i.e. to select the optimum and most appropriate MDA under specific circumstances of a construction project); Chapter 10 will present these improvements in the form of a 'Model'.

The reliability and validation of the above components are included in Chapter 11.

Figure 9.1 below has graphically illustrated the process of the development of this 'Framework of Improvements'.

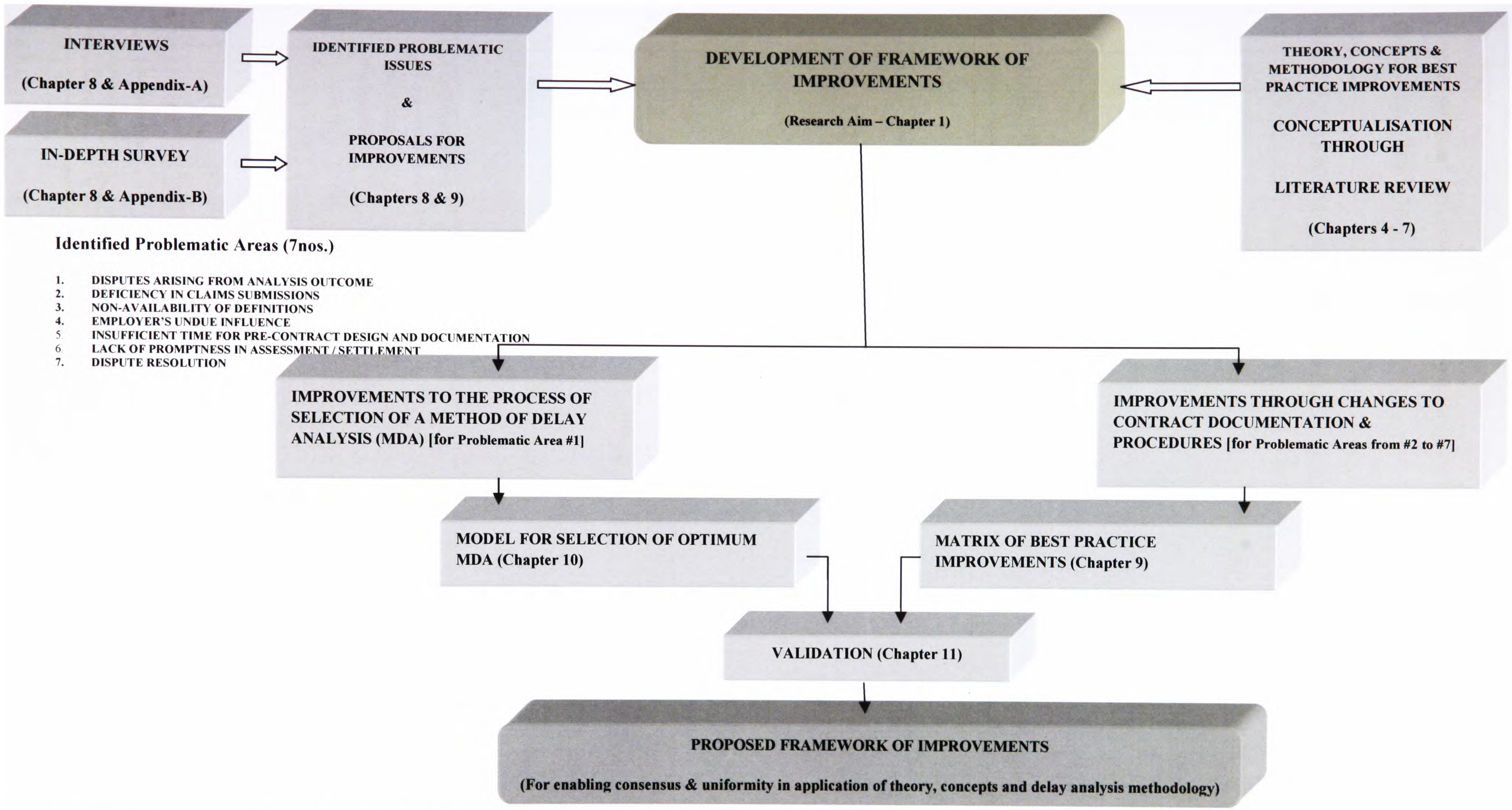


Figure 9. 1 Development of Proposed Framework of Improvements

In order to facilitate establishing the parameters of the Framework, the areas of 'improvements' perceived by both interviewees and survey-respondents are tabulated in the following Table 9.1.

Table: 9. 1 Factors Influencing Problematic Situations

	Identified Areas of Problematic Situations	Factors contributing to dispute escalation (Table B.40)	Prevention Factors (Table B.41)	Efficiency Factors (Table B.42)
1	**Disputes arising from analysis outcome**	Lack of consensual approach to use appropriate MDA and agreement to outcome of MDAs used (due to absence of such consensual approach/ objective basis.)		Consensual approach to select MDA for delay analysis.
2	**Deficiency in claims submissions**	Submission of Global Claims (and their potential rejection for inadequacy and lack of proof); Failure to comply with conditions precedent for admission of claims for assessment, and resulting denial of admission; Failure to establish other party's 'liability' through chain of proof; Failure to link liabilities with effects (delay impact) using appropriate methodology to quantify;		A clear mechanism for delay claims presentation by contractors for establishing 'liability' and quantum defined in the contract;
3	**Non-availability of definitions**		Pre-defining contentious issues in contract documents.	
4	**Employer's undue influence**		'engineer's impartiality' against own faults or outside pressure;	'engineer's impartiality' against own faults or outside pressure;
5	**Insufficient time for pre-contract design and documentation**		Allowing sufficient time to complete design; Control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;	
6	**Lack of promptness in assessment / settlement**			Prompt and timely award of extension of time;

7	**Dispute resolution**		Availability of a contractually stipulated mechanism to resolve delay claims at site level on day-to-day basis;	

Synthesising the overall 'Factors Influencing Problematic Situations' in Table 9.1, the necessary parameters for the discussion of these proposed 'Framework of Improvements' are identified in the Table 9.2 below.

Table: 9.2 Parameters for Proposed Framework of Improvements

	Identified Areas of Problematic Situations	Proposed Improvements	Item Reference in Chapter 9
1	**Disputes arising from analysis outcome**	• Consensual approach to select MDA for delay analysis.	9.2
2	**Deficiency in claims submissions**	• Compliance with conditions precedent/ timely submission of notice and particulars • Establishing causation (or avoidance of Global Claims, unless essential conditions exist) • Keeping proper records to establish 'liability' for proving entitlement; • Use of proper baseline programme and updates for establishing 'liability' and quantum	9.3
3	**Non-availability of definitions**	• Pre-defining contentious issues in contract documents (as for issues of Concurrency, Float, Criticality)	9.4
4	**Employer's undue influence**	• Measures for 'engineer's impartiality' - against own faults or outside pressure	9.5
5	**Insufficient time for pre-contract design and documentation**	• Allowing sufficient time to complete design; Control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;	9.6
6	**Lack of promptness in assessment / settlement**	• Pre-defining time period for assessment and award of extension of time; • Avoiding 'wait & see' policy	9.7
7	**Dispute resolution**	• Considering alternative to current ADR mechanism	9.8

Accordingly, the forthcoming sections of this Chapter would discuss the 'improvements' under the above seven areas of 'Problematic Situations' and the respective best practice recommendations in the context of the theoretical and conceptual basis provided by the literature review and supplemented by the findings of the overall research inquiry.

9.2 Disputes Arising From Analysis Outcome

9.2.1 Consensual Approach to Select MDA for Delay Analysis

When inquired about use of MDAs, the overall results of interviews and survey indicated that the issue of 'disputes arising from analysis outcome' was a major problematic situation in delay claims resolution. It is observed that this factor was ranked overall at the third highest level of significance among the 12 'Problematic Situations' (ref. Table B.40 above) by the survey-respondents. The main cause of such disputes was identified as the use of different MDAs by the contractors and consultants which may produce vastly different outcomes depending on their levels of objectivity and sophistication (Ng, Skitmore *et al.,* 2004; Bubshait and Cunningham, 1998). The summary results for Question no.19 of the Survey questionnaire (Table B.31 above) also confirmed that most of the disputes would arise from the use of less sophisticated MDAs. This situation was largely corroborated by the literature review as well. RP-FSA (2009) viewed that a main cause related to this problematic situation was the mutual scepticism between the parties about the impartiality of the particular MDA chosen. According to most of the interviewees who discussed this issue, the reasons for disputes are largely related to the issues of quantum which results from the 'methodology' at different levels of sophistication as used by either party. For example, a contractor who would use less sophisticated and highly subjective MDA would not consider his own delays occurred in concurrent with the excusable delays. If the consultant used a MDA like Time Impact Analysis such concurrent delays may be revealed, and consequently, that may affect the contractor's expected claimed recovery. This situation may lead to further disputes. In another instance, this situation was explained by an interviewee as caused by lack of transparency for what the consultant was producing as the outcome of analysis. He emphatically said that he could not recall giving back to the contractors any document to show how the analysis was done. (ref. Appendix A- KTH: 45:13.4 - 47:15.8).

Pre-defining the Method of Delay Analysis to be used in the contract was among the suggestions made by the interviewees (for example, ref. Appendix A- NS: 29:53.5 - 35:57.7; AR: 1:05:02.5 - 1:07:55.9). However, this suggested approach has a potential to restrict other available MDA options which could fit the actual circumstances of the project better than a predefined MDA which may not be appropriate in changed situations of a post-contract phase. It is a fact that there is no universally accepted single MDA which can suit to *all* the circumstances (Bubshait and Cunningham, 1998; SCL Protocol, 2002; Arditi and Pattanakitchamroon, 2006; RP-FSA, 2007, 2009, and 2011). For example, if TIA is pre-defined but no proper and regular updates to CPM programme are carried out in the duration of the contract the information essential for implementing TIA would not exist; in that case an alternate MDA may be more appropriate. Therefore, if MDA is pre-defined, it would require a challenging burden on the contract administrators to ensure that the project circumstances are always conducive to the use of the defined MDA.

However, there was another suggestion that this consensus as to the use of MDA to be agreed "by post contract general agreement to follow a certain guideline or a Protocol" (for example, ref. Appendix-A: KTH: 45:13.4 - 47:15.8). This suggestion seems more practical and implementable than having a pre-defined MDA.

Selection of a methodology for forensic delay analysis relies on professional judgment and expert opinion of the practitioners. Therefore, it requires many subjective decisions and depends on a number of criteria. These judgments invariably vary from one analyst to the other, as they are subjective, qualitative and impressionist and lack transparency. Consequently, many disputes arise due to intuitive decision making in regard to MDA. Thus, generally the reasons are mutual suspicions due to use of different MDA (RP-FSA, 2007). As quoted above, these opposing preferences to use MDAs by the practitioners of the two competing groups may produce divergent outcomes in the claims analysis and that would result in disagreement and possibly escalating the disputes to further and higher levels. Thus, all these suggestions of improvements to this problem situation were considered in order to form some Model or contractual device or guidelines in order to develop mutual trust between the parties on the outcome of a delay analysis on a relatively higher objective basis.

Suggested Best Practice Improvements

In order to address the foregoing suggestions of improvement, developing a 'Model' to select the most optimum MDA under objective circumstances was thought to be a more appropriate measure than predefining the MDA to be used. Its exclusive purpose is to provide a higher degree of objectivity to the MDA selection process, expecting that it would help improving parties' mutual trust on the delay analysis outcome and thus minimise mutual suspicions. Such Model is presented in the forthcoming Chapter 10. It is a main contribution of this research study to the delay analysis and dispute resolution discipline.

9.3 Deficiency in Claims Submissions

9.3.1 Compliance with Conditions Precedent and Establishing Causation

When discussing compliance with conditions precedent in bespoke contracts, a majority opinion of the interviewees confirmed a high rate of failure (80% - ref. Table A.13 above) to comply by the contractors. On the other hand, the interviewees agreed that majority of deficiencies in contractors' claims were in the failure to establish entitlement (for example, ref. Appendix A- SM: 1:05 - 1:12:17.1; SW:1:19:34.5- 1:25:06.6) . The other deficiencies are related to non-submission of claims particulars until very late stages, quantum/ methodology issues and denial of own concurrent delays. These observations are much consistent with the findings from the literature review which observed that the principal reasons for delay assessments were related to lack of details and clarity in substantiation, and delays in submissions of details by the claimant (Kumaraswamy and Yogeswaran, 2003). Accordingly, these deficiencies in claims submissions would usually result in a protracted delay claims resolution process and possible escalation of disputes to further and advanced levels (ref. Items A.3.4 and A.3.5 of Appendix -A).

The assessment process can be meaningful only if the necessary particulars are submitted /made available to the engineer, as the onus to prove causation is on the contractor as the claimant. Thus, a claims submission which is properly detailed and established with causation, and complying with the conditions precedent would greatly reduce reasons for rejection of claims and help to make the claims resolution process efficient and expeditious as suggested by some of the interviewees (for example, ref. Appendix A- KTH: 47:15.8 - 48:55.4)

The survey-respondents were inquired about their ranking of importance for factors influencing dispute escalation particularly in view of deficiencies in claims submission (Question no.21). As indicated by summary results in Table B.40 above, for both Contracting Group and the Consulting Group, the most contributing factor to dispute escalation was the 'Global Claims'. According to the Consulting Group the next two factors mostly contributing to dispute escalation were the failure to comply with the prescribed time for submission of delay claims 'notices' and their 'particulars'. For the Contracting Group the next factors mostly contributing were the failure to establish 'liability' and 'quantum', and 'Delay analysis method used by one party being disagreed/challenged by other party'. As for the Consulting Group, these three factors stood as the third most contributing cluster of factors to escalation of dispute.

Accordingly, there was a generally convergent position among the survey-respondents and interviewees that (i) compliance with conditions precedent (as to 'notice' and 'particulars') and (ii) establishment of proper causation by the contractors in their delay claims would lead to improve the overall delay claims resolution process and greatly reduce dispute escalation.

In other words, the main suggestions to minimise deficiencies in the contractors' claims submissions were as follows:

1. Define in the contract the format and the content that should essentially be complied by the contractors in their claims submission.
2. The defined content should cover the requirements for sufficient particulars in the claims in order to establish causation (by doing so automatically deterring global claims) and their submission in a timely manner and in the right format (to comply with conditions precedent).

<u>Suggested Best Practice Improvements</u>

In order to address the foregoing issues the following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording:

1. The requirements of the 'notifying' of a relevant delay event requiring extension of time, the precise number of days within which such 'notice' to be given from the happening of the relevant delay event, the mode of the communication of

'notice', the addressee of the 'notice'; similarly define the procedure and the timing for submission of 'particulars' (final or interim particulars);

2. The form and content of the full particulars (final and/or interim) of the delay claim to be submitted to the engineer with the supporting evidence which shall not be limited to (i) identification of the event, (ii) liability for the event, (iii) reference to contractual entitlement arising from the relevant 'event' for which the employer has contractually assumed responsibility for the risk of time and or cost, (iv) the details of contractor's actual progress at the time of the event, (v) detailed description and the length of the effects arising from the relevant 'event', and (vi) demonstration of the effects of the event upon the consented programme. For continuing effects the fully detailed claim shall be considered interim, and the claimed effects are to be considered as accumulated delay at the time of the submission of interim claim.

3. If the contractor fails to comply with ANY of the above requirements, it will lose its right to an EOT (and cost) under the contract and the employer will be discharged from all liability in connection with any such event, circumstance or claim to which the contract terms apply.

9.3.2 Use of Proper Baseline Programme & Updates and Keeping proper records

The majority of the interviewees suggested that the frequency of use of CPM Programme in projects was pretty high (ref. Table A.8 above) and the majority of survey-respondents (ref. Table B.32 above) also confirmed this by attributing the highest ranking to the use of CPM Programmes among other contemporaneous records.

In the literature review (Chapter 7) it was found that where the use of CPM schedule is so common in construction projects (like in the US industry), the importance of utilising the CPM in asserting or refuting a delay claim is also high (Baram, 1994; McCullough, 1999). Here, the updating of the programme is expected to be preceded by existence of a proper baseline CPM programme.

As observed in the literature review the Baseline Schedule and the As-Built Schedule are the two most important schedules in a forensic analysis (Livengood, (2007b). Thus, on one hand, failure to recognise that the as planned schedule that was worked with was deficient in some regard may lead to the entire delay analysis being discredited (Reams, 1990; Baram, 1994; McCullough, 1999; Briggs, 2006; Livengood, 2007b; Keane and Caletka, 2008). Many interviewees were also emphatic on the importance of ensuring the accuracy in Baseline Programme (for example, ref. Appendix A- SW: 1:19:34.5 - 1:25:06).

On the other hand, updating the CPM programme is essential for more sophisticated MDAs like Time Impact Analysis (TIA) than for simplistic methods like Impacted-As-Planned (IAP).

Without relying on what actually happened, the objectivity and value of delay analysis is greatly diminished (Bramble and Callahan, 2000); this is well recognized by courts, at least in the US jurisdiction (ref. Chapter 7).

If the programme is irreparably deficient for the purpose, one cannot expect any acceptance to the outcome of the delay analysis based on it only because it is the approved programme. Thus, unless the CPM programme is fully updated in terms of the delays, gains, mitigation, acceleration and the contractor's entitlement to EOT as of the time of the occurrence of the delay event, such programmes cannot be relied on for credible results of the delay analysis. In that situation they would become obsolete to be used as the basis for delay analysis.

However, in the contemporary practice with the contractor organisations in the local setting, it seemed a proper updating of the CPM programme is not the regular situation despite the very frequent use of CPM programme in the projects as the baseline. A majority (60%) of the interviewees who discussed this issue opined that though the contractors generally carried out updates of the programme such updates were either irregular or improperly done (ref. Table A.9 above) or with 'doctored' information to conceal possibly slipping performance or defaults of the contractors own. In this regard it was observed that the Contracting Group of the survey-respondents considered updating the consented programme with as-built data was of least importance to them. This may be due to that, for using Impacted As Planned method, which is the most preferred MDA of the Contracting Group, they do not have to rely on such as-built data (ref. B.4.5 in Appendix –B).

In the literature review (ref. Chapter 7) it was observed that,

- For the success in delay claims, any impressionistic estimates or similar methods cannot substitute the requirements based on objectivity and factual, hard evidence to prove causation;
- Lack of 'Keeping records' seems to be a major reason associated with lack of causation and hard evidence to support/prove the claimed delays;
- Lack of 'Keeping records' seems to be one of the major factors contributing to the late determination of the claims, as the burden of submission of sufficient particulars to enable the consultant to evaluate the claim is primarily on the contractor.

Thus, the CPM Programme issues apart, keeping other essential records required for delay claims presentation and evaluation is also of high importance.

Suggested Best Practice Improvements

In order to improve the current situation as to the foregoing issues the following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording:

1. It is the contractor's responsibility to maintain a CPM Programme during the lifecycle of the project, providing periodic (preferably monthly if not fortnightly) enabling the employer's consultant to monitor and record the actual progress of the works;
2. The maximum number of days within which the contractor has to submit the detailed CPM Programme for the consultant's approval/consent. (ICE Conditions of Contract 7th edition (1999) requires this be within 21 days from the award of contract);
3. The maximum number of days within which the consultant should, in writing, either approve or reject with reasons and return for re-submission of the submitted programme. (ICE Conditions of Contract 7th edition (1999) requires this be within 21 days from the receipt of the programme); if this does not happen, then the consultant is deemed to have accepted the programme as submitted;
4. The maximum number of days within which the contractor has to re-submit the programme in the case of consultant's rejection. (ICE Conditions of Contract 7th edition (1999) requires this be within 21 days from the written rejection of the programme);

5. The consequences for the contractor's failure to abide by the above requirements. (NEC3 Conditions of Contract Clause 50.3 allows the employer to retain one quarter of amounts due as interim payments where the contractor fails to submit a first programme for acceptance - if none is identified in the contract data);
6. The requirements of maintaining software copies of the consented programme and the periodical updates of the same, including any revised versions of the original (agreed or to be agreed), jointly by the contractor and consultant; The original and its updated programmes should consist of all relevant activities, related to design, manufacturing, procurement and on-site construction. It should also clearly identify the long-lead procurement items and the information the contractor reasonably requires from the employer or his consultant, and when it is required and all employer or consultant activities and constraints (such as approvals and employer-supplied services or materials).
7. The Accepted Programme and its Updated Programmes should be the means by which actual against planned progress is monitored, and used as a tool for determining EOT. If the amount of progress the contractor considers it has achieved is disagreed by the consultant, it should be notified to the contractor by the consultant, and both should then attempt to reach agreement. If they do not agree, the consultant's view should prevail unless and until overturned under the contract dispute resolution procedures, as to the updates and the use of same in the delay claims analysis.
8. Mandatory keeping of objective, contemporaneous project records. A simple clause for 'keeping records' as proposed by SCL Protocol is re-produced below as guidance for such contract terms:

   > "The employer and the contractor agree that there shall be [*daily*] [*weekly*] records kept [*by the contractor*] identifying generally the activities on site, labour on site, plant on site, sub-contractor work on site, delivery of material to the site, list of any instructions given, weather conditions encountered, and any delays encountered which shall be submitted regularly to the CA or the employer on a [*weekly*] [*monthly*] basis".

   The required format of these records may be pre-defined with necessary 'pro formas' attached to the contract documentation.

9. The contract should require from the contractor fully detailed method statements, cross referenced to the programme, displaying how he intends to construct the works, and the resources it intends to deploy;
10. It may be beneficial to all parties if there would be a pre-submission joint discussion or workshop in order to ensure the programme is complying with the information required by the contract and fully reflecting the contract work scope; the operational methods are realistic and practical; the resources allocated are realistic to achieve the contract milestones.

9.4 Non-availability of Definitions

Perplexed issues like 'concurrency', 'float ownership', theory of 'criticality' are still lacking universally accepted definitions, permanent industry standards, and firm legal positions. Further, nature of particulars and records to be used in delay claims submission and assessment, defined time period for assessment and employer approval of EOT, and other procedural issues also become potential dispute areas due to lack of clarity/definitions on same in the contract documents. These also potentially contribute to protracted delay claims resolution process and possible escalation of disputes to a greater extent.

Here, the interviewees' mainly suggested improvements were to clearly define in a delay event 'who is responsible to what' and 'who gets what'. This is intrinsically related to setting out a firm position for each party as to their rights and liabilities in the event of perplexed issues of concurrent delays, float ownership, entitlement after passing the completion date, and so on (for example, ref. Appendix A- SM: 1:05:38.4 - 1:12:17.1; KTH: 47:15.8 - 48:55.4 and 11:18.0 - 20:41.4).

9.4.1 Issues of Concurrency and Float Ownership

As observed in the literature review, there is still no universal position as to the definition of 'concurrent' delays (Peters, 2003; Livengood, 2007d; Keane and Caletka, 2008), and there is hardly any convergent position between the experts' opinions on the issues associated with remedies for 'concurrent delays'; The legal position is also not certain in essential issues like how to apportion liabilities in concurrent delays (for example the judgment in '*John Doyle*' followed 'Dominant Cause' approach whereas many other recent cases decided on 'Malmaison' approach). Similarly, there is still no universal position as to who should own the 'Float', whether it is the contractor or the employer or should it be belonged to the project for consumption by either party on 'first come, first served' basis (Peterman, 1978; Guy Ponce, 1986; Nash, 2002; Eggleston, 2006; RP-FSA, 2007; SCL Protocol, 2002). There are arguments for all three positions.

When inquired on the issues of (i) apportioning time and cost in concurrent delays (ii) true concurrency' and 'concurrent effects, and (iii) 'ownership of the float' the overall awareness of the majority of survey-respondents of both Contracting and Consulting Groups was generally complemented by the majority of the interviewees. The perceptions of the majority of both interviewees and survey-respondents were generally corroborated by the literature review and they were largely similar to the principles promoted by the SCL Protocol (2002) on these issues (ref. Chapter 4, 'Findings' under item 4.3). However, there were some divergent views among a minority of both survey-respondents and the interviewees who perceived differently, particularly on more contentious scenarios associated with these issues. This dissension was also consistent with the general findings of literature review that confirmed lack of a universal position as to the definitions of 'concurrent delays', basis of apportioning liabilities and recovery in a concurrent delay situation, and 'float' ownership.

These uncertainties were discussed in length during the interviews and many interviewees' suggested improvement to the situation was to ensure pre-agreed position on these issues between the parties. It was suggested that such pre-defined agreement could be ensured through express provisions in the contract or kind of a Protocol (for example, ref. Appendix A- KTH: 47:15.8 - 48:55.4; SM: 1:05:3A.4 - 1:12:17.1)

Thus, it was envisaged that providing such pre-defined positions in express provisions of the contract may contribute to minimise the after-the-event debating over these issues.

<u>Suggested Best Practice Improvements</u>

In order to improve the current situation as to the foregoing issues the following improvements to the contract documents and claims submissions by the contractors are suggested:

<u>Issues on 'concurrent' delays and apportioning delay liabilities:</u>

The following principles (which are mainly sourced from SCL Protocol, 2002 and current legal positions in the UK and US jurisdictions) are recommended to be incorporated in the terms of contracts in properly drafted wording:

1. Where contractor delay to completion (i.e. "non-excusable" delay) occurs concurrently with employer delay to completion (i.e. "excusable and compensable" delay), the contractor's concurrent delay should not reduce any EOT due;
2. Where employer risk events and contractor risk events occur (on separate critical paths) sequentially but have concurrent effects, here again any contractor delay should not reduce the amount of EOT due to the contractor as a result of the employer delay;
3. Where an excusable and compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, the contractor's concurrent delay should not reduce any EOT due; the EOT entitlement must be on 'net' basis only, added to the prevailing contract completion date;
4. Where an excusable but non-compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, no EOT or compensation is due;
5. The 'but-for', 'dominant cause', 'First-in-line', 'Devlin' and similar approaches are rejected for dealing with apportioning liabilities in concurrent delay situations;
6. The entitlement to EOT is an estimated prolongation and may not exactly be tallying with the actual prolongation at the completion of project; however, the compensation must be on the basis of actual costs only;
7. There is no automatic entitlement to 'cost' where the contractor is entitled to EOT; If the contractor incurs additional costs that are caused both by employer delay and contractor delay, then the contractor should only recover compensation if he is able to separate the additional costs caused by the employer delay from those caused by the contractor delay; corresponding to this, the employer's right to recover segregated unliquidated damages for the contractor delay is to be preserved.

Issue of 'Float Ownership':

If 'project float' (or 'terminal float') is owned by the contractor as suggested by RP-FSA (or NEC 3 conditions of contract) then the contractor is entitled to EOT for all delays caused by the employer to the 'planned completion date' in the programme which may be earlier than the contract completion date;

The current UK and US legal positions are based on that an employer delay has to be critical (to meeting the completion date) before an EOT will be due (e.g. the '*Glenlion*' case in the UK and *'Gassman'* case in the US); According to this position, whether the 'point of criticality' is applied at the contract completion date (as per Total Float Value theory) or at the predicted completion date (as per Longest Path theory), no residual float should exist before an EOT is due. Therefore, that float is not time for the exclusive use or benefit of either the employer or the contractor is compatible with this current judicial thinking.

Accordingly, in order to avoid any uncertainty on this issue the following principle is recommended to be incorporated in a clearly defined term of contract in properly drafted wording:

1. The 'float' (i.e. without differentiating to 'network float' and 'project float' or 'terminal float') is owned by the project and the 'float' is there to be used by whichever party needs it first; there will be no entitlement to EOT or LD unless all the 'float' is consumed.

9.4.2 Issue of 'Pacing' Delays

As a connected issue to 'concurrency' and 'float', a 'pacing' delay can be found when a party makes efforts to get relieved from its obligation to a delay occurred stating that was a delay as a result of an expressed 'pacing' (RP-FSA, 2007; Zack, 1999). 'Pacing' delays have to occur in a period of concurrent delays. Therefore, the difficulties normally inherent in concurrent delays, particularly in distinguishing the 'driving' activities in concurrent delays, are also common to 'pacing' delays. Accordingly, both the employers and contractors can argue that the delays caused by them were not to be considered relevant as the works were already in delays caused by the other party and there was no reason to hurry and wait. Thus, a 'pacing' delay can be found when a party makes efforts to get relieved from his obligation to a delay occurred stating that was a delay as a result of an expressed 'pacing'. It is based on the thinking 'why to hurry and wait'.

Pacing delays can be misused and wrongfully applied as a global excuse for a failure to perform.

Suggested Best Practice Improvements

In order to prevent such abuse the following pre-conditions (which are mainly sourced from RP-FSA, 2007) may be clearly included in the contract documents in properly drafted wording, in order to consider/admit a claim based on 'pacing' delay:

1. The claiming party has to cogently and convincingly show that it had the contemporaneous ability to resume progress at a normal, un-paced rate and it could have completed the schedule activity on time if necessary;
2. The claiming party has to submit evidence of contemporaneous intent (e.g. giving 'notice' for adopting 'pacing' measures in view of the already on-going delay of the other party) for showing that the 'pacing' was a conscious and deliberate decision that was made at the time of pacing.
3. For any consideration for a 'pacing' delay claim, submission of the foregoing contemporaneous evidence is an absolute necessity.

9.4.3 Issue of 'Measuring criticality' in forensic scheduling

The overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' theory. Thus, if the contract explicitly or implicitly infers that the point of measuring criticality is the prevailing contract completion date and not the project completion date, then the Longest Path approach cannot be implemented under such situation (unless there is no 'gap' between the contract completion date and the project (predicted) completion date set by the Longest Path). As a solution to this issue, the interviewees suggested pre-defining in the contract documents whichever the approach to be used in measuring criticality for quantification of delay claims (for example, ref. Appendix A-KTH: 11:18.0 - 20:41.4)

As summary results of Table A.6 above indicate, this proposition was acceptable to the overall majority (80%) of the responding interviewees. The summary of results of

Table B.26 above indicated that the overall majority of both Groups of survey-respondents were also in agreement with the 'Total Float' theory, although a substantial minority (Overall 35%) took the 'Longest Path' theory as their approach.

Also, the majority agreed the principle that after passing the contract completion date all delays become critical, and therefore, there is automatic entitlement to extension of time due to employer's delays on day-for-day basis. This position was also consistent with the 'Total Float' theory as well as the SCL Protocol's principle on this issue.

This high percentage of supporting the 'Total Float' theory may be explained as due to that most of the bespoke contract forms in the UAE require EOT or 'Penalty' to be determined against 'contract completion date', with no reference to' project (or predicted) completion date' which otherwise would have required 'Longest Path' approach.

However, the general findings of the literature review (ref. Chapter 05) on this issue were:

- There is still no universal position as to the question of definition of criticality that whether all activities having total float less than or equal to zero are critical (Total Float Theory), or only those having the maximum negative float are critical (Longest Path Theory); this position is consistent with the survey results which indicated a significant dissenting minority opinion (Overall 35%) to the majority perceptions.
- SCL Protocol has taken a position that, unless the terms of contract require otherwise, to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date.

In order to improve the current situation as to the foregoing issues the following improvements to the contract documents and claims submissions by the contractors are suggested:

- The said two definitions (Total Float theory & Longest Path theory) for 'criticality' generate different or contrasting outcomes in the apportioning of liabilities and the recovery of damages/losses;
- Whether to use the 'Longest Path Theory' or the 'Total Float Theory' is a matter

for the terms of the contract (RP-FSA, 2007); in order to add certainty to the contract risk-distribution and for avoiding post-contract disputes the best solution is to conspicuously address the issue of 'criticality' in the contract itself (Peters, 2003).

Suggested Best Practice Improvements

Therefore, in order to avoid any uncertainty on this issue the following principles are recommended to be incorporated in the clearly defined terms of contract in properly drafted wording:

1. If the requirement is to use 'Longest Path' approach, then clearly set out that the critical delays are to be found only on those delays on the 'Longest Path' and all delays on subordinate paths are non-critical relative to the project (predicted) completion date set by the Longest Path.
2. If the requirement is to measure criticality against the contract completion date, then clearly set out that to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date or contractual milestones.

9.5 Employer's Undue Influence

9.5.1 Engineer's impartiality

The majority of the interviewees were in agreement that there were various forms of pressure exerted by employers on engineers, causing an undue influence over the engineer's impartiality set out in the contracts. This phenomenon was mostly seen with the public sector employers, and the majority of the interviewees (70%) agreed to it (ref. Table A.15 above).

Many comments were made by the interviewees on this issue and how such 'impartiality' was being compromised in the projects. The emphasis of the issue can be observed in most of the interviewees' statements (ref. Appendix –A). Among these, one observed that the employer would inform his view to the consultant (ref. Appendix A- SH: 1:00:05.6 – 1:08:45.5); another viewed that 80-90 percent of the employers were interfering with the engineer's determination as the 'ultimate pay-master' or the employer would employ his own in-house expertise / hire a third party to pinpoint some 'errors' in order to prolong the process (ref. Appendix A- KTH: 0:00.0 -7:09.5); one observed that not only the contractors but consultant too would not tend to upset the employers as they need good relationship with the employers and otherwise they might not get any future work from the same employer (ref. Appendix A-NS 36:35.0 - 39:42.0).

Thus, the phenomenon of employer's undue influence in the local settings is to be considered real.

Suggested Best Practice Improvements

In order to avoid or minimise such undue influence on the consultants' impartiality in delay claims resolution process it would be best to entrust the role of claims evaluation to a truly independent body. The necessary measures in this regard are suggested under item 9.8 below.

9.6 Insufficient time for Pre-contract Design and Documentation

In Question no.22, the survey-respondents were asked to rank their perceived importance on 'factors' in prevention of delay claims disputes. Among the factors considered were (i) allowing sufficient time for consultants to complete the design and contract documents before issuing for tender, and (ii) Establish high level quality control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents (ref. Table B.41above). With a substantial concordance the two Groups attributed very high importance to these two factors for their potential to assist preventing delay claims.

On the other hand, most of the interviewees pointed out the problem situations which could be arising from not allocating sufficient and realistic time for carrying out relevant processes of design, documentation, planning and construction. One interviewee commented on the 'fast-track mentality' of the employers which ignored the essential processes or the reasonable time required for such processes in their desire to get the fastest 'returns' for investment. Thus, among the improvements proposed, there was a great emphasis on allocating sufficient time for these pre-contract processes (for example, ref. Appendix A- ID: 1:16:31.3 - 1:20:47.6; SH: 1:00:05.6 - 1:08:45.5; AP:1:14:08.4 - 1:15:32.3).

Suggested Best Practice Improvements

Considering the foregoing suggestions, in order to avoid or minimise such unnecessary and unwarranted 'hurry' which would negatively impact on the project objectives, and more particularly, provide a source for most of the variations and ensuing delay claims and possible disputes, the following improvements to the practices of pre-contract procedures are suggested:

1. Developers (employers) should realistically assess 'fast-track' requirements based on objective aims of a project before deciding on the approach of procurement; if not in dire need, only for the sake of impressing investors of potential 'fast returns', putting a project on 'fast-track' must be strictly avoided; these initial but decisive tasks of project appraisal must be carried out by competent professional advisers rather by the financiers or non-technical advisors/investors;
2. Developers should appreciate that even when a project is decided to be on fast-track, there are certain minimum pre-requisites to be firmly determined (for example determining exact requirements to be built, sufficiency of design preparation and availability of site for construction and so on);
3. Allocation of sufficient time for the consultants to complete conceptual and detailed design stages;
4. Realistic time allocation for initial planning and particularly interfacing, if multiple phases of construction and multiple contractors are involved on same site;
5. Allocation of sufficient and realistic construction time;
6. Allocation of sufficient time for reviewing the design, drawings, specifications and other tender documentation prior to calling for bids;
7. Strict quality controlling of the tender documents, in order to ensure avoiding conflicts, ambiguities, 'gaps' and so on for minimising post-contract time/cost claims; primarily this is the responsibility of the consultants, but the final approval must be given by the employer, preferably after a further quality assurance by his in-house professional staff wherever it is possible;
8. Strict quality controlling of the contract documents at award stage, to ensure the intentions of the final position (including possible negotiations and final agreed positions) are truly reflected and without having conflicts, ambiguities, 'gaps' and so on. Again, the employer's final approval to these contract documents must be given as in the case of the tender documents.

9.7 Promptness in Assessment and Settlement

9.7.1 Prompt review and Assessment

A further issue considered important was defining a specific time period for review/approval process by the consultant and or the employer when the contractor submits various submittals (shop drawings, Material Submittals and so on) requiring such review, assessment and approval. Some interviewees found a lack of certainty on definitively prescribed time for the consultants/employers caused delay claims/disputes (for example, ref. Appendix A- KTH: 47:15.8 - 48:55.4)

The other issue considered important was defining a specific time period for review and assessment by the consultants of the contractors' delay claims. Finke (1997) pointed out that in most construction projects the delays are often left unanalysed until the end of the job. In most of the bespoke contracts in the local industry require, on receipt of such detailed particulars and as soon as reasonably practicable, the engineer (consultant) to make his determination. The engineer shall make his determination after due consultation with the employer and the contractor, and shall notify the contractor of the determination, with a copy to the employer. However, very often this obligation of the engineer is not fulfilled within a reasonable time (although even some bespoke contracts stipulate a definite period for the engineer's assessment but not for the employer's approval process) since sufficiently detailed particulars are received enabling him to assess and determine any entitlement as claimed. The lack of resources or other influences may be responsible for such lapses. However, in other occasions, it is the contractors' lapses to submit sufficient particulars to enable such determination as required by the terms of the contract. During the interviews many practitioners emphasised the timely assessment of the delay claims and its potential to reduce further disputes (for example, ref. Appendix A- NS: 43:40.7 - 48:09.5; KTH: 11:18.0 - 20:41.4)

Suggested Best Practice Improvements

In order to avoid or minimise such delay to the assessment by the consultants in delay claims resolution process it would be best incorporating a specific time period (from the time sufficient interim or final particulars are submitted by the contractor for an interim determination or a final determination) in the contract within which the engineer should form his assessment in principle (in an interim determination) or assessment with specific entitlement to EOT and formally notify the outcome of the entitlement to EOT. (For example, the FIDIC 1999 Red Book Clause 20.1 has, in this regard, prescribed 42 days for the engineer's response).

9.7.2 Prompt Award/Settlement

All the interviewees confirmed that there was invariably a strict requirement in bespoke contract forms that there should be an approval obtained from the employer prior to engineer's determination of extension of time. However, the majority of them also agreed that the employers' approval did not come promptly as it should be.

Some interviewees confirmed that such employer-approval delays could be a major cause of dispute as the 'wait & see' policy may create a 'gap' between the contract completion date and the project (predicted) completion date if the contract expressly requires using 'Longest Path' approach (ref. Table A.14 above). The majority of the survey-respondents have also agreed to this position (ref. Table B.37 and B.38 above).

As commented by most interviewees, an element of abuse of giving employer's specific approval to the engineer's determination of extension of time exists in most of the projects. Remedying such attitude is essential to an efficient delay claims resolution as viewed by many interviewees. A suggested measure to this end is to set out a specific time period for such approval.

A viable suggestion to reduce inordinate delays in giving employer's approval was to limit the 'approval' requirement (unless removing it altogether, if possible) to the consultant's due notifying to the employer as to his intention to issue formal determination of the claimed entitlement for delay claim. This may enable the consultant to act immediately once his evaluation outcome is available. (ref. Appendix A-NS: 17:45.2 - 21:20.9)

Alternately, there can be a prescribed time for the employer to give his consent or otherwise to the engineer's recommended entitlement to EOT. This will enable the contractor to promptly decide on the next measures for recovery of entitlement which he thinks due.

In order to discourage any 'wait & see' policy, the SCL Protocol proposed that applications for EOT should be made and dealt with as close in time to the delay event that gives rise to them.

Suggested Best Practice Improvements

Considering the foregoing suggestions, in order to discourage potential negative effects of an employer's 'wait & see' policy the following is suggested:

1. If possible, employer's approval requirement for the consultant's determination of EOT should be done away altogether; this will ensure the consultant's impartiality on the matter and if the employer disagrees with the consultant's evaluation outcome he may proceed to the formal dispute resolution mechanism (specified in the contract or otherwise);
2. If the employer's 'approval' requirement is retained, then define in clear language that prior to issuing formal determination of entitlement to EOT, the employer should be notified of it; however, the employer's approval is required for issuing the same and not for the content of the engineer's determination; preferably, there may be a prescribed time within which such approval or disagreement should be given and it should not be withheld out of 'bad faith'; in any case, the engineer's formal determination of the EOT entitlement should be independently notified, whatever the employer's decision is;
3. The contractor's claims for EOT should be made and dealt with as close in time as possible to the delay event that gives rise to the application.

9.8 Dispute Resolution

9.8.1 Dispute Resolution Mechanism for Day-to-day Site Issues

Many interviewees agree on the lack of impartiality of the engineer when it comes to claims against the employer or against the engineer himself with regard to his opinions, acts of commission or omission. Thus, a suggested solution was to contractually set out a dispute resolution mechanism to resolve day-to-day issues by a separate body independent of the engineer/employer. These suggestions on the issue were mainly in favour of FIDIC 1999 based Dispute Adjudication Board (DAB) or Dispute Resolution Board (DRB) approaches (for example ref. Appendix A- SM: 1:05:38.4 - 1:12:17.1; SH: 1:00:05.6 - 1:08:45.5)

Thus, there was a strong concordance among the practitioners that in order to have a more independent and fairer resolution of delay claims disputes, the adjudication or decision making role has to be performed by a third party and not by the consultant himself.

It is noted that the majority of the bespoke forms of contract used in the local setting are based on FIDIC 'Red Book' 4th edition 1987 or 1992 version. However, as pointed out by Gaitskell (2005), by the 1990s, major civil engineering contractors in the UK and internationally became critical of the central role played by the engineer appointed under the standard forms published by the FIDIC and the ICE. FIDIC, accordingly, made the essential change and in 1995 introduced a dispute board approach first into its Orange Book, and then in November 1996 into the 1996 version of 4th edition of 'Red Book'. The approach has been maintained in FIDIC's 1999 Red Book and so on in the form of a Dispute Adjudication Board (DAB).

It is noted that except for that the DAB is appointed by the parties and having independent role (the payment for DAB is equally shared by the parties) replacing the engineer from his conventional former role under FIDIC Clause 67.1 of 'Red Book' 4th edition 1987 or 1992 version, the rest of the mechanism of DAB in FIDIC 1999 is almost same to that of Clause 67.1. Thus, The conclusion produced by a dispute board will be only temporarily binding and if one or both parties wish to challenge the DAB's determination, the dispute can go to the next level i.e. arbitration or court litigation (depending on the contract terms) after attempting to settle the dispute amicably within a prescribed time. A DAB determination shall become final and binding if one or both parties do not challenge it within the prescribed period.

<u>Suggested Best Practice Improvements</u>

In order to avoid or minimise such undue influence on the consultants' impartiality in delay claims resolution process the following measures are suggested:

1. Where FIDIC Clause 67 of 'Red Book' 4th edition 1987 or 1992 version is still in use (particularly in bespoke forms of contract which follow FIDIC Clause 67 verbatim), replace it with the mechanism stipulated under Clauses 20.2 – 20.8 of FIDIC 1999 'Red Book' which describes the appointment and functioning of Dispute Adjudication Board (DAB), decision making, amicable settlement, arbitration and so on;

2. In this case, it must be clearly defined that DAB is making 'decisions' and not merely 'recommendations' (which is the case of an ordinary Dispute review Board);
3. The prime purpose of a DAB is to 'nip in the bud' problems before they escalate to dispute level; therefore, to enable its full advantages, a DAB should be appointed at the commencement of a project and stay in place until its conclusion;

9.9 Summary

Baki (1999) argued that a claims prevention program would begin with the careful preparation of contract documents and complete, clear, detailed, and specific contract documents. Accordingly, the foregoing 'Framework of Improvements' has strived to contribute to such 'claims prevention programme' by adding certainty to some of the common problem issues which may otherwise contribute to further escalation of disputes in delay claims.

The improvements suggested in this 'Framework' are primarily related to the problem situations identified through the data collected from the interviews and the in-depth survey. Initially, from the responses of the interviewees, seven areas of proposals for improvements established. The interviewees apart, the survey-respondents also, with a significant concordance, identified the most prominent factors which may contribute to disputes escalation, as well as to prevention of disputes and enhancing efficiency of resolution process, implying proposals for such improvements. These proposals for improvements were then supplemented by the best practices identified through the literature review (Chapters 4-7), and developed into a 'Framework of Improvements'. This 'Framework of Improvements' consists of two principal components as discussed above:

(1) The improvements to be adopted through changes to <u>contract documentation</u> and <u>procedures</u>; these are presented in the foregoing sections; and

(2) The improvements to the process of selection of a MDA (i.e. the optimum and most appropriate MDA under specific circumstances of a construction project); which will be presented in the form of a 'Model' in Chapter 10.

The following Table 9.3 presents a matrix of the 'Framework of Improvements' incorporating the above considered problem situations/areas and the suggested best practice improvements.

Table: 9. 1 MATRIX OF THE 'FRAMEWORK OF IMPROVEMENTS'

	Problematic Situations	**Problem Area**	**Suggested Best Practice Improvements**
1	**Disputes arising from analysis outcome**	• Selection of most optimum MDA for delay analysis under specific circumstances of a project.	• Developing a 'Model' to select the most optimum MDA under objective circumstances – **See Chapter 10**
2	**Deficiency in claims submissions**	• Compliance with conditions precedent/ timely submission of notice and particulars • Establishing causation (or avoidance of Global Claims, unless essential conditions exist)	• Following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording: 1. The requirements of the 'notifying' of a relevant delay event, the precise number of days within which such 'notice' to be given from the happening of the relevant delay event, the mode of the communication of 'notice', the addressee of the 'notice'; similarly define the procedure and the timing for submission of 'particulars' (final or interim particulars); 2. The form and content of the full particulars (final and/or interim) of the delay claim to be submitted which shall not be limited to (i) identification of the event, (ii) liability for the event, (iii) reference to contractual entitlement arising from the relevant 'event' for which the employer has contractually assumed responsibility for the risk of time and or cost, (iv) the details of contractor's actual progress at the time of the event, (v) detailed description and the length of the effects arising from the relevant 'event', and (vi) demonstration of the effects of the event upon the consented programme. For continuing effects the fully detailed claim shall be considered interim, and the claimed effects are to be considered as accumulated delay at the time of the submission of interim claim. 3. If the contractor fails to comply with ANY of the above requirements, it will lose its right to an EOT (and cost) under the contract and the employer will be discharged from all liability in connection with any such event.
		• Keeping proper records to establish 'liability' for prove entitlement;	• Following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording:

		• Use of proper baseline programme and updates for establishing 'liability' and quantum	1. It is the contractor's responsibility to maintain a CPM Programme during the lifecycle of the project, providing periodic (preferably monthly if not fortnightly) enabling the employer's consultants to monitor and record the actual progress of the works; 2. The maximum number of days within which the contractor has to submit the detailed CPM Programme for the consultant's approval/consent; 3. The maximum number of days within which the consultant should, in writing, either approve or reject with reasons and return for re-submission of the submitted programme. If this does not happen, then the consultant is deemed to have accepted the programme as submitted; 4. The maximum number of days within which the contractor has to re-submit the programme in the case of consultant's rejection; 5. The consequences for the contractor's failure to abide by the above requirements (for example, NEC3 Conditions of Contract Clause 50.3 allows the employer to retain one quarter of amounts due as interim payments where the contractor fails to submit a first programme for acceptance - if none is identified in the contract data); 6. The requirements of maintaining software copies of the consented programme and the periodical updates of the same, including any revised versions of the original (agreed or to be agreed), jointly by the contractor and consultant. The original and its updated programmes should consist of all relevant activities, related to design, manufacturing, procurement and on-site construction. It should also clearly identify the long-lead procurement items and the information the contractor reasonably requires from the employer or his consultant, and when it is required and all employer or consultant activities and constraints (such as approvals and employer-supplied services or materials). 7. The Accepted Programme and its Updated Programmes should be the means by which actual against planned progress is monitored, and used as a tool for determining EOT. If the amount of progress the contractor considers it has achieved is disagreed by the consultant, it should be notified to the contractor by the consultant, and both should then attempt to reach agreement. If they do not agree, the consultant's view should prevail unless and until overturned under the contract dispute resolution procedures, as to the updates and the use of same in the delay claims

			analysis. 8. Mandatory keeping of objective, contemporaneous project records. A simple clause for 'keeping records' as proposed by SCL Protocol is re-produced below as guidance for such contract terms: "The employer and the contractor agree that there shall be [daily] [weekly] records kept [by the contractor] identifying generally the activities on site, labour on site, plant on site, sub-contractor work on site, delivery of material to the site, list of any instructions given, weather conditions encountered, and any delays encountered which shall be submitted regularly to the CA or the employer on a [weekly] [monthly] basis" 9. The contract should require from the contractor fully detailed method statements, cross referenced to the programme, displaying how he intends to construct the works, and the resources it intends to deploy; 10. It may be beneficial to all parties if there would be a pre-submission joint discussion or workshop in order to ensure the programme is complying with the information required by the contract and fully reflecting the contract work scope; the operational methods are realistic and practical; the resources allocated are realistic to achieve the contract milestones.
3	**Non-availability of definitions**	• Pre-defining contentious issues in contract documents (for issues of Concurrency, Float, Criticality)	• The following principles (which are mainly sourced from SCL Protocol, 2002 and current legal positions in the UK and US jurisdictions) are recommended to be incorporated in the terms of contracts in properly drafted wording: **Issues on 'concurrent' delays and apportioning delay liabilities:** 1. Where contractor delay to completion (i.e. "non-excusable" delay) occurs concurrently with employer delay to completion (i.e. "excusable and compensable" delay), the contractor's concurrent delay should not reduce any EOT due; 2. Where employer risk events and contractor risk events occur (on separate critical paths) sequentially but have concurrent effects, here again any contractor delay should not reduce the amount of EOT due to the contractor as a result of the employer delay; 3. Where an excusable and compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, the contractor's concurrent delay should not

			reduce any EOT due; the EOT entitlement must be on 'net' basis only, added to the prevailing contract completion date; 4. Where an excusable but non-compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, no EOT or compensation is due; 5. The 'but-for', 'dominant cause', 'First-in-line', 'Devlin' and similar approaches are rejected for dealing with apportioning liabilities in concurrent delay situations; 6. The entitlement to EOT is an estimated prolongation and may not exactly be tallying with the actual prolongation at the completion of project; however, the compensation must be on the basis of actual costs only; 7. There is no automatic entitlement to 'cost' where the contractor is entitled to EOT; If the contractor incurs additional costs that are caused both by employer delay and contractor delay, then the contractor should only recover compensation if he is able to separate the additional costs caused by the employer delay from those caused by the contractor delay; corresponding to this, the employer's right to recover segregated unliquidated damages for the contractor delay is to be preserved. **<u>Issue of 'Float Ownership':</u>** 8. The 'float' (i.e. without differentiating to 'network float' and 'project float' or 'terminal float') is owned by the project and the 'float' is there to be used by whichever party needs it first; there will be no entitlement to EOT or LD unless all the 'float' is consumed. **<u>Issue of 'Pacing' Delays</u>** 9. The claiming party has to cogently and convincingly show that it had the contemporaneous ability to resume progress at a normal, un-paced rate and it could have completed the schedule activity on time if necessary; 10. The claiming party has to submit evidence of contemporaneous intent (e.g. giving 'notice' for adopting 'pacing' measures in view of the already on-going other party's delay) for showing that the 'pacing' was a conscious and deliberate decision that was made at the time of pacing. 11. For any consideration for a 'pacing' delay claim, submission of the foregoing contemporaneous

			evidence is an absolute necessity. **<u>Issue of 'Measuring criticality' in forensic scheduling</u>** 12. If the requirement is to use 'Longest Path' approach, then clearly set out that the critical delays are to be found only on those delays on the 'Longest Path' and all delays on subordinate paths are non-critical relative to the project (predicted) completion date set by the Longest Path. 13. If the requirement is to measure criticality against the contract completion date, then clearly set out that to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date or contractual milestones.
4	**Employer's undue influence**	• Measures for 'engineer's impartiality' - against own faults or outside pressure	In order to avoid or minimise such undue influence on the consultants' impartiality in delay claims resolution process the following measures are suggested: **<u>Dispute Resolution Mechanism for Day-to-day Site Issues</u>** 1. Where FIDIC Clause 67 of 'Red Book' 4th edition 1987 or 1992 version is still in use, replace it with the mechanism stipulated under Clauses 20.2 – 20.8 of FIDIC 1999 'Red Book' which describes the appointment and functioning of Dispute Adjudication Board (DAB), decision making, amicable settlement, arbitration and so on; 2. In this case, it must be clearly defined that DAB is making 'decisions' and not merely 'recommendations' (as in the case of an ordinary Dispute Review Board); 3. The prime purpose of a DAB is to 'nip in the bud' problems before they escalate to dispute level; therefore, to enable its full advantages, a DAB should be appointed at the commencement of a project and stay in place until its conclusion;
5	**Insufficient time for pre-contract design and documentation**	• Absence of allowing sufficient time to complete design and a control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;	In order to avoid or minimise such unnecessary and unwarranted 'hurry' the following improvements to the practices of pre-contract procedures are suggested: 1. Developers (employers) should realistically assess 'fast-track' requirements based on objective aims of a project before deciding on the approach of procurement; if not in dire need, only for the sake of impressing investors of potential 'fast returns', putting a project on 'fast-track' must be strictly avoided; these initial but decisive tasks of project appraisal must be carried out by competent professional advisers rather by the financiers or non-technical investors;

			2. Developers should appreciate that even when a project is decided to be on fast-track, there are certain minimum pre-requisites to be firmly determined (for example determining exact requirements to be built, sufficiency of design preparation and availability of site for construction and so on); 3. Allocation of sufficient time for the consultants to complete conceptual and detailed design stages; 4. Realistic time allocation for initial planning and particularly inter-facing, if multiple- phases of construction and multiple contractors are involved on same site; 5. Allocation of sufficient and realistic construction time; 6. Allocation of sufficient time for reviewing the design, drawings, specifications and other tender documentation prior to calling for bids; 7. Strict quality controlling of the tender documents, in order to ensure avoiding conflicts, ambiguities, 'gaps' and so on for minimising post-contract time/cost claims; primarily this is the responsibility of the consultants, but the final approval must be given by the employer, preferably after a further quality assurance by his in-house professional staff wherever it is possible; 8. Strict quality controlling of the contract documents at award stage, to ensure the intentions of the final position (including possible negotiations and final agreed positions) are truly reflected and without having conflicts, ambiguities, 'gaps' and so on. Again, the employer's final approval to these contract documents must be given as given to the tender documents.
6	**Promptness in assessment / settlement**	• Pre-defining time period for assessment and award of extension of time; • Avoiding 'wait & see' policy	**<u>Prompt review and Assessment</u>** 1. In order to avoid or minimise such delay to the assessment by the consultants in delay claims resolution process it would be best incorporating a specific time period (from the time sufficient interim or final particulars are submitted by the contractor for an interim determination or a final determination) in the contract within which the engineer should form his assessment in principle (in an interim determination) or assessment with specific entitlement to EOT and formally notify the outcome of the entitlement to EOT; **<u>Prompt Award/Settlement</u>** 2. If possible, employer's approval requirement for the consultant's determination of EOT should be done away altogether; this will ensure the consultant's impartiality on the matter and if the

			employer disagrees with the consultant's evaluation outcome he may proceed to the formal dispute resolution mechanism (specified in the contract or otherwise); 3. If the employer's 'approval' requirement is retained, then define in clear language that prior to issuing formal determination of entitlement to EOT, the employer should be notified of it; however, the employer's approval is required for issuing the same and not for the content of the engineer's determination; preferably, there may be a prescribed time within which such approval or disagreement should be given and it should not be withheld out of any 'bad faith'; in any case, the engineer's formal determination of the EOT entitlement should be independently notified, whatever the employer's decision is; 4. The contractor's claims for EOT should be made and dealt with as close in time as possible to the delay event that gives rise to the application.
7	**Dispute Resolution**	• Considering alternative to current ADR mechanism	See 'Dispute Resolution Mechanism for Day-to-day Site Issues' suggested above

CHAPTER TEN

10.0 A Model for Selecting Optimum Method of Delay Analysis

10.1 Introduction

It is suggested that "*Central to successful resolution of delay based claims is the fair and equitable apportioning of parties' liabilities. However, such fairness and equity in apportioning may be fettered by many factors in contemporary practices adopted by both contractors and employers*" (Perera and Sutrisna, 2010a, p 601). The principal goals and rationale of this research are, thus, inspired by the need for identifying such major obstructive factors and providing possible improvements to the problematic situations that may stem from them. One such obstructive factor in apportioning liabilities is identified as that there is no universally acceptable Method of Delay Analysis (MDA) among practitioners. The literature review (ref. Chapter 6) has evidently confirmed this lacuna. Further, the overall merged results and findings of both interviews and in-depth survey (ref. Chapter 8) indicated that the existing dichotomous use of MDAs was mainly responsible for the opposing outcomes of delay analyses and the resulting distrust and scepticism between the rival parties. Accordingly, the merged results of the research inquiry have clearly confirmed the research proposition that '*In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust*'.

In delay claims resolution and apportioning liabilities, application of MDA has an essential role in establishing the causation by technical proof opposed to proof by inference. There are such methodologies based on critical path method as well as other not so sophisticated methods of calculation. They are numerous and referred to by different names. The outcomes produced by some methods are more reliable and relatively objective, but those by others are overwhelmingly subjective. However, none of these methods is considered perfect. The element of subjectivity is inherent in all MDAs, albeit at different degrees. Farrow (2001, p.6) pointed out " *each analyst will have to consider and challenge a wide variety of related issues and each analyst will apply different degrees of personal experience and judgment*". Thus, all delay analyses and their outcomes are fair to be viewed not as product of generalised mathematical process but of subjective, individual judgments (of variety of factors and circumstances) upon which the selection of a particular MDA is made.

Ng, Skitmore *et al.* (2004) argue that the amount of delay that can be attributed to the employer or the contractor depends on what delay analysis technique employed. Bubshait and Cunningham (1998) pointed out that there would not be one single analysis method that suits every situation. SCL Protocol (2002) recognized the absence of such universally acceptable single method of analysis. RP-FSA (2007) points out that no forensic schedule analysis method is exact. Thus, the industry generally accepts that there is no single analysis methodology universally available and applicable to all situations of claims resolution.

On the other hand, the selection of a methodology for forensic delay analysis also relies on judgment and opinion of the practitioners. Therefore, it requires many subjective decisions and depends on a number of criteria. These judgments invariably vary from one analyst to the other, as they are subjective, qualitative and impressionistic. The current research inquiry conducted so far has found that this imprecise situation on 'which MDA' to be selected to quantify effects of delay has caused problematic situations and disputes between the practitioners of both sides. The findings of the interviews and the in-depth survey have confirmed that many disputes arise due to intuitive decision making in regard to MDA. Intuitive decisions which cannot be supported by tangible data and documentation may appear illogical. For intuitive decisions it is difficult to get it accepted by others, particularly because the Decision Maker (DM) is unable to justify it with persuasive logic (Saaty, 2006).

This Chapter presents some improvements to this particular problematic situation. It is based on a simulated process proposed for more objective decision-making in selection of optimum MDA, which fits into a 'Model'. It, in fact, would be the key component of the overall 'Framework of Improvements' proposed in the research outcome.

In the forthcoming sections, the Chapter presents the need for such Model, the selection of a decision making method/technique that is most appropriate for developing the Model, the place of the selected method in the research philosophical position, the elements of the proposed Model and the application process of the selected decision making method in the Model building, a case study based worked example to illustrate the application of the Model in practice, and finally, the potential constraints of the Model. Necessary validation of the Model is included in Chapter 11.

10.2 Need for a Solution

In the intention to add to and/ or enhance the existing knowledge base in the delay claims resolution sphere, the research study aims to bring about contractually sound, practical improvements to problematic situations in contemporary practices in delay claims domain. At the initial stages, through the findings of the Pilot Study and peer discussions, an area of such improvements was identified in developing a Model in order to aid the practitioners for the selection of a defendable, objective, and most appropriate MDA under the specific circumstances of a project. The Chapter 6 reviewing the literature regarding selection of appropriate MDA has found some effort in the recent past towards this need. The RP-FSA identifies and recommends eleven factors in choosing an analysis method. Bubshait and Cunningham (1998) conclude that the best MDA is to be selected on the basis of time and resources available and the accessibility of project documentation. In a UK industry based study, Braimah and Ndekugri (2007) identified eighteen 'factors' in six groups that influence the selection of MDA, and ranked them according to their relative importance. Arditi and Pattanakitchamroon (2006) identified four Criteria (data requirements, time of analysis, capability of methodology and time and effort required) towards selection of MDA. SCL Protocol (2002) identifies seven factors that largely dictate the use of a MDA after completion of a project.

However, relative to the other areas of delay claims that have been subject to research there is a dearth of comprehensive empirical research study on the issue of selection of MDA. Lack of such empirical research is found and much felt in the Middle East region. During the preliminary inquiry and interviews stages, it is revealed that practitioners in the UAE experience substantial problems and dispute escalation during claims resolution due to individual, arbitrary approaches taken in the selection of MDA.

Thus, further empirical research in this area is considered as a significant contemporary need. Discussing the choice of a forensic schedule analysis methodology, RP-FSA (2011, p.137) emphasises that *'because individuals generally work for one party to a dispute, there is often skepticism about the impartiality of the particular methodology chosen. Therefore, it is vitally important that all practitioners understand clearly what it takes to overcome this skepticism when choosing and using a particular delay evaluation method'*.

It is in this context of decision making, the current research has been endeavouring to build a Model in order to enable the practitioners to choose the optimum MDA on a more objective and tenable basis for delay analysis. Consequently, the Model is expected to enhance fair and equitable outcome in apportioning liabilities, especially through overcoming possible scepticism about the impartiality of the particular method chosen.

10.3 Selection of Decision Making Method

The proposed Model has to be built upon a suitable 'decision making technique' which is capable to deal with multiple factors or criteria that influence the selection of the optimal MDA under a set of specific project circumstances. Though there is no generally accepted agreement for what constitutes a 'good decision' (Harrison, 1975) still a decision can be categorized as good to the extent of its appropriateness, timeliness, effectiveness and efficiency (Friday-Stroud and Sutterfield, 2007). Thus, the appropriate 'decision making technique' is expected to satisfy these characteristics in order to secure 'good decisions' on selection of the optimal MDA.

Both approaches of Multiple Attribute Decision Making (MADM) and Multiple Objective Decision Making (MODM), which are branches of Multiple Criteria Decision Making (MCDM), have been considered in order to select the most suitable decision making method. Yoon and Hwang (1995, p.2) suggest that the MADM *"refers to making preference decisions (e.g. evaluation, prioritization, election) over the available Alternatives"*. However, the MODM shows a fundamental difference with the MADM as to its dealing with the problems. Yoon and Hwang (1995, p.2) noted that *"in contrast to MADM problems, MODM problems involve designing the best Alternative given a set of conflicting objectives"* and *"the Alternatives are created in the design process and can be many as it produces"*. In this instance, it is reckoned that it is the MADM and not the MODM that can deal with the type of the problem in hand, as the solution for it has to be found from a finite number of MDAs which are already available and in use. Thus, the MADM has been considered as the most suitable approach for the decision making for the current research study. Yet, the presence of several alternative options of varying complexity among the MADM techniques made the task of selecting the most appropriate method somewhat difficult.

For picking a method it is suggested to keep the following in mind: a) the method appropriate to the problem, the people who will use it, and the institutional setting in which it will be implemented; (b) how easy are the methods to use; (c) the method most likely to be valid, which accurately reflects the values of the Decision Makers, and (d) how results of different methods significantly differ. (Hobbs *et al.* (1992) cited in Yoon and Hwang, 1995).

Ginevicius and Podvezko (2007) pointed out that all multi criteria approaches in the current use could be divided into two groups, namely (i) the relatively *simple* methods and (ii) the *complex* methods. The methods such as Simple Additive Weighting or SAW method, (Hwang and Lin, 1987; Hwang and Yoon, 1981; Yoon and Hwang, 1995; Zavadskas, 1991), Weighted Product Method (Bridgman, 1922; Starr, 1972; Yoon, 1989), Analytic Hierarchic Process or AHP (Saaty, 1980, 2006, 2009), and so on can be considered under the first group as these methods can be used without relatively complicated calculations. The second group includes methods such as TOPSIS (Hwang and Yoon, 1981; Opricovic and Tzeng, 2004), VIKOR (Opricovic and Tzeng, 2004), ELECTRE (Roy, 1971; Nijkamp and Van Delft, 1977; Voogd, 1983), Simplified Proportional Evaluation (Ginevicius *et al.*, 2004), and many other methods (Beuthe and Scannella, 2001; Brans *et al.*, 1986; Hokkanen and Salminen, 1997; Larichev and Moshkovich, 1997; Ma *et al.*, 1999; Roy, 1996). For their complicated calculation, these complex methods need a good knowledge of mathematics and skills in using computers. However, Ginevicius and Podvezko (2007, p528) argued that the calculations of these more complicated methods *"show that most of the problems may be solved by simple multicriteria methods"* without the need of complicated calculations as the results obtained from both types of approaches are practically similar. In their study, the data obtained by using simple methods of calculation and more sophisticated techniques were in perfect agreement *"proving that simple methods can be successfully used alongside more complex approaches."* (Ginevicius and Podvezko, 2007, p538).

Also, Yoon and Hwang (1995) cited that Karni *et al.* (1990) had considered three real life cases to compare rankings by different methods and found that "*rankings by AHP, SAW and ELECTRE do not differ significantly either*".

Having considered these observations, for the proposed Model, a simple method of multi criteria approach was preferred to the complex techniques. This was also because that the majority of DMs who would use the Model on a busy construction site or in an office setting would not reasonably be expected to possess such higher knowledge of mathematical and computer skills to understand complex algorithms. It is believed that simple techniques would allow the DMs to use the Model with better understanding and confidence than one built on algorithms which are too complicated to understand its functionality. Also it was noted that in spite of being 'simple' they were still reflecting the DMs' values with no less accuracy than the complex methods.

10.4 Choice of Technique

As simple multi criteria approach was chosen, the selection of specific technique for developing the Model was intended to limit to three methods, namely Analytic Hierarchy Process (AHP), Simple Additive Weighting (SAW) method and Weighted Product Method (WPM).

Zavadskas *et al.*(2009) pointed out the following as the main requirements of Multiple Attributes Decision Making (MADM):

- Establishing system to evaluate Attributes that relate system capabilities to Goals;
- Developing alternative systems for attaining the Goals;
- Evaluating Alternatives in terms of Attributes (the values of the Attribute functions);
- Applying a normative multiple attributes analysis method;
- Accepting one Alternative as "optimal" (preferred);
- If the final solution is not accepted, gathering new information and going into the next iteration of multiple attributes optimization.

An examination of the methods AHP, SAW and WPM indicates that all three approaches have very similar characteristics to comply with these main requirements. All of them are normative models. Opposed to descriptive models which attempt to describe the way making such decisions, normative models attempt to define the way a DM should make a decision (Yoon and Hwang, 1995). The multiple Criteria (and their sub-Criteria) with limited number of pre-specified Alternatives (MDAs) require inter and intra attribute comparisons, and like most MADM methods, they require a homogeneous data type; all three methods can effectively satisfy that requirement through dimensionless and normalised data in the decision matrices.

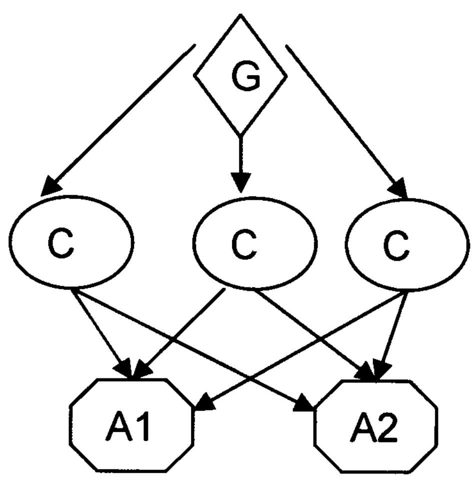
However, each of these methods requires different input preference information or scales. As MADM methods, these methods also work with the same fundamental tool, namely, the decision matrix. In a decision matrix, the a_{ij} is the performance of Alternative i according to Criterion j. The manner that a MADM method works with the a_{ij} is what becomes it different from another (Salomon and Montevechi, 2001). The same is true as for the differences between these three methods. In this case, a brief overview of the operational aspect of these three approaches is pertinent.

Analytic Hierarchy Process (AHP)

The AHP approach generally consists of four phases, namely (i) structuring the problem to build up the hierarchy, (ii) collecting data through pair-wise comparison, (iii) determining the priorities, and (iv) analysis for the solution of the problem. It requires the DM to make pair-wise preference judgments between the Alternatives with reference to Attributes/Criteria. In the outcome, the Alternative with the highest number of frequency where it is judged higher in the pair-wise judgments is ranked first as the solution for the problem.

The Figure 10.1 below illustrates three level-hierarchies of a typical AHP process:

Figure 10. 1 Three level-hierarchies of a typical AHP process



In this decision hierarchy structure, at level 1 the focus is the achieving Super-Goal 'G'. Level 2 comprises the Criteria 'C1', 'C2' and 'C3' which contribute to super-goal. In this hierarchic arrangement, the only restriction is that any element in one level must be capable of being related to some elements in the next higher level, which serves as a Criterion for assessing the relative impact of elements in the level below (Saaty, 2006).

Zanakis *et al.* (1998) referred to at least four versions of AHP, namely, original, geometric scale, right eigenvector and mean transformation solution. In the following description, only the geometric approach is considered for illustrating the basic principle.

The pair-wise comparisons basically establish how many times more dominant is one element than the other with respect to a certain Criterion or Attribute (Saaty, 1980). Based on this principle, first, a pair-wise comparison is used to obtain the relative importance among the three Criteria. The importance ratios between three Criteria with respect to level 1 Super-Goal can be stored in a ($n_x n$) matrix whose typical element a_{jk} represents the weight ratio of w_j/w_k. The remaining elements of the matrix are filled by employing the reciprocal property of the matrix: $a_{jk} = 1/a_{kj}$ and $a_{jj}=1$, for all j and k. The number of pair-wise comparisons required can be expressed as $n\,\frac{(n-1)}{2}$. Thus, for three Criteria there will be just 3 comparisons. The pair-wise judgment among the three Criteria with respect to level 1 can be concisely shown as follows, presuming judgments of preference are c1=3, c2=2 and c3=4:

$$\begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \end{array}\begin{array}{c} \begin{array}{ccc} C_1 & C_2 & C_3 \end{array} \\ \begin{bmatrix} W1/W1 & W1/W2 & W1/W3 \\ W2/W1 & W2/W2 & W2/W3 \\ W3/W1 & W3/W2 & W3/W3 \end{bmatrix} \end{array} = \begin{bmatrix} 1 & 1.5 & .75 \\ .66 & 1 & .50 \\ 1.33 & 2 & 1 \end{bmatrix}$$

Secondly, geometric mean of each row of the matrix is computed and then the resulting numbers are normalised. This is done by multiplying the n elements in each row, taking the n^{th} root normalizing the resulting numbers (by dividing each number by the sum of the numbers):

	Geometric mean			**Weight (normalised)**
C1	$(1x1.5x0.75)^{1/3}$ =	1.0396	=	0.3338
C_2	$(.66x1x0.50)^{1/3}$ =	0.6936		0.2227
C_3	$(1.33x2x1)^{1/3}$ =	1.3810		0.4435
	sum =	**3.1142**		**1.0000**

Through normalization, computational problems caused by differing measurement units of the Criteria are eliminated and obtaining comparable scales can be achieved. Then, similar to the above process, pair-wise comparison of the two Alternatives A1 and A2 at level 3 with respect to each of three Criteria at level 2 will be carried out. Presumed comparisons are:

For Criterion c1

$$\begin{array}{c} \\ A_1 \\ A_2 \end{array}\begin{array}{c} \begin{array}{cc} A_1 & A_2 \end{array} \\ \begin{bmatrix} w1/w1 & w1/w2 \\ w2/w1 & w2/w2 \end{bmatrix} \end{array} = \begin{bmatrix} 1 & 0.33 \\ 3 & 1 \end{bmatrix}$$

	Geometric mean			Weight (normalised)
A_1	$(1x.33)^{1/2}$ =	0.5744		0.2490
A_2	$(3x1)^{1/2}$ =	1.7320	=	0.7510
	sum =	**2.3064**		**1.0000**

For Criterion c2

$$\begin{array}{cc} & \begin{array}{cc} A_1 & A_2 \end{array} \\ \begin{array}{c} A_1 \\ A_2 \end{array} & \begin{bmatrix} w1/w1 & w1/w2 \\ w2/w1 & w2/w2 \end{bmatrix} \end{array} = \begin{bmatrix} 1 & 0.50 \\ 2 & 1 \end{bmatrix}$$

$$\begin{array}{cc} & \text{Geometric mean} \\ \begin{array}{c} A_1 \\ A_2 \\ \\ \end{array} & \begin{bmatrix} (1x.50)^{1/2} & = & 0.7071 \\ (2x1)^{1/2} & = & 1.4142 \\ \textbf{sum} & = & \textbf{2.1213} \end{bmatrix} \end{array} = \begin{array}{c} \text{Weight (normalised)} \\ \begin{bmatrix} 0.3333 \\ 0.6667 \\ \textbf{1.0000} \end{bmatrix} \end{array}$$

For Criterion c3

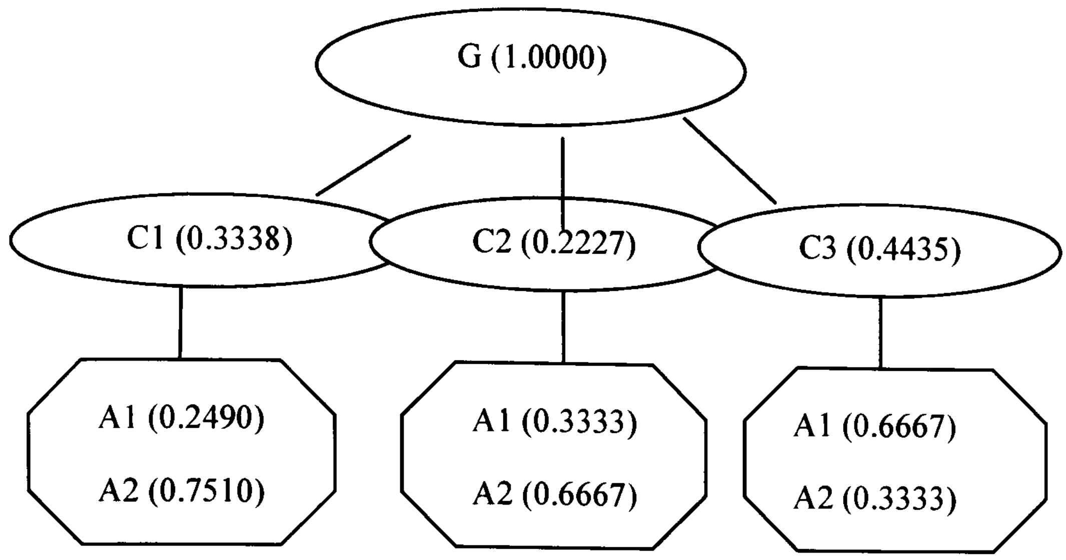
$$\begin{array}{cc} & \begin{array}{cc} A_1 & A_2 \end{array} \\ \begin{array}{c} A_1 \\ A_2 \end{array} & \begin{bmatrix} w1/w1 & w1/w2 \\ w2/w1 & w2/w2 \end{bmatrix} \end{array} = \begin{bmatrix} 1 & 2 \\ 0.50 & 1 \end{bmatrix}$$

$$\begin{array}{cc} & \text{Geometric mean} \\ \begin{array}{c} A_1 \\ A_2 \\ \\ \end{array} & \begin{bmatrix} (1x.2)^{1/2} & = & 1.4142 \\ (0.50x1)^{1/2} & = & 0.7071 \\ \textbf{sum} & = & \textbf{2.1213} \end{bmatrix} \end{array} = \begin{array}{c} \text{Weight (normalised)} \\ \begin{bmatrix} 0.6667 \\ 0.3333 \\ \textbf{1.0000} \end{bmatrix} \end{array}$$

Thus, the relative contributions (i.e. Weights) among the two Alternatives towards the three Criteria are computed as:

$$\begin{array}{cc} & \begin{array}{ccc} c1 & c2 & c3 \end{array} \\ \begin{array}{c} A1 \\ A2 \end{array} & \begin{bmatrix} 0.2490 & 0.3333 & 0.6667 \\ 0.7510 & 0.6667 & 0.3333 \end{bmatrix} \end{array}$$

Computation of contribution of each Alternative to the Super-Goal (level 1) by aggregating the resulting weights vertically, is the final step. Accordingly, the overall priority for each of Alternative A1 and A2 is obtained by summing the product of the Criteria weight and the contribution of the Alternative with respect to that criterion.



(Adopted from Yoon and Hwang, 1995)

The resulting computations for each of the Alternatives are:

$A1 = 0.3338(0.2490)+0.2227(0.3333)+0.4435(0.6667)=$ **0.4530**

$A2 = 0.3338(0.7510)+0.2227(0.6667)+0.4435(0.3333)=$ **0.5470**

Accordingly, the best Alternative for achieving the Super-Goal is through A2 which has the higher value.

The value of an Alternative can be mathematically expressed as

$$v(A_i)=V_i = \sum_{j=1}^{n} w_j \, v_j(x_{ij}), \quad i=1,\ldots..m$$

(where $v(A_i)$ is the value of Alternative A_i , and w_j and v_j(.) are weight and value of Attribute x_j , respectively.)

A substantial debate can be witnessed among the specialists work in MADM as to the strengths and weaknesses of AHP. The main advantages of AHP have been recognised as its flexibility to capture both subjective and objective evaluation of a decision making problem, its ability to trace inconsistencies of judgments and so on which appeal the DMs. (Macharis *et al.,* 2004; Ramanathan, 2001; Millet and Wedley, 2002).

However, the method has also drawn some major criticisms. Macharis *et al.* (2004) argued that its essential basis of pair-wise comparison may become very large and a lengthy task; this was agreed by other specialists as well: Chou *et.al* , (2008, p. 134) argued " *the most existing approaches such as AHP-based methods require complex computation*" and Takeda (1982) argued that AHP based approaches with exhaustive pair-wise comparison can be extremely time consuming if the MADM problem included numerous Attributes. Triantaphyllou (2000, p.25) agreed *"when pair-wise comparison are used the entire process may become impractical when the number of the entities (i.e. Alternatives an or Criteria) to* *be compared becomes large"*. On the other hand AHP usually uses 9-point scale (Saaty, 1990) and sometimes a DM might find difficult to distinguish among the Alternatives (or among Attributes or Criteria) and decide whether one Alternative is 7 or 8 times more important than another (Belton and Gear, 1983).

Weighted Product Method (WPM)

Although under the same category of 'Scoring Methods', WPM differs from SAW as WPM does not transform the different measurement units into a dimensionless scale through 'normalisation' (as SAW method does). Instead of 'normalisation', WPM connects the Attributes by multiplication. In this case, the weights become exponents associated with each Attribute value with positive power for benefit Attributes, and negative power for cost Attributes (Yoon and Hwang, 1995).

Yoon and Hwang (1995) consider WPM as a method possessing sound logic and a simple computational process, but it has not yet been a widely utilised method.

In WPM the value of Alternative A_i can be expressed as follows:

$$V(A_i) = V_i = \prod_{j=1}^{n} x_{ij}^{wj}, i = 1, \ldots, m.$$

It requires comparing each Alternative value with the standard value for true meaning of values. The expression below presents the value ratio between an Alternative and the ideal Alternative (where x_j^* is the most favourable value for the j^{th} Attribute). The preference of A_i increases when R_i approaches 1.

$$R_i = \frac{V(A_i)}{V(A^*)} = \frac{\prod_{j=1}^{n} x_{ij}^{wj}}{\prod_{j=1}^{n} \left(x_j^*\right)^{wj}}, i = 1, \ldots m$$

Simple Additive Weighting Method (SAW)

SAW method uses a simple arithmetical process of multiplication and addition. The basic principle of SAW is to obtain a 'weighted sum' of mathematical performance ratings of each Alternative under all Attributes. (MacCrimmon, 1968; Chen and Hwang, 1992). It works in two primary steps. First it scales the values of all Attributes making them comparable; then the total score for each Alternative is computed by multiplying the comparable value of each Attribute by the Importance Weight assigned to the Attribute and summing up these results over all the Attributes (Hwang and Yoon, 1981; Virvou and

Kabassi, 2004; Chou *et al.*, 2008). This calculation process of the value of an Alternative can be submitted in the following mathematical expression:

$$V(A_i) = \sum_{j=1}^{n} w_j \, r_{ij}, \qquad i = 1, \ldots\ldots, m$$

(Where $V(A_i)$ is the Value Function of the i^{th} Alternative, r_{ij} is the comparable rating or Normalised Value of x_{ij} and w_j is the Importance Weight of the j^{th} Attribute.)

The Alternative which has the highest score of Value Function is ranked the best option. SAW method employs additive weighted preferences whereas AHP uses a ratio scale to bring out pair-wise comparisons. However, except for these differences in computational approach, Zanakis *et al.* (1998) found, in a simulation experiment on methods of MADM, that all AHP versions behaved similarly and closer to SAW, and Hwang and Yoon (1981) recognized the close relationship between the two methods. Thus, as to the selection of the appropriate decision making technique for the development of the Model, it was to be decided primarily between AHP and SAW methods (As mentioned before, WPM has not yet been a widely utilised method, and therefore not considered).

In that experimental study Zanakis *et al.* (1998) used SAW as the benchmark for comparison of performances of other MADM methods. These other methods included AHP's all four versions, MEW (Multiplicative Exponential Weighting), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution); and ELECTRE (Elimination et choix traduisant la réalité). It was argued *"The rationale for selecting SAW as the benchmark is that its simplicity makes it extremely popular in practice"* (Zanakis *et al.* 1997, p. 513). Even some researchers argued that SAW should be the standard for comparisons, because *"it gives the most acceptable results for the majority of single-dimensional problems"* (Triantaphyllou and Mann, 1989). This argument was further confirmed when the rank-reversal dimension indices in an experimental simulation found that the best performance was from SAW and Multiplicative Exponential Weighting (MEW) methods over the other MADM methods (Zanakis *et al.*, 1998). However, it was also noted that, MEW had not been applied often in view of its *"practitioner-unattractive mathematical concept"* (Zanakis *et al.*, 1998, p.510).

Thus, SAW's main attraction to the practitioners, over the other MADM methods is its simplicity (Hobbs et al., 1992; Zanakis *et al.*, 1995; Zanakis *et al.*, 1998). Largely due to this 'simplicity', it has been suggested that SAW method is the most widely used MADM method (Chou *et al.*, 2008; Hwang and Yoon, 1981; Chang and Yeh, 2001; Virvou and

Kabassi, 2004). Modarres and Sadi-Nezhad (2005, p.235) also argued that "*Due to simplicity and practicality, Simple Additive Weighting (SAW) is the most popular method of classical MADM.*". Earlier, Yoon and Hwang argued (1995, p.32) that SAW method was "*probably the best known and most widely used MADM method*" (1995, p.32). In another instance, Chang and Yeh (2001) confirmed the superiority of SAW in an empirical study of the three evaluation methods (SAW method, Weighted Product Method (WPM) and TOPSIS).

The findings of these studies strongly confirm that simpler evaluation techniques are often superior (Chou *et al.*, 2008) and among them the best for its simplicity and popularity is SAW method.

On the other hand, criticism against AHP by some specialists on MADM is mainly for its pair-wise comparison approach. According to these arguments such pair-wise comparison may become very large and a lengthy task, and consequently, exhaustive, time consuming and impractical (Macharis *et al.*, 2004; Chou et.al., 2008; Takeda,1982; Triantaphyllou, 2000).

When deciding between AHP and SAW methods for the most appropriate technique for the Model development, the main focus was on the research aim and objectives. To achieve the research aim it is required developing a decision making Model (as a principal component of the proposed 'Framework of Improvements') using mathematical modelling and simple computer technology; primarily it was to utilise the data collected from a psychological domain. This approach was driven by the need to adopt a more straightforward and simpler method to obtain the practitioners' input to the maximum possible extent. The rationale for the approach was that the input process involved numerous Criteria/Attributes to be 'judged' and, hence it required to keep the responding process essentially simple in order to avoid a potentially lower response rate if it would have been felt 'too much time consuming' by the respondents.

Thus, considering that all AHP versions behave similarly and closer to SAW (Zanakis *et al.*, 1998), it was required to evaluate AHP and SAW in terms of the ability to satisfy these concerns in order to keep the responding process simple. The common basis for both techniques is that the Model is based on a hierarchy of 4 Levels which has 4 Alternatives (at Level 4), 23 Attributes (at Level 3) and 7 Criteria (at Level 2). This would have required each respondent to carry out 144, 1518 and 21 times of pair-wise comparisons or judgments (based on $n\ \frac{(n-1)}{2}$) for those 'Alternatives' against 'Attributes', 'Attributes' against 'Criteria' and among 'Criteria' themselves, respectively, to get to the prioritization with a AHP hierarchy. Corresponding to this, SAW approach would require 96 (=24x4), 23 and 7 times of direct and 'individual' ranking for those 'Alternatives' against 'Attributes', 'Attributes' against 'Criteria' and among 'Criteria' themselves, respectively.

Thus, it was observed, given all the other factors were equal, there would be a 'less time' consumption for a SAW based responding process than for an AHP based process. Therefore, in view of the advantages such as 'less time' consumption and 'simplicity' over the other MADMs, SAW was considered the most suitable decision making technique for the Model development. With these advantages, SAW method could be considered as reasonably able to satisfy the characteristics of a good decision making technique, namely, appropriateness, timeliness, effectiveness and efficiency (Friday-Stroud and Sutterfield, 2007). Further, as the most widely used and the popular method of MADM (Chou *et al.,* 2008; Hwang and Yoon, 1981; Chang and Yeh, 2001; Virvou and Kabassi, 2004; Modarres and Sadi-Nezhad, 2005; Yoon and Hwang, 1995) there was no further issue of validity as to this method selected. Consequent to this decision, therefore, it was required to collect the necessary data for the Model from the survey-respondents on the basis of a 5-point Likert scale.

A case in point that may vindicate this decision is that although 'Likert' scale approach has been used instead of a more complex approach like 'pair-wise comparison', still, when asked about the 'easiness of answering' the overall survey questionnaire, a majority feeling (overall 73%) was that it was not an easy task (ref. Table Q#31.5 in Appendix-C). Thus, if the Questions no. 28 & no.29 (which provided data for the Model building) were to be rated using 'pair-wise' approach requiring every respondent to do around 1680 times of comparisons, it could have been felt more 'difficult', 'extremely time consuming', and 'impractical' (Takeda,1982; Triantaphyllou, 2000) by the respondents, and possibly resulted in a lower rate of response than now.

10.5 'SAW' Method in Research Perspective

Although it has heavily relied on mathematical manipulation, SAW has the ability to effectively use mixed or multi methods in dealing with the data collected and their analysis. In this instance, it can perform relying on both quantitative and qualitative approaches.

As would be seen from the research methodology (ref. Chapter 2), the philosophical basis of this research study has been established on Critical Realism. Ontologically, Critical Realism acknowledges the existence of multiple subjective meanings within participants' 'personal' and 'social' worlds. The inquiry methods (in-depth survey and interviews) adopted in this research are expected to gather such data on multiple judgments, approaches and methods of practitioners who may construct meaning in different ways even for the same occurrence or facts. Thus, to handle such data and their analysis towards building the Model, a compatible approach and techniques are required.

Such approach should have the ability to recognize multiple constructed realities in differences within perceptions, judgments, attitudes and practices among practitioners dealing with delay claims. The judgments and the like phenomena are intangible, and they have to be first measured before we can use them as variables. SAW can be readily used as a tool or a method of relative measurements of such intangibles. It allows for differences in opinion with an ability to develop a best compromise. With the aid of a device like Likert scale, it can easily deal with converting such judgments into numerical values giving the advantage of comparison of such subjective data and information on a uniform basis. Thus it enables quantifying essentially emotional 'factors' or 'Attributes' in a decision making process. Accordingly, SAW impressively fits into the role in deriving measurements out of such subjective and qualitative data for decision making (selection of the optimum MDA). It is a kind of bridging the gap between soft data and hard data. (Soft data basically deals with the subjective mind, whereas hard data are related to the objective world). It helps to resolve conflicts in human perceptions and judgments and bring together different perspectives of different practitioners to choose the best of a set of Alternatives. Accordingly, SAW's role is expected to result in the phenomenon of apportioning liabilities in delay claims resolution being seen from different perspectives illuminated with mixed methods.

Thus, SAW enables a DM to combine quantitative and qualitative data through assignment of numerical values to qualitative (psychological) data and firmly displays its ability to use mixed methods. This places the SAW's performance in full harmony with the philosophical position of this research study which promotes the use of mixed methods.

10.6 Application of 'SAW' Method

10.6.1 Selection Factors

The literature review carried out in Chapter 6 identified the relevant 'factors' that influence the selection of an appropriate MDA. In application, these 'selection factors' are intrinsically influenced by the unique characteristics of strengths and weaknesses of the MDAs reviewed. This intimate relationship can be summarised as follows:

1. If the terms of contract pre-define the application parameters that may affect selection of the appropriate MDA; for example, if the contract pre-defines a mandatory use of the 'Longest Path' approach for delay claims, MDAs like Time Impact Analysis [TIA] or Impacted As Planned [IAP] (for prospective analysis) can operate with that approach but not a MDA like Collapsed As Built [CAB] (which operates in retrospective analysis only) ;
2. Project characteristics, such as project value, size, duration, and so on, are crucial for selection of MDA; for example, the higher the value the greater the accuracy of analysis is expected, and therefore, a more sophisticated MDA is more suitable than a simpler one;
3. The time of the project when the delay analysis is to be carried out is also an influencing factor for selection of MDA; a project progressed into more advanced stages may have more complications than a project at a very early stage. A simpler MDA may be adequate at non-complicated stages of a project (for example, access delays at the beginning of a project may not require a sophisticated MDA to analyse the so obvious impact on completion date);
4. The claimed value or the claimed amount of time or the scope of the claim (number of events, their simplicity etc.) may also be factors to be considered in the selection of MDA. Use of sophisticated MDAs with high expertise would not be economical and time-efficient if the claimed time/cost are not significant to justify the cost of delay analysis;

5. Availability of CPM based baseline programme may be necessary for some MDAs but not for others. For example, importance of a CPM based baseline

programme for TIA, IAP or As-Planned v As-Built [APvAB] is not same for CAB technique which does not require a baseline programme);

6. Similarly, availability of CPM as-built programme updates may be necessary for some MDAs but not for others. For example, it is important for TIA but not for APvAB which can be implemented without frequently updated progress schedules;
7. The importance of 'other records' is generally felt by all MDAs but for some they may be essential. For example, unless a final programme is mutually agreed CAB requires to build its as-built critical path based on the other records;
8. Generally, for establishing 'causation' for events in isolation, TIA, CAB and IAP provide more convincing results than APvAB;
9. If properly implemented all four MDAs are capable to establish concurrency/mitigation, but IAP's outcome is more theoretical and subjective than others;
10. Generally, CAB can directly illustrate isolated effects attributed to a particular delay event and its source of responsibility requiring no further exercise, but the other MDAs require a further round of evaluation to do that;
11. Cost of the delay analysis may relate to need of expert-input; the simpler MDAs are relatively cheaper to implement as they are technically easy to perform (for example IAP); however, where the issues are complicated then it would be essential to use more sophisticated MDAs as there is a risk of rejection if the analysis is sub-standard for want of better expertise.
12. Similar to cost, the time required/allowed to carry out delay analysis may be a factor influencing the selection of MDA; generally more sophisticated MDAs take longer than the simple MDAs;
13. Admissibility by triers-of-fact (i.e. arbitrators, judges) may be higher for the MDAs like TIA and CAB than the other MDAs; this may be a factor to be considered under certain circumstances influencing the selection process.

The selection factors used in this Model have been formulated using the literature review carried out in Chapter 6. In this case, mainly two sources of literature have been relied upon, namely (i) the eleven 'factors' recommended by RP-FSA (2007, 2010) for choosing a MDA, and (ii) the eighteen 'factors' used by Braimah and Ndekugri (2007) for choosing a MDA, in their study based on UK industry.

Table 10.1 below illustrates the close relationship between the 'factors' identified in these two sources, and how the 23 'factors' used in the proposed 'Model' have been related to them.

Table: 10. 1 Selection Factors Sourced from Literature Review

11 nos. Factors identified in literature review (RP-FSA, 2007, 2010)	**18 nos. Factors identified in literature review (Braimah and Ndekugri, 2007)**	**23 nos. Factors used for proposed Model**
Purpose of Analysis	Reason for the delay analysis	**High quality of transparency** (clearly established Causation)- (LTR);**Need of showing concurrent delays/ mitigation** -(NC);**Need to illustrate isolated delay effects** (IEE);**Need of sequential (chronological) analysis** -(COA)
Source Data Availability and Reliability	Updated programme availability; Records availability; Nature of baseline programme; Baseline programme availability	**Baseline programme availability** -(ABP);**Baseline programme type (e.g. CPM)** (TBP);**As-built periodical updates of programme** -(AB);**As-built periodical updates of programme -mutually agreed** (AAB);**Availability of other records** (e.g. Daily Records etc.) - (AOR)
Complexity of the Dispute	-	**Obscurity and sophistication of issues in prolongation claims** -(OBS)
Contractual Requirements	Form of Contract	**Concurrency defined in the contract ;Float ownership defined in the contract ; "Longest path" is defined in the contract as the analysis method** (AM)
Forum for Resolution and Audience	Dispute resolution forum; The other party to the claim	-
Legal or Procedural Requirements	Applicable legislation;	**Need to be readily admissible in arbitration/litigation**
Size of the Dispute	The amount in dispute; Nature of the delaying events; The number of delaying events	**Amount of time claimed**-(MT); **Amount of cost (of prolongation) claimed**-(MC);**Number of events claimed and to be analysed** - (NE)
Budget for Forensic Schedule Analysis	Cost of using the technique	**Concern for cost of analysis method** -(CA)
Time Allowed for Forensic Schedule Analysis	-	**Concern for time to be spent for analysis** -(TSA)
Expertise of the Forensic Schedule Analyst and Resources Available	Skills of the analyst.	**Expert skills (for analysis method)** -(XS)
Custom and Usage of Methods on the Project or the Case	-	-
-	Time of the delay; Size of project; Duration of the project; Complexity of the project	**Value of the project** - (PV),**Size of the project**-(PS);**Duration of the project**- (PD);**Status (prevailing stage) of the project** -(PCS);**Complexity of the project**-(PC)

10.6.2 Elements of the Model

In any problematic situation 'Attributes' are multiple. In the problem resolving process it is required to generate the relevant Attributes for each problem setting. Keeney and Raffia

(1976) suggested the use of a literature survey and /or a panel of experts to identify the Attributes in the problem area. Accordingly, the relevant 'Attributes' (or elements) used in the proposed Model have largely been influenced and contributed by the 'selection factors' sourced from the literature review as discussed above (ref. Table 10.1 above).

Yoon and Hwang (1995) stressed the necessity that Attributes represent the desired mission and suggested one way to derive the Attributes hierarchically from a super goal; goal hierarchy formulation starts with the listing of overall performance objectives serving a super goal. They noted such hierarchy to consist of at least three levels: focus or overall goal at the top, multiple Criteria that define Alternatives in the middle, and competing Alternatives at the bottom. The current research uses a similar hierarchy of Criteria, Attributes (or sub-Criteria) and Alternatives (i.e. Methods of Delay Analysis – MDAs); all these elements have been identified through the literature review and the findings of the research. The purpose of the proposed Model or the 'Super Goal' is the selection of optimum MDA under given circumstances of a project. This is consistent with the research aim and objectives. The selection of Criteria is driven by their ability and influence to achieve the 'Super Goal'; likewise, the selection of Attributes is made as they emerged from each of the elements of Criteria in the 'Level' above. While the number of Criteria and Attributes depends on the nature of the problem, each of them may have different units of measurement. These units may be quantitative (e.g. number, money etc.) or qualitative (e.g. importance, significance, necessity of presence etc.). Assigned 'weights' are the quantitative way to express the importance of each Criterion/Attribute relative to the others. The survey-questionnaire has provided a measuring scale based on a five point Likert scale to assess such relative importance of Attributes in a ranking order. How these data have been used in the application of the SAW method is described in the forthcoming section.

The hierarchy of the proposed Model is composed as follows:

LEVEL 1-'Super Goal' i.e. the selection of the optimum Method of Delay Analysis;

LEVEL 2- The 'Criteria' to achieve the 'Super Goal'; the following 7 Criteria are identified, as generally informed by the literature review:

	Criteria	Criteria
1.0	Contractually specified requirements as for delay analysis	(CCR)
2.0	Project constraints (magnitude, complexity etc.)	(PC)
3.0	Claims magnitude and complexity	(CMC)
4.0	Records availability	(RecA)
5.0	Proof of causation (transparency of analysis)	(PrOfc)
6.0	Time and cost of analysis	(T&C)
7.0	Legal admissibility (by triers) - need to be readily	(Ladms)

LEVEL 3- The 'Attributes' or sub-criteria of the above 'Criteria'; the following 23 Attributes are identified as they emerged from the above Criteria and largely informed by the literature review as discussed before:

Criteria		Attributes		Attributes Abbreviations
1	Contractually specified requirements as for delay analysis – (CCR)	1.1	Concurrency & float ownership defined in the contract	(C&F)
		1.1.1	Concurrency defined in the contract	
		1.1.2	Float ownership defined in the contract	
		1.2	Longest Path Approach defined in the contract	(AM)
2	Project constraints (magnitude, complexity etc.) – (PC)	2.1	Value of the project	(PV)
		2.2	Size of the project	(PS)
		2.3	Duration of the project	(PD)
		2.4	Status (prevailing stage) of the project	(PCS)
		2.5	Complexity of the project	(PC)
3	Claims magnitude and complexity – (CMC)	3.1	Amount of time claimed	(MT)
		3.2	Amount of cost (of prolongation) claimed	(MC)
		3.3	Number of events claimed and to be analysed	(NE)
		3.4	Obscurity and sophistication of issues in prolongation claims	(OBS)
4	Records availability – (RecA)	4.1	Baseline programme availability	(ABP)
		4.2	Baseline programme type (e.g. CPM)	(TBP)
		4.3	As-built periodical updates of programme	(AB)
		4.4	As-built periodical updates of programme -	(AAB)
		4.5	Availability of other records (e.g. Daily records etc.)	(AOR)
5	Proof of causation (transparency of analysis) – (PrOfc)	5.1	High quality of transparency (clearly established causation)	(LTR)
		5.2	Need of showing concurrent delays/ mitigation	(NC)
		5.3	Need to illustrate isolated delay effects	(IEE)

		5.4	Need of sequential (chronological) analysis	(COA)
6	Time and cost of analysis – (T&C)	6.1	Expert skills (for analysis method)	(XS)
		6.2	Concern for cost of analysis method	(CA)
		6.3	Concern for time to be spent for analysis	(TSA)
7	Legal admissibility (by triers) - need to be readily admissible in arbitration/litigation – (Ladms)	(no Attributes)		

LEVEL 4- The 'Alternatives' or the Methods of Delay Analysis (MDA); the following 4 most widely used MDAs are identified:

ALTERNATIVES (METHODS OF DELAY ANALYSIS)		ALTERNATIVES' ABBREVIATIONS
1	As Planned Vs As Built	(APvsAB)
2	Impacted As Planned	(IAP)
3	Collapsed As Built	(CAB)
4	Time Impact Analysis	(TIA)

Figures 10.2 below illustrates SAW's role in the conceptual Model.

10.6.3 Application of SAW

Yoon and Hwang (1995) have given a detailed description and guidance as to the use and mechanism of SAW method. Accordingly, scores (rates) for the Alternatives are to be obtained by adding the contribution from each strand of Attribute/ Criterion. However, the ratings of the respondents (given in the survey-questionnaire) were based on different measurement units using a 5 point Likert Scale. As the different measurement units of items cannot be added, a '*common numerical scaling system such as normalization is required to permit additions among Attribute values*'. (Yoon and Hwang 1995, p32). Therefore, the scores of both Criteria and Attributes have to be 'normalised', and such normalisation is applied on the 'Weighted Averages' of their aggregated scores computed from the ratings given by the respondents. It is suggested that the basic principle of SAW is to obtain a 'weighted sum' of the performance ratings of each Alternative under all Attributes (MacCrimmon, (1968); Chen and Hwang, (1992); cited in Chou *et al.* (2008)).

The Weighted Average of each Criterion and Attribute can be mathematically expressed as:

$$WA_i = \sum w_i x_i / n$$

(w_i is the weight (rate) assigned to the i^{th} option; x_i is the number of respondents who selected the i^{th} option; n is the number of respondents).

Having established the Weighted Average of each Criterion and Attribute, the algorithm for the operation of the Model is developed in the following major steps according to SAW principles:

<u>Step - I</u>

The respective Weighted Averages for the Criteria and Attributes are converted into Normalised Weights in order to get a dimensionless, common numerical scaling system (Yoon and Hwang, 1995); for this, first, all the 7 nos. Criteria in the Model were considered as a single group, and the Weighted Average of each Criterion was divided by the Sum of the Weighted Averages of all the Criteria in the group; the Weighted Averages were then normalised to sum '1'; this process was also adopted separately for the each of the Attributes grouped under the 7 nos. Criteria, and the Weighted Average of each Attribute was divided by the sum of the Weighted Averages of all the Attributes in the particular group it is belonged to, normalising the Weighted Averages to sum '1'.

<u>Step – II</u>

Then, an 'Importance Weight' (W) for each Attribute was computed through multiplying its Normalised Weight by the Normalised Weight of its corresponding Criterion.

<u>Step – III</u>

It is noted that the above processes in Step I and II are already completed in the 1st stage of the Model by the time the Model is to be used by the DM who needs to select the optimal MDA. Thus, the input of the DM occurs in the 2nd stage of the Model. The necessary information for this input is to be sourced from the contract documents, the delay claims submitted, and all other relevant project records and documents.

Next, a comparable rating of each Alternative for the corresponding Attribute is obtained by normalising the rating given by the DM; the DM's input is through answering the specific 'questions' which appear on the Model's worksheet titled 'Decision Maker's Input'. The answers have to be based on the specific circumstances of the project in which the Model is to be used. The appropriate answers are selected and provided through a pull-down menu in the worksheet. The rating of each Alternative is made on a scale ranging from '0' (lowest) to '1.5' (highest) and the scores to each Alternative are attributed as determined by the DM's answers.

Yoon and Hwang (1995, p34) used '*Linear Normalisation*' in their suggested normalised decision matrix. Thus, Linear Normalisation is carried out in a procedure that divides the DM's rating of the Alternatives for an Attribute by the maximum value rated.

The Normalised Value of x_{ij} can be presented as:

$r_{ij} = x_{ij} / x_j,\quad i=1,....,m;\quad j = 1,....,n.$ [m is the number of Alternatives as n is the number of Attributes]

(Where x_{ij} is the rated value of the i^{th} Alternative for j^{th} Attribute and x_j is the maximum rated value scored by any of the Alternatives for j^{th} Attribute).

Then, $0 \leq r_{ij} \leq 1$, and x_{ij} is more favourable as r_{ij} approaches '1'.

Thus, each Alternative is rated against 23 Attributes and 1Criterion directly (Criterion titled 'Legal Admission' has no Attributes or sub-Criteria).

Step – IV

In this Step the 'Value Functions' of each Alternative is computed to select the highest scoring Alternative.

The Value Function of an Alternative in SAW Method can be mathematically expressed as:

$$V(A_i) = \sum_{j=1}^{n} w_j\, r_{ij},\qquad i = 1,......,m$$

(Where $V(A_i)$ is the Value Function of the i^{th} Alternative, r_{ij} is the comparable rating or Normalised Value (see Step III) of x_{ij} and w_j is the Importance Weight (see Step II) of the j^{th} Attribute.)

Step – V

The Alternative which has the maximum Aggregated Value Function is the optimal MDA that suits to the specific circumstances of the project. Thus, for example, in the application of the Model with reference to the specific project circumstances in the case study considered below, the Aggregate Value Function for Alternative 1 (i.e. APvAB technique) is computed as:

$$V(A_1) = \sum_{j=1}^{24} w_j\, r_{ij}$$

$$=0.0792(.8)+0.0795(1.0)+\ldots\ldots 0.0430(1.0)+0.1202(.67) = \mathbf{0.7317}$$

The other 3 Alternatives have the following 'Aggregate Value Function':

$V(A_2) = 0.7883$, $V(A_3) = 0.9555$, $V(A_4) = 0.9801$.

Accordingly, the highest 'Aggregate Value Function' is scored by the Alternative 4, which is the Time Impact Analysis (TIA) method. Thus, it is the most optimum MDA for delay analysis under the specific circumstances of this Project. In the order of scoring, the 2nd most appropriate MDA next to TIA is the Alternative 3 which is Collapsed-As-Built method.

10.7 A Case Study Based Worked Example

It is believed that a real world worked example would be best to illustrate the application of the Model. Accordingly, the Model uploaded in the internet has used the information/circumstances of the following case study.

10.7.1 Project-Specific Circumstances

The following are real-world project-specific circumstances which can be considered as a case study for illustrating the application of the proposed Model.

- The form of contract is a bespoke version of modified FIDIC Form 4th edition (1987).
- The project's contract sum is circa AED 318 Million (approximately £53 million). The final account is expected to be around AED 340 million (approximately £56.7 million).
- The scope of work is to construct a Central Utility Complex of approximately 6000 M^2 for an expansion of an existing international Airport. The work consists of construction of a reinforced concrete and steel framed Chiller Hall, Cooling Towers complete with all mechanical, electrical and plumbing services associated with the buildings including the provision of a building management system (BMS) internal services, 11kV/400V transformers, 11kV standby generators, with all associated medium voltage switchgear, panel boards, and cabling and distribution networks and external works.

- The overall completion of the project with four separate contractual milestones was to achieve within 618 days.
- The work is, however, substantially completed after 789 days from the commencement date, with 171 days of time over-run.
- The contractor has notified 27 major delaying events and 30 other secondary events. The claimed causes of these events are variations, suspension of works, late issue of information, access delays caused by other interface-contractors working on the site etc. The overall claim is for 200 days of entitlement to extension of time with the cost of prolongation and acceleration which is circa AED 15 million (£2.5 million). No claim for cost of 'disruption' has been submitted although a 'notice' of disruption claim was given once.
- The contractor submitted the final particulars of his claims after the substantial completion of the works. Thus, he has not complied with the prescribed time of the Contract for submission of such particulars although almost all his 'notices' were given within prescribed time.
- In spite of these procedural failures or technicalities, the engineer's evaluation has revealed that had the contractor complied with the requirements of such technicalities he would have been entitled to extension of time *in principle*.
- The contractor has used 'Impacted As Planned' analysis method to establish his entitlement. In the submission, the contractor has not shown any of his own delays. According to the engineer's staff, there have been many delays of the contractor's own due to lack of resources, slow rate of progress, delayed submission of shop drawings, delayed material procurement, defective works etc.
- The contractor's Baseline Programme was submitted as required by the Contract provisions (Clause 14.1). This was a CPM based Programme. The employer's consent for this Programme was promptly given as required by the contract.
- In spite of the substantial delays to the original completion date(s), however, no revised programme was required or submitted.
- During the construction, the contractor regularly submitted a 'look-ahead' programme in every fortnight. Additionally, there have been monthly updates of the Activities of the programme submitted to the engineer. It is noted that although at the early months these updates were verified and mutually agreed between the contractor and the engineer, that practice did not continue.

However, there are no records of the engineer's objection to such unverified updates either.

- Site records are reasonably kept. These include daily records of productivity, Inspection Requests, Site Instructions issued, submittal logs etc.
- The engineer's office has a separate team of delays and claims analysts. Recently, the engineer informed the contractor of the non-acceptance of the MDA used in the claims submission, as it did not consider and base on what actually happened on site. The engineer considers the MDA should be on a more objective basis. The contractor disagreed. According to the contractor, his method used (Impacted As Planned) is based on CPM, and has clearly established the cause and effect of the employer caused delays, and therefore the entitlement to extension of time.
- In view of this situation, the engineer's delay analyst ought to select the optimum MDA under the existing circumstances. Such selection should be logical, objective and defendable against possible onslaught from the contractor's side.

Other pertinent facts of the circumstances are:

- The applicable form of contract does not define a MDA or concept of concurrency. However, it states that the project 'float' is not exclusively owned by either party, but can be consumed on 'first come first served' basis. This means the 'float' is owned by the project. There is no express provision in the contract requiring 'Longest Path' to be used for deciding the 'critical effect' of a delay.
- The form of contract requires the engineer to secure prior approval from the employer as to the matters of extension of time. The employer has a panel appointed to consider the engineer's recommendation for such extension of time based on the assessed entitlement of the contractor. The panel always insists on:
    - Clearly established causation;
    - Concurrent effects of the delays when prolongation costs claims are present;
    - Use of a robust, tenable MDA and outcome.
- As for interim claims submissions there is a provision in the contract for the engineer to notify his 'Interim Determination' in principle of the

contractor's entitlement to extension of time, within 56 days. However, there is no such time constrain as to the final determination.

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10.7.2 Application

The application of the Model is to select the most appropriate among the following 4 primary MDAs, which are the mostly used by the practitioners as found in the interviews and in-depth survey:

1. As Planned v As Built (APvAB);
2. Impacted As Planned (IAP);
3. Collapsed As Built (CAB), and
4. Time Impact Analysis (TIA).

The Model is applied to all these 4 MDAs at the same time. These are called the 'Alternatives' in the terminology used in the Model.

The DM's 'input' is purely driven by the project-specific circumstances discussed above. However, the corresponding 'rating' of each Alternative (i.e. MDAs) is to be governed by the 'suitability' or ability of each MDA to fit into those project-specific circumstances as represented through the Attributes at Level 3. In fact, this performance 'suitability' is essentially decided by the unique characteristics and abilities of each of the MDAs and their behaviour under such specific circumstances.

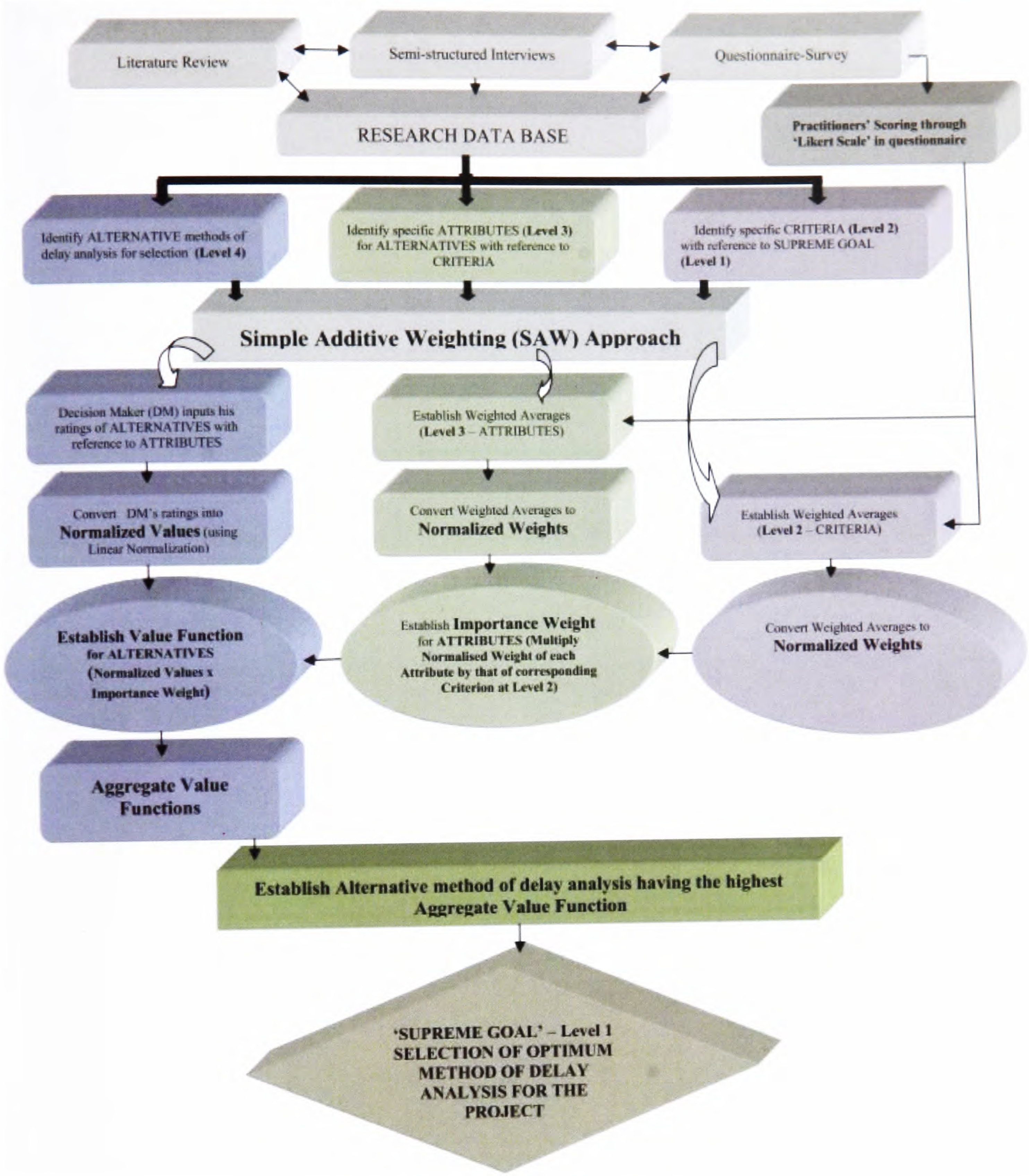
The Table 10.2 (Model Application and DM's Input in Case Study) below shows the Attributes of the Model, general behavioural characteristics of MDAs towards these Attributes if they (Attributes) are actually present in circumstances of a project, and the DM's possible input (at the 'Step 3' of the Model) in relation to the specific circumstances of this Case Study project.

Table: 10. 2 Model Application and Decision Maker's Input in Case Study

	Attributes	MDAs behavioural Characteristics	Decision Maker's Input
1.1	Concurrency & float ownership defined in the contract	APvAB is not directly affected by 'Float' ownership but others are. 'Concurrency' is possible to be established by all four MDAs, if properly implemented, but the outcome of IAP would be more subjective than the other three MDAs (Note: "Approximate Concurrency" can be produced by IAP, and therefore, considered here).	**'Concurrency' is not defined in the contract but 'float ownership' is.**
1.2	Longest Path Approach defined in the contract	If 'Longest path' approach is already defined by the agreed contract, only TIA or IAP can operate with that approach.	**'Longest Path' approach is not required in expressed terms in the contract.**
2.1	Value of the project	Generally the higher the value of the project the greater the accuracy of analysis is expected; if the value of the project is low, APvAB and IAP are more effective. CAB and TIA are more effective if it is of high value.[low= <10million AED; moderate = >10m but <100m AED; high = >100m AED]	**Project Value is 'High'**
2.2	Size of the project	Generally the greater the size of the project the higher the sophistication of analysis is expected; if the size of the project is small, APvAB and IAP are more effective. CAB and TIA are more effective if it is of large size. [small= <5,000 m^2; medium = > 5,000 m^2 but <50,000 m^2; large = >50,000 m^2]	**Project Size is 'Medium'**
2.3	Duration of the project	The shorter the duration, the simpler and smaller the project is, if the duration is short, APvAB and IAP are more effective. CAB and TIA are more effective if it is of long duration. [short= < 01 year; medium = > 01 year but < 03 years; long = >03 years]	**Project Duration is 'Medium'**
2.4	Status (prevailing stage) of the project	If at the timing of the claims assessment, project is still in an early stage APvAB and IAP are more effective. Ideally, CAB can be used where the actual completion is achieved. TIA method can be used in all stages.	**Project is at 'Completion' stage**
2.5	Complexity of the project	If the project is a 'simple' one, APvAB and IAP are more effective; if the project is highly sophisticated then CAB and TIA are more effective. [simple= normal mechanical and electrical (M&E) works in the scope; moderately sophisticated = some specialist M&E works in the scope; highly sophisticated = extraordinary M&E requirements in the scope]	**Project is 'Highly Sophisticated'**
3.1	Amount of time claimed	If the claimed 'time' is small, APvAB and IAP are more effective; CAB and TIA are more effective when the claimed time is large. [small= < 25% of contract duration; moderate = > 25% but <50% of contract duration; large = >50% of contract duration]	**Amount of time claimed is 'Moderate'.**
3.2	Amount of cost (of prolongation) claimed	If the claimed 'cost' is small, APvAB and IAP are more effective; CAB and TIA are more effective when the claimed time is large. [small= < 5 m AED; moderate = > 5m but <50 m AED ; large = >50 m AED]	**Amount of cost claimed is 'Moderate'.**
3.3	Number of events claimed and to be analysed	If the claimed 'number of events' is few, APvAB and IAP are more effective; CAB and TIA are more effective when there are many claimed events. [few= < 5 events; moderate = > 5 events but <25 events ; many = >25 events]	**'Many' events are claimed**

3.4	Obscurity and sophistication of issues in prolongation claims	If the issues are 'simple', APvAB and IAP are more effective; CAB and TIA are more effective if the issues are highly complex. [simple= no specialist mechanical and electrical (M&E) input required to understand events claimed; moderate = some specialist M&E input required; complexed = specialist M&E input required throughout]	**Project is 'Complex'**
4.1	Baseline programme availability	The question asked is whether a baseline programme is in use? and each Alternative is scored on whether it is critical for the implementation of the method. Generally, APvAB, IAP and TIA would critically require a baseline programme; CAB does not need a baseline programme as a must.	**Baseline programme is in use**
4.2	Baseline programme type (e.g. CPM)	The question asked is whether a CPM baseline is in use? and each Alternative is scored on whether it is critical for the implementation of the method. Generally, IAP and TIA would critically require a CPM programme. APvAB and CAB do not need a CPM programme as a must.	**A CPM Baseline programme is in use**
4.3	As-built periodical updates of programme	For TIA, such programme updates are a must. CAB would be benefitted though it can still do without such updates and mainly use other records to build final status of programme. They are not a must for APvAB and IAP does not need such updates.	**As-built periodical updates of programme are available**
4.4	As-built periodical updates of programme -mutually agreed -	Generally, TIA would be greatly effective with such information. CAB would be benefitted though it can still do without. APvAB and IAP do not need such updates.	**As-built periodical updates of programme -mutually agreed- are available**
4.5	Availability of other records (e.g. Daily records etc.)	Generally, unless there is mutually agreed final programme, CAB needs such information as a must; APvAB, IAP and TIA could be benefitted though they can still do without them and rely on programme updates.	**Other records are available**
5.1	High quality of transparency (clearly established causation)	Generally, TIA, CAB and IAP can establish clear 'causation' whereas APvAB's ability to do that is insufficient.	**High quality of transparency is a priority need**
5.2	Need of showing concurrent delays/ mitigation	Although properly implemented all four MDAs are capable to establish concurrency/mitigation, IAP's outcome is more theoretical and subjective than others.	**Showing concurrency/mitigation is a priority need**
5.3	Need to illustrate isolated delay effects	Generally, CAB can satisfy this need directly and with no further exercise; However, APvAB, IAP and TIA cannot satisfy that without further research and filtering as their delay effects are intertwined.	**This is not a priority need in the contract**
5.4	Need of sequential (chronological) analysis	IAP and TIA methods (both prospectively and retrospectively) and CAB (retrospectively) can be generally carried out in a chronological order with no extra effort, but APvAB cannot do that with efficient manner;	**This is not a priority need in the contract**
6.1	Expert skills (for analysis method)	APvAB and IAP methods are relatively simple to use and require no such expert skills; However, CAB and TIA require more expert skills to use;	**Expert skills are available**
6.2	Concern for cost of analysis method	APvAB and IAP methods are relatively economical; However, CAB and TIA are more costly to use.	**Cost of Analysis is not a constraint.**
6.3	Concern for time to be spent for analysis	APvAB and IAP methods are comparatively not time consuming; however, CAB and TIA are more time consuming methods.	**Time of Analysis is not a constraint.**
7.0	Need to be readily admissible in arbitration/litigation	CAB and TIA methods are generally favoured by arbitrators/courts; However, APvsAB and IAP are not readily admissible.	**This is a specified need.**

Figure 10. 2 SAW in the Conceptual Model



There are 1 Supreme Goal, 7 Criteria, 23 Attributes and 4 Alternatives (MDAs) as the elements of this Model, described under 10.6.2 above. The respective Weighted Averages for each of the Criteria and Attributes were calculated from the Likert scale based rating of the importance/significance of them as expressed by the respondents to the Questions no.28 – no.30 of the in-depth survey.

These Weighted Averages were converted into the respective Normalised Weights as described under Step 1 above. A screen-shot of the Step 1 calculation of these Normalised Weights for the 'Criteria' and the 'Attributes' as applied is displayed below under Figures 10.3 and 10.4.

Figure 10. 3 Normalised Weights for the 'Criteria'

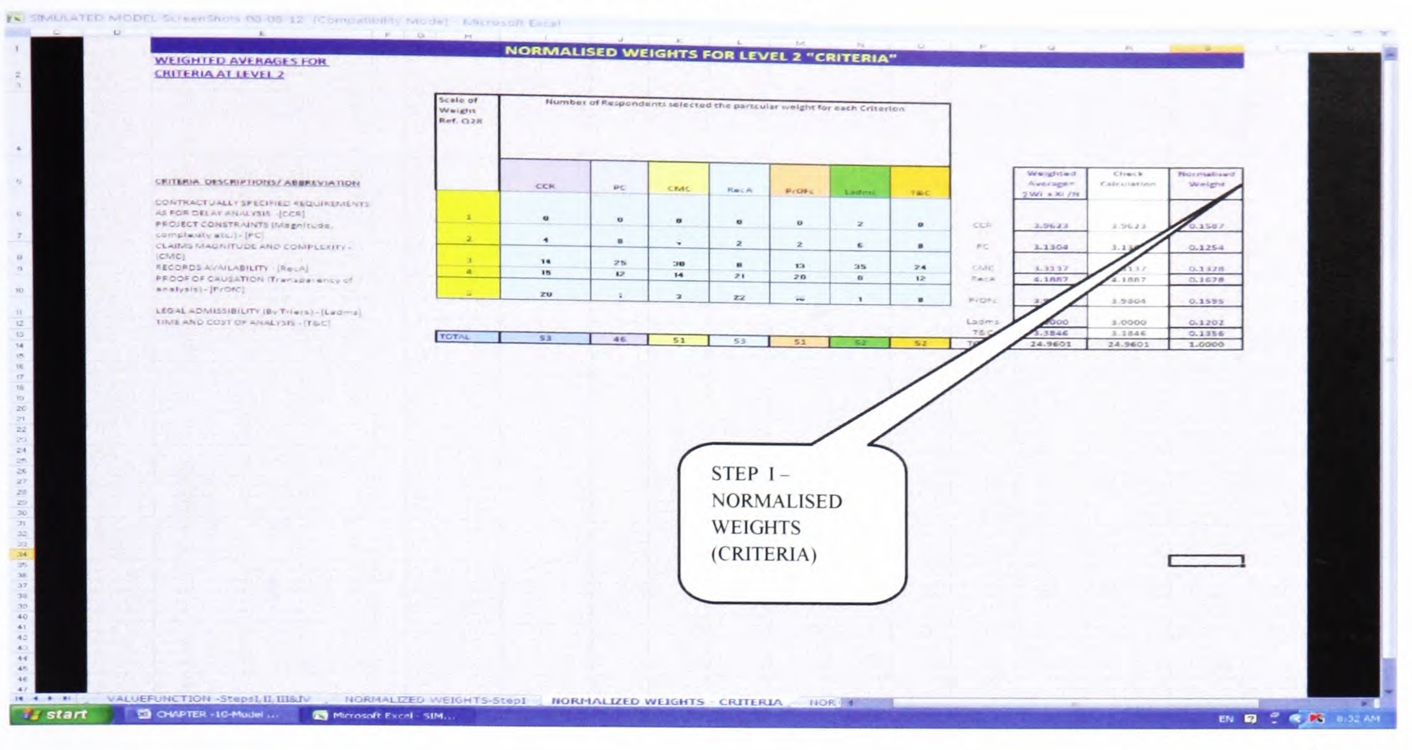
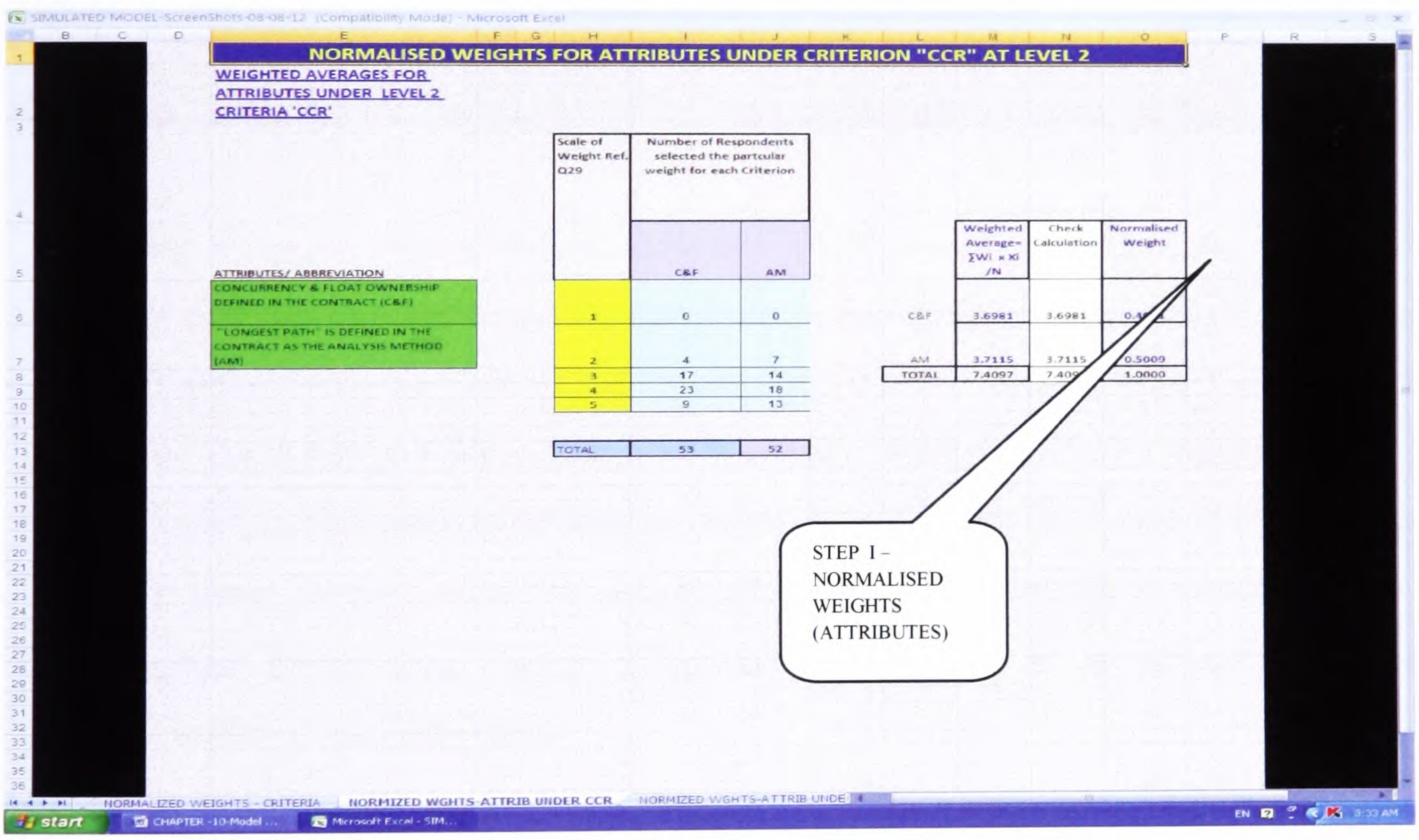
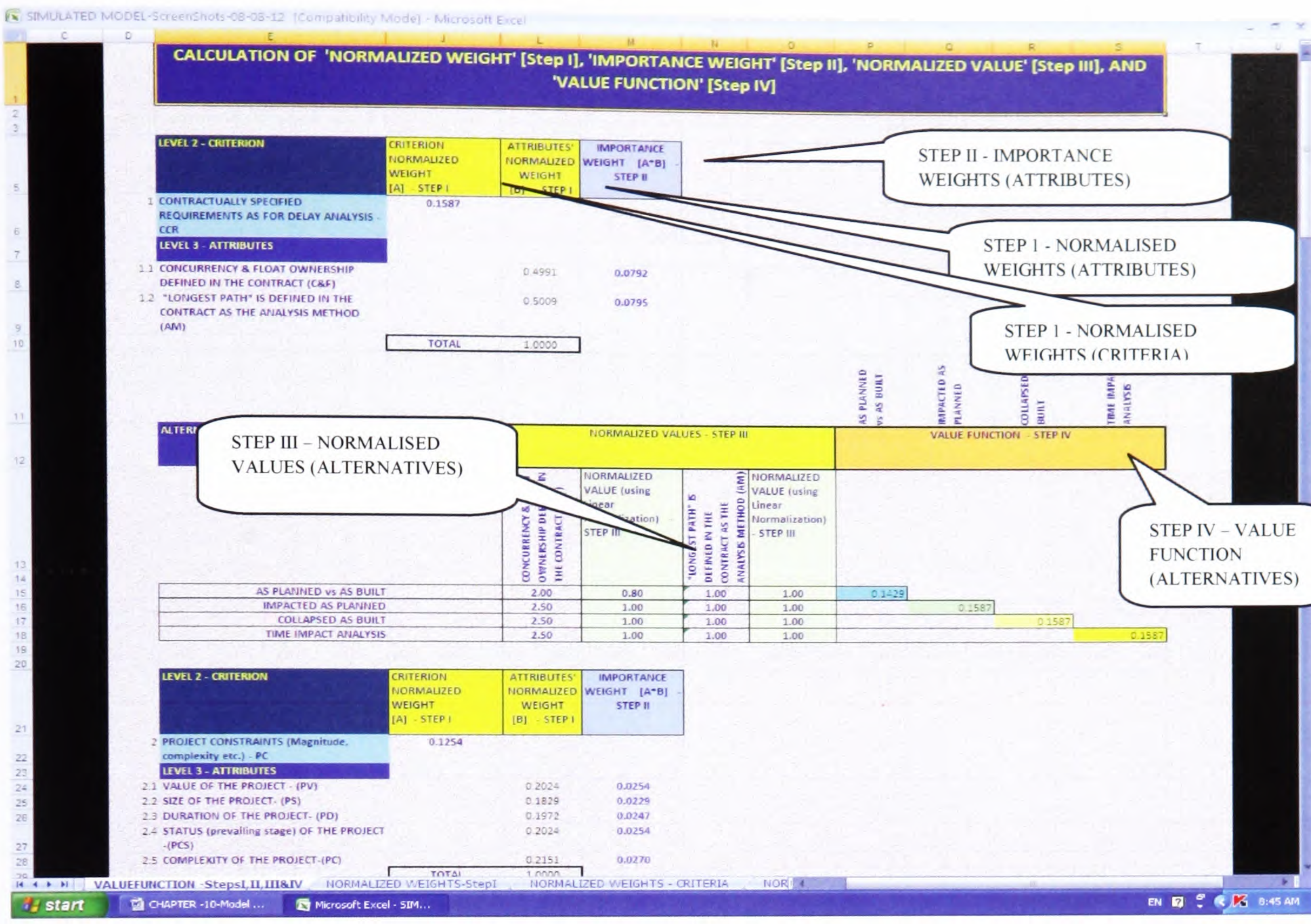


Figure 10. 4 Normalised Weights for the 'Attributes



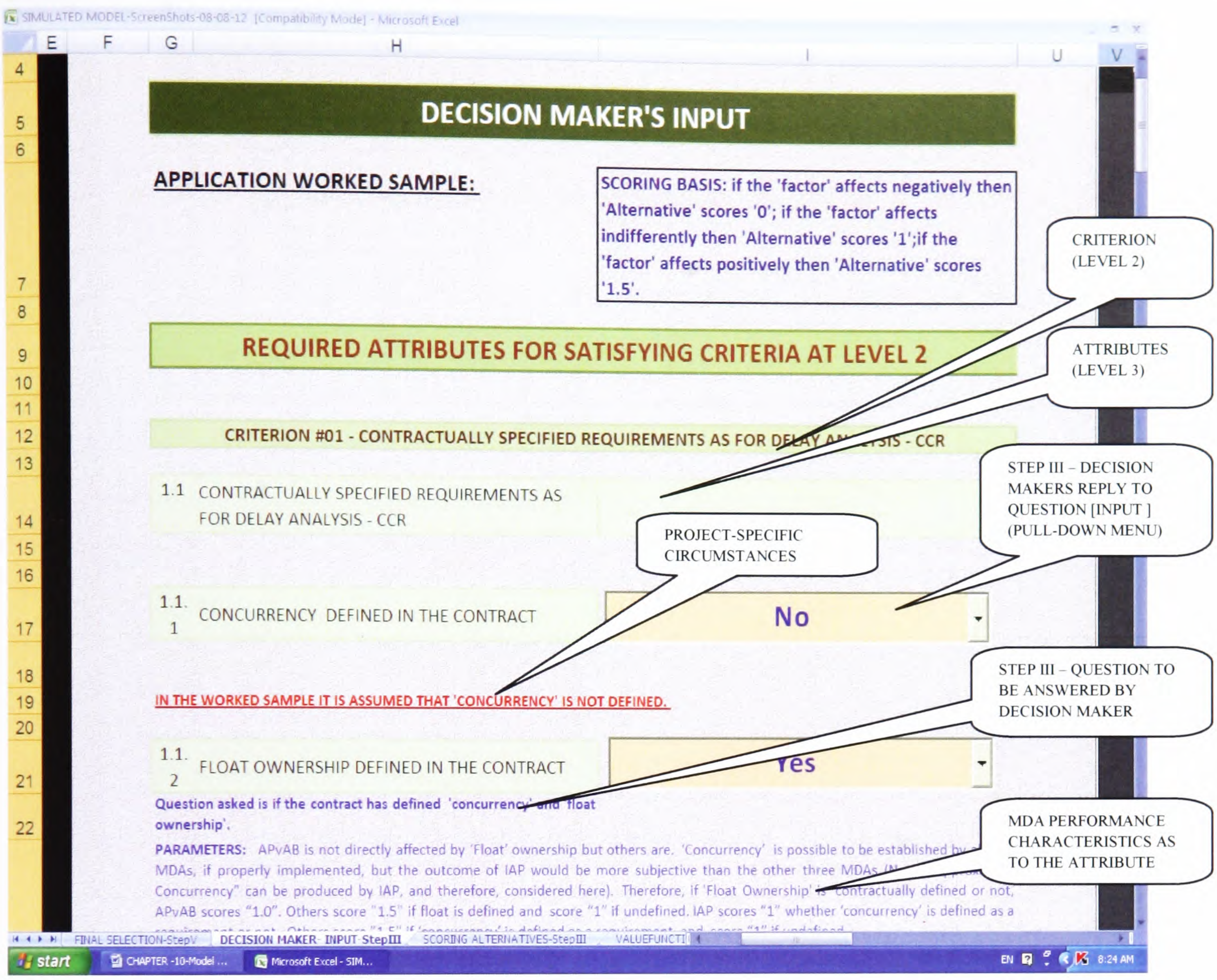
In the Step II, 'Importance Weight' (W) for each Attribute was computed by multiplying its Normalised Weight by the Normalised Weight of its corresponding Criterion. A screen-shot at Step II calculations is shown below in Figure 10.5.

Figure 10. 5 Calculation of Importance Weights (for the 'Attributes) and Value Functions (for the 'Alternatives')



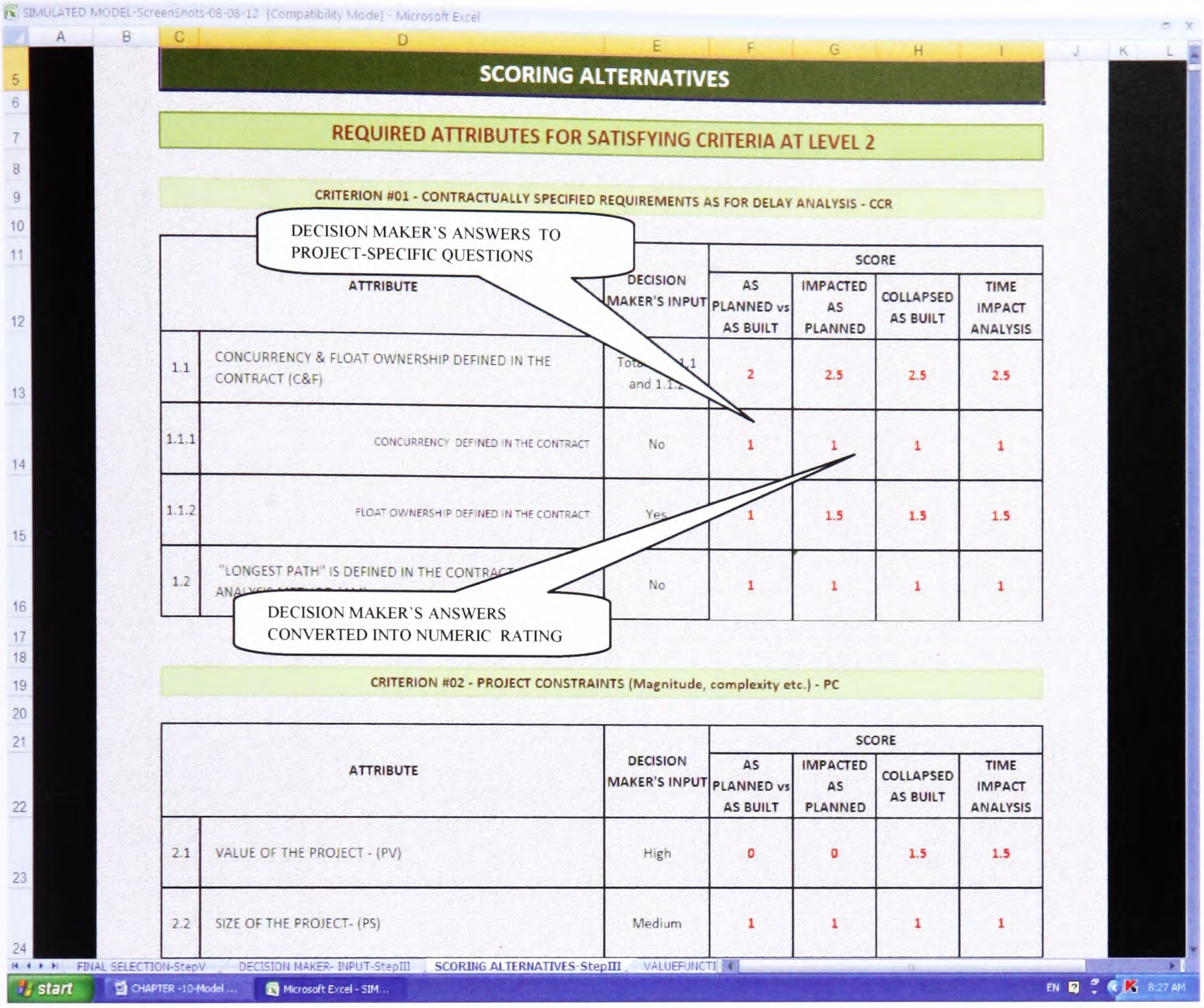
At Step 3 (Stage 2) computation process, the DM's input takes the form of providing simple answers to project specific questions in the Model, which are accessed through a pull-down menu appears in the spreadsheet titled 'Decision Maker's Input'. For each of the Attributes there is a project specific 'Question' to be 'answered' by the DM under given parameters and scenarios (see Figures 10.6 and 10.7 for screen-shots); then, depending on the answer each of the 4 Alternatives is scored with an appropriate rating (see Figure 10.8 screen-shot). This is an automated process, independent of the DM's task.

Figure 10. 6 'Decision Maker's Input'



The Decision Makers input (answers) being converted into numeric ratings (scores) is displayed in the screen-shot below:

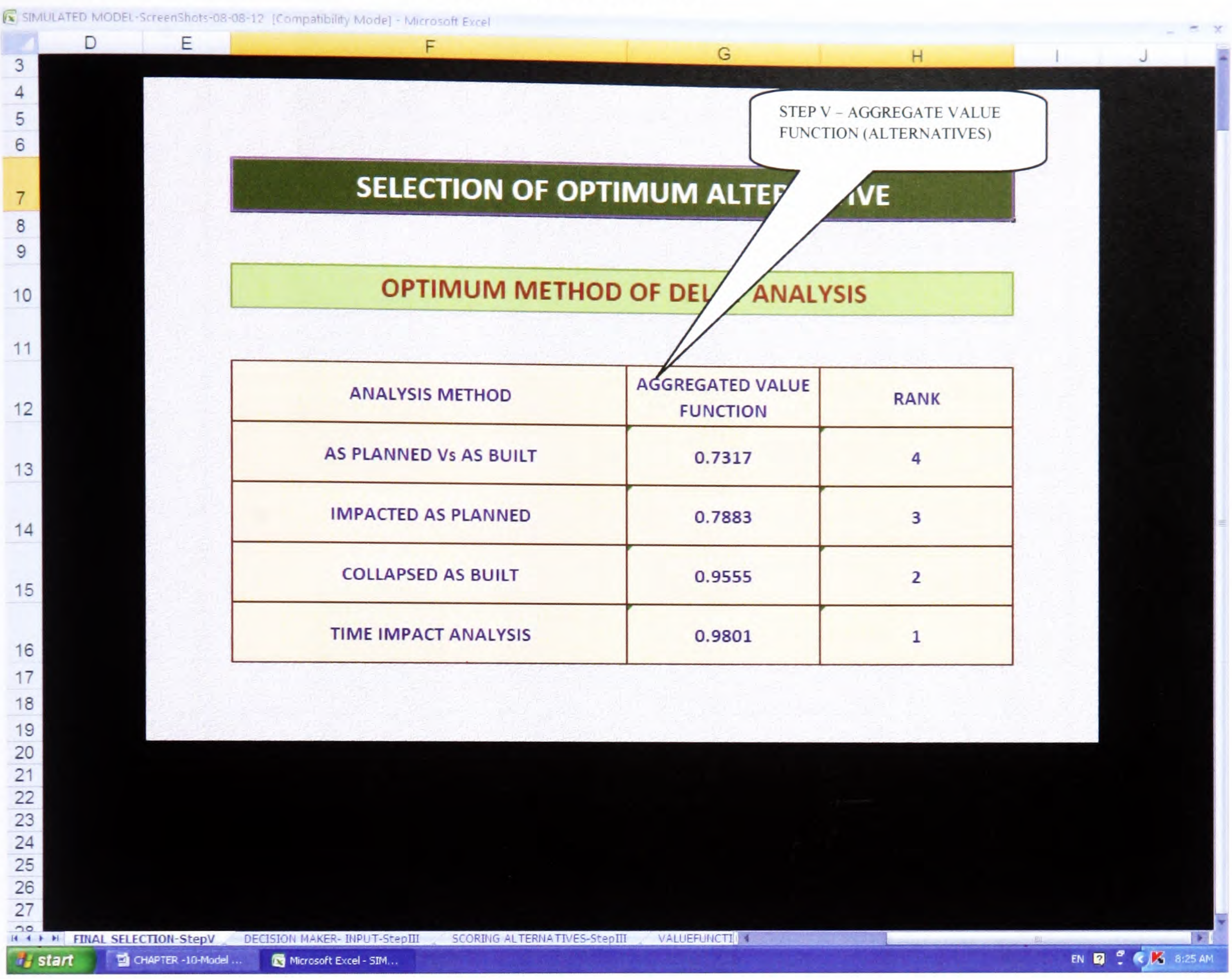
Figure 10. 7 Conversion of Decision Makers Input (Answers) into Numeric Ratings (Scores)



These ratings will be automatically converted into comparable Normalised Values of the Alternatives against each Attribute by using Linear Normalization. In the Step IV, these Normalised Values will be multiplied by the Importance Weight of the corresponding Attribute in order to obtain the Value Functions of the Alternatives (see Figure 10.5 screen-shot).

At the Step V, all the Value Functions of each Alternative are totalled together in order to obtain the Aggregated Value Function of that Alternative. The Alternative which obtains the highest Aggregated Value Function is considered the most suitable MDA to be used under the specific circumstances of the project. Under the case study scenario considered above, the Time Impact Analysis (TIA) has the maximum Aggregated Value Function of all Alternatives and hence ranked 1st. The following Figure 10.8 is a 'screen shot' of the outcome of the application of the Model in this case-study project.

Figure 10. 8 Outcome of the Application of Model



ANALYSIS METHOD	AGGREGATED VALUE FUNCTION	RANK
AS PLANNED Vs AS BUILT	0.7317	4
IMPACTED AS PLANNED	0.7883	3
COLLAPSED AS BUILT	0.9555	2
TIME IMPACT ANALYSIS	0.9801	1

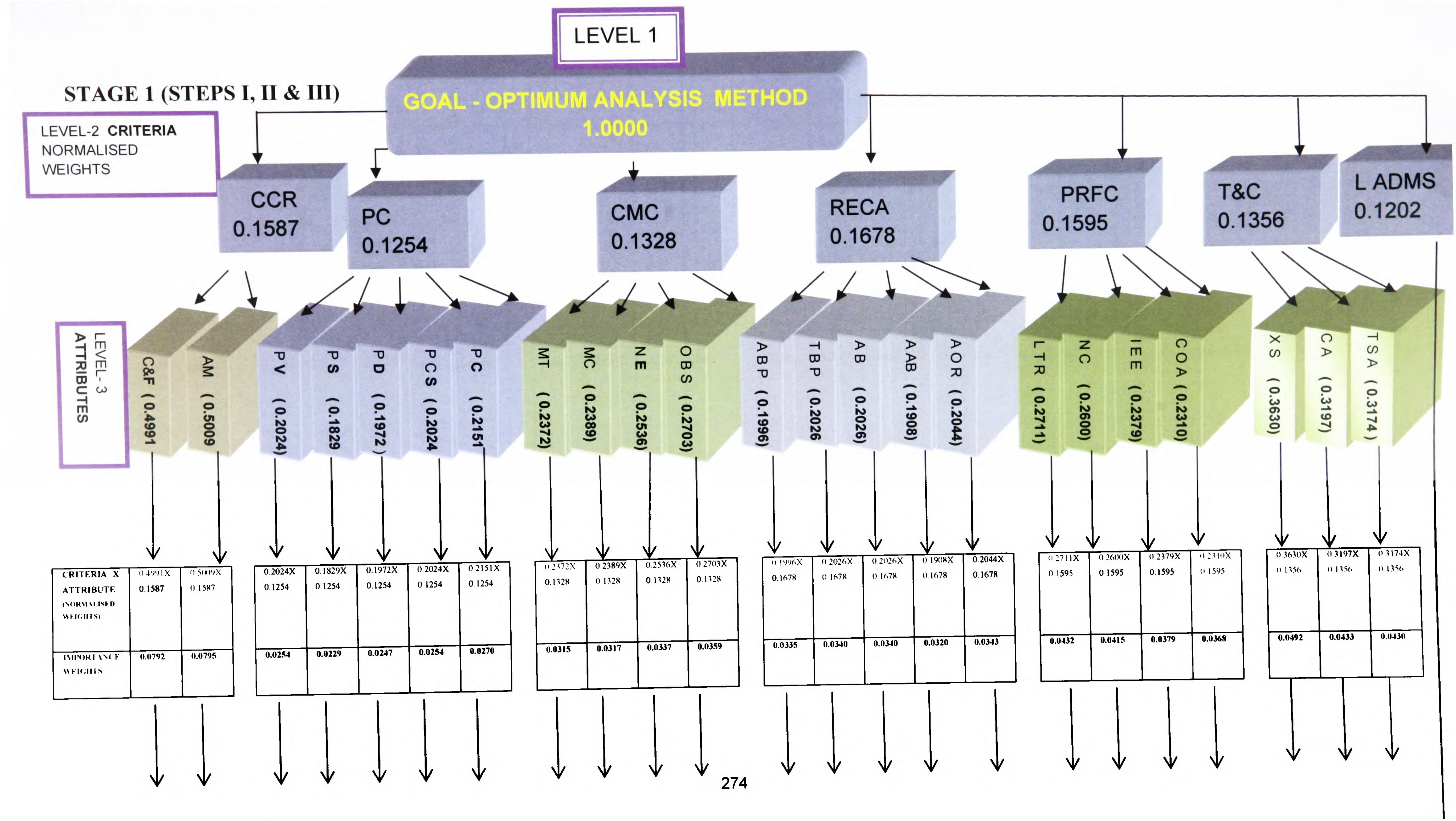
The above 'screen-shots' were captured from the 'Excel' based spreadsheets of the developed Model. However, as these 'screen-shots' are only a limited visual presentation for the purposes of this Chapter, a fully operational electronic copy of the Model has been uploaded to the following Website and available to any interested party to download.

<nihalperera.herobo.com>

(User Id: *nihalpererasalford* Password:*30092012*)

Figure 10.9 below illustrates the hierarchical calculations of the Model from Step I to V.

Figure 10. 9 Application of SAW – Model Matrix



LEVEL- 4
ALTERNATIVES

STAGE 2 – SCORING FOR ALTERNATIVES (STEPS IV AND V)

ALT-1 (APVAB)	0.0792 X 0.8	0.0795X 1.00	0.0254X 0	0.0229X 1.00	0.0247X 1.00	0.0254X 0.67	0.0270X 0	0.0315 X 1.00	0.0317X 1.00	0.0337X 0.67	0.0359X 0	0.0335X 1.00	0.0340 X 0.67	0.0340X 0.67	0.0320X 0.67	0.0343X 0.67	0.0432X 0	0.0415X 1.00	0.0379 X 1.00	0.0368X 1.00	0.0492X 0.67	0.0433X 1.00	0.0430 X 1.00
ALT-2 (IAP)	0.0792X 1.00	0.0795X 1.00	0.0254X 0	0.0229X 1.00	0.0247X 1.00	0.0254X 0.67	0.0270X 0	0.0315 X 1.00	0.0317X 1.00	0.0337X 0.67	0.0359X 0	0.0335X 1.00	0.0340 X 1.00	0.0340X 0.67	0.0320X 0.67	0.0343X 0.67	0.0432X 1.00	0.0415X 0.67	0.0379 X 1.00	0.0368X 1.00	0.0492X 0.67	0.0433X 1.00	0.0430 X 1.00
ALT-3 (CAB)	0.0792X 1.00	0.0795X 1.00	0.0254X 1.00	0.0229X 1.00	0.0247X 1.00	0.0254X 1.00	0.0270X 1.00	0.0315 X 1.00	0.0317X 1.00	0.0337X 1.00	0.0359X 1.00	0.0335X 0.67	0.0340 X 0.67	0.0340X 0.67	0.0320X 0.67	0.0343X 1.00	0.0432X 1.00	0.0415X 1.00	0.0379 X 1.00	0.0368X 1.00	0.0492X 1.00	0.0433X 1.00	0.0430 X 1.00
ALT-4 (TIA)	0.0792X 1.00	0.0795X 1.00	0.0254X 1.00	0.0229X 1.00	0.0247X 1.00	0.0254X 0.67	0.0270X 1.00	0.0315 X 1.00	0.0317X 1.00	0.0337X 1.00	0.0359X 1.00	0.0335X 1.00	0.0340 X 1.00	0.0340X 1.00	0.0320X 1.00	0.0343X 0.67	0.0432X 1.00	0.0415X 1.00	0.0379 X 1.00	0.0368X 1.00	0.0492X 1.00	0.0433X 1.00	0.0430X 1.00

ALT-1 (APVAB)	0.0634	0.0795	0.0000	0.0229	0.0247	0.0170	0.0000	0.0315	0.0317	0.0226	0.0000	0.0335	0.0228	0.0228	0.0215	0.230	0.0000	0.0415	0.0379	0.0368	0.0330	0.04 33	0.04 30	0.1202 X 0.67 0.0805
ALT-2 (IAP)	0.0792	0.0795	0.0000	0.0229	0.0247	0.0170	0.0000	0.0315	0.0317	0.0226	0.000	0.0335	0.0340	0.0228	0.0215	0.230	0.0432	0.0278	0.0379	0.0368	0.0330	0.04 33	0.04 30	0.1202 X 0.67 = 0.0805
ALT-3 (CAB)	0.0792	0.0795	0.0254	0.0229	0.0247	0.0254	0.0270	0.0315	0.0317	0.0337	0.0359	0.0224	0.0228	0.0228	0.0215	0.0343	0.0432	0.0415	0.0379	0.0368	0.0492	0.04 33	0.04 30	0.1202 X 1.00 = 0.1202
ALT-4 (TIA)	0.0792	0.0795	0.0254	0.0229	0.0247	0.0170	0.0270	0.0315	0.0317	0.0337	0.0359	0.0335	0.0340	0.0340	0.0320	0.0230	0.0432	0.0415	0.0379	0.0368	0.0492	0.04 33	0.04 30	0.1202 X 1.00= 0.1202

<u>AGGREGATED VALUE FUNCTION OF ALTERNATIVES:</u>

ALT- 1 (APVAB) =

(0.0634+0.0795)+(0.0000+0.0229+0.0247+0.0170+0.0000)+(0.0315+0.0317+0.0226+0.0000)+(0.0335+0.0228+0.0228+0.0215+0.0230)+(0.0000+0.0415+0.0379+0.0368)+(0.0330+0.0433+0.0430)+(0.0805) = **0.7317**

ALT- 2 (IAP) =

(0.0792+0.0795)+(0.0000+0.0229+0.0247+0.0170+0.0000)+(0.0315+0.0317+0.0226+0.0000)+(0.0335+0.0340+0.0228+0.0215+0.0230)+(0.0432+0.0278+0.0379+0.0368)+(0.0330+0.0433+0.0430)+(0.0805) = **0.7883**

ALT-3 (CAB) =

(0.0792+0.0795)+(0.0254+0.0229+0.0247+0.0254+0.0270)+(0.0315+0.0317+0.0337+0.0359)+(0.0224+0.0228+0.0228+0.0215+0.0343)+(0.0432+0.0415+0.0379+0.0368)+(0.0492+0.0433+0.0430)+(0.1202) = **0.9555**

ALT-4 (TIA) =

(0.0792+0.0795)+(0.0254+0.0229+0.0247+0.0170+0.0270)+(0.0315+0.0317+0.0337+0.0359)+(0.0335+0.0340+0.0340+0.0320+0.0230)+(0.0432+0.0415+0.0379+0.0368)+(0.0492+0.0433+0.0430)+(0.1202) =**0.9801**

HIGHEST AGGREGATED VALUE FUNCTION = 0.9801; THEREFORE, THE OPTIMUM MDA IS 'TIME IMPACT ANALYSIS' (TIA)

Figure 10.9 above illustrates the calculation of these results as produced by the Model after applying the potential input of a DM who would base his judgment on the project-specific circumstances of the case study.

10.7.3 Potential Constraints

The main potential constraint of the Model is deriving from the input of the respondents to the in-depth survey. The process of Weighted Averages and their Normalised Weights has converted the raw data collected from the respondents' ratings (of relative importance among Criteria and Attributes) into dimensionless and comparable common numerical scaling system. However, it is noteworthy that the original ratings have entirely been determined by the varied individual levels of perception and experience of the respondents, and the competence of their judgments. Therefore, the original ratings would potentially inherit a degree of inconsistency, depending on the coherence of the sampling frame involved in the in-depth survey; to that extent the final outcome of the Model may be affected by subjectivity, and result in a lower level of generalisation than one would expect in a pure scientific research albeit there was a significant level of concordance between the rankings of both Groups of survey respondents, as indicated by the test statistics for question nos. 28-30.

Another constraint that may affect the final outcome is in the parameters/factors and weighted ratings allocated for the DM's input. The currently fixed parameters and ratings related to DM's input are believed to have reflected reasonably meaningful behaviours of the MDAs with reference to the corresponding Attributes; as these parameters are largely based on the existing literature on the subject (for example SCL and RP-FSA Protocols) and previous studies (for example, Arditi and Pattanakitchamroon (2006); Braimah and Ndekugri, 2007) the Model can be regarded as reasonably inclusive of most of the perceivable main parameters/'factors'; but it cannot be completely ruled out that there could be different parameters/factors and ratings preferred by another group(s) of practitioners who may be beyond the immediate research sample or research setting, depending on their multiple perceptions towards them. In that sense, in spite of the comprehensiveness of the parameters/factors used, they are, to a degree, still qualitative and imprecise, and therefore, may be exposed to potential changes. These potential constraints may warrant further research and future improvements to refine the proposed Model further. However, as evaluated by the expert panel (see Chapter 11) even in its current form, the Model may possess an ability to provide the practitioners an objective and tenable basis for delay analysis more than any other intuitive and one-sided approach to select the MDA. Hence, it has the potential to yield a fair and equitable outcome in apportioning liabilities, especially aiming at overcoming possible scepticism over the impartiality of the particular method chosen.

10.8 Summary

The Chapter has presented a principal instrument of the 'Framework of Improvements' discussed in the Chapter 9, i.e. a simulated Model which is expected to aid the practitioners for the selection of a defendable, objective, and most appropriate MDA under the specific circumstances of a project. The motivation for developing this Model came from a significant contemporary need as perceived by the practitioners involved in delay claims in the local industry.

In the foregoing discussions, the issue of selection of the Decision Making Method appropriate for the Model was addressed and the Simple Additive Weighting (SAW) method was selected as the technique suitable for the development of the Model. In this instance, SAW method was considered in the perspective of the philosophical basis of this research.
The application of SAW method was discussed in detail, along with the components and the hierarchical structure of the Model. As for SAW application, a step by step description of the mechanism of the Model was submitted together with its mathematical aspects. A real-world project was utilized as a case-study worked example to demonstrate how the Model would operate and produce its final outcome, i.e. selecting the most appropriate MDA under the project-specific circumstances. The explaining of this mechanism was presented with relevant 'screen-shots' taken at the main 'steps' of the Model at operation.

Note: a fully functional version of the Model has been uploaded to the following Web site and available to any interested party to download.
<nihalperera.herobo.com> (User Id: *nihalpererasalford* Password:*30092012*)

The Chapter has concluded with a discussion of the potential constraints of the Model.
The next Chapter 11 will address the issue of reliability and validation of the Model and other Improvements of the 'Framework'.

CHAPTER ELEVEN

11.0 Evaluation of 'Framework of Improvements'

11.1 Introduction

The main outcome of the research inquiry of contemporary practices through the interviews and in-depth survey is the development of a Framework of Improvements as discussed in the Chapters 9 and 10. Accordingly, the main constituents of this outcome are:

1. The improvements to be adopted through changes to contract documentation and procedures (Chapter 9); and
2. The improvements to the process of selection of a MDA (i.e. the optimum and most appropriate MDA under specific circumstances of a construction project) which is presented in the form of a Model (Chapter 10).

In order to report with confidence and credibility of this outcome, it is essential to evaluate these components. This Chapter has discussed the necessary evaluation process and its findings.

The selected technique for this evaluation is *reliability* and *validation.*

The entity of *reliability* is a pre-requisite for validity. However, Trochim (2006) argued that it's not possible to calculate reliability exactly, instead it has to be estimated and this is always an imperfect endeavour. Generally, four categories of reliability tests are available as (1) Test-Retest Reliability, (2) Parallel-Forms or Alternate-Forms Reliability (3) Inter-Rater or Inter-Observer Reliability, and (4) Tests for Internal Consistency.

The entity of *validity* consists of external validity and internal validity. The external validity addresses the ability to generalise the research findings beyond the research sample or setting under which the research undertaken. Internal validity deals with the issue whether the identified inputs within their attributes actually produced the expected output (Onwuegbuzie and Leech, 2006b). Thus, generally, validation refers to the degree that an instrument measures what it has been designed or intended to measure (Netemeyer *et al,* 2003; Nunnaly, 1978; Burton and Mazerolle, 2011). In other words a Model (or Framework) is developed with a specific purpose and its validity is to be determined with respect to that purpose

(Sargent, 1998). However, Kleijnen (1995) argued that validation could not be assumed to result in a perfect Model, because the perfect Model would be the real system itself and by definition, any Model would be a simplification of reality.

The following sections of this Chapter has discussed on the evaluation of the components of 'Framework of Improvements', in terms of reliability and validation of the instrument.

11.2 Reliability Process

Similar to 'validity' test, 'reliability' is also a necessary entity of instrument development to report the findings /results obtained with confidence. It is defined that reliability refers to the consistency of a test or measurement (Netemeyer, *et.al.,* 2003).

As the data collection for the Model development was mainly done through the quantitative strand using a questionnaire based in-depth survey, the reliability test is to examine the consistency of the data collected through that instrument. It is noted that the constituents of the Framework are based on the findings of both quantitative and qualitative strands; in this case, an acceptable level of consistency of the qualitative data has already been found through the 'triangulation' process adopted in Chapter 8 which showed a substantial convergence between the findings of literature review (Chapters 4-7) and the merged findings of the interview results (Appendix-A) and the survey results (Appendix-B). Therefore, the main focus of the consistency test is on the quantitative strand.

For testing consistency in quantitative data there are four different, general classes of reliability estimates as described above. The following is a brief evaluation of the suitability of these 4 methods relative to the type of the instrument that requires to be tested for reliability:

1. *Test-Retest Reliability*: is used to assess the consistency of a measure from one time to another (the assumption is, if instrument is reliable there will be close agreement over repeated tests when the variables being measured remain unchanged). Thus, for this method it is always necessary to have a control group that is measured on two occasions (pre-test and post-test) and the same instrument is given twice to the same group in two different times. However, the data collection through the survey approach was not carried out in two stages or the participants were not asked to respond in two different times. This method, therefore, cannot be applied to the current instrument which is not conducive to its application.

2. *Parallel-Forms or Alternate-Forms Reliability*: is used to assess the consistency of the results of two similar tests measuring the same variables simultaneously. The scores of the two forms are then correlated to calculate the consistency. However, as Trochim (2006) pointed out the parallel forms estimator is typically only used in situations where use of two forms as alternate measures of the same thing is intended. As the type of current instrument is not in that category, this test of Reliability is also not applicable.
3. *Inter-Rater or Inter-Observer Reliability*: which is used to assess the degree of consistency to which different raters agree when measuring the same phenomenon simultaneously. As the in-depth survey has been carried out among two Groups (Contracting Group and Consulting Group) using the same questionnaire within the same time period, this approach is suitable to be applied for testing the instrument. In this approach, the test is carried out through using Intra-Class Correlation Coefficient (ICC).
4. *Tests for Internal Consistency*: which is used to assess the consistency of results across items within a test. Stemler (2004) suggested that the consistency test was for functional purpose of getting judges to consistently apply a scoring rubric. Similar to the reasons discussed as to Inter-Rater Reliability above, the Internal Consistency Test is also applicable to the current circumstances. In this instance, Cronbach's Alpha is to be used for testing the consistency, considering that the survey has collected the data (scores) using a Likert scale, and not dichotomously.

Accordingly, using SPSS software, the two methods of Inter-Rater Reliability and Internal Consistency have been carried out. The Table 11.1 below shows the summary results obtained for these 2 tests (see Appendix - D for source of calculations). The item 'A' of the Table 11.1 contains the reliability results for the scores attributed by the 2 Groups as to the elements at Level 4 (Alternatives) of the Model hierarchy. The item 'B' contains those scores attributed to the elements at Levels 2&3 (Criteria & Attributes) of the Model hierarchy, together with all the scores attributed to the associated questions. Item 'C' consists of the combined data from 'A' and 'B'.

It is noted that values greater than 0.70 are typically acceptable for consistency estimates of Inter-Rater Reliability (Barrett, 2001) and these statistical results are within the acceptance range. Thus, it can be confirmed that there exist a substantial Internal Consistency rate and

Inter-Rater Reliability or Intra-Class Correlation Coefficient with reference to the research instrument used in the development of the Model.

Table:11. 1 Results of Reliability Statistics

		Internal Consistency	**Intra-Class Correlation Coefficient (ICC) or Inter-Rater Reliability**	
		Cronbach's Alpha	**Single Measure**	**Average Measure**
A	**Ratings for** - 4 nos. Alternative MDAs (at Level 4 of the Model) with reference to 23nos.'Attributes' (Level 3 of the Model) [Based on Tables B.45-B.48]	0.761	0.614 (P<.001, N=92, *df*=91)	0.761 (P<.001, N=92, *df*=91)
B	**Ratings For** - Level of awareness (Table B.27); Frequency of Use(Table B.28); Level of Perceived Effectiveness (Table B.30); and Level of Dispute Against the Use (Table B.31); Frequency of Using Contemporaneous Records (Table B.32); Promptness of Claims Submission (Table B.35); Promptness of Claims Assessment(TableB.36); Promptness of Award of EOT (Table. B.38); Frequency of Obstacles for selecting an appropriate MDA (Table B.39); Problematic situations contributing to dispute escalation (TableB.40); Prevention Factors (Table B.41); Efficiency Factors (Table B.42); Significance Index-Criteria in Level 2 of Proposed Model (Table B.43); Importance Index-Attributes in Level 3 of Proposed Model (Table B.44);	0.934	0.876 (P<.001, N=109, *df*=108)	0.934 (P<.001, N=109, df=108)
C	**Ratings for ALL (A+B above)**	0.942	0.890 (P<.001, N=201, *df*=200)	0.942 (P<.001, N=201, *df*=200)

11.3 Validation Process

Martis (2006) argues that usually the simplest model, which expresses a valid relation, will be the most powerful; however, there is no single test that would allow the modellers to assert that their models have been validated. Thus, it can be seen that a wide range of validation schemes has been developed by many authors like Balci and Sargent (1982a, 1982b, 1984), Barlas (1996), Barlas and Carpenter (1990), Burton and Mazerolle (2011), Forrester (1961), Forrester and Senge (1980), Gass (1983), Khazanchi (1996), Ijeoma *et al.* (2001), Sargent (1998, 2003,2010), and Saysel *et al.* (2004) and so on, as presented in the literature.

Of these, the following seem to be more commonly used:

a. Animation: The Model's operational behaviour is displayed in graphical or visual animation and compared with the behaviour of the actual system;
b. Comparison to Other Models: The results (output) of other validated Models of the actual system are compared with the various output of the simulation Model being validated;
c. Degenerate Tests: The degeneration of the Model's behaviour is tested by simulation of such situations using appropriate selection of values of the input and internal parameters;
d. Event Validity: The "events" of occurrences of the simulation Model are compared to those of the real system to determine if they are similar;
e. Extreme Condition Tests: The Model is tested by running under extreme and unlikely combination of levels of factors in the system to see whether the structure and outputs should be plausible in such situations;
f. Face Validity: Evaluation by individuals (experts and/or potential participants) knowledgeable about the system of whether the Model and/or its behaviour are reasonable. For example, is the logic in the conceptual Model correct and are the Model's input-output relationships reasonable;
g. Content Validity: Evaluation by individuals (experts and/or potential participants) knowledgeable about the system of the Model's representativeness of the topic to be studied. For example, are the instrument's credibility, accuracy, relevance, and breadth of knowledge regarding the domain reasonable;
h. Historical Data Validation: If historical data exist (e.g., data collected on a system specifically for building and testing a Model), part of the data is used to build the Model and the remaining data are used to determine (test) whether the Model behaves as the system does. (This testing is conducted by driving the simulation Model with either samples from distributions or traces);
i. Internal Validity: Several replications (runs) of a stochastic Model are made to determine the amount of (internal) stochastic variability in the Model. A large amount of variability indicates lack of consistency. It may cause the Model's results to be questionable and if typical of the problem entity, may question the appropriateness of the policy or system being investigated;

j. Operational Graphics: Values of various performance measures are shown visually or graphically as the Model runs through time to ensure they behave correctly;
k. Parameter Variability - Sensitivity Analysis: In order to determine the effects on the Model's behaviour and output, the values of the input and internal parameters of a Model are changed. The same relationships should occur in the Model as in the real system. If there are any parameters that are sensitive, i.e., cause significant changes in the Model's behaviour or output, they should be made sufficiently accurate prior to using the Model which may require iterations in Model development.
l. Predictive Validation: In this technique, the Model is used to predict (forecast) the system's behaviour, and then the system's behaviour and the Model's forecast are compared to determine if they are the same. The system data may come from an operational system or by conducting experiments on the system;
m. Traces: The behaviours of different types of specific entities in the Model are traced (followed) through the Model to determine if the Model's logic is correct and if the necessary accuracy is obtained.
n. Turing Tests: Evaluation by individuals (experts and/or potential participants) knowledgeable about the system of whether they can discriminate between system and Model outputs (Inability to discriminate is an indication of Model validity).

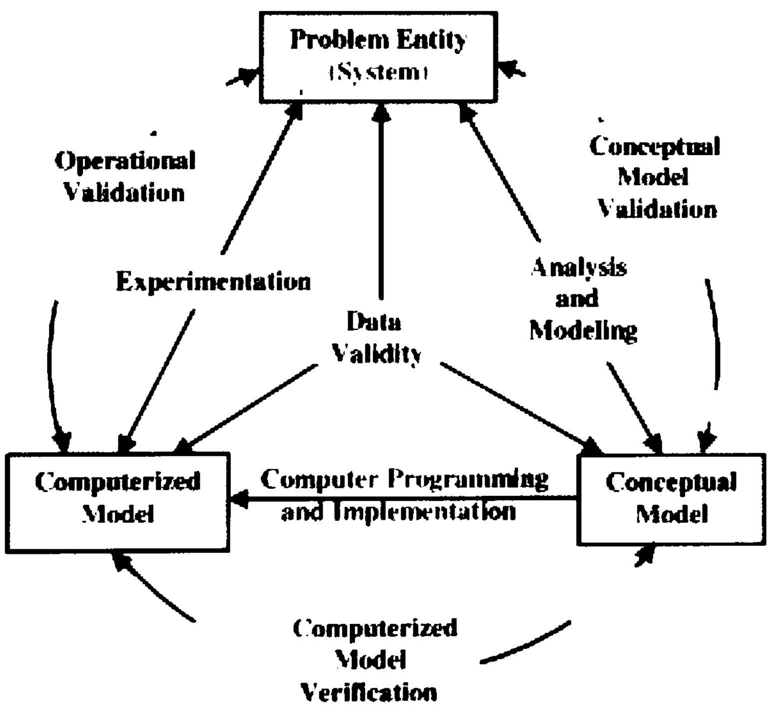
Sargent (2010) submitted that the above techniques and tests were used in Model validation either subjectively or objectively.

Considering the characteristics and type of the Framework/Model, and since similar 'Other Model(s)' or other 'gold standard' benchmark for a real system is not available to compare with the output of the developed Model, it would be mainly three techniques of these that may be used in the evaluation. They are, 1) Face Validity, 2) Content Validity, and 3) Internal Validity. Some of the other tests in the above list may generally be covered by these tests (for example, the expected output of Turing Tests may be encompassed within the results of 'Face Validity' and 'Content Validity' carried out through the expert panels) or not relevant to the present Framework/Model (for example, validation by 'Comparison to Other Models' and 'Historical Data Validation').

The Face Validity and Content Validity have been secured via a panel of experts which comprised of individuals with extensive expertise, involvement and experience in the domain the Framework/Model is implemented. In fact, there have been two separate panels involved in the evaluation of the two components of the Framework (i.e. one for improvements suggested through documentation and the other exclusively for the Model), although most of the members were common participants for both panels.

Burton and Mazerolle (2011) identified 4 common procedures for establishing the validity of an instrument: 1). Face Validity, 2) Content Validity, 3) Criterion Validity and 4) Construct Validity. It may be noted that the first two of these 4 are already included in the list above. The Criterion Validity is to test the accuracy of the instrument by comparing it to a previously established and valid instrument or some other external criterion (Netemeyer *et al.*, 2003). In this case it is almost similar to the 'Comparison to Other Models' method in the list above which is ruled out for inapplicability to the present case. Construct Validity is described as providing the researcher with confidence that the instrument actually measures what it is intended to measure. This seems to be similar to the *Operational Validity* discussed below.

Further, the *'Simplified Version of the Modeling Process'* submitted by Sargent (1996, 2010) as shown below is considered for the validation purposes:



'Simplified Version of the Modelling Process' - Source: Sargent (1996, 2010)

In the application of this version to the proposed Model, the Problem Entity is identified through the interviews and in-depth survey as to the problem of selection of the optimum MDA for given circumstances of a project; the Conceptual Model is represented by the hierarchical Model based on SAW decision making tool (see Chapter 10); the Computerised Model is the conceptual Model presented using the Microsoft Excel software. The Validation process as suggested in this version is to be carried out in the following manner:

(i) *Conceptual Model Validity* which determines the correctness of theories and assumptions underlying the conceptual Model and the reasonableness of the Model representation of the Problem Entity for the intended purpose of the Model;

(ii) *Computerised Model Verification* which is to ensure the correctness of the computer programming and implementation of the conceptual Model; and

(iii) *Operational Validity* which is to determine that the Model's output behaviour has sufficient accuracy for the Model's intended purpose over the domain of the Model's intended applicability.

This 'Simplified Version of the Modeling Process' is suggested to implement considering three basic approaches for deciding whether a simulation Model is valid or invalid. As suggested by Sargent (1996, 2010), these approaches are: (a) Development team to take decision as part of Model development (which is the most common approach); (b) Use of a third (independent) party to decide the validity (after the Model is developed); (c) use of a scoring Model (Balci, 1989; Gass and Joel, 1987) a method which is seldom in use and not recommended by Sargent (1996). Thus, it is appropriate to use both option (a) and option (b) as suitable for the validation of the proposed Model.

Considering the various techniques discussed above, thus, the following approaches are considered for validation of the components of the Framework:

- For 'Improvements through the documents and procedures' : **(i)** Face Validity and Content Validity by an independent panel of experts;
- For improvements through the 'Model' : **(i)** The validity measures suggested by Sargent (2010) in 'Simplified Version of the Modeling Process' during the Model development stage, which complies with the 1st approach suggested by him above, **(ii)** Internal Validity, and **(iii)** Face Validity and Content Validity by an independent panel of experts (This has followed the 2nd approach suggested by Sargent (1996,2010) above, i.e. 'Use of a third (independent) party to decide the validity, after the Model is developed').

11.4 Face Validity and Content Validity

Face and Content validity are normally secured via a panel of experts who judge the instrument's appearance, relevance and representativeness of its elements ((Burton and Mazerolle, 2011; Netemeyer *et al.*, 2003).

In order to carry out 'Face validity' and 'Content validity' through obtaining expert opinion, a survey approach was preferred to interviews approach mainly due to the time and cost constraints involved in the latter. In this instance, the use of internet was preferred over postal services, in- person or use of the telephone. The reasons were similar to those considered under item 3.4 Data Capture (see Chapter 3) when the use of internet was selected for the in-depth survey. Thus, web-based survey questionnaires were prepared with the aid of 'SurveyMonkey-Pro' software. There were 2 separate questionnaires for the components of the Framework: one for validating the component related to the improvements to be adopted through changes to contract documentation and procedures as described in Chapter 9, and the other for the purpose of investigating the validity of the 'Model' which is described in Chapter 10.

However, a challenging situation faced was that in the prevailing circumstances of the UAE industry there were no many experts available with genuine hands-on experience of the delay analysis. Thus, initially, 15 experts were earmarked as potential participants; the majority of them had already participated in the previously conducted semi-structured interviews and were willing to contribute to the research process further. However, none of them was involved in the Model development process. The criteria for the selection were primarily their experience in delay claims resolution as the core involvement, professional and academic qualifications, and their responsibilities/standing in the respective organisations. This was because the level of delay analysis knowledge and involvement for the purpose of this validation process was expected to be somewhat higher than an average claims practitioner in order for obtaining the best credibility and integrity of the responses.

Finally, the actual responses were 11 nos. only. Of them 9 and 7 experts participated respectively in the evaluation of the 'Model' and the 'Improvements related to contract documentation and procedures'. This is altogether 73% response rate, which is a satisfactory rate under the circumstances. Table 11.2 below indicates the details of the 11 experts who consented to participate (only 5 of the 11 experts participated in both panels). Altogether, there were 7 civil engineers and 4 chartered quantity surveyors. Among them were 5 Fellows and 1 Member of Chartered Institute of Arbitrators and all of them possessed Masters of Law degrees in construction law and arbitration specialty. All the 11 experts were actively and full-time involved in delay/claims analysis and resolution. The combined experience of them was over 130 years with an average experience of around 12 years. There were 1 Director, 1 Managing Partner, 1 Associate, 1 Consultant, 2 Managers, 1 Chief QS and 4 delay claims practitioners. These were considered as sufficient credential for the credibility of their judgments in the evaluation of the Framework.

Table:11. 2 Details of Experts - Panel Nos.1 & 2

S/N	Profession	Designation	Academic Qualifications	Professional Qualifications	Number of Years of Experience in Delay Claims (Analysis/Resolution)	Nature of Organisation/ Business	Panel Involvement
1	Civil engineer	Contracts Administrator/ Delay Analyst	BSc.,(Civil) LL M (Construction Law & Arbitration)	MCIArb.	13 Years	engineering Consultancy	Panels no.1 & 2
2	Civil engineer	Claims Specialist	MSc, (Civil Eng.); LL M (Construction Law & Arbitration)	FCIArb.	15Years	engineering Consultancy	Panels no.1 & 2
3	Civil engineer	Delay Analyst	BSc, (Civil Eng.); LL M (Construction Law & Arbitration)	FCIArb.	12Years	engineering Consultancy	Panels no.1 & 2
4	Chartered Quantity Surveyor	Director of Contracts & Commercial	MBA	FRICS	15Years	Property Development (Semi-Government)	Panel no.1 only
5	Chartered Quantity Surveyor	Claims Consultant	BSc., (QS); LL M (Construction Law & Arbitration)	FRICS, FCIArb.	12 Years	engineering Consultancy	Panel no.1 only
6	Chartered Quantity Surveyor	Associate	LLM (Construction Law & Arbitration)	AIQS(SL), AAIQS, FCIArb.	5 years	Cost and Claim Consultants and Project Managers	Panels no.1 & 2
7	Civil engineer	Contracts/ Claims Manager	LLM Construction Law, Master of Engg	FCIArb.	15 years	engineering Consultancy	Panels no.1 & 2
8	Chartered Quantity Surveyor	Chief Quantity Surveyor/Assitant Team Manger	BSc., (QS); MBA	AIQS, MRICS	13 years	Infrastructure, METRO, TRAM (Semi-Government)	Panel no. 2 only
9	Civil engineer	Delay Analyst	BSc, (Civil Eng.); Certified Contracts Administrator		08 years	engineering Consultancy	Panel no. 2 only
10	Civil engineer	Delay /Claims Analyst	BSc, (Civil Eng.);		08 years	Property Development (Private Sector)	Panel no. 2 only
11	Civil engineer	Managing Partner	BSc, (Civil Eng.);		15 years	Contracts & Claims independent expert/ Service Provider	Panel no. 2 only

It is submitted that 'Face' and 'Content' validity are qualitative measures of validity (Burton and Mazerolle, 2011; Netemeyer *et al.*, 1978). On the other hand, the improvements to be adopted through changes to contract documentation and procedures were primarily of qualitative type. Therefore, it would be appropriate to first deal with the 'improvements' through the documentation and procedures.

A. Improvements to be adopted through changes to contract documentation and procedures

Summary Results of Face Validity and Content Validity

Burton and Mazerolle (2011) described the Face Validity as an evaluation of an instrument's appearance by a group of experts and or potential participants with the purpose of establishing an instrument's ease of use, clarity, and readability. They also described the 'Content Validity' as an evaluation of instrument's representativeness of the topic to be studied by a group of experts with the purpose of establishing instrument's credibility, accuracy, relevance, and breadth of knowledge regarding the domain.

In line with these descriptions, the panel of expert was asked the pertaining questions through a questionnaire. The questionnaire was accompanied with a 'Matrix of the Framework of Improvements' describing the 'suggested best practice improvements' for the identified 'Problem Areas' (The template of the related questionnaire and the document 'Matrix of the Framework of Improvements' are included in Appendix – E). The 'best practice improvements' suggested in this 'Matrix' covered many problematic Areas. A series of improvements were suggested covering measures that can be adopted in pre and post-contract stages. Primarily they were related to stipulating clear definitions and risk distribution in the contract documents leading to certain changes in currently adopted practices as to apportioning liability in delay claims resolution. The experts' opinions were inquired on the overall clarity and readability of these suggested best practice improvements. As Table 11.3 shows below, the panel found an overall acceptance for the clarity and readability of the content of the instrument, with 57% stating that the content 'is very clear and readable'.

Table:11. 3 Clarity and Readability

Clarity and readability of the content of the 'Suggested Best Practice Improvements' for a user

	Frequency	Percent	Valid Percent	Cumulative percent
Content is very clear and readable	4	57.1%	57.1%	57.1%
Content is reasonably clear and readable	3	42.9%	42.9%	100.0%
Content is too complicated and unclear	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	7	100	100	

On the issue of ease of use, Table 11.4 shows the level of adaptability of the suggested best practice improvements in the local practices. In this case, although there was an overall confirmation of their adaptability, the majority (86%) of the experts cautiously stated that it might 'take time' for that. This means any immediate acceptance of the suggested improvements in the local practices may not be expected, although in the long run it would be feasible. This reluctance may be particularly due to the 'authoritarian' attitudes/role that prevail among the local employers/consultants who generally prepare the contract documents as a norm and always look for the least and minimum risk to themselves. However, this reality would necessitate exploring potential avenues, including future research, to enable the Framework draw adequate attention towards itself from the practising delay and claims analysts.

Table:11. 4 Level of Potential Adaptability

The level of potential adaptability of the 'Suggested Best Practice Improvements' in the local industry and current practices (The current practices as represented by both contractor and employer/engineer entities)

	Frequency	Percent	Valid Percent	Cumulative Percent
Easily Adaptable	1	14.3%	14.3%	14.3%
Adaptable but may take time	6	85.7%	85.7%	100.0%
Difficult but not impossible	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	7	100	100	

The panel of experts was asked whether the suggested improvements adequately represent the breadth of knowledge of the domain. As summary results of Table 11.5 show the panel was 100% satisfied with an 86% approval that this representation was 'highly adequate'.

Table:11. 5 Breadth of Represented Knowledge

The breadth of knowledge represented by the 'Suggested Best Practice Improvements' regarding the related topics and domain.

	Frequency	Percent	Valid Percent	Cumulative Percent
Highly Adequate	6	85.7%	85.7%	85.7%
Reasonably Adequate	1	14.3%	14.3%	100.0%
Not Adequate	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	7	100	100	

Next, related to the previous question, an inquiry was made as to the adequacy of accuracy and credibility of the knowledge represented in the suggested improvements. This aspect was to be evaluated against the current legal position in the UK and the US, using the construction law knowledge and training that most of the panel members possessed. Table 11.6 presents the summary results of this evaluation. Accordingly, 57% of the panel thought the accuracy and credibility were reasonably adequate, and a lower percentage of 43% thought it was highly adequate. In any case, it was a 100% overall confirmation of its adequacy.

Table:11. 6 Accuracy and Credibility

Accuracy and Credibility of knowledge represented by the 'Suggested Best Practice Improvements' regarding the related topics and domain.(The accuracy and credibility of knowledge may be measured against current best practices, for example the UK / US industry practices and legal position)

	Frequency	Percent	Valid Percent	Cumulative Percent
Highly Adequate	3	42.9%	42.9%	42.9%
Reasonably Adequate	4	57.1%	57.1%	100.0%
Not Adequate	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	7	100	100	

The main purpose of these suggested improvements was/is that their implementation would significantly contribute to enhance certainty in risk distribution in contracts, and considerably minimise /avoid dispute situations in delay claims resolution. Thus, the question whether these improvements could make such contribution was asked from the experts. Table 11.7 indicates that 86% of the panel confirmed an expectation of 'significantly high contribution', if they were adopted. However, as previously noted it may 'take time' for their implementation before seeing any substantial effect of such contribution to the existing practices. However, some members of the panel observed that certain improvements suggested in the Matrix had already been implemented to an extent, particularly the conditions precedent and the principles regarding dealing with concurrent delays. Nevertheless, there was no uniformity of opinions on this, and some of these observations may represent the circumstances limited to the members own organisations only, instead of a prevailing situation across the local industry.

According to these test results, it is evident that the Improvements to be adopted through changes to contract documentation and procedures have highly satisfied the expert panel in terms of clarity and readability, potential adaptability (though subject to a 'long term' possibility), breadth of knowledge of domain represented, accuracy and credibility of the knowledge represented, and the ability to achieve the 'effects' intended, and thus significantly established their Face and Content validity.

Table:11. 7 Ability to Contribute

If adopted, would the 'Suggested Best Practice Improvements' significantly be able to contribute to enhance certainty in risk distribution in contracts and considerably minimise /avoid dispute situations in delay claims resolution?

	Frequency	Percent	Valid Percent	Cumulative Percent
Significantly high contribution is expected	6	85.7%	85.7%	85.7%
A general contribution is expected	I	14.3%	14.3%	100.0%
No significant contribution is expected	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	7	100	100	

B. The improvements to the process of selection of a MDA through the Model

Summary Results of Face Validity and Content Validity

After the development of the Model, for the evaluation of the Face and Content validity, the panel members were provided with a short questionnaire, a Worked Example based on a case-study to illustrate the application of the proposed Model and a soft copy of the proposed Model in fully functional and interactive mode (For template of questionnaire, the letter to the panel participants and the details of the Case-study please see Appendix – E; the Worked Example of the Model based on this case-study can be accessed through <nihalperera.herobo.com> (User Id: *nihalpererasalford* Password:*30092012*)

They were requested to make necessary interaction with the Model through using their own case-studies in the evaluation of its functions. As Table 11.8 indicates all nine members of the panel used the Model with their own case-studies. Some members indicated that they had used up to three separate case-studies for checking the performance of the Model under varying scenarios, confirming a fair amount of interaction with the Model.

Table:11. 8 Respondent's use of the Model

Have you used this Model with any of own case study(ies)?	Frequency	Percent	Valid Percent	Cumulative Percent
YES	9	100.0%	100.0%	100.0%
NO	0	0.0%	0.0%	100.0%
Total	9	100	100	

The panel members were particularly requested to give their informed opinion on the following aspects, in terms of Face Validity and Content validity, which tested the Model's ability to building the correct system with an accurate representation of the knowledge of the experts, as well as tested whether the Model possessed a satisfactory range of accuracy consistent with the intended application (Sargent 2003):

a) Simplicity, comprehensiveness and clarity of the content;
b) Accuracy in performance of the automated process;
c) Representativeness of the domain as to the wholeness of 'criteria' and 'attributes';
d) Realistic representativeness of 'parameters' aiding the Decision Maker's judgment process;
e) Suitability of the scales used to measure the eligibility of each method of delay analysis against the corresponding 'attributes';
f) Consistency of the Model's behaviour (output) under changing circumstances (input);
g) Model's ability to provide a Decision Maker a stronger, more tenable and objective position;
h) Model's ability to contribute to minimise mutual scepticism between the parties in selection of a method of delay analysis;
i) Model's ability to operate with normal skills;
j) Experience in use of similar devices for selection of MDA.

On the issue of simplicity, comprehensiveness and clarity of the content, Table 11.9 shows the experts evaluation. Overall 89% experts confirmed that the content was simple, comprehensive and clear for a user (with 67% stating it was 'very simple, comprehensive and clear'). However, 1 member (11%) found that the content was 'too complicated and unclear for a user'. It was not apparent whether this panel member had thought of below-average users, as the same member assessed other characteristics of the Model in a positive light on par with others.

Table:11. 9 Simplicity, comprehensiveness and clarity of the content of the Model

Please state your opinion on the level of simplicity, comprehensiveness and clarity of the content of the Model for a user.

	Frequency	Percent	Valid Percent	Cumulative Percent
Content is very simple, comprehensive and clear for a user	6	66.7%	66.7%	66.7%
Content is reasonably simple, comprehensive and clear for a user	2	22.2%	22.2%	88.9%
Content is too complicated and unclear for a user	1	11.1%	11.1%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

Although during the Model development stage several iterations of the Model were conducted to ensure a smooth running of the final product, the panel of experts was also expected to use it and evaluate on the accuracy of automated performance. It was indicative that altogether 15 nos. case-studies have been used in this expert-evaluation (3 nos. by 2 experts, 2 nos. by 2 experts, and 1 each by other 5 experts). The summary results of this test of accuracy in performance of the automated process are shown in Table 11.10 below. Accordingly, 89% of the panel of experts decided that 'Automated process is stable and runs smoothly with no abnormal behaviour'. However, 1 member stated 'Not sure'; however, it was not clear the specific reason/area of 'problem' which prompted that response (there was no reasoning given although a space was provided for 'comments' in the questionnaire).

Table: 11. 10 Accuracy in performance of the automated process

Does Model's automated process run smoothly with no clashes and implement the Model with no abnormal behaviour?

	Frequency	Percent	Valid Percent	Cumulative Percent
Automated process is stable and runs smoothly with no abnormal behaviour	8	88.9%	88.9%	88.9%
Automated process is unstable and requires corrections	0	0.0%	0.0%	88.9%
Not sure	1	11%	11.1%	100.0%
Total	9	100	100	

Model's representativeness of the breadth of domain knowledge was an important aspect of the evaluation by the experts. During the development of the Model, defining the constructs of 'Criteria', 'Attributes' and the 'Parameters' was carried out based on a thorough exploration of domain literature and the convergent results of the interviews and the in-depth survey. However, as there was no pre-existing 'gold standard' scale, it was necessary to refer these constructs to an expert evaluation for necessary testing of reliability and validity. Therefore, the panel of experts was requested to test and evaluate these constructs with reference to the following:

1. Adequacy of the wholeness of the "Criteria" used for the 'Goal' of the Model i.e. selection of the optimum Method of Delay Analysis;
2. Adequacy of the wholeness of the "Attributes" used to measure the eligibility of each Method of Delay Analysis; and
3. The representativeness of 'parameters' which would aid the Decision Maker's judgment process.

The following Tables 11.11, 11.12 and 11.13 present the summary results for these 03 evaluations. Accordingly, as to the wholeness of 'Criteria', there has been an overall confirmation with 78% of the experts stating it was 'Highly Adequate' (Table 11.11). As to the wholeness of 'Attributes', with an overall confirmation, 56% of the experts thought it was 'Highly Adequate' along with 44% stating 'Reasonably adequate' (Table 11.12). Table 11.13 shows similar overall confirmation for the representativeness of 'parameters' with 56% stating that was 'Very Realistic' and 44% stating 'Generally Realistic'.

Table:11. 11 Representativeness of the domain as to the wholeness of 'criteria'

Please state your opinion on the wholeness of the "Criteria" used as necessary for selection of the optimum Method of Delay Analysis: (Please refer to Worked Example softcopy worksheet "LIST-CRITERIA-ATTRIBS-ALTvs")

Wholeness of "Criteria" is	Frequency	Percent	Valid Percent	Cumulative Percent
Highly Adequate	7	77.8%	77.8%	77.8%
Reasonably Adequate	2	22.2%	22.2%	100.0%
Not Adequate	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

Table:11. 12 Representativeness of the domain as to the wholeness of 'attributes'

Please state your opinion on the wholeness of the "Attributes" used to measure the eligibility of each Method of Delay Analysis:(Please refer to Worked Example softcopy worksheet "LIST-CRITERIA-ATTRIBS-ALTvs")

Wholeness of "Attributes" is	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Highly Adequate	5	55.6%	55.6%	55.6%
Reasonably Adequate	4	44.4%	44.4%	100.0%
Not Adequate	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

Table:11. 13 Realistic representativeness of 'parameters'

Please state your opinion on 'PARAMETERS' as given under each Attribute:(Please refer to Worked Example softcopy worksheet "DECISION MAKER- INPUT")

The explained PARAMETERS are	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Very Realistic	5	55.6%	55.6%	55.6%
Generally Realistic	4	44.4%	44.4%	100.0%
Not Realistic	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

At the Level 4 of the Model, through the Decision Makers input, relevant scores are attributed to each of the Alternative MDA. Each MDA scores according to its 'behaviour' in relation to each Attribute (factors), and these scores are based on a pre-determined scale (scoring scale: if the 'factor' affects negatively then 'Alternative' scores '0'; if the 'factor' affects indifferently then 'Alternative' scores '1'; if the 'factor' affects positively then 'Alternative' scores '1.5'). The panel of experts was requested to evaluate the accuracy and suitability of the allocated scales to measure the 'eligibility' of each MDA to become the optimum MDA. This evaluation was expected to be on a thorough knowledge of each of the MDAs with reference to their strengths, weaknesses, and behaviour in the presence of project-specific Attributes. The summary results of Table 11.14 indicate the overall satisfaction of the panel of experts as to the suitability of these scales, with 67% stating they were 'very suitable' and 33% holding 'Generally suitable'.

Table:11. 14 Suitability of the scales

Please state your opinion on the suitability of the scales used to measure the eligibility of each Method of Delay Analysis against the corresponding 'Attributes' :(Please refer to Worked Example softcopy worksheet "DECISION MAKER-INPUT").

The scales are	Frequency	Percent	Valid Percent	Cumulative Percent
Very Suitable	6	66.7%	66.7%	66.7%
Generally Suitable	3	33.3%	33.3%	100.0%
Not Suitable	0	0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

Consistency of the Model's delivery of the optimum MDA (output) under varying scenarios/circumstances (input) was found stable and corresponding to the intended application, when tested through several iterations during the development stage of the Model. The panel of experts was also requested to test this aspect for determining whether the Model possessed a satisfactory range of accuracy consistent with intended application (Sargent 2003). Table 11.15 below indicates the summary results of this test. There was an overall confirmation from the panel of experts that the changing scenarios ('input' based on varying case-study scenarios) applied on Model generated an output (the optimum MDA in relation to the 'input') with consistency and accuracy. Of them, 67% thought 'Output is very consistent and accurate for the intended purposes of Model'.

Table:11. 15 Consistency of the Model's behaviour (output) under changing circumstances (input)

Under changing input (based on varying case-study scenarios), how do you find the output behaviour in the Model?

	Frequency	Percent	Valid Percent	Cumulative Percent
Output is very consistent and accurate for the intended purposes of Model	6	66.7%	66.7%	66.7%
Output is generally consistent and accurate for the intended purposes of Model	3	33.3%	33.3%	100.0%
Output is not consistent and not accurate for the intended purposes of Model	0	0.0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

One prime purpose of developing this Model is to enable its users justify and defend the selected MDA as the most optimum and objective under a given set of project-specific circumstances. In other words, the use of the Model is expected to place the DM on a stronger, more objective and tenable position than he would have been if the MDA was selected on an intuitive and subjective basis. Therefore, the panel's opinion was sought whether the Model had such ability. The summary results in Table 11.16 show a 100% confirmation by the experts that the Model could provide such strong, tenable and objective position to its users.

Table:11. 16 Ability to provide stronger, more tenable and objective MDA

Do you think a Decision Maker's position would be stronger, more tenable and objective when he uses the Model to select the Method of Delay Analysis (MDA) than when he selects MDA intuitively?

	Frequency	Percent	Valid Percent	Cumulative Percent
Model provides a stronger, more tenable and objective position	9	100.0%	100.0%	100.0%
No , don't think there is a difference	0	0.0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

Likewise, another prime purpose of developing this Model is to contribute to minimising mutual scepticism between the parties in selection of a MDA. This expectation is based on the Model's ability to select a MDA on a transparent and objective basis rather than on the basis of this or that party's perceived inclinations. Therefore, the panel's opinion was sought whether the Model had such ability to contribute as intended. The summary results in Table 11.17 show an overall confirmation by the experts that the Model could make such contribution as expected, with 56% stating it would be a 'significantly high contribution'.

Table:11. 17 Ability to contribute to minimising mutual scepticism

In your opinion, would the Model significantly be able to contribute to minimising mutual scepticism between the parties in selection of a Method of Delay Analysis suitable for a given project.

	Frequency	Percent	Valid Percent	Cumulative Percent
Significantly high contribution expected	5	55.6%	55.6%	55.6%
Generally high contribution expected	4	44.4%	44.4%	100.0%
No significant contribution expected	0	0.0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

During the development stage, it was intended to make the Model as simple as possible without unnecessary complications for a potential user or requiring costly resources for a technically more advanced and sophisticated device. As most of the DMs are expected to be familiar with commonly used, simple 'spreadsheets' software, 'Microsoft Excel' has been used for developing the Model. Thus, the intention was to enable potential users to operate the Model with normal computer skills, and without requiring any specialised resources. The panel of experts was also requested to look into this aspect. Table 11.18 submits the results of this examination. Accordingly, the experts decided that the Model could operate effectively without requiring any special skills or costly resources. However, nearly 45% of them were of the opinion that though with normal skills it still requires a brief prior training. This seems to be a fair assessment as such prior 'training' could be provided within a few hours to a user who has 'normal computer skills'.

The panel of experts was requested to make any comments aiming to further improve the Model functions. Thus, one expert commented "*Although Excel software is robust enough to carry out the expected deliverables of the Model, a more commercialised approach would help to wider use of Model among practitioners. For example, linking the Model with popular planning software currently in the market*". This comment was aiming to deliver more integrated package of solution by linking the Model to other popular planning software like 'Primavera'.

Table:11. 18 Ability to operate with normal skills

Please state your opinion whether the Model can be used without requiring special skills or costly resources, but with ordinary computer skills of a competent delay analyst.

	Frequency	Percent	Valid Percent	Cumulative Percent
Use of the Model requires normal skills only.	5	55.6%	55.6%	55.6%
Use of the Model requires normal skills but a brief prior training.	4	44.4%	44.4%	100.0%
Use of the Model requires special skills and costly resources.	0	0.0%	0.0%	100.0%
Not sure	0	0%	0.0%	100.0%
Total	9	100	100	

However, this level of advanced software integration is beyond the scope of the current study. It is also thought that such integration may result in depriving the Model users of its current 'simplicity' and the low cost. Nevertheless, this suggestion may be worth considering in future research/development in this domain, particularly as a potential means for the Model and its intentions to reach the practitioners in local industry in a relatively shorter time, particularly in the context of the concerns referred to in the next paragraph.

Another comment was "*In the long term and ultimately, I agree that such Model would contribute to minimise the mutual scepticism. However, in the short term the contribution would be limited as I consider the scepticism/distrust between the parties to be deep rooted which would hinder in looking at the Model objectively*". In fact, this 'syndrome' was observed and recognised by the panel no.1 as well, which examined the other component of the Framework (i.e. Improvements through changes to contract documentation and procedures). Therefore, any expectation of immediate acceptance of these improvements by the local industry would be an over-estimate and too optimistic.

Finally, the panel of experts was asked of any previous experience of using a similar Model/device in the selection of MDA. All answers were negative as expected (see Table 11.19 below). Thus, this result is indicative that the development of the current Model is a new approach to the local industry practitioners.

Table:11. 19 Existence of similar Models

Have you used any Model/ device similar to the current for selection of method of delay analysis?

	Frequency	Percent	Valid Percent	Cumulative Percent
NO	9	100.0%	100.0%	100.0%
YES	0	0%	0%	100.0%
Total	9	100	100	

According to the above test results, it is evident that the suggested Improvements to the process of selection of a MDA through the Model have satisfied the expert panel in terms of simplicity, comprehensiveness and clarity of the content, accuracy in performance, representativeness of the breadth of domain knowledge, accuracy and credibility of the knowledge represented, suitability of the constructs, consistency of performance and the ability to achieve the 'effects' intended. Therefore, these results have significantly established the Face Validity and Content validity of these suggested improvements.

11.5 Validity Measures in 'Simplified Version of the Modelling Process'

The 'Simplified Version of the Modelling Process' as suggested by Sargent (1996, 2010) has been related to the validation and verification of the proposed Model.

In order to validate Problem Entity, Conceptual Model, and Computerised Model which are essential elements of 'Simplified Version of the Modelling Process', the following measures were followed during the Model Development stage.

Conceptual Model Validity

The applications of theories, concepts and practices for apportioning liabilities in delay claims and the SAW method as the decision making tool were extensively reviewed against the current literature of the domain, convergent results of interviews and in-depth survey data analyses and also through peer-discussions to ensure that they were applied correctly during the Model development.

The Model hierarchy structure, the causal relationships within and between its components of 'Criteria', 'Attributes' and 'Alternatives' and the mathematical calculations conducted (for SAW approach) were also evaluated, reviewed and re-checked several times to determine their accuracy for the intended purpose of the Model and the consistency between input and output at several iterations made using different project scenarios.

Computerised Model Verification

The Model is built exclusively using Microsoft Excel software. All the algorithms, relationships, links and formulas used for mathematical calculations were reviewed through several iterations to ensure their accuracy and for the intended purpose. Through this extensive review and checking during the Model development, the simulation function of the Model was ensured as generally error free.

Operational Validity

The amount of accuracy required for the Model's intended purpose is when the Model is within the acceptable range of a set of experimental conditions (Sargent, 1996). For this purpose eight different sets of experimental conditions were formed on the basis of one real life and seven hypothetical case-studies and the behaviour of each 'Alternative' (i.e. MDA) in the computerised Model was observed against the possible scenarios deriving from these sets of conditions. The discussion under Internal Validity below contains the details of the results of these observations. These observations confirmed an acceptable amount of accuracy of the Model as logically and reasonably expected from its behaviour within the given sets of conditions of case-studies. Accordingly, in each case-study scenario the outcome (i.e. the optimum MDA) produced by the Model was reasonably compliant with the applicable project circumstances.

To the extent that all these results were satisfactory, sufficient confidence is obtained that the Model's output behaviour has the accuracy required for its intended purpose over the area of its intended applicability.

11.6 Internal Validity

The key focus in internal validity is causal relationship. Robson (2002, p 103) argued *"If a study can plausibly demonstrate this causal relationship between treatment and outcome, it is referred to as having internal validity"*. Thus, it is necessary to examine whether the inputs fed into the Model application do actually produce the intended output (i.e. the optimum MDA) as to its main purposes. For Internal Validity Sargent (1996) suggested several replications (runs) of a stochastic (a randomised) Model to determine the amount of (internal) stochastic variability in the Model. Accordingly, several iterations of Model (runs) were carried out with varying scenarios that could be probable in construction projects, satisfying such Internal Validity requirements. On the other hand, as a criterion for validity 'accuracy' is described as measuring how correct does the outcome of the system match reality or expectations and the correctness *"is measured by comparing the number of correct answers against known answers"* (Awad,1996, p.387).

Table 11.19 below illustrates eight potential case scenarios of DM's decision making input. (As mentioned above, the Case 1 scenarios are as same as the case-study used in explaining the functions of the Model in Chapter 10). The 'Decision Maker's Input' depicts the options available in the pull-down menu of the Model at Step III of its functioning (see Figure 10.6). The column entitled 'In favour' shows the particular MDAs qualified for a positive 'scoring', after being affected by the respective input of the DM. The column entitled 'Against' shows the particular MDAs that earned a negative 'score', in view of the respective input of the DM. A blank cell depicts that any effect of the DM's input is neutral.

Table 11.20 indicates the respective scoring of each MDA based only on the 'effects' shown in Table 11.19 (i.e. manually predicted effects). The MDA which gets the highest net score is ranked 1st, i.e. the predicted most optimum MDA, and so on.

Table 11.21 contains the 'actual' ranks obtained by each MDA in the eight cases as a result of the application of the Model on each of the eight case scenarios with the respective input by DM (with the 'input' shown in Table 11.19 remaining constant).

Table 11.22 illustrates a comparison analysis between the 'actual' and 'predicted' ranks of each MDA in all eight cases. Accordingly, for selecting the optimum MDA the 'actual' and 'predicted' results are similar in 6 out of 8 cases. It is around 75% consistency rate. As for overall results, all 'actual' and 'predicted' results in 21 times out of total 32 comparisons are similar. This is generally a 66% consistency rate.

Further, the probability to have 21 similar results out of 32 comparisons was tested using Exact Binomial Probability test (Lowry, R. 2008). This test is expressed as:

$$P_{(k \text{ out of } N)} = \frac{N}{k(N-k)} \; (p^k)\,(q^{N-k})$$

Where,

N = the number of comparisons

k= the number of similar results

p= the probability that similar results will occur on any particular comparison; and

q= the probability that similar results will not occur on any particular comparison.

(Note: For using Binomial Probability, where a Predicted Result tallies the corresponding result produced by the Module it is considered a positive outcome, whereas there is no tally between the two results, it is considered a negative outcome. Accordingly, there have been 21 'positive' outcomes and 11 'negative' outcomes out of the 32 comparisons).

Using MS Excel 2007 Binomial Distribution Analysis formula [BINOMDIST (21,32,0.5,0.5)]:

$P(\leq 21) = 0.9749487701$

Thus, the probability to have 21 or more similar results from 32 relative comparisons is:

$$\begin{aligned} P(\geq 21) &= 1 - (P<21) \\ &= 1 - (P(0) + P(1) + \ldots. + P(20)) \\ &= 1 - 0.9749487701 \\ &= 0.\ 0250212299 \end{aligned}$$

This result indicates that the probability of having this level of consistency in performance occurring by chance is significantly low. Therefore, the Model is considered *generally* consistent in its performance for the intended purpose.

This consideration is also consistent with the summary results of Table 11.15 which contained the experts' checking of the consistency of the Model's behaviour. Accordingly, 67% of the experts held that under changing input (i.e. changing varying project circumstances) the Model's output was *very* consistent and accurate for the intended purposes of the Model; the remaining 33% were in the opinion that output was *generally* consistent and accurate for the intended purposes. Thus, although the panel of experts was limited to nine members these findings have not only confirmed the results of comparative analysis described above, but also are indicative of a certain amount of generalisation (albeit to an extent limited to the expert panels' input) and particularly of the consistency and accuracy of the Model for its intended purpose, i.e. objective selection of the optimum MDA under project-specific circumstances. Nevertheless, due to the relatively low number of these iterations further external validation of the Model would be required to measure a level of wider generalisation through future research, covering a wider participation of external practitioners in its application in real-life circumstances.

Robson (2002) argued that Internal Validity could be established when the identified inputs within the Model attributes are actually producing the expected output. Thus, these results confirm that the anomalies between the predicted and actual outcomes of the Model performance in each possible combination are significantly minimum. These replications have also plausibly demonstrated that the Model's consistency in rational outcomes (causal relationship between input and output) is highly satisfactory, and thus having a sufficient internal validity.

Table:11. 1 Model Replication for Internal Validation – Model Development Process

Attributes		Decision Maker's Input (Case 1)	In favour	Against	Decision Maker's Input (Case 2)	In favour	Against	Decision Maker's Input (Case 3)	In favour	Against	Decision Maker's Input (Case 4)	In favour	Against
1.1.1	Concurrency is defined in the contract	'No'	-	-	'Yes'	IAP, CAB, TIA	-	'No'	-	-	'Yes'	IAP, CAB, TIA	-
1.1.2	Float ownership is defined in the contract	'Yes'	IAP, CAB, TIA	-	'No'	-	-	'Yes'	IAP, CAB, TIA	-	'No'	-	-
1.2	Longest Path Approach defined in the contract	'No'	-	-	'Yes'	IAP, TIA	APvAB, CAB	'No'	-	-	'Yes'	IAP, TIA	APvAB, CAB
2.1	Value of the project	'High'	CAB, TIA	APvAB, IAP	'Low'	APvAB, IAP	-	'Moderate'	-	-	'Moderate'	-	-
2.2	Size of the project	'Medium'	-	-	'Large'	CAB, TIA	APvAB, IAP	'Small'	APvAB, IAP	-	'Small'	APvAB, IAP	-
2.3	Duration of the project	'Medium'	-	-	'Long'	CAB, TIA	APvAB, IAP	'Short'	APvAB, IAP	-	'Short'	APvAB, IAP	-
2.4	Status (prevailing stage) of the project	'Completion' stage	CAB	-	'Early' stage	APvAB, IAP	CAB	'Intermediate' stage	-	CAB	'Intermediate' stage	-	CAB
2.5	Complexity of the project	'Highly Sophisticated'	CAB, TIA	APvAB, IAP	'Simple'	APvAB, IAP	-	'Moderate'	-	-	'Moderate'	-	-
3.1	Amount of time claimed	'Moderate'.	-	-	'Large'.	CAB, TIA	-	'Small'.	APvAB, IAP	-	'Small'.	APvAB, IAP	-
3.2	Amount of cost (of prolongation) claimed	'Moderate'.	-	-	'Large'.	CAB, TIA	-	'Small'	APvAB, IAP	-	'Small'	APvAB, IAP	-
3.3	Number of events claimed and to be analysed	'Many'	CAB, TIA	-	'Few'	APvAB, IAP	-	'Moderate'	-	-	'Moderate'	-	-
3.4	Obscurity and sophistication of issues in prolongation claims	'Complexed'	CAB, TIA	APvAB, IAP	'Simple'	APvAB, IAP	-	'Moderate'	-	-	'Moderate'	-	-
4.1	Baseline programme availability	'Yes'	APvAB, IAP, TIA	-	'No'	-	APvAB, IAP, TIA	'Yes'	APvAB, IAP, TIA	-	'No'	-	APvAB, IAP, TIA
4.2	Baseline programme type (e g CPM)	'Yes'	IAP, TIA	-	'No'	-	IAP, TIA	'Yes'	IAP, TIA	-	'No'	-	IAP, TIA

4.3	As-built periodical updates of programme	'Yes'	TIA	-	'No'	-	TIA	'Yes'	TIA	-	'No'	-	TIA
4.4	As-built periodical updates of programme - mutually agreed -	'Yes'	TIA	-	'No'	-	TIA	'Yes'	TIA	-	'No'	-	TIA
4.5	Availability of other records (e.g. Daily records etc.)	'Yes'	CAB	-	'No'	-	CAB	'Yes'	CAB	-	'No'	-	CAB
5.1	High quality of transparency (clearly established causation)	'Yes'	IAP, CAB, TIA	-	'No'	-	-	'Yes'	IAP, CAB, TIA	-	'No'	-	-
5.2	Need of showing concurrent delays/ mitigation	'Yes'	APvAB, CAB, TIA	-	'No'	-	-	'Yes'	APvAB, CAB, TIA	-	'No'	-	-
5.3	Need to illustrate isolated delay effects	'No'	-	-	'Yes'	CAB, TIA	APvAB, IAP,	'No'	-	-	'Yes'	CAB, TIA	APvAB, IAP,
5.4	Need of sequential (chronological) analysis	'No'	-	-	'Yes'	IAP, CAB, TIA	APvAB	'No'	-	-	'Yes'	IAP, CAB, TIA	APvAB
6.1	Expert skills (for analysis method)	'Yes'	CAB, TIA	-	'No'	APvAB, IAP,	CAB, TIA	'Yes'	CAB, TIA	-	'No'	APvAB, IAP,	CAB, TIA
6.2	Concern for cost of analysis method	'No'	-	-	'Yes'	APvAB, IAP,	CAB, TIA	'No'	-	-	'Yes'	APvAB, IAP,	CAB, TIA
6.3	Concern for time to be spent for analysis	'No'	-	-	'Yes'	APvAB, IAP,	CAB, TIA	'No'	-	-	'Yes'	APvAB, IAP,	CAB, TIA
7.0	Need to be readily admissible in arbitration/litigation	'Yes'	CAB, TIA	APvAB, IAP	'No'	-	-	'Yes'	CAB, TIA	APvAB, IAP	'No'	-	-

Table 11.20 Model Replication For Internal Validation – Model Development Process (contd.)

Attributes		Decision Maker's Input (Case 5)	In favour	Against	Decision Maker's Input (Case 6)	In favour	Against	Decision Maker's Input (Case 7)	In favour	Against	Decision Maker's Input (Case 8)	In favour	Against
1.1.1	Concurrency is defined in the contract	'No'	-	-	'Yes'	IAP, CAB, TIA	'No'	'No'	-	-	'Yes'	IAP, CAB, TIA	-
1.1.2	Float ownership is defined in the contract	'Yes'	IAP, CAB, TIA	-	'No'	-	'Yes'	'Yes'	IAP, CAB, TIA	-	'No'	-	-

1 2	Longest Path Approach defined in the contract	'No'	-	-	'Yes'	IAP, TIA	'No'	'No'	-	-	'Yes'	IAP, TIA	APvAB, CAB
2 1	Value of the project	'Low'	APvAB, IAP	-	'High'	CAB, TIA	'Low'	'High'	CAB, TIA	APvAB, IAP	'Low'	APvAB, IAP	-
2.2	Size of the project	'Large'	CAB, TIA	APvAB, IAP	'Medium'	-	'Large'	'Medium'	-	-	'Large'	CAB, TIA	APvAB, IAP
2.3	Duration of the project	'Long'	CAB, TIA	APvAB, IAP	'Medium'	-	'Long'	'Medium'	-	-	'Long'	CAB, TIA	APvAB, IAP
2 4	Status (prevailing stage) of the project	'Early' stage	APvAB, IAP	CAB	'Completion' stage	CAB	'Early' stage	'Completion' stage	CAB	-	'Early' stage	APvAB, IAP	CAB
2 5	Complexity of the project	'Simple'	APvAB, IAP	-	'Highly Sophisticated'	CAB, TIA	'Simple'	'Highly Sophisticated'	CAB, TIA	APvAB, IAP	'Simple'	APvAB, IAP	-
3 1	Amount of time claimed	'Large'.	CAB, TIA	-	'Moderate'.	-	'Large'.	'Large'.	CAB, TIA	-	'Moderate'.	-	-
3 2	Amount of cost (of prolongation) claimed	'Large'.	CAB, TIA	-	'Moderate'.	-	'Large'.	'Large'.	CAB, TIA	-	'Moderate'.	-	-
3 3	Number of events claimed and to be analysed	'Few'	APvAB, IAP	-	'Many'	CAB, TIA	'Few'	'Few'	APvAB, IAP	-	'Many'	CAB, TIA	-
3.4	Obscurity and sophistication of issues in prolongation claims	'Simple'	APvAB, IAP	-	'Complexed'	CAB, TIA	'Simple'	'Simple'	APvAB, IAP	-	'Complexed'	CAB, TIA	APvAB, IAP
4.1	Baseline programme availability	'Yes'	APvAB, IAP, TIA	-	'No'	-	'Yes'	'No'	-	APvAB, IAP, TIA	'Yes'	APvAB, IAP, TIA	-
4 2	Baseline programme type (e.g. CPM)	'Yes'	IAP, TIA	-	'No'	-	'Yes'	'No'	-	IAP, TIA	'Yes'	IAP, TIA	-
4 3	As-built periodical updates of programme	'Yes'	TIA	-	'No'	-	'Yes'	'No'	-	TIA	'Yes'	TIA	-
4.4	As-built periodical updates of programme -mutually agreed -	'Yes'	TIA	-	'No'	-	'Yes'	'No'	-	TIA	'Yes'	TIA	-
4.5	Availability of other records (e g Daily records etc)	'Yes'	CAB	-	'No'	-	'Yes'	'No'	-	CAB	'Yes'	CAB	-
5.1	High quality of transparency (clearly established causation)	'Yes'	IAP, CAB, TIA	-	'No'	-	'Yes'	'No'	-	-	'Yes'	IAP, CAB, TIA	-
5 2	Need of showing concurrent delays/ mitigation	'Yes'	APvAB, CAB, TIA	-	'No'	-	'Yes'	'No'	-	-	'Yes'	APvAB, CAB, TIA	-
5 3	Need to illustrate isolated delay effects	'No'	-	-	'Yes'	CAB, TIA	'No'	'Yes'	CAB, TIA	APvAB, IAP,	'No'	-	-
5 4	Need of sequential (chronological) analysis	'No'	-	-	'Yes'	IAP, CAB, TIA	'No'	'Yes'	IAP, CAB, TIA	APvAB	'No'	-	-
6 1	Expert skills (for analysis method)	'Yes'	CAB, TIA	-	'No'	APvAB,	'Yes'	'No'	APvAB,	CAB,	'Yes'	CAB,	-

						IAP,			IAP,	TIA		TIA	
6.2	Concern for cost of analysis method	'No'	-	-	'Yes'	APvAB, IAP,	'No'	'Yes'	APvAB, IAP,	CAB, TIA	'No'	-	-
6.3	Concern for time to be spent for analysis	'No'	-	-	'Yes'	APvAB, IAP,	'No'	'Yes'	APvAB, IAP,	CAB, TIA	'No'	-	-
7.0	Need to be readily admissible in arbitration/litigation	'Yes'	CAB, TIA	APvAB, IAP	'No'	-	'Yes'	'No'	-	-	'Yes'	CAB, TIA	APvAB, IAP

Table:11. 2 Model Replication For Internal Validation – Predicted Results

MDA	CASE-1				CASE-2				CASE-3				CASE-4				CASE-5				CASE-6				CASE-7				CASE-8			
	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK	+	-	NET	RANK
AS PLANNED VS AS BUILT	2	4	(2)	4	8	6	2	2	6	1	5	3	7	4	3	2	7	3	4	3	3	7	(4)	4	5	4	1	3	5	5	0	4
IMPACTED AS PLANNED	4	4	0	3	10	5	5	1	8	1	7	2	10	3	7	1	9	3	6	2	6	6	0	3	6	4	2	2	8	4	4	3
COLLAPSED AS BUILT	11	0	11	2	7	6	1	3	6	1	5	3	3	6	(3)	3	5	1	4	3	8	5	3	1	8	4	4	1	10	2	8	2
TIME IMPACT ANALYSIS	13	0	13	1	8	7	1	3	9	0	9	1	4	7	(3)	3	13	0	13	1	8	7	1	2	7	7	0	4	14	0	14	1

Table:11. 3 Model Replication For Internal Validation – Actual Results

ANALYSIS METHOD (MDA)	CASE-1 AGGREG-ATED VALUE	RANK	CASE-2 AGGREG-ATED VALUE	RANK	CASE-3 AGGREG-ATED VALUE	RANK	CASE-4 AGGREG-ATED VALUE F	RANK	CASE-5 AGGREG-ATED VALUE	RANK	CASE-6 AGGREG-ATED VALUE	RANK	CASE-5 AGGREG-ATED VALUE	RANK	CASE-6 AGGREG-ATED VALUE	RANK	CASE-7 AGGREG-ATED VALUE	RANK	CASE-8 AGGREG-ATED VALUE	RANK
AS PLANNED VS AS BUILT	0.7317	4	0.7276	2	0.8397	4	0.7964	2	0.7964	4	0.6884	2	0.7964	4	0.6884	2	.7940	2	.6654	4
IMPACTED AS PLANNED	0.7883	3	0.8258	1	0.8963	2	0.8946	1	0.8275	3	0.7866	1	0.8275	3	0.7866	1	.8127	1	.8015	3
COLLAPSED AS BUILT	0.9555	2	0.5644	3	0.8931	3	0.5680	3	0.8895	2	0.6304	3	0.8895	2	0.6304	3	.6783	3	.8416	2
TIME IMPACT ANALYSIS	0.9801	1	0.5237	4	0.9516	1	0.5358	4	0.9395	1	0.5643	4	0.9395	1	0.5643	4	.5411	4	9626	1

Table:11. 4 Model Replication For Internal Validation – Predicted Results vs Actual Results

ANALYSIS METHOD (MDA)	CASE-1		CASE-2		CASE-3		CASE-4		CASE-5		CASE-6		CASE-7		CASE-8	
	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank	Predicted rank	Actual rank
AS PLANNED VS AS BUILT	4	4	2	2	3	4	2	2	3	4	4	2	3	2	4	4
IMPACTED AS PLANNED	3	3	1	1	2	2	1	1	2	3	3	1	2	1	3	3
COLLAPSED AS BUILT	2	2	3	3	3	3	3	3	3	2	1	3	1	3	2	2
TIME IMPACT ANALYSIS	1	1	3	4	1	1	3	4	1	1	2	4	4	4	1	1

Accuracy of prediction (overall) = 21 out of 32 times ; Accuracy of prediction (Selection of optimum MDA) = 6 out of 8 times.

11.7 External Validity

External validity of the developed Model may refer to the extent to which its results can be generalised or extrapolated beyond the immediate research sample or setting in which the research took place. In this instance, it was subject to the external validity through the panel of independent experts as described previously in this Chapter. According to the results of this evaluation, the panel of experts found a high rate of consistency of the Model's output under changing circumstances (input) through conducting several iterations of varying scenarios and circumstances (ref. Table 11.15 above). Thus, to this extent, it may be observed that the Model has produced generalised findings under varying circumstances and scenarios, though at a lower level than one would have expected the level of generalisation in a pure scientific research outcome, as discussed under item 10.7.3 of Chapter 10.

11.8 Data Validity

The Data Validity, which is usually not considered to be part of Model validation (Sargent, 1996, 2010), is generally related to the Framework/Model development and its input/output data, and has mainly to concern about the correct procedures adopted for collection of data and testing of their outcome. The knowledge acquisition for developing the 2 main components of the Framework was carried out through the literature review, semi-structured interviews and an in-depth survey. Under section 3.7 'Data Reliability and Validation' (see Chapter 3 – 'Data Collection & Analysis'), the reliability and validity of the data collected through these instruments have already been discussed in detail; the robustness of the instrument of knowledge acquisition was also demonstrated in the findings of the data analysis (see Chapter 8, and Appendices A & B) which revealed a high level of convergence between the findings of literature review, interviews and survey merged results. Therefore, these already addressed issues are not repeated here.

11.9 Academic Validity

During the research study a conference paper and a journal paper (see Table 11.23 below) were prepared and published to disseminate the research methodology adopted in this study and the conceptual frame work used for the Model for selection of optimal MDA. Utilising the avenue of such academic work was purposefully done in order to obtain necessary feedback from the academics as well as the practitioners who were involved in the sphere of research issues. This was also to serve the purpose of academic validity required for the research outcome. These papers were peer-reviewed and their content was open to be challenged. Any criticism was carefully evaluated and where necessary used to improve the robustness of the research outcome. This open dissemination of the research work and the academic validity gained through peer-reviews and the acceptance for publication of the papers gave substantial credibility to the research outcome.

Table:11. 24 Dissemination of research

Related Chapters	**Publication**
Research methodology (Chapter 2)	Perera, N and Sutrisna, M. (2010a), Research Methodological Position For A Doctoral Study On Apportioning Liability In Delay Claims, *In:* 5th Scientific Conference On Project Management (SCPM) Conference On *Concepts, Tools & Techniques For Managing Successful Projects*, 29-31 May 2010, Hereklion, Crete, Greece, pp. 601-608.
A Model for Selecting Optimum Delay Analysis Method (Chapter 10)	Perera, N and Sutrisna, M. (2010b), The Use of Analytic Hierarchy Process (AHP) in the Analysis of Delay Claims in Construction Projects in the UAE, *In: The Built & Human Environment review*, Volume 3, Special Issue 1. 2010, pp. 29-47

11.10 Summary

Based on the findings of the literature review (Chapters 4-7) and the convergent results of the semi-structured interviews and in-depth survey (Chapter 8, Appendices A & B) a comprehensive 'Framework of Improvements' (Chapter 9) has been submitted as the outcome of this research study. This 'Framework' consists of 2 main components:

1. The improvements to be adopted through changes to contract documentation and procedures (Chapter 9); and
2. The improvements to the process of selection of a MDA (i.e. the optimum and most appropriate MDA under specific circumstances of a construction project) which is presented in the form of a 'Model' (Chapter 10).

In order to report with confidence and credibility of this outcome, it was essential to evaluate these instruments. This evaluation has been carried out through a process of *reliability* and *validation* in the foregoing discussion of this Chapter.

The test results for the *reliability* of the instrument used for developing the Model indicated substantially higher Inter-Rater Reliability and Intra-Class Correlation Coefficient. The entity of *reliability* was considered related to *validity* and both may influence each other.

The evaluation for *validity* has involved independent external panel of experts which has generally dealt with Face Validity and Content Validity of both components following a survey approach, while an Internal Validity test was undertaken as to the development phase of the Model component. The issues of External Validity, Reliability and Academic Validity have also been addressed in the discussion.

In conclusion, the findings of the *reliability* and *validation* have significantly confirmed that the developed Model would perform as it has been intended and according to the purposes with an acceptable level of accuracy. The Model has substantially met its intended requirements in terms of the methods adopted in its development and the results obtained through several iterations of running the Model under varying sets of project-specific circumstances. As to the 'improvements suggested to the contract documents and practices' of the Framework, the findings of the independent panel of experts have confirmed their representativeness of the best practice standards and adaptability as the intended purposes though it may 'take time' to prove its usefulness and acceptance by the local industry.

Also, these findings have generally substantiated the research proposition that '*The problem situations in the contemporary practices can be reduced by developing a suitable framework for improving consensus and uniformity among the DMs for appropriate application of essential theory, concepts and delay analysis methodology*'.

CHAPTER TWELVE

12.0 Conclusions and Recommendations

12.1 Introduction

Delay claims resolution has an essential role for conclusion of projects. Its process is centred on the apportioning of liabilities between the claiming party and the defending party. This process consists of two phases of causation: (1) establishing each party's potential liability for the claimed occurrence, and (2) determining the quantum of the 'effect' flowing from that liability. The degree of success of the process depends on the extent of acceptability by the parties of the outcome of this apportioning. However, the domain literature shows a situation of varying theories and legal positions on convoluted issues and it has mainly contributed to a lack of consensus among the practitioners on the theories, concepts and methods to be applied for this apportioning. Such uncertainty is exacerbated by intuitive measures adopted by the practitioners.

The findings of a Pilot Study and initial peer discussions revealed that this situation desperately required improvements to the contemporary local practices to make the delay claims resolution process less contentious and to minimise the negative effects of its problems. Although there were some studies in the past related to construction claims in the regional context, a clear need was present to examine the delay claims phenomena more comprehensively and in-depth in order to develop such improvements in a structured manner. This research was undertaken in order to satisfy this need to some extent. Accordingly, the principal research aim and main objectives to achieve it were set at the beginning. Thus, the research inquiry was set out towards first investigating the current practises adopted in apportioning liabilities in delay claims resolution, and identifying possible problematic situations associated with such practices. On the findings of this investigation, and mainly informed by the literature review the research managed to develop a substantially reliable Framework of Improvements with the intention, at least, to minimise/reduce the negative effects of such problematic situations.

Thus, in this concluding Chapter, it would be necessary first to review those research objectives in terms of their accomplishment through the research findings and conclusions. This is followed by a discussion to review that to what degree the general research propositions have been confirmed by the research outcome. Following this, a further discussion is included as to the credibility of these findings, the limitations of the research and recommendations for future research towards developing continuous improvements to the domain's problem areas.

12.2 Research Objectives, Questions, Propositions and Outcome

As Chapter 1 has set out, the principal aim of this research study is, ***'to develop a Framework of Improvements through investigating the problems involved in the contemporary practices of apportioning liability in construction delay claims'.***

Towards achieving this principal aim, it also set out three main objectives. Through various phases of the research study, these objectives have now been substantially accomplished. In order to review these achievements the research objectives are revisited along with the research findings and outcomes, in the following discussion. This discussion also entails a review of how the research central questions have been answered and research propositions have been found by the outcome of research inquiry.

12.2.1 Review of Research Objectives

- **Objective no.1 - Investigating current practices in the local setting in relation to awareness, experience, and approaches as to theoretical, legal and methodological issues related to delay claims resolution process.**

  In order to fulfill this objective, the intended investigation has been carried out using both qualitative and quantitative methods of inquiry in mixed method approach. For the qualitative strand, semi-structured interviews of selected 10 experts/specialists were conducted. As to the quantitative approach, mainly an in-depth survey based on a comprehensive questionnaire was carried out among 74 respondents who were involved in delay claims resolution from both contracting and consulting (for developers) entities. All the questions in both strands were designed with the following intentions:

  - to gain factual and grounded understanding of how the apportioning of liabilities of parties is carried out from practitioners' perceptions, approaches and experience, in the resolution of delay claims, and
  - to investigate any problem situations encountered by practitioners in the process, how and why such problems occur, and what measures can be suggested to overcome their negative effects.

The captured data from both interview and in-depth survey were separately analysed with necessary rigour. Then, these analysed results were interpreted for necessary meaning of such results. Generally, this was done by interpreting the extent to which the two databases converge, whether inconsistencies, contradictions, differences or similarities were found, and what conclusions could be drawn from those differences or similarities. Chapter 8 ('Conclusions of Merged Results') has comprehensively summarised the findings of interviews and in-depth survey (see Appendices-A & B for a detailed discussion as to findings/analysis of interviews and survey data) and presented a detailed account of such convergence and divergence found among the practitioners awareness, experience as well as various practices on procedural issues related to delay claims resolution. These findings were also found substantially corroborated by the literature review.

Accordingly, this process enabled to form a significant repository of the performance of current local practices in terms of their awareness, experience, and approaches as to such theoretical, legal and methodology issues. In this case a synthesised account is given in Chapter 8, summarising the findings of interviews and in-depth survey.

Thus, the outcome of the successful accomplishment of this objective was the gaining of a comprehensive, in-depth understanding of the contemporary local practices in the resolution of delay claims. As found in the merged results of inquiry (ref. Chapter 8), the following findings have been salient in this understanding:

- The consensus among the practitioners as the theoretical aspects of the issues such as 'concurrent delays', 'Float ownership', theory of criticality in forensic scheduling, and generally on apportioning of liabilities in delay claims was found higher than anticipated; the majority of the respondents showed a high degree of agreement with SCL Protocol principles in this regard, albeit there was also a substantial minority holding dissenting views;
- The frequency of use of the MDAs by the practitioners was generally correlated to their level of awareness of the respective MDAs;
- More sophisticated MDAs were the least vulnerable when challenged while simpler methods were weak to defend;
- The majority of both Consulting Group and Contracting Group respondents considered the use of 'CPM based baseline programmes' of high priority; however, when it came to updating such programmes, the

Contracting Group did not attribute the same priority as the Consulting Group did;

- All respondents held that in practice the Contractors preferred and used less sophisticated MDAs in delay claims, and the Employers' consultants mostly preferred and used more robust and sophisticated MDAs in the assessment of the claims. This dichotomy paved the way to scepticism as to each others' selection of MDA / their results and to potential escalation of disputes to higher levels;
- The presence of conditions precedence as to procedures of claims submission (for giving 'Notice', submission of 'particulars' and so on) was very common in the bespoke contracts used in local practices; however, the contractors' compliance with conditions precedent was low and also there was a legal uncertainty on implementing prevention principle and conditions precedent;
- There was no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution;
- Major areas of problematic situations which may contribute towards escalating the existing disputes in delay claims to more advanced levels are identified.

- **Objective no.2 –Identifying potential problematic issues in these practices which may obstruct efficiency and fairness in delay claims resolution process.**

This objective was successfully accomplished as intended during the research inquiry through interviews and in-depth survey. Chapters 8 and 9, as well as Appendices A & B, have provided a detailed account of these problematic situations identified by the interviewees and the survey respondents. This eventually provided the knowledge-basis to build the suggested Framework of Improvements addressing those pressing issues in the real-life conditions of Decision Makers/Practitioners/ Experts. That apart, the knowledge acquired in this research inquiry provided a comprehensive data base as to the problematic issues arising from the current practices of delay claims resolution adopted in the local settings, which can be used by potential researchers. The main areas of those problematic situations are:

1. Disputes arising from analysis outcome.
2. Deficiency in claims submissions.
3. Non-availability of definitions.
4. Employer's undue influence.
5. Insufficient time for pre-contract design and documentation.
6. Promptness in assessment / settlement.
7. Dispute Resolution.

- **Objective no.3 - Incorporating existing body of knowledge into contemporary practices and views, to develop a robust Framework of Improvements in order to minimise/ reduce the negative effects of such problematic issues.**

This objective has been fulfilled through comprehensively suggested Best Practice Improvements to contract documentation and certain existing procedures. As graphically presented in Figure 9.1, the proposed 'Framework of Improvements' consists of two main components:

(1) The improvements to be adopted through changes to contract documentation and procedures which are presented through Chapter 9; and

(2) The improvements to the process of selection of a MDA (i.e. to select the optimum and most appropriate MDA under specific circumstances of a construction project); this is presented through Chapter 10 in the form of a 'Model'.

The whole of Chapters 9 has first described these suggested best practice improvements in a detailed manner, and presented a Matrix of the Framework of Improvements (see Table 9.3).

When these suggested improvements submitted for the evaluation by an independent panel of experts, although there was an overall confirmation of their adaptability, the majority (86%) of the experts cautiously stated that it might 'take time' for acceptance in the local settings (see Table 11.4). This means any immediate acceptance of the suggested improvements in the local practices would be an over-expectation, although in the long run it is a possibility. Thus, though this objective has been fulfilled, to see its full effects may 'take time' according to domain experts.

Apart from the Matrix of the Framework of Improvements, this objective has also been accomplished through the Model presented in Chapter 10. At the initial stages, through the findings of a Pilot Study and peer discussions, a need of improvements was identified in developing a Model in order to aid the practitioners for the selection of a defendable, objective, and most appropriate MDA under the specific circumstances of a project. This objective was formed accordingly. Subsequently, the findings of the literature review, interviews and the in-depth survey also firmly confirmed that many disputes would arise due to intuitive decision making in regard to MDA. Intuitive decisions which cannot be supported by tangible data and documentation may appear illogical and create disputes.

Thus, Chapter 10 presented some improvements to this particular problematic situation by developing the intended Model. It is based on a simulated process proposed for more objective decision-making in selection of optimum MDA. It, in fact, is the key component of the overall Framework of Improvements proposed in the research outcome. The Model has substantially met its intended requirements in terms of the methods adopted in its development and the results obtained through several iterations of running the Model under varying sets of project-specific circumstances. However, although the findings of the independent panel of experts have confirmed the Model's substantial accuracy and ability to deliver as intended, some expressed a reservation that "*in the short term the contribution would be limited as ... the scepticism/distrust between the parties to be deep rooted which would hinder in looking at the Model objectively*". Although this reservation may be justifiable, these kinds of constraints are beyond the ambit of the research; but the developed Model has nevertheless fulfilled the objective in the theoretical and technical terms.

Thus, having accomplished all three research objectives, it can be inferred that the research aim has been substantially achieved.

12.2.2 Response to Research Questions

In a previous discussion at Chapter 8 it was observed that, through fulfilment of the research objectives, the research inquiry had found satisfactory answers to the following two central research questions:

1) How convergent are the practitioners' perceptions and implementation of the theory and the methods of analysis applicable to the apportioning of liabilities in delay claims resolution?

2) What are the potential problematic situations arising from these perceptions, and methods?

The 'improvements' suggested mainly by the interviewees have been used in the developing a 'Framework of Improvements' as discussed in the Chapter 9 followed by the developed Model in Chapter 10. These proposed improvements are associated with the 'problematic situations' identified in the findings of both qualitative and quantitative strands. To this extent, it may be affirmed that the research inquiry has found answers to the third central research Qusetions as well, which is:

3) How can such problematic situations be dealt with through improvements to current practices?

12.2.3 Review of Research Propositions

Having initially developed from the peer discussions, the researcher's working environment, reflection on empirical experience in claims management and been further informed by the literature review and the findings of the Pilot Study, certain research propositions were formed as mentioned in Chapter 1. These propositions were as follows:

1. The tacit or explicit awareness on essential theory, concepts, legal position and Methods of Delay Analysis applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers);
2. In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust;
3. Generally, there is no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution;
4. Usually, there is a significant amount of undue pressure and interference from employer-organisations over the engineers (consultants) when determining the entitlement to extension of time;
5. The problem situations in the contemporary practices can be reduced by developing a suitable framework for improving consensus and uniformity among

the DMs for appropriate application of essential theory, concepts and delay analysis methodology.

It is necessary to observe how these propositions are either confirmed or rejected by the conclusions of the research inquiry. Chapter 8 ('Outcome of Merged Data Analysis and Discussion') has summarised the conclusions of the merged results of both qualitative and quantitative strands. Accordingly, based on the merged results and findings, item 8.6 has reported that the nos. 2, 3 & 4 of the above propositions have generally been confirmed by the conclusions of the merged results.

However, the conclusions of these merged results as to 'Awareness' have found somewhat differently with the research proposition no.1 of the above list. This is in view of that the overall merged results as to the awareness on delay claims theory indicated *a greater consensus among the majority* of the practitioners on the awareness on delay claims theory as to i) apportioning time and cost in concurrent delays, (ii) true concurrency' and 'concurrent effects, (iii) 'ownership of the float', (iv) measuring criticality, (v) automatic entitlement to extension of time for excusable delay after passing contract completion date, and (vi) effectiveness of various MDAs. However, the overall results also showed existence of a significant amount of dissension from a minority to the majority opinion among practitioners on the same issues. Thus, to the extent of this dissension, the research proposition that "The tacit or explicit awareness on essential theory, concepts, legal position and Methods of Delay Analysis applicable to delay claims resolution generally remains divergent among the practitioners of both sides" seems to have only *partially* been confirmed.

The remaining research proposition, i.e. no. 5 of the above list, is reviewed under the 'Credibility of Findings', which is discussed next.

12.3 Credibility of Findings

Chapter 11 has included a detailed account of the approaches used to evaluate the credibility of the main research outcome, which is the Framework of Improvements. This section below has briefly overviewed the findings of those approaches. In addition to that, the validity of overall data obtained through the interviews and in-depth survey has been discussed in detail under item 3.7 of Chapter 3.

12.3.1 Reliability and Validity

The research's main outcome is the Framework of Improvement as described before. In order to report with confidence and credibility of this outcome, it was essential to evaluate its components. The two main components of the Framework are:

1. The improvements to be adopted through changes to contract documentation and procedures (Chapter 9); and
2. The improvements to the process of selection of a MDA (i.e. the optimum and most appropriate MDA under specific circumstances of a construction project) which is presented in the form of a Model (Chapter 10).

The selected technique for this evaluation was *reliability* and *validation.*

In this case the validation of the component no.1 was carried out with 'Face Validity' and 'Content Validity' tests as the improvements contained in it were qualitative type. As for the Model component, along with these two tests, 'Internal Validity' test was also carried out following a reliability test.
For both components, due to the constraints and reservations as to immediate adaptability in local practices the External Validity test was limited to an evaluation by an independent panel of experts which conducted an independent Face Validity and Content Validity tests for both components.

Having examined the characteristics of four general categories of reliability test, the tests of Inter-Rater Reliability and Internal Consistency were selected and carried out. Table 11.1 shows the summary results of these two tests. These summarised results indicated that with reference to the ratings obtained from the two Groups of practitioners for the respective data, generally, the Intra-Class Correlation Coefficient (or Inter-Rater Reliability) at 95% (or higher) Confidence Interval was 0.89 ($P<.001$, $N=201$, $df=200$) with Cronbach's α 0.94.

A reliability coefficient of 0.70 or higher is considered acceptable for consistency estimates of Inter-Rater Reliability (Barrett, 2001). As indicated in these summarised results, the other ratings received from the survey-respondents as to the foregoing are also within or well above this acceptable margin.

The panels of experts which conducted 'Face Validity' and 'Content Validity' tests constituted 7 and 9 members respectively for component no.1 and no.2 of the Framework of Improvements. As shown in Table 11.2 ('Details of Experts'), these members were highly qualified, both academically and professionally, and well experienced in the domain. The summary results of this evaluation can be found under Table 11.3 to Table 11. 7. According to these test results, it is evident that the suggested 'Improvements' to be adopted through changes to contract documentation and procedures have highly satisfied the expert panel in terms of clarity and readability, potential adaptability (subject to a 'long term' possibility), breadth of knowledge of domain represented, accuracy and credibility of the knowledge represented, and the ability to achieve the 'effects' intended. Accordingly, these results have significantly established their Face and Content validity.

As to the Model component, the summary results of the Face Validity and Content Validity can be found from Table 11.8 to 11.19. According to these test results, it is evident that the suggested 'Improvements' to the process of selection of a MDA through application of the Model have satisfied the expert panel in terms of simplicity, comprehensiveness and clarity of the content, accuracy in performance, representativeness of the breadth of domain knowledge, accuracy and credibility of the knowledge represented, suitability of the constructs, consistency of performance and the ability to achieve the 'effects' intended. Therefore, these results have significantly established the Face Validity and Content validity of the suggested improvements through the Model.

As established in the above outcomes of reliability and validity tests, it can be said that this evaluation has ~~also~~ been significantly fulfilled, and the tests observed the developed Framework and Model have the potential to serve the intended purposes. These results also seem to have endorsed the research proposition that '*the problem situations in the contemporary practices can be reduced by developing a suitable framework for improving consensus and uniformity among the DMs for appropriate application of essential theory, concepts and delay analysis methodology*'. However, a wider success of the suggested 'Improvements' will have to be seen only after their possible integration into the local practices in the long run.

12.4 Originality of Contribution

Research contribution can be basically described as what it adds that is new, apart from what has already been there in the domain knowledge. Such contribution can be demonstrated in several ways namely, addition of knowledge that is currently lacking, resolving a theory conflict, specifying more detail about that already known, or summarising current work (Whitworth, 2009). As discussed in Chapter 1 there have also been some other studies related to construction claims in the regional context and elsewhere, but the body of knowledge as to the contemporary local practices and their problem situations related to delay claims resolution can be considered insufficient and lacking. Thus, a clear need was there for examining the delay-claims phenomena in a structured and more comprehensive in-depth manner in order to understand the current practices, their problematic issues and to develop possible improvements to make the resolution process more efficient, consensual and less contentious, minimising the negative effects of its problems.

In fulfilling this need, this research has contributed new knowledge to the domain, specifying in more detail about that already known, and in doing so also synthesised best practice domain knowledge and standards with the contemporary practices in the form of suggested 'Framework of Improvements'.

Accordingly, the major contributions of originality from this research study to the existing domain knowledge of the delay claims and resolution discipline are presented as follows:

- Developing and presenting a 'Framework' of best practice improvements to contract documentation and contemporary practices in order to minimise/ reduce the negative effects of identified problematic issues that exist in the local practices of delay claims resolution;
- Developing and presenting a user-friendly, robust decision-making Model to enable practitioners (Decision Makers) to objectively and reliably select the optimum Method of Delay Analysis (MDA) appropriate to a given set of project-specific circumstances; as there is no universally acceptable MDA in industry, this would enable practitioners to defend the selected MDA on a stronger basis of objectivity if challenged against the outcome of the delay analysis.

- Building a comprehensive data base through semi-structured interviews and an in-depth survey as to current practices of delay claims resolution adopted in the local settings, which can be used by potential researchers;
- Establishing a wide knowledge base of essential theory and practice in delay claims resolution, including latest case law in the UK and US jurisdictions, which can be used as a repository by the practitioners and potential researchers;
- A comprehensive summary of primary methods of delay analysis, their mechanisms, strengths and weaknesses which can be used by practitioners as a basis of reference and check-list;

12.5 Ethical Issues

For conducting research, Fontana and Frey (1994) identified three main traditional ethical considerations which are:

(1) *Informed consent*, that is the consent is received from the subject after he/she has been carefully and truthfully informed about the research;

(2) Right to privacy, that is protecting the identity of the subject; and

(3) Protection from harm- physical, emotional or any other kind.

The main inquiry strategy of this research was based on interviews and surveys, and from the design stage of interviews and survey questionnaire these topics were seriously considered.

Accordingly, to all potential interviewees and survey participants a letter was individually delivered to obtain his/her 'informed consent' for the participation (templates of these letters are included in Appendix-E). These letters clearly explained the purpose of the interview or survey and of the data to be collected. A typical statement included in these letters was *"This consent is sought on a written undertaking by me, as the researcher, that the use of all such data is for academic purpose only, and the collection, analyzing, and disseminating the results of data will be used strictly confidential, without being detrimental to the participant in any way and within the Data Protection (Amendment) Act –UK (2003)"*. Thus, the purpose of the collection of the data was clearly informed and there was no feeling of deception. This undertaking given to the interviewees and the survey participants, including the protection of confidentiality and anonymity undertaken for their 'right to privacy', has been strictly adhered to in the reporting of findings and results of the research.

In addition, every time prior to beginning of an interview, the subject was informed that the interview had to be audio-recorded and any time if he/she needed it could be stopped. This was aimed to eliminate any mental pressure on the interviewee for expressing his/her genuine observations and experience. On the other hand, there was no pressure at all on the subjects to participate either in interviews or surveys.

In the data collection phase, the semi-structured interview questions and the survey questionnaire were designed with due consideration to ethical issues. There was not a single question in either form which could have been unduly influential or harmful to the interviewees/survey-respondents physically, emotionally or any other kind. All questions were clearly presented within the stated purpose of the inquiry.

The ethical issues for this research have been evaluated and approved by the Research Governance and Ethics Committee of the University of Salford.

12.6 Limitation of Research Contribution

The main focus of this research is on apportionment of liabilities in delay claims and as Chapter 1 mentioned the study, therefore, is limited to apportionment of liability in the claims for *delay*. Accordingly, there are certain associated issues which have been excluded from the current study. Thus, the procedures involving prolongation 'cost' claims are purposely excluded from the scope of the research. This is because only after the resolution of apportionment of liability for 'delay' that the issue of 'compensability' for such delay would be relevant. On the other hand, the research scope also excluded the issues related to 'disruption' which is defined in the literature (SCL Protocol, 2002) as disruption to progress instead of disruption to completion, and hence to be independent of prolongation claims.

With regard to the developed Model, the main potential constraint is deriving from the input of the respondents to the in-depth survey. The process of Weighted Averages and their Normalised Weights has converted the raw data collected from the respondents' ratings (of relative importance among Criteria and Attributes) into dimensionless and comparable common numerical scaling system. However, the original ratings have entirely been determined by the varied individual perceptions and experience of the respondents, and the competence of their judgments. As these are largely determined by psychological constructs, the original ratings have the potential to inherit a degree of inconsistency, depending on the coherence of the sampling frame involved in the in-depth survey; to that extent the final outcome of the Model may be affected by subjectivity, regardless that there was a significant level of concordance between the rankings of both Groups of survey respondents.

A further limitation to the suggested Framework of Improvements is the potential 'resistance' for its adaptability in the local practices. This issue is currently limiting its external validation only to a panel of independent experts. Ideally, for measuring its ability to generalise, a wider use by independent practitioners is required. However, as expressed by the panel of experts such acceptance may 'take time' due to potential reluctance to change the existing practices.

12.7 Recommendations for Future research

The following can be identified as areas of further research and improvement required, based on the potentials revealed through this study.

- The claims for prolongation costs and 'disruption' claims have been excluded from the research, as the main focus is on apportionment of liability in the 'time' claims. Particularly the 'disruption' claims would be considered as independent from prolongation claims, and therefore, they are considered not germane to this research inquiry. However, it is evident that most of the theory and concepts related to 'time' issues are intrinsically related to the 'cost' issues though the determining rules could be different. For example, entitlement to 'time' may be on estimated basis but as for 'cost' it is invariably on actual basis (SCL Protocol, 2002). Therefore, further exploration and study can be conducted focusing on the contemporary local practices and their potential problems as to resolution of claims for costs of 'prolongation' and 'disruption'. Such future research may allow a more complete repository covering both 'time' and 'cost' aspects of apportioning liability in delay claims.

- As mentioned before, the 'ratings' of the survey-respondents have provided a main mathematical basis for the function of the Model. However, as these are largely determined by psychological constructs of the individuals, the original ratings have the potential to inherit a degree of inconsistency. This may generally depend on the sampling frame. For example, there could be different perception on the level of attributable ratings/scores to Criteria and Attributes envisaged by a sample of practitioners beyond the immediate survey sample/settings.

  Therefore, future research would be required for continuous refinement or periodical development of the Model through conducting further inquiry to collect data from different sample of population. Such future research may confirm the coherence of the judgments of the current sampling frame, or find different judgement in different circumstances/parameters/ attribution of scores.

- The adaptability /integration of suggested Framework of Improvements into local practices seems to be a long-term task (as generally expressed by the panel of experts). However, in order to make the stakeholders/ practitioners aware of the existence of the Framework and its potential benefits it would be necessary to investigate the best means and avenues for its widest possible use and implementation. For this end, as a short-term measure, it is intended to introduce to the in-house top management with the aim of implementing it in the future construction projects in an incremental manner. That apart, a post-thesis study may be undertaken to explore the effective avenues for wider implementation of it among the external stakeholders/practitioners in the local settings. Such undertaking may be conducted in a wide range from journal papers to a comprehensive research study. The findings of such effort may also contribute to further refinement of the current Framework including further development of the Model.
- The theory of 'critical path' in forensic analysis of delays is inextricably linked with the issue of analysing concurrent delays and determining compensation. However, as observed in the literature review Chapter 5, the two theories involved, namely Longest Path and Total Float Value theory, may yield contrasting results particularly if the project (predicted) completion date is different from the prevailing contractual completion date in a given situation. Which theory is to be followed is a matter of the terms of contract. Time Impact Analysis based on the Longest Path approach is the preferred MDA by RPA-FSA (2007, 2009, 2011). However, there is virtually no reference/guidance in the published domain literature on what MDA is suitable when Total Float Value approach is to be followed, if necessitated by explicit or implicit terms of a contract. This absence of reference/guidance is much conspicuous in SCL Protocol, which otherwise seems to be much popular among the practitioners in the local settings. As it is clear that this aspect of the forensic delay analysis is not adequately addressed yet, it has become one major area that needs substantial future research.

12.8 Summary

This Chapter has presented a review of the main research objectives in terms of their accomplishment through the research findings and conclusions. This has been followed by a discussion to review that to what degree the general research propositions have been confirmed or otherwise by the research outcome. In this discussion it is clearly observed that the research outcome has *substantially* fulfilled the research aim through the largely accomplished research objectives.

Also it has now been confirmed that the three central research questions set out in Chapter 1 have been fairly answered in a positive manner, through the findings and the results discussed in Chapter 8 as well as by the best practice Framework for Improvements proposed in Chapter 9 and the simulated Model presented in Chapter 10.

In this Chapter a further discussion is also included as to the credibility of the research findings, the limitations of the research contribution and recommendations for future research towards continuous improvements to the domain issues.

In summary, the main outcome of the research has been a 'Framework of Improvements' developed on the existing domain knowledge and the research findings; it has aimed at providing best practice improvements to certain problem situations in delay claims resolution process which were identified through the research inquiry. Towards achieving the principal research aim by implementation of this 'Framework', it is expected enabling consensus and uniformity among the practitioners of either side for appropriate application of essential theory, concepts and delay analysis methodology.

The components of this Framework have been subject to necessary validation. Consequently, it can reliably be used by the practitioners in order to minimise/ reduce escalation of disputes and enhance efficiency and fairness in delay claims resolution process. Thus, if consciously implemented, it has the potential to bring forth substantial corporate benefits to both employers and contractors, by eliminating waste of time and money in unnecessary disputes in delay claims resolution process. Apart from this major outcome, the research has also contributed to the domain knowledge by providing a comprehensive data base as to the current practices of delay claims resolution adopted in the local settings. The study has also established a knowledge base of essential theory, legal position and practice in delay claims resolution, which can be used as a repository by practitioners and potential researchers.

In conclusion, it can be stated that this research study has substantially fulfilled the research objectives and its main aim, and made significant contributions to the existing knowledge of the delay claims resolution domain, while presenting potential means of substantial corporate benefits to the stakeholders involved in the process of delay claims resolution.

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APPORTIONING LIABILITY IN CONSTRUCTION DELAY CLAIMS: AN EVALUATION OF CONTEMPORARY PRACTICES IN THE U.A.E. AND A PROPOSAL FOR IMPROVEMENTS

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VOLUME 2 OF 2

November 2012

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(ANALYSIS OF INTERVIEW RESULTS & ASSOCIATED TABLES)

APPENDIX – A

A.0 THE INTERVIEW RESULTS

A.1 Introduction

These interviews were semi-structured in nature, but the interviewees were allowed, in an inductive style, to express their views even on themes that were peripheral to the research. The main purpose of the interviews was to capture these expert practitioners' views, perceptions and experience on topics inquired within the main themes, having a focus on individual meaning and the importance of rendering the complexity of a situation. On the other hand, the data captured through these interviews permitted the expected triangulation as the main advantage of employing mixed methods which is the chosen inquiry strategy for this study. Consequently, in a complementary fashion, these data are expected to be used to enhance interpretability of statistical analysis of the data collected through the in-depth survey-questionnaire. As the purpose to examine in the 'triangulation' is to see whether these interview results complement (or otherwise) to the in-depth survey results, a broader perspective to interview data analysis is applied and the 'patterns and trends' of the views/perceptions and approaches of the interviewees are evaluated using generally a supportive/non-supportive (or confirmative/ non-confirmative) dichotomy.

These semi-structured interviews were conducted with the main purposes of

- Gaining factual and grounded understanding of how the apportioning of liabilities of parties is carried out from practitioners' perceptions, approaches and experience, in the resolution of delay claims, and
- Investigating any problematic situations encountered by practitioners in the process of such apportioning of liabilities, how and why such problems occur, and what measures can be suggested to overcome their negative effects through improvements to the current practices.

These purposes were informed by the research propositions and the central research propositions. Being semi-structured interviews, the interviewees were provided sufficient opportunity to speak about many issues outside the structured questions. The interviews, each having average length of 100 minutes, were audio-recorded and fully transcribed with the permission of the interviewees. (It may be noted that the initials of the names of the respective interviewees and the audio-timeline produced by NVivo programme are referred within the cited extracts of the interviews transcripts used). The transcripts were then subjected to hierarchical coding in a template with a fully developed coding system using NVivo ver.8 software. This initial template contained 06 'Themes', 37 'Sub-themes' and their 'Sub-Codes' which eventually refined and developed at the data analysis stage into 06 'Themes', 27 'Sub-themes' and their 'Sub-Codes'. The Sub-themes and their associated questions to the interviewees were framed to investigate the practitioners' responses to issues regarding current awareness, experience, and approaches as to legal, contractual, and technical issues related to apportioning liabilities in delay claims resolution.

The six main themes were:

1. Theme -1 : Interviewees' Background;
2. Theme -2 : General Background of Project Delays & Causes;
3. Theme -3 : Awareness
4. Theme -4 : Adopted Practices
5. Theme -5 : Problematic Situations
6. Theme -6 : Suggested Improvements

The broader inquiry and discussion with the interviewees were carried out expanding the main themes into the following sub-themes:

1. General causes of delay;
2. General rate of success in completion of projects ;
3. Concurrent Delays – Applicability in Contracts (Apportioning time and cost);
4. Concurrent Delays – Pacing Delays;
5. Concurrent Delays – 'True Concurrency' and 'Concurrent Effects' ;
6. Ownership of 'Float';
7. Measuring 'criticality' in forensic scheduling;
8. Zero Float School and Longest Path (or Lowest Float Value) School;
9. 'Criteria to measure fairness;
10. SCL - Suitability;
11. Use of CPM Programme;
12. Programme Updating ;
13. contractors' most preferred MDA;
14. Consultants' most preferred MDA ;
15. Interviewee's own preferred MDA ;

16. Suitability & effectiveness of MDA ;
17. Presence of Conditions precedent in bespoke contracts ;
18. Compliance with Conditions precedent in bespoke contracts ;
19. Implementing Conditions precedent in bespoke contracts ;
20. Employer requirement of approval prior to engineer's determination ;
21. Delay in engineer's determination ;
22. Rate of request for engineer's Decision ;
23. Disputes arising from analysis outcome ;
24. Deficiency in claims submissions ;
25. Non-availability of definitions ;
26. Employer's undue influence ;
27. Contractor's risk management against Employer's undue influence.

The content of this Appendix-A is in two parts. The first part contains an *Introduction* and the *Interview Data Analysis* broadly under the main themes. The second part presents the findings of the data analysis. This concludes with a Summary of the main findings.

A.2 Interview Data Analysis

A.2.1 Overview of Responses

These interviewees, a total of 10, were purposively selected mainly using snowballing technique and in line with the Purposive Sampling strategy as described earlier in Chapter 2. Polkinghorne (1989) recommended that researchers may interview from 5 to 25 individuals who have all experienced the phenomenon. All of these interviewees were experts in delay claims resolution, representing both sides of the barrier i.e. contractors and employers organizations, and therefore, 10 individuals was considered to be a comfortable number. Majority of them were claims and delay analysts with civil engineering and quantity surveying background, with a single case of a practicing construction lawyer.

The Table A.1 below shows the profile of the interviewees (for maintaining the pledged confidentiality, only the initials are used to identify the individual practitioners). Accordingly, there are 05 civil engineers, 04 quantity surveyors, and 01 construction lawyer among the interviewees, who are well experienced professionals in the construction claims industry.

Table: A. 1 Interviewees' Background

S/N	interviewee Name (initials only)	Profession	Current Designation/ Involvement	Claims Experience
1	SH	Construction Lawyer	Head of Construction and engineering department in Al-xxxxxxx. and Company (Law Firm)	As a solicitor in England and Wales since 1997; since 2001 practicing as a construction lawyer in Dubai
2	AP	Chartered Quantity Surveyor (FRICS)	Senior Commercial Manager (Public Sector)	Qualified as a Chartered Quantity Surveyor in 1993; working in Dubai since then mainly for government entities.
3	ID	Civil engineer	Claims Practitioner (Freelance)	As a claims consultant, since 1982 practicing in the UK, from 1986 to 2008 in Southern and Central Africa, Hong Kong, Japan; since 2008 Dubai
4	KTH	Civil engineer (BSc)	Claims Practitioner (Freelance)	Overall 12 years as a claims consultant, in Pakistan, Germany, China and since 2005 in Dubai.
5	AR	Civil engineer (BSc., LLM, FCIArb.)	Senior Claims Specialist (Private Sector)	Working as Claims Specialist in consultancies in Pakistan and Dubai for last 8 years
6	GE	Chartered Quantity Surveyor (FRICS)	Partner at X.X. Xxxxxx. (Private Sector)	20-22 years in claims and disputes (12 years in Dubai)
7	NS	Quantity Surveyor/ Claims Consultant (BSc. LLB)	Head of Contracts Dept. (Private Sector)	21 years in the UK; since 2005 in Dubai in claims management
8	SW	Chartered Quantity Surveyor (LLM., FCIArb., AAIQS)	Senior Contracts Administrator (Private Sector)	37 years in Sri Lanka and Middle East; since 1998 in Dubai in contracts administration and claims management
9	SM	Civil engineer (BSc., LLM, FCIArb.)	Contracts & Claims Administration Manager (Private Sector)	Working as Claims Specialist in consultancies in Pakistan and Dubai for last 15years
10	SP	Civil engineer (BSc., LLM, FCIArb.)	Claims Specialist (Private Sector)	Working as Claims Specialist in consultancies in Pakistan and Dubai for last 6 years

A.2.3 General Background of Project Delays & Causes

Under this theme, several sub-themes were formed and the related questions were forwarded to the interviewees. A summary of the information collected is as follows:

<u>Sub-Theme: General causes of delay</u>

Although not in the same order, the interviewees identified the following as major causes of delays to construction projects in the UAE:

1. Design uncertainty at tender (AR, KTH, NS, SW, SM AND SH);
2. Subcontractor and material shortages (GE);

3. Interfacing problems, i.e. multiple contractors operating on a same site (AR, GE, KTH,SW);
4. Lack of planning of work completion (ID);
5. Lack of mock-ups (ID);
6. Lack of coordinated, efficient performance by various statutory authorities (AP);
7. Traditions and culture unfamiliarity of contractors from outside of region (GE, SH);
8. Access delays (NS);
9. Inadequate time allocation for projects (NS, SW).

According to the views, the most cited causes of construction delays were (1) Design uncertainty at tender;(2) Interfacing problems, i.e. multiple contractors operating on a same site, including 'Access Delays'; (3) Inadequate time allocation for projects; and (4) Traditions and culture unfamiliarity of contractors from outside of region.

Sub-Theme: General rate of success in completion of projects

The interviewees were asked about their own experience as to general 'success rate' of the projects in the UAE. Some extracts of the responses received are:

> *"Around 60 to 70 % [of projects] would be completed within 10 to 15 % of the [excess time]...then, there are extreme cases which would require 50 % more time..."*(AR); *"50% of projects are delayed by more than 50% of their contract time"* (GE); *"every project is delayed. In my experience I didn't see any project being completed on time..."*(KTH); *"I would say 70% were more than 50% of their original contract completion dates"* (NS); *"...I would say about 75% exceeded 50% [of contract duration]"* (SW); *"...you can say 25 to 30% overrun"*(SM); *"it's very difficult to put figures out without having done any sort of empirical study on that. But I would say many of them were over a year delayed on what would usually be two or three-year delivery"* (SH).

Thus all the interviewees were in consensus that no project was successfully completed without delays and within its original contract period, though they experienced various percentages of such delays due to variance of factors.

A.2.4 Awareness

Sub-Theme: Concurrent Delays – Applicability in Contracts (Apportioning time and cost)

It is noted in the Literature Review that when it comes to apportioning costs in concurrent delay situations, there are many schools of thought adopting various approaches (Arditi and Robinson, 1995). A very contentious of these approaches is the proposition that, regardless of concurrency, 'whenever the contractor gets extension of time he will automatically get cost as well' (Gibson, 2008). This proposition was submitted to the interviewees for inquiring their positions.

Table: A. 2 Apportioning Time and Cost on 'concurrency'

THEORY/ CONCEPT

'Regardless of concurrency, whenever the contractor gets extension of time he will automatically get cost as well'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2		1	
3	1		
4		1	
5		1	
6			1
7		1	
8		1	
9		1	
10			1
TOTAL	**2**	**6**	**2**
%	**20%**	**60%**	**20%**

Table A.2 indicates that for the majority (60%) of the interviewees who discussed this issue the apportionment of costs in concurrent delays was essential; however the minority were either supportive (20%) or neutral (20%) to this proposition. The extracts of some main comments are:

- *"No, I think it has to be apportioned. It does not seem fair. I mean, that's what we, in my experience that's what has been done. ..."* (AR: 12:2A.6 - 15:20.6);
- *"Well, there is City REC... But there was also an article, I think if you find Steven Hunt wrote an article in Construction Weekly or Construction News, I think just before City Inn or a bit of time before City Inn came out where he put the theory ...... that he felt that the all-or-nothing approach might be the concept of apportionment or sharing of risk and liability. ... I think City Inn went too far and it ended up..."* (GE: 0:3A.5 - 12:13.4);

- *"I'll not just follow a process or a Protocol slavishly, although it does have the advantages of perhaps having certainty but if you follow it to the nth degree then you get unfairness and I think that arbitrators and tribunals will try their best to bring some degree of fairness, which is why, I think, when we come to concurrency where we get so many confusing decisions because it's not possible necessarily for one size to fit all and I think judges in tribunals decide what the answer is first and then they work backwards and they form just a feeling that they think: "I think this guy is more of the bad guy than that guy." And they then try and back fit a methodology or an answer to give them the answer that they want. I think that's how the judging process, if I can call it, takes place. That's why I think they've got so many conflicting different results because different judges, different arbitrators..."* (GE: 21.37 – 23.34)
- *"... I would agree that sometimes, if he had the concurrent delay ....then he shouldn't be entitled to the full, you know, justification or financial compensation for that particular time"* –(ID: 31:37.3 - 34:33.8);
- *"The concurrent delays should not be taken in to account when it comes to apportionment of liabilities of delays... (Q: You mean the time? A: Yes exactly.) When it comes to costing, the cost of delay or the prolongation cost, then of cause it is relevant but when it comes to time liability concurrent delay should not be taken into account, I agree with that."* (KTH: 22:23.5 - 23:55.7);
- *"In FIDIC - 4th Edition there are 7 clauses where the contractor's entitlement for Extension of Time and cost are explicitly defined. So, when it is defined like that, the contemplation of the parties at that time is to, you know, they agree to these conditions that the contractor is entitled for the cost and time. Q: Regardless of the Concurrency situations? A: No, I mean, it is... I would say it is not fair. you know, as per the SCL Protocol apportionment is the best thing, I mean mostly equitable, but then if the contract says like that, without any sort of... without any sort of explicit provision for the segregation and simply says that the engineer shall evaluate the Time Extension and shall evaluate the cost, without referring to concurrencies and segregation then I see there is a problem."*- (SW: 24:45.8 - 33:39.2).

In replying to another common question, all the interviewees confirmed 100% agreement to the principle that the contractor should not be deprived of his right to time extension, even if he is in a concurrent delay with excusable delays (Table A.3).

Sub-Theme: Concurrent Delays – Pacing Delays

Only a few interviewees discussed this issue, but all of them were supportive of applying the principles discussed in the Literature Review (RP-FSA, 2009). Summarising the comments made one interviewee said:

> *"Why hurry to it? yeah. I'm a very big, you know, addicted applicator of that, you know, 'why hurry and wait'.* – (ID: 34:33.8 - 38:36.7).

Table: A. 3 Apportionment of Liability in 'concurrent delays'

THEORY/ CONCEPT

'The contractor should not be deprived of his right to time extension, even if he is in a delay concurrent with an excusable delays'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2	1		
3	1		
4	1		
5	1		
6	1		
7	1		
8	1		
9	1		
10	1		
TOTAL	**10**	**0**	**0**
%	**100%**	**0%**	**0%**

Sub-Theme: Concurrent Delays – 'True Concurrency' and 'Concurrent Effects'

SCL Protocol principle that contractor should not be deprived of his right to time extension, although he is in the concurrent delay at the same time with the excusable delays is applicable where the delays are in true concurrency (concurrency of causes happening at the same time), or while the delaying events occurring at different times but their 'effects' on completion are felt at the same time (SCL Protocol, 2002, App.A; Bamble and Callahan, 2000). The consensus among the majority (70%) of the interviewees were high in supporting this principle that both 'concurrent causes' and 'concurrent effects' are having equal potency for extension of time (ref. Table A.4).

Table: A. 4 Perception on "True Concurrency' and 'Concurrent Effects'

THEORY/ CONCEPT

'Both 'concurrent causes' and 'concurrent effects' are having equal potency for extension of time

Response	Supportive	Non-supportive	Neutral or No Position
1		1	
2	1		
3			1
4	1		
5	1		
6			1
7	1		
8	1		
9	1		
10	1		
TOTAL	7	**1**	**2**
%	**70%**	**10%**	**20%**

Among the comments of the interviewees, the following extract reflects the common position:

- *"A: I think what's important is ... the effect of completion is of significance. So, it means the concurrent effect is important as opposed to true concurrency. I mean concurrent delays do not have to be happening at the same time to be termed concurrent delays. Two delays, one the employer commenced and the other the contractor commenced. Both having an effect on the time of completion and can be termed as concurrent effects. That's valid yes"* (KTH: 14:2A.4 – 26:12:5);

Sub-Theme: Ownership of 'Float'

As to the ownership of 'float', generally SCL Protocol (2002, Section 1.3.6) principle is that 'it is belonged to the project', and can be used on first come first served basis. Alternate propositions are either 'it is belonged to the contractor' or 'it is belonged to the consultant'. It seems, generally, the basis for SCL Protocol on the issue of 'float ownership' is formed by the legal position of the decision in the UK and some US cases (e.g. *"Ascon Contracting"; "Malmaison"; "The Royal Brompton"; " Titan Pacific Construction Corp. v United States"; " Motherwell Bridge".)*

As summarised in Table A.5, the vast majority of the interviewees (90%) were in favour of that 'it is belonged to the project' and can be used on first come first served basis.

Table: A. 5 Perception on 'Float' ownership

THEORY/ CONCEPT - 'The 'float' is belonged to the project'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2	1		
3	1		
4	1		
5	1		
6			1
7	1		
8	1		
9	1		
10	1		
TOTAL	**9**	**0**	**1**
%	**90%**	**0%**	**10%**

Thus, the majority position (90%) seems to be very consistent with the SCL Protocol's position.

The extracts of some interviewees' comments are as follows:

- *"A: Ownership, in our practice, I mean, whoever utilizes the float first... gets to the float first, and then he takes over. Q: You mean, first come first served? A: First come, first served."* (AR: 18:20.6 - 19:06.5);
    - *"They said that it is going to the project...... First come, first serve basis.... Not to any party. They called it first come first serve basis."*- (AP: 56:27.4 - 57:14.0);
    - *"The project owns float....."* (GE: 26:12.8 - 26:25.3)
    - *"It is shared, whosoever uses it first generally, and it is shared. But again, having said that Nihal, if delays occur in the contract. Like I recall Dubai Civil Aviation had an expressed provision to the effect what I just said, it is shared whoever first calls belongs to him. If there is an express provision then that is obviously different. But on a general basis, I believe the ownership of float is whoever uses it first"* (KTH: 26:12.5 - 28:00.9)
    - *"Right. There are, maybe, I don't know, 50 different views as you know, about float. .... my view is that when it comes to assessing contractor's entitlement, I think project should keep the float, or when analysis is done, it should be adjusted in line with as-built data and float should be taken out. .... Not owned by either party, no......Because that's the only way, I believe,*

we can establish true effect or effect near to the true result. " –(NS: 25:23.0 - 26:30.6)

- "*Yes, in the UK. Not so much here. I have given advice on that. In UK, I was involved in Ascon, which is generally quoted about float. We were acting for one of the parties on that. And I think I favour and I can't remember the name of the judge on that, but I think I favour the judge's position on that. But it's a first come first served, I think.* "- (SH: 22:29.9 - 25:32.1)

Sub-Theme: Measuring 'criticality' in forensic scheduling

Further on 'float', a primary issue has been the issue of so-called 'residual float' in the Longest Path method which precludes an automatic entitlement to extension of time for the employer's delays occurring after passing the contract completion date. The importance of this issue was discussed in the Literature Review in detail.

'Total Float Value' school follows the principle that after passing the contract completion date all delays become critical, and therefore, regardless of contractor is in a critical delay, there is automatic entitlement to EOT due to employer's delays on day-for-day basis (Keane and Caletka, 2008). On the other hand, the 'Longest Path' School does not accept this principle as it considers critical delays are determined only by the 'Longest Path' at the occurrence of the employer delay (Wickwire *et al.*, 2003). The interviewees were required to express their perception on this issue; the overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' school, except for one interviewee who supported the 'Longest Path' approach. Thus, if the contract explicitly or implicitly infers that the point of measuring criticality is the prevailing contract completion date and not the project completion date, then the Longest Path approach cannot be implemented under such situation. As summary results of Table A.6 indicate, this proposition was acceptable to the overall majority (80%) of the responding interviewees. One interviewee perceived against and differently, while another did not have a clear position.

Table: A. 6 Measuring 'criticality' in Forensic Scheduling

THEORY/ CONCEPT

'If the contract explicitly or implicitly infers that the point of measuring criticality is the prevailing contract completion date and not the project completion date, then the Longest Path approach cannot be implemented under such situation'

Response	Supportive	Non-supportive	Neutral or No Position
1	1		
2	1		
3	1		
4	1		
5	1		
6		1	
7	1		
8	1		
9	1		
10			1
TOTAL	**8**	**0**	**0**
%	**80%**	**10%**	**10%**

The extracts of some comments expressed by the interviewees are as follows:

- *"A: The float element, per se, I mean everything will become negative; everything is critical after the contract completion date. At the right time, that's the question. We think that as per that rule, if it is beyond the contract completion if there is an element of delay the contractor will be entitled to that. Q: So you mean that, for example, if the contractor is in delay after passing the prevailing contract completion date and if you just give an instruction to a variation work then the contractor will automatically get the Time Extension, A: Yes, he will get time extension from that variation only: So you basically favour to this concept automatic entitlement? A: Yeah .It would be unfair otherwise, I believe."* - (AR: 19:06.5 - 21:16.7)
- *Q: Delay in what? Contract completion date or the project completion date? A: Delaying the completion date. If past the original completion date. But I'm actually looking at what's the delay in completion. Q: So it could be two different dates. A: Yeah, but I've already passed the completion date so that's just I'm not interested in the contract completion date."* – (GE: 26:25.2 - 30:12.3)
- *"A: I mean, before contract completion date, like I said, that float should be owned by the project, so should be taken out and adjusted. After contract completion date, if contractor was given some work, then again, net effect of*

*that work should be added, so again, there shouldn't be any float" –(*NS: 26:30.5 - 29:07.2)

- *"A: There is no Float; the reason is, as per the contract, you know the clause 14 program is for the completion of the works. Right? But there is a situation like this, now, if the Employer doesn't grant any EOT - Extension of Time to the existing time for completion, then the contractor, the authority or the usage of the clause 14 program expires once the contract completion is achieved, that date passed. So therefore... Q: So after that date you do not reckon any float in the program? A: No. Q: So, automatic Extension of Time after passing the contract completion date, even while the contractor is in delay? A: Yeah. Q: So, you accept that concept? A: The Balfour Beatty v Chestermount? Yes. Although there are criticisms for that but then as it is now, it is the only... you know... I would say the plausible decision here."*- (SW:35:1A.6 - 37:31.4)
- *"In our evaluation we follow this, Zero float concept. We are following that; if there is a negative float of even a single day on one path, we give him extension of time. Q: Time extension regardless of a longest path? A: Yeah, regardless of the longest path. Q: I see. Ok. So that means, going a little bit further, if there is an excusable delay after passing the prevailing contract completion date, the contractor would get automatic time extension for that? A: Yes, even if he has delayed. Q: So this is something contrasting with Mr John Wickwire, because... A: Yeah, it is different from the John Wickwire.. "*- (SM: 27:23.0 - 28:43.6)
- *"A: Yes. The clause 44 says that the contractor would be entitled to extension of time, if I mean... after the contract completion date. Q: So, that means your criticality is measured from that point? A: From that point."*- (SP: 28:03.0 - 29:23.2)
- *"A: It's primarily the contract completion date which is the determining factor of delay... the contract completion date may have been changed by the way as we know. It may have been already extended by clause 43 of FIDIC. So prevailing contract completion date is of significance. I mean where the contract is expressly defined a point of measure in the criticality which is contract completion date. "*- (KTH: 29:59.6 - 36:17:1)

Sub-Theme: Zero Float Value School and Longest Path (or Lowest Float Value School)

A specific question was directed to the interviewees in order to gauge their level of perception as to the roles of the foregoing two schools which have greatly influence the scheduling analysis in delay claims resolution.

When CPM based MDAs are used, the decision to apply Longest Path or Total Float approach should be consistent with the terms of contract (RP-FSA, 2009). This was the majority position found when inquired about the interviewees' perceived 'criteria to measure fairness' (see next Sub-Theme). However, in spite of this, during general discussion, some of the interviewees mentioned that they wanted to use Total Float approach while some others inclined to use only the Longest Path approach. Thus, divergent positions to prefer/use this or that MDA regardless of the terms of the contract were quite patent among the interviewees. The following extracts of some of the comments made by the interviewees reflect this situation.

- *"A: I think I probably tend to agree with the longest path approach. Whether that's applied to the contract completion date or the actual project completion date.... I would go for the longest path as to: Did it actually in fact delay the completion of the project? ..."* (GE: 30:12.3 - 33:35.2).
- *"...My view is, or my preference is, definitely the zero float school. I would like to follow that principle."*- (NS: 14:5A.5 - 15:47.3).
- *"Now if that one term says that it is that there is defined time for completion, then without adhering to that you just go for the longest path and you know it is very common here that even if you analyze your first delay event and before you sort of, inform the contractor, so, he will have to get the Employer's approval. Right? So in such circumstances, it is very rare that the Time for Completion is revised in a timely manner, for you to proceed with the second Delay Event. So under such circumstances, I don't think this longest path serves the purpose."*- (SW: 37:31.4 - 39:4A.2).

Sub-Theme: 'Criteria to measure fairness

Most of the interviewees who discussed this issue agreed to that the criteria to measure fairness in apportioning liabilities have to be the agreed terms (intentions) of the parties at the time of entering into the Contract (RP-FSA, 2009). This position therefore seems consistent with the results of Table A.6 above. However, in some local practices, fairness was said to have been compromised for Employers' benefit.

The extracts of some comments made by the interviewees are as follows:

- *"Q: So in other words what you say is the criterion to measure the fairness and equity in apportioning the liability is purely the terms of the contract which were agreed between the parties? A: That's right. Yes. Fairness and equity again, I feel is restricted or engineer has to be fair and reasonable, but within the terms of the contract,"* – (NS: 7:17.4 - 8:12.5)
- *" And if there is an interpretations of a certain contract clause or condition, again in that the engineer as per the text book approach, is that the engineer has to walk straight and be completely neutral, but practically, whenever, for example there is a contract, which requires an interpretation of a certain item, in my experience, is again treated towards, slightly towards the Employer."* - (AR: 56:42.7 - 59:11.7)

<u>Sub-Theme: SCL - Suitability</u>

SCL Protocol seems to have greatly influenced the delay claims practitioners in the UAE. Thus, a specific question was forwarded to the interviewees to inquire how they view and judge this document. From the summary results of Table A.7, it was found that the majority (70%) of the interviewees who discussed this issue were supportive of SCL principles, though some were supportive but with reservation. One interviewee opined that this support was due to the *"British influence of these Construction Lawyers"*, particularly in Dubai.

Table: A. 7 Applicability of SCL Protocol

THEORY/ CONCEPT

'SCL Protocol is applicable to local settings'

Response	Supportive	Non-supportive	Neutral or Reserved
1	1		
2	1		
3			1
4	1		
5	1		
6			1
7	1		
8	1		
9	1		
10			1
TOTAL	**7**	**0**	**3**
%	**70%**	**0%**	**30%**

The following are some comments made by the interviewees:

- *"A: It is widely used in this part of the world I think. Because, of the British influence of these Construction Lawyers in this part of the world especially Dubai. Especially in Dubai, even not in Abu Dhabi. In Dubai they have very good say in construction disputes. They are promoting that. Q: Okay, now on your own perceptions? A: I am okay with that. Fair and equitable. It has merits to take. There are a lot of merits we can take out of it,"* – [AP: 53:07.7 - 54:20.8).
- *"I think everybody waited around as if it's a bible sometimes. I don't disagree with a lot of what's in there from a common sense perspective but the all-or-nothing approach, as I've said earlier, particularly comes to aspects of concurrency that I'm not so sure..... So I think that the Protocol was written for the UK with the UK in mind and it has a number of common law principles enshrined and in which don't necessarily work here. I think from a factual perspective and how you look at things forensically, there's a fair amount of common sense in there but I wouldn't say it's universally applicable to the Middle East*". (GE :0:3A.5 - 12:13.4; & 50:09.3 - 53:16.0)
- *"I think they are very very fair and they should be used more widely I think... and correctly used. There is a lot of misinterpretations as well I see but it should be properly and correctly used "-(*KTH: 50:07.1 - 50:41.1)

- *A: Yeah. I think it's totally applicable. It is very well recognized by all the parties, all the contractor's, engineer's, and Employer's, all the parties they do recognize that and to my knowledge not a single contractor has objected to any of the principles which have been identified or which have been stated in the Protocol...*"(SP: 48:0A.0 - 50:12.0)

A.2.5 Adopted Practices

Sub-Theme: Use of CPM Programme

According to Table A.8, a 60% of the interviewees suggested that use of CPM Programme in projects was pretty high. However, a number of interviewees were in the opinion that the rate of use of CPM Programme in projects was at a less than 50% rate. On the other hand, most of the interviewees observed that although the CPM Programmes was used in projects, their usage in the delay claims resolution was not at an effective level. Another view expressed by many of them was that although a CPM programme was submitted as it was a mandatory requirement in the contract, most of the time it was left un-updated and considered as a cosmetic feature by the contractors without understanding the real use or significance of it in project administration and claims management.

Table: A. 8 Use of CPM Programme in projects

Response	High	Low
1	1	
2		1
3		1
4	1	
5	1	
6		1
7	1	
8	1	
9	1	
10		1
TOTAL	**6**	**4**
%	**60%**	**40%**

Thus, there was a substantial amount of views expressed in the interviews reflecting a lack of due consideration being given to the role of the Programme in claims submission.

Some of these comments are cited below:

- *"Q: How often, the CPM based programs are used in construction programs, for monitoring basically, in your experience, percentage wise? A: I think 99 % is being used.* " - (AR: 32:20.9 - 33:05.6).
- *"A: CPM Programming in the project and claims submission. Project, yes, claims submission, I would say... 50%. Maybe less than 50%"*- (NS: 14:42.4 - 15:23.2).
- *"Right. Now in my experience, it is hardly done. I mean using of these Programs to monitor the Project, or monitor the progress of the project, it is hardly done, and I would say something like to 20 to 30%?"*- (SW: 18:53.9 - 21:31.8).
- *"I think 100 %"*-. (SM: 33:03.1 - 33:36.5).
- *"I think. 90 %, it's pretty good..."*- (SP: 23:37.9 - 24:31.2).
- *"Some of the contractors submit the CPM only to fulfill that requirement. They will submit the Clause 14* [programme] *without truly understanding the significance of that...* " - (AR: 47:41.0 - 49:25.8).
- *"A: Yes. This is the feeling going to be with the contractor is cosmetic. Q: You mean they don't feel as... A: Take it serious..."* – (AP: 33:39.6 - 39:1A.0).
- *"A: ...Quite often you get to the part where a project's been built but the program's never been consented to. Q: So if we put it in percentage terms, I mean. A: Let's say 10% or 20%. Say 10% of projects never have a consented program.* " – (GE: 47:1A.6 - 48:40.0).
- *"I mean it is very difficult to say that the program reflects the intended method fully."*- (SW:15:51.4 - 18:53.9)

Sub-Theme: Programme Updating

A majority (60%) of the interviewees who discussed this issue opined that though the contractors generally carried out updates of the programme such updates were either irregular or improperly done (ref. Table A.9 below) or with 'doctored' information to conceal possibly slipping performance or defaults of the contractors.

Some of the interviewees' comments are cited below

- *"A: The updates are…I would recommend around 50 % of them has that. They update it."* – (AR: 47:41.0 - 49:25.8);
- *"A…50 percent of the cases I would say there are good As-built given."– (KTH: 39:42.2 - 41:57.6);*
- *"But what the contractor's are doing, they are not updating. They try to use this one and submit the revised program with the extended period."* –(AP: 33:39.6 - 39:1A.0);

In line with the previous expressions, some interviewees opined that though the contractors used the consented Programme in claims they mostly used not the actual consented programme but a 'doctored' consented programme:

- *"A: It is not the consented program. Only I think 20% of the time they use the consented program. …..A: They change it. A: Not purposely, maybe they don't understand the importance of not changing it. They don't understand it. …."*-. (SM: 38:05.2 - 39:2A.7).

Table: A. 9 Programme Updating

Response	Properly done	Irregular/Improperly done
1		1
2		1
3		1
4	1	
5	1	
6		1
7		1
8	1	
9	1	
10		1
TOTAL	**4**	**6**
%	**40%**	**60%**

Sub-Theme: contractors' most preferred MDA

As indicated in Table A.10, the majority (80%) of the interviewees who discussed this issue agreed that the most preferred MDA of the contractors was Impacted as Planned (IAP). Some said that use of impacted as planned was to be blamed on lack of expertise or knowledge as to other more sophisticated ones like Time Impact Analysis (TIA). Others opined that depending on circumstances the contractors would use either Impacted As Planned or Time Impact method.

Table: A. 10 Contractors' most preferred MDA

Response	'Impacted As Planned'	'Impacted As Planned' or Other
1	1	
2	1	
3	1	
4	1	
5	1	
6		1
7	1	
8	1	
9		1
10	1	
TOTAL	**8**	**2**
%	**80%**	**20%**

Some of these opinions are as follows:

- *"A: .... they use Impacted As-Planned A: Majority of them appear to use that, at least in my experience, they still like to use that. It seems perhaps logical for them or easy for them..... Maybe they are doing with the best of intention. I would still blame that, consider that they don't have the expertise. Q: So, this must be the main cause? A: I think that this is the main issue, because most of the time they come to us and they seek guidance on how to prepare it. They bring their planners and have a sit with us and once they do understand they do prepare it, but in the first instance, they have a problem of how it is going to be done. Q: So this is general experience in Dubai? A: General experience. . "* –(AR: 27:29.7 - 33:35.6);
- *"A: I would say the most popular one that I have seen here is As-Planned Impacted..... . Q: That's the most favourite for contractors? A: Yeah it is. But it's easy, isn't it?"* – (GE:39:03.9 - 40:04.7);
- *"Q: so which is the most used? A: As planned impacted. It is the quickest way; it's the quickest solution really. "* – (ID:53:03.9 - 54:0A.7);
- *"In terms of percentage , about 70-80 percent would start with Impacted As-Planned and may be during the negotiations they may be convinced to change their method, but usually they tend to start with Impacted As-Planned for the sake of easiness because it is easy to start with. . "* –(KTH: 41:57-43:36);

- *" ..... Percentage wise, if I say... in my experience, you know, all of them were using As-Planned Impacted. 99%... "* – (SW: 21:32.3 - 23:14.4);
- *"They use a mixture. They don't use time Impact Analysis, As-Built but-for they never use. They try to use Impacted As-Planned because it gives them the maximum entitlement. "* – (SM: 42:15.0 - 45:00.5);
- *"Generally, it is two types' methods what I have come across; some are giving Time Impact Analysis what we are also asking them to do and some are giving As-Planned method. There was one contractor which gave the sort of a bar chart. But mostly, if I talk about, most contractors it's Time Impact or As-Planned"*-(SP: 33:52.9 - 35:01.1)

Sub-Theme: Consultants' most preferred MDA

As indicated in Table A.11, the majority (70%) of the interviewees who discussed this issue agreed that the most preferred MDA of the consultants was Time Impact Analysis (TIA) but the others maintained that depending on circumstances the consultants would use either Impacted As Planned or Time Impact method or other method.

Some of these interviewees' opinions are as follows:

- *A: The consultant is probably a mixture. Some consultants will take an as-planned impacted and just critique it and interrogate it and they'll probably use the same methodology but they'll slightly amend it and it might produce a slightly different answer. There are others who would probably just reject it straight away and so as-planned impacted hopelessly flawed come back with proper timeslots or windows analysis or something that shows what was actually going on at the time. But there are some certainly large employers in Dubai who seem to either allow or their engineers prefer to use an as-planned impacted method and I quite often see certain correspondents to use the agreed method and we find that the engineer and the contractor have somehow, somewhere have actually agreed that they'll use an as-planned impacted method. They wouldn't say why but I guess because it's easy or it's quick. "* – (GE: 39:03.9 - 40:04.7);

- *"A: Consultant's side, of-course they tried to sort of ... base the analysis on the Time Impact Analysis basically, but I have my doubts that all the Consultants carry out in that fashion. "* – (SW: 49:36.0 - 52:4A.0).
- *A: Right, it depends. contractors generally they prefer impacted as planned, consultant it depends, if they are working for contractor, they try to push impacted as planned, if not, then they try to use, time impact. "* – (NS: 8:31.1 - 9:37.3).

Table: A. 11 Consultants' most preferred MDA

Response	**'Time Impact Analysis'**	**'Time Impact Analysis'or Other**
1	1	
2	1	
3	1	
4	1	
5	1	
6		1
7		1
8	1	
9		1
10	1	
TOTAL	7	3
%	**70%**	**30%**

Considering the foregoing results as to the use of MDA by the contractors and consultants, there appears to be a clear divergence between the two groups.

Sub-Theme: Suitability & effectiveness of MDA

Having been inquired about their perceived level of effectiveness of the popular MDAs, the majority (60%) of interviewees held that suitability or effectiveness of an MDA depended on the circumstances under which it was used (ref. Table A.12). However, some interviewees (20%) considered Time Impact Analysis would give better accuracy of all MDAs in any circumstances, while another preferred less sophisticated methods like Impacted-As-Planned in view of the less time needed to get the results (20%).

Table: A. 12 Suitability & Effectiveness of MDA

Response	Depends on circumstances it is used	Depends on use of 'Time Impact Analysis'	Depends on use of 'Impacted As Planned' method
1	1		
2		1	
3	1		
4	1		
5	1		
6			1
7	1		
8	1		
9		1	
10			1
TOTAL	**6**	**2**	**2**
%	**60%**	**20%**	**20%**

Some of these opinions are as follows

- " *... It is the point in time in the contract period which is important. If it is right at the beginning of the project and the issue is something like the possession of site which prevented starting from day 1 , then Impacted As-Planned would be as good as anything else. .* " – (KTH: 48:55.4 - 50:07.1);
- " *My view is to follow time impact analysis or use time impact analysis, or follow guidelines given in SCL Protocol, main reason for that one is, that I personally believe that time impact analysis is giving lot more accurate result than with impacted as planned, and I'm not saying that matter cannot be used or matter is not right, impacted as planned generally gives estimated result which can be quite inflated sometimes. Time impact will consider all the as-built records and as-build updates, so it tends to give more accurate picture, or reflects what happens on site...* " –(NS: 9:37.3 - 11:21.3).
- "*TIA-- Time-Impact Analysis might be very straightforward, if that's all you've got. But if you've got 200-300 delay events, then the time-impact analysis is going to be extremely difficult. Likewise a collapsed as-built if you've got 200-300 delay events could also be really difficult. So you might end up with an as-planned/as-built comparison which is not perfect either but it might be something that you can do a bit more quickly. ..*" –(GE: 40:04.7 - 44:2A.5);

Sub-Theme: Presence of Conditions precedent in bespoke contracts

Almost all interviewees confirmed the presence of conditions precedent with regard to compliance requirements in bespoke contract forms. These requirements are generally related to submitting Notices and Particulars within a prescribed time and manner and set out the consequences for failure to comply with those requirements. These consequences invariably lead to forfeiting /time barring the contractor's right to claim extension of time/cost. Most of the interviewees were in favour of the conditions precedent to bar claims where the contractor had failed to give notice of such claims within the prescribed time of contract. Some of the comments are cited below:

- *"Q: Rejection of the claims on the basis of time barring? A: 100 %."* – (AP: 1:09:32.4 - 1:13:19.6);
- *"A: Yes I have always experienced conditions precedent for notices particularly... Q: So is this a general situation in Dubai? A: Yes, correct. ."* –(KTH: 52:34.8 - 53:04.2);
- *"By not giving notice, he removed employer's right to go back and say "Sorry I don't want you to go ahead, I don't want that change." Now in that situation, a strict wording of condition precedence, can be applied..."* –(NS: 17:45.2 - 21:20.9);
- *"A: In especially the notice provision. Almost all the bespoke contracts contain a clause saying that if the contractor does not notify the events within a certain time, then either the engineer shall not evaluate the extension or the contractor has forfeited his rights for an extension. Q: So, if the contractor is not complying with these conditions he has to forfeit all his rights? A: Forfeit all his rights. Yes. ."* – (SW: 52:4A.0 - 54:52.2);
- *"A: and clearly it is written, if you don't follow these time frame then you will not be entitled to any time and the Employer will be free from any obligations..."* –(SM:48:15.7 - 48:59.7).

Sub-Theme: Compliance with Conditions precedent in bespoke contracts

Although most of the operational forms of bespoke contracts used in the local settings have a universal presence of conditions precedent, it was required to explore how they were complied with. As indicated in Table A.13, majority (80%) opinion of the interviewees confirmed a high rate of failure to comply by the contractors. However, one interviewee noted that with the employers who were reputed for strictly implementing barring provisions, such failure was very minimal.

Some of these opinions are as follows:

- *"In terms of notice requirement, I would say that 25% of contractors do comply with it, 75% do not. This 25% are, I would say, again, they're major contractors and they have some sort of in house capability to understand contractual mechanism, and consequences of it. In terms of detail interim or final particulars, I would say 80% do not comply with it, maybe 90% do not comply with it. Very rarely, 10% comply..... generally as a rule, thumb rule, I think that 80 - 90% do not comply with it......"* –(NS:17:45.2 - 21:20.9);
- *"I would say again, as a percentage, in say 75 % of the cases the contractor's fail to. ."* –(SW: 52:4A.0 - 54:52.2);
- *"Q: Normally when you come to the compliance, particularly the notice requirements, how much of the contractors are complying with this? A: Maybe 25%. Q: Notice requirements. So 75% fail. A: 75% fail. .."* –(SM: 48:15.7 - 48:59.7);
- *"Q: ... What are the repercussions for the contractor's who do not comply with this? A: Claim fails. There is no entitlement, to cost or time."* – (SP: 0:07.3 - 4:30.8);
- *"I'd say 75 percent would be compliant, would be given on time, but when it comes to detailed and interim and final particulars , not more than 20 percent would be actually compliant with the conditions precedent of the contract"*- (KTH: –52:34.8 - 53:04.2).
- *".... No more arguments. Because of that most of the ... contractor's are top on the claims, top with the clause. So they serve the notice on time... "*
  – (AP: 1:09:32.4 - 1:13:19.6);

Table: A. 13 Contractors' compliance with Conditions Precedent

Response	Comply	Comply with 'Notice' requirement but fail in 'particulars'	Fail to comply
1	1		
2			1
3			1
4			1
5			1
6		1	
7			1
8			1
9			1
10			1
TOTAL	**1**	**1**	**8**
%	**10%**	**10%**	**80%**

<u>Sub-Theme: Implementing Conditions precedent in bespoke contracts</u>

In the UAE jurisdiction, there is no published case law upholding these conditions precedent. Though there may be some provisions which could support conditions precedent under certain circumstances as discussed before in Chapter 7 of literature review (e.g. UAE Federal Law No. 5 of 1985, Section 287), the UAE law may or may not provide relief to the contractors claims where delays are purely caused by the other side although the contractors have failed to comply with such conditions precedent. Thus it seems 'yet-to-be tested' area.

The interviewees who discussed this issue confirmed that while some employer organizations take a lenient approach to use the failures as a negotiation tool in settling the claims, others strictly impose the right to forfeit /bar the claims if such failures occur from the contractors' side. One interviewee noted that certain conditions precedent were having grey areas and that caused the implementation questionable. Some responses received are extracted below:

- *"Q: So you mean first you disqualify him for the entitlement and then you use your expertise and the information available and submit an outcome to him A: To the Employer The Employer may use it as a negotiation tool and occasionally, sometimes, it is used as a negotiation tool and sometimes, the employer, because the employer has a right. The Employer can convey the outcome."* – (AR:43:32.8 - 47:17.5);
- *"Maybe a tool of negotiation or in fact maybe it's just, I think, there's quite a few employers will say: "Yeah, we did cause that and we did cause loss." And "Okay, he was late with his notice".... They mostly have some form of*

committee that's set up and most public sector organizations that will review claims and that committee I would think at most instances would make a decision: "Okay, we won't uphold the time bar provisions in the contract." (GE: 58:12.9 - 1:09:26.6);

- *"Yes, I think the employers do use it as a tool to negotiate, yes they do."* – (KTH: 52:34.8 - 53:04.2);
- *"Right. Now, frequency of rejection, I would say, maybe, 30 %. Because, especially the Employers like ...., irrespective of this notice provisions or detailed particulars, they prefer the engineer to carry out the Delay Analysis and in my experience, most of the time they end up with settling these things and you know, they don't sort of penalize the....Now, I believe that's a grey area, in most of the form of contract. What level of detailed particulars contractor has to provide. So there is a dispute. contractor will generally claim what he has provided is sufficient for engineer to carry out assessment and engineers view is that what contractor has provided is not sufficient. Now if it is not sufficient, then to provide sufficient detail, within a prescribe time period, he will fall outside that one. So this is also a grey area, but generally as a rule, thumb rule, I think that 80 - 90% does not comply with it.....*

  Frequency of time bar. Not many. In terms of percentage, I would say 5% claims are time barred, but employers use it as a big negotiating tool with the contractor. When contractor is aware that he has failed and may lose his entitlement, then that moves or shifts the power in favor of employer to negotiate it..." –(NS: 17:45.2 - 21:20.9)

Sub-Theme: Employer requirement of approval prior to engineer's determination

All the interviewees reckoned that there was invariably a strict requirement in bespoke contract forms that there should be an approval obtained from the employer prior to engineer's determination of extension of time. There were different opinions amongst the interviewees as to the time taken by the employer to give such approval; accordingly, this approval would be available sometimes within 03 months (which is said to be 'reasonable' time) or would be subject to a 'wait & see' policy by the employers as they need to know full picture with all the delays known before giving approval or not (which might lead to a dispute situation and interference in engineer's impartiality). However, the majority of the interviewees agreed that the employers' approval did not come promptly (70%) and the same interviewees confirmed that such employer-approval delays could be a major cause of dispute as the 'wait & see' policy may create a 'gap' between the contract completion date and the predicted completion date, if the contract expressly requires to determine EoT/Penalty to the extent the contract completion date is affected (ref. Table A.14). This situation would have required measuring the criticality against the contract completion date (which is a fixed and agreed date) using 'Total Float' approach instead of 'Longest Path' approach which measure criticality against the changing predicted completion date.

Table: A. 14 Employer's Approval for EOT

Response	Reasonably Prompt and Contemporaneous	Inordinately Delayed	A source of problems
1	1		
2		1	1
3		1	1
4		1	1
5	1		
6		1	1
7		1	1
8		1	1
9		1	1
10	1		
TOTAL	**1**	7	7
%	**30%**	**70%**	**70%**

The extracts of some responses are as follows:

- *"Q ... I think according to .... Standard forms, before you do the determination, you have to get the approval of the Employer. A. Yes that would take around 3 months....On average... So if you look at the time period than it is 3 months it is a very reasonable time for them. I think they cannot do it faster. "* –(AR:53:25.5 - 55:26.6);
- *"A: ... the procedures are bit of strange like engineer has to do first, after the engineer does the evaluation it has to be sent to our department, Contract Department. We will evaluate and we send it to the End User, for example, Road Department. Road Department may agree with our evaluation or may not. Assume agreed then it has to go to the Claims Committee, there is something called Claims Committee. Right? Once the Claims Committee approves, it is a matter of days to send the consent, send the approval under*

Clause 2.1 or 2.2, we send the approval and if this process is followed it gives the... It is a long process. Q: How long it normally takes, since the time the engineer sends his recommendations? A: 3 to 4 months...." – (AP:1:14:0A.4 - 1:15:32.3);

- *"Q: So in that case, the engineer cannot notify his determination formally to the contractor. A: Mmhmm, Yes. Q: So this might be a major cause of dispute? A: It is, yes. Remember the employer sometimes has a case against the engineer. " –* (ID:1:02:1A.9 - 1:05:05.9);
- *"Q: How do you reckon the availability or rather prompt availability of employer's approval? Is it immediately after engineer's analysis or...? A: Usually delayed. It's usually delayed" – (KTH: 3:2A.2 - 4:09.8);*
- *"A: I will go back to your previous question that* [whether] *employers approval is not generally available immediately. Now this is, I believe is because of 2, 3 things. One is that employers do not want to accept, although they are aware, they do not want to accept that project is in delay. Second thing is that their attitude is, "We want to know the whole picture and then we can decide which is not right. Because, first thing, you don't know how many delay events are going to happen in future." So in a lot of time, they delay the approval, thinking that if after month or two months once they know, sort of more realistic picture, then they will give approval. Third is, they know that by giving extension of time is always going to increase some cost, and they don't want to accept it. Again although they are fully aware that it's going to happen, they don't want to accept it. Q: So it is basically a wait and see policy? A: Wait and see policy in terms of approval, yes..." – (NS: 7:34.8 - 9:26.9);*
- *"A: That's right. That is in most of the cases, it is like that; the Employer's approval you know it takes time, and it never occurs within that period, so. If you take the percentage I would say something like, unless it is a very small job or very small thing, it takes I think around 90%. 90% of the cases it is, you know, we don't get the approval. A: Alright. In most of the cases, it is almost at the end of the project. Q: So almost at the end of the project? A: Almost at the end of the project. Yes..." – (SW: 57:25.3 - 1:05:26.8);*
- *"A: Yeah, we are required to get the approval of the Employer, before we can inform, officially, the contractor. Q: So in this case only wait and see?*

A: Wait and see. Employer sometimes instead of quickly approving the time they want to see the progress of the contractor, but very, you can say very rarely. Not generally. ." – (SM:55:44.1 - 57:52.1);

- *"... the Employer always takes time to approve and previously, if you want to know this that it was taking around more than 4 months or like this, and then it was reduced to 3 or 2 ½ months, but recently, from the past two months we are seeing that our reports have been approved in 1 to maximum 1 ½ month.... So, it is very much improved now. I mean in one month, I would say, is a very good time for the employer... " – (SP: 0:00.0 - 27:02.1).*

<u>Sub-Theme: Delay in engineer's determination</u>

Although in some bespoke forms of contract, there is a prescribed time for the engineer to make his determination, <u>almost all</u> the interviewees agreed that this was not complied by the engineers in view of various reasons e.g. contractors' own delays in giving information, lack of consultants' resources, employer-delays to give approval, employers requiring to have further review on engineer's assessment and so on. Some of the interviewees maintained that the engineer-determination was long after the project is completed or never, but others' experience was that although such determination was not done within a prescribed time still it happened before the completion of project and it was done within a prescribed time if all the particulars and resources were available. Some of the comments made are as follows:

- *"We try to do it within the reasonable time, depending upon the resources again... "* – (AR: 53:25.5 - 55:26.6);
- *"Q: So in this case, yeah, it's actually not a question. In most of the cases, recommendations from the engineer for awarding time, that award are not very much prompt mostly because the employers take their time... " A: Yeah, or you get the element of: "It can't possibly be that. That's ridiculous. Can you look at it again, please?"*- (GE: 33:35.2 - 35:43.2);
- *"Q: In your experience, how timely do the engineers comply with this period? A: Never.* [laughs] *Never. Not at all."* – (ID: 1:02:1A.9 - 1:05:05.9);
- *"Q: So that means they [employers' engineers] are normally prompt in 80 percent after the cease of the effects? A: No, I would not say prompt. Long after the project is completed... ."* – (KTH: 57:13.8 - 59:1A.3);

- *"A: In my experience, the forms of contract I have worked do prescribe time for completion, time for engineer's determination, yes. .. Again in my experience, its not after the project is completed, its not after all the claim events ceased to have an effect, but, its definitely not, within the time period prescribed in the contract. So it's somewhere in between. In most of the cases, I feel that engineer, they miss time period stipulated in the contract for to carry out determination. But they still do it, before all the delay events cease to have an effect, or, they, before the project completion date. Q: You mean in the majority of cases. A: Majority of cases..."* – (NS: 4:43.0 - 7:35.1);
- *"A: Now. It is actually, it is one thing why that delayed because the engineer may not be getting the relevant information to do the analysis. Yes there are instances where the engineers sort of wait till everything is completed to do that. Q: So. What you say is, I mean, if he gets, presumably, if he gets all these things, he would determine within 56 days? ... A: In most of the cases..."* – (SW: 57:25.3 - 1:05:26.8);
- *"Q: Ok. So when you come to these 56 days for interim determination, how much the engineer is complying with the ..... A: 0%.* (Laughs) *Q: So when you say 0% how do you specify? Is it long after the project is complete or ...? A: No no no. Generally it depends on the situation. Resources, how much resources are available and then the priority, which contract you will look into it. It is not; generally it is not after completion. Q: So it is after the end of all the events? A: No not necessarily. It depends on the resources. "* – (SM: 52:55.5 - 55:44.1);
- *"A: But even that has not been followed. I mean. We were unable to follow that 56 days thing. Because of our resources... "* – (SP: 0:00.0 - 27:02.1).

<u>Sub-Theme: Rate of request for engineer's Decision</u>

According to most of the interviewees discussed this issue, it appears in average 40%-50% of the contractors seek engineer's Decision when they disagree with the outcome of engineer's Determination on an EoT claim, particularly in order to trigger the arbitration process since under almost all bespoke contracts an engineer's Decision is a pre-requisite to commence that process. Others seem to proceed to non-confrontational options like informal amicable settlement with only a few advancing to mediation and arbitration stages. However, there are some divergent estimates of the percentage (as high as 85%) of requests for engineer's Decisions by the contractors, but it seems far above the average percentage.

- *"A: They move onto the engineer's Decision, you know... Q: How often do they do that in terms of percentage? A: 25% to 50% I'd say..." – (AR: 39:02.3 - 41:20.3);*
- *"I'll give you a general percentage, I think. For engineer's decision, I would say 40% is a good figure. Amicable settlement, 15%. Mediation, 5%. Arbitration, 5%. This is the general... overall percentages I think, the way the UAE market has seen that happen. ." – (KTH: :09.5 - 8:06.2);*
- *"In terms of engineer's decision, I would say 80-85% contractors will ask engineer's decision. ...... Going back to your question, 85% contractors will ask for engineer's decision. In terms of arbitration, or formal procedures, all the numbers have increased recently in UAE, in Dubai, I still feel that the contractors are not prepared to upset the employer or employers by starting arbitration. So arbitration or mitigation, they see it as a last, last resort..." – (NS: 26:56.3 - 28:26.4);*
- *"Q: So if you said that, going to the engineer's decision, on the issue of Delay Analysis Resolution, how much did you say percentagewise? A: Maybe 30% I think..." – (SM: 1:04:00.4 - 1:05:3A.4).*

A.2.6 Problematic Situations

Sub-Theme: Disputes arising from analysis outcome

The reasons for contractors' disagreement with engineer's determination of EOT are varying.

According to most of the interviewees discussed this issue, the reasons for disputes are greatly related to issues of quantum which results from a certain 'Methodology' used by either party. A contractor may not have a sufficient knowledge to identify differences in various MDAs or challenge a particular Methodology used by the consultant, but his concern and objection is that he does not get what he claims for. A contractor who would use less sophisticated and highly subjective MDA would not consider his own delays occurred in concurrent with the excusable delays. In this case, if the consultant used a MDA like Time Impact Analysis such concurrent delays may be revealed and consequently that may affect the contractor's claimed recovery. This situation may lead to further disputes. Another issue cited was lack of transparency. In this instance, the contractors were kept from knowing how the outcome of the engineer's assessment was arrived, or what it was based on. Generally the reasons are mutual suspicions due to use of different MDA; ignorance and lack of expertise from contractor's side as to MDAs and different outcomes.

The following are some extracts of the responses:

- *"A: In some cases, yes, apportion of liability can become an issue, especially when there are concurrent delays, contractor, in my experience again, 98% contractors or even 100% will not accept their delays. And their argument is, sort of "We did not delay it." Or "We are not wrong." So when it comes to assessing loss and expense, because of concurrent delays, if they are getting lot less money than what they want to get, they ask for engineer's decision......"* – (NS: 29:53.5 - 35:57.7);
- *"Q: So, normally, what would be the reaction from the contractor for the difference... for example, I mean, if they use Impacted As-Planned normally they don't show the concurrent delay?. A: No Q: But when we use the Time Impact you used to, I mean... A: Yeah. They disagree. Q: They disagree? So, this is source of disagreement A: It is a big source, because for impacted as planned in the first instance they will have a lot of time. But when you do Time Impact, it turns out that if they are asking 100 days it comes out to like 5 days. A: So first they have to understand that this is what it is........ The contractors who have strong Claims Team, we have noted that their disputes are minimal........... Q: So this is partly due to the ignorance? A: Ignorance. And partly due to resources - lack of resources,"* – (AR: 34:15.4 - 37:00.3);
- *"A: But again I don't recall us giving back detailed reports of how we carried out that analysis... They may develop disputes if they were given out reports......I mean, the disputes are in respect of the delay analysis methodologies while one may say... you know, the preferred method is the impacted baseline. The other may say it is time-impact analysis... so that's the first primary reason of a dispute. It contributes to the overall dispute definitely, and then it lowers the fairness in the resolution process so we must have a consensus, either by way of expressed provisions in the contract or by post contract general agreement to follow a certain guideline or a Protocol. And then that will bring the disputes down quite a bit, I think"*- (KTH: 45:13.4 - 47:15.8).

<u>Sub-Theme: Deficiency in claims submissions</u>

According to most of the interviewees discussed this issue, majority of deficiencies in contractors' claims are in the failure to establish entitlement. The other deficiencies are related to non-submission of claims particulars until very late stages, quantum/ methodology issues and denial of own concurrent delays. Some responses received are as follows:

- *"A: Most of the claims come in to Dubai Municipality, my experience is that most of the claims come in, they submit at the end of the project..."* – (AP: 1:15:32.2 - 1:18:04.8);
- *"A: ... Usually what happens the contractor doesn't submit a well prepared claim and for the engineer, as you know the best data is available by them, the contractor. The engineer or the Employer doesn't have that comprehensive data. So to go into the documentation, to look into the effects of a delay then to see its impact on the program it takes a lot of time and a lot of time is cons.."* (SM: 24:31.1 - 25:35.0).

Sub-Theme: Non-availability of definitions

Among the suggestions made by the interviewees for 'improvements' was to include a MDA specific definition in the contract itself. However, this approach may restrict other available MDA options which may fit the potentially unexpected circumstances of a project where the defined MDA would not. Therefore, it would require a challenging burden on the contract administrators to provide additional resources to ensure that the project circumstances are always conducive to the use of the defined MDA. The following extract reflects this general suggestion of improvement.

- *"A: First of all, I think the Contract Documents should clearly spell out the methodology. Q: Delay Analysis Methodology? A: Yeah. Clearly, whatever method that we are using, irrespective if it is Time Impact Analysis or As-built-but-for or Impact As-Planned. (1:5:44) It has to be clearly spelled out. This is something which has to be easily established from the beginning date that this is how we are going to do. So the contractor does not have any excuse that it is new or this was not informed to me. Similarly the requirements that he has to submit a Time Impact Analysis, with issue on his claims, or the exact requirements should be spelt out. Q: So when you say that, it has to be compatible with the terms of the contract? A: Yeah. Q: Which is, I mean, having Time for Completion, as defined. A: Defined. Q: And measuring the criticality should be against that? A: Against that. Q: So, that sort of things should be there? A: That should be there. "* – (AR: 1:05:02.5 - 1:07:55.9)

Sub-Theme: Employer's undue influence

The interviewees' experience on this issue was divergent and somewhat contrasting: the majority (70%) confirmed such influence is a norm than an exception, particularly from the employers of the public sector, while some interviewees either denied it or said there was no deliberate 'wait & see' policy by employers or any undue influence by the employers on the engineers (ref. Table A.15). One interviewee related his personal experience as an employee of a civic body ("...") where the 'Resident engineers' were personally subject to 'arm twisting' in order to tow the line dictated to them by the officials, but another said that the impartiality was not affected because although the communication of the approval may be delayed there was no pressure exerted by the employers on the engineer-decisions.

Table: A. 15 Employer's Influence on consultants

Response	It is a norm	Only in exceptional cases	No influence
1		1	
2	1		
3	1		
4	1		
5			1
6	1		
7	1		
8	1		
9	1		
10	1		1
TOTAL	7	1	2
%	70%	10%	20%

Some extracts of these comments are as follows:

- *A: I would say that 80-90 percent of the employers are interfering with the engineer's determination. .....In the end, you know, like I said the employer is the ultimate pay master. So, that must be one of the major reasons, which obviously is never in writing or anything. But this must be the primary reason. The other official reasons sometimes are that the employer, either himself or his own in-house expertise or hire third party to evaluate the engineer's assessments to pinpoint the errors therein just to prolong the process of the determination. That's also another case in most of the employers.* " – (KTH: 0:00.0 -7:09.5);

- *"A: Generally, engineers, and not only contractors, even consultants are not sort of keen to upset the employer. They know they have to be impartial, but when they know that their assessment is going to upset their employer, they tend to accept pressure from the employer, main thing is, they want to work with the same employer again. And one of the worry they have is, that if they disagree, that they might not get any future work.* – (NS: 36:35.0 - 39:42.0);
- *"A. I say they would rather not make the decisions at all. But, when you say impartial, I mean, they probably tend to look at these things in extension of time with a very critical eye as if they were acting for the employer. I think the Nakheel form of contract in fairness was adapted where there was little doubt as to who the engineer was batting for. But that's not to say he would be biased. But it wouldn't be totally impartial assessment but he wouldn't be pressurized to say something that he's not comfortable in saying. Usually producing a determination when he is not entirely comfortable with, he would generally look at these things from the employer's perspective rather than in any sort of middle ground".* –(SH: 46:20.1 - 48:24.7)
- *"A: There is no pressure, I think it is more... or because of that approach, there is no pressure. It doesn't come to that stage that the Employer starts exerting pressure, perhaps because the employer is getting the results more or less which... Q: So, did you have any experience that the Employer is requesting engineer's decision against this outcome? A: No. ."* – (AR: 56:42.7 - 59:11.7);
- *"Q: In your perception, do the Employer's exert pressure on their Consultants to be bias? A: Yeah, Xxxxxxxxxxxx. Q: How often it happens? A: Depends on the person to person. Q: Average? A: Average 50 %. Q: 50 % of the cases. But, this is other than the situation where you get the wait and see policy? A: Yeah. Q: So, in what form? I mean, if I ask you this pressure is coming from the Employer? A: He would dictate how to evaluate and he would point out the Consultant's faults. Or simply threaten him like, in the next project we will not, in the next project you would not be approved as Resident engineer......"* – (AP -1:14:0A.4 - 1:15:32.3);
- *"Q: This kind of employer interference, in your experience, is it coming from public sector employers or private sector employers? A: Mainly public sector..."* – (ID: 1:09:04.3 - 1:10:45.7);

- *"A: Employer doesn't want to give approval, and then he can be accused of affecting engineer's decision, or engineer's determination. And that means engineer is not impartial in his rule. A scenario I will give you is that engineer decided that contractor is entitled, employer says "No, I don't think you are entitled and I don't want to give you my approval" what can engineer do? If we follow that engineer needs approval to award extension of time of 100 days he has assessed, then he can't carry out determination, so I think approval should be limited on him only to notifying, Not the content of his determination. Q: How often, this, scenario is occurring in Dubai? A: I believe it happens in 90% cases, maybe more..."* – (NS: 17:45.2 - 21:20.9);
- *"A: .... It happens quite often. So, you know the conditions are such that they will have to obtain approval and in the approval process they ask so many questions and so... It is the situation. Even sometimes within the Employer's staff, you know the Site engineers who are involved with the project, you know, they put a lot of pressure, asking questions like, "has that really happened or not? It shouldn't be like that?"Q: Yes. Okay, so in this case, what is the percentage basically? This kind of instances? A: I think. It is as, you know, Employer's organization, I would say, most of the, I mean, 95 %."* – (SW: 1:05:26.7 - 1:09:00.0);
- *"A: The impartiality is not affected because the communication of the time may be delayed but the quantum, which is worked out by the engineer, the Employer never refuses that. Maybe they will discuss it that "how you came up with this extension of time?" whatever the reason, but they don't influence. Q: They do not influence? A: They will give their comments that "we feel that this is not correct", they can argue but they cannot influence. Q: So they normally do not exert pressure on the engineer's Decision? A: No. Never. Q: I see. So in this case only wait and see? A: Wait and see. .. " – [SM: 55:44.1 - 57:52.1];*

Sub-Theme: contractor's risk management against Employer's undue influence

Majority of the interviewees confirmed the contractors' dissatisfaction over the undue influence and 'wait & see' policy of the employers. However, according to most of the interviewees the majority of the contractors silently suffer in view of the risk of losing the future business with these powerful employers (mainly in public sector), while others use various tactics to cover their risks/losses. However, one interviewee recalled his experience that with a particular 'difficult' employer the contractors had a habit to add an extra premium to the tender sums for covering such undue risks. Thus, the interviewees' experience on this issue was somewhat divergent.

> *"A: Negotiating settlement, this future work definitely plays a big part in negotiating settlement. Like, in lot of cases, contractor accepts lower entitlement than what he is contractually entitled, because he wants to work with same employer again. And he knows that that particular employer is going to generate enough work for him next two three years or five years."*
>
> – (NS: 36:35.0 - 39:42.0);
>
> *"A: Nowadays I think up to something like 75-80 % of the cases. Yes.... That is because of anticipation into future projects. At the same time, they make it a point that they recover those losses in the other forthcoming tenders, by increasing the prices. It happened at XXX, you know; I can clearly see that the prices we got in 1997 when we started with XXX and midway between 2000 and 2002, before the rapid boom, still there was an increase of about 20 to 30% in the contract prices.Q: You mean over and above the average? A: Over and above the escalated market. Q: So this is to cover the risk? A: That is to cover the risk..."* – (SW: 1:10:45.9 - 1:12:43.2).

A.2.7 Proposed Improvements

The interviewees were requested to suggest any improvements/ solutions to the problematic situations as perceived and discussed. Accordingly, a series of improvements suggested with reference to clear definitions and risk distribution stipulated in the contract documents, allowing sufficient time for design, documentation, planning and construction; assessing fast-track requirements realistically; sufficiency in claims submission, promptness in assessment of claims and approval process; changing negative employer-attitudes (e.g. 'wait & see' policy), enhancing transparency in assessment of entitlement, engineer's impartiality; and alternate dispute resolution approaches to the current mechanism. These suggestions were generally influenced by the most cited causes of construction delays which were discussed earlier. Subsequently, they have been largely used in the construction of the proposed 'Framework of Improvements' presented in Chapter 9.

<u>The following are some of the extracts of these suggestions.</u>

<u>Clear definitions in the contract documents</u>

"In terms of using, and especially agreeing in advance, ideally, if possible, in the contract, what method and approach should be used, they can bring down this dissatisfaction to a very minimum level... " – (NS: 29:53.5 - 35:57.7);

"Measuring criticality, float ownership and so on, that's not generally defined in the contracts, or expressly provided. And then again I say a standard must be relied or agreed upon as the basis of settlement.

.... There should be a consensus prior to even going into those issues, there should be a consensus of what are the actual principles that are applicable to the specific project that we are talking about....There should be express provisions in the contract or alternatively in agreement of method of particular standard or Protocol to be used as a basis of settlement. That would reduce the disputes dramatically". ......I'm a strong, you know, vocal supporter of the SCL Protocol. I always keep referring back to it that somehow this should be either incorporated in the contracts or agreed in this or going to be the basis of resolution of the delay claims." (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

"We can definitely clarify, what method, or what approach engineer will use or implement in his assessment. What level of information contractor is required to submit, we can clarify that thing. Now this may not be as contract clauses, but attachment or guidelines to go with the contract document, can be a part of contract documents. Also, in terms of approval process, there has to be... I think this whole mechanism, has to be divided into different different ways. Like how much time engineer is obliged to take for his assessment and how much employer should take for his approval. At the moment there is one whole period, at the moment. So, if determination is not done within that period, that means, it's a breach. But there is no time period, or there is no clarification saying that employer should give his approval within 28 days, or

within 10 days. And that can reduce lot of complications we are facing."(NS: 43:40.7 - 48:09.5)

"The other thing is that now we are using the CSI specifications in our Organization but there is a special division, I mean; in division 1 there is a special section, you know a separate section for contract management process. I think that has to be developed you know spelling out all these matters required, like what should constitute the Detailed Particulars, right? And who owns the Float. I mean right now we have some things in there, but we will have to modify that to eliminate whatever the misconceptions we are having in the analysis process. Specially, I would suggest to specifically writing the method of Delay Evaluation or process. I mean we are dealing with.....A: How it is to be evaluated and what sort of process we are using. I mean, there are several methods of evaluating like As-Planned Impacted, As-built versus As Planned, you know collapse As-built and so on and so on. But then as we following Time Impact Analysis, why can't we just write it there that all delay claims will be evaluated using Time Impact Analysis therefore, contractors are required to provide updated programs in this period to facilitate...Q:You mean agreed and establish As-Built records? A: As-Built records. Yes.Q: So, you suggest that the contractor also should abide by definitive process? A: Definitive process, because if we establish that in the specifications, I can't see any reason why he should not oblige to do that. It becomes a requirement; in case of a delay and that is the process going to adopt." (SW: 1:19:34.5-1:25:06.6)

"A: I think my suggestion is that, I think that what even Wickwire in his book has said that we should clearly write down the steps. That under the contract the contractor is required to submit his delay in this format, give a sample Headings. Q: so you mean the methodology should be defined? A: Clearly defined that you are required to do the Time Impact Analysis. You are required to submit the detailed particulars in this format. You are required to do the Time Impact Analysis using these steps. Not in that detail, but you should give an outline.Q: Guidance? A: Guidance. That we will only accept a correct submission which follows these outlined data". (SM: 1:05:3A.4 - 1:12:17.1)

"A: Like we say the program should be submitted in this format, Clause 14.1 program, same way we can say that whenever you want to claim Extension of Time you should submit the detailed particulars in this format. (SM: 1:05:3A.4 - 1:12:17.1)

"A. Well, from a practical perspective as we discussed earlier, achieving a high level of design completion addenda would help. I think having better draft of scope documents would help because rarely do I come across a situations where the contractors are the problem, solely the ill-defined scope or the poor design the outset that is the cause of all the issues between the parties rather than the contract itself. And I would think a stricter and more thorough adherence to the mechanisms provided in the contract. [SH: 1:00:05.6 - 1:08:45.5]

Clear-cut Risk distribution in the contract documents

"the risks should be clearly defined in the contract terms. Who's responsible for what delay? Timely reviews of submittals such as the drawing methods and so on by the contractor, if a clear, precise number of days defined in the contract of the engineer's review that should help. Because that becomes a big issue during the course of the project where the engineer sits on the... consultant sits on the approvals or the employer's specific approval is not there and there should be clear cut number of days defined in the contract, of how many days they have to..." (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

A: That all the parties should know what their obligation is and what the responsibilities are? What are their obligations? Whose liability is real? It is to be clearly defined. These are critical issues. They should be spelled out clearly in that contract. It should not be hidden". (SM: 1:05:3A.4 - 1:12:17.1)

Allocating sufficient time for design, documentation, planning and construction

".... Prior to the start of the project, you eliminate a lot of the consequential effects, actually during the construction phase. More time at the beginning, more time to do the programs, and then have a quick construction process, with quicker turnarounds, or approval of drawings, approved for construction drawings, design and different design developments of the drawings as well." (ID: 1:16:31.3 - 1:20:47.6)

Sufficiency in contractors' claims submission

"And generally, you say that submissions by contractors compliance causations. Now, yes definitely that would be one way of reducing disputes. So, submissions by contractors are in the right format, timely and are sufficiently detailed explanatory, which would help... Generally to resolve the disputes, yes. . " (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

Promptness in determination

"Timely assessment, ..., is definitely one of the key factors. So, the onus there is on the engineer and obliviously to carry out the approval... That will be a big help in reviewing and eliminating disputes, timely assessment of claims. (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

Employer's prompt approval

"A: First of all the approvals process from the employers side which is prerequisite as per FIDIC 4 should be timely, which I felt generally is not the case. The employers did take forever to give approval." (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

"And, so wait-and-see can be avoided by clearly defining in the contract the number of days that the engineers got to review a particular claim. And if the engineer is not doing so, then almost all of the delay goes to the engineer or employer then. So, again, the better defined the contract clauses is, the better resolution of these disputes." (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

"Second is, carrying out assessment within the stipulated period in the contract, so contractor is not waiting, not getting frustrated, and third is, employer giving lot more independent status to their consultants and accepting, what their consultant, either engineer or other consultant, has done, can reduce unhappy situation quite a lot.- (NS: 43:40.7 - 48:09.5)

Transparency in assessment basis

"...the contractor should be given the detailed analysis to see how they got, how much they got and the way they got it. It's important for the... the process is transparent to ...to close the disputes is important for them to see how the

process was carried out. ... Yes it will definitely reduce disputes if it was open to both sides." (KTH: 47:15.8 - 48:55.4) 11:1A.0 - 20:41.4)

Programme

"Q: So. How about the programming aspect? What kinds of improvements do you envisage? A: In the programming....Q: The Clause 14. A: The Clause 14 actually, I think, in my opinion, it is better to conduct a workshop or something like that. Generally. They should look into the program before even giving the consent to identify unwanted constrains and logic problems, such things so that the program reflects the contemplation or the contractor's real method of execution. I mean, he put forward the program yeah? But then of course these planners, they used to put so many constrains which are unwarranted and unwanted. So those things have to be identified by the engineers, who administrate the contract, before signing the contact and get those things cleared. So that they have a realistic program to start with." (SW: 1:19:34.5 - 1:25:06.6

Engineer's impartiality

"Even where the engineer consultant didn't have to give any impartiality as very often as we discussed. The employer will make it clear what his view is .So a clearer role for the engineer or perhaps a better appreciation of the part that a actually independent or truly impartial engineer can actually go a long way to ensure that your project is more successful in terms of delay in time and budget". [SH: 1:00:05.6 - 1:08:45.5]

Dispute resolution mechanism for day-to-day site issues

A: It can be beneficial, because instead of, that is my personal opinion, instead of having the engineer the authority to decide to do something a third party who has no interest either with the contractor, or with the Employer or with the engineer, because engineer is being paid by the Employer, so in the back of his mind he will that thing, that "I have to protect the Employer against any dispute". So he will be slightly biased towards the Employer. So there should be a Management Consultants or DRB, DAB or DRB which we say. Who are independent and who are familiar, who come regularly to the site. That is, I *think, a good way to avoid that situation of competition. Q: So it will reduce the....? A: It will reduce. Of course! ...".* (SM: 1:05:3A.4 - 1:12:17.1)

".... I supposed, in a sense that's what FIDIC 99 tried to achieve with the inclusion of the adjudication boards and the need for an ongoing review by the independent adjudication board. Q. You mean at the site level? Before it escalates to the dispute situation? A. Before it escalates to a dispute situation. So the idea with that process is to instil the discipline in that project... Yes... of keeping on top of events, making determinations when they should be made. At the site level. You called it DDR or DRB.... But of course very few developers take on that part of the '99 contract in its entirety. The Abu Dhabi form of Contract does still allow for the appointment of an adjudication board but on an adhoc basis rather than from the beginning of the project. Clearly the FIDIC had intended the adjudication board or the review board will be established from the outset of whatever ongoing function. The intention being presumably to, in most instances, take away the possibility of dispute. If things are resolved, that's when they go. [SH: 1:00:05.6 - 1:08:45.5]

A.3 Results of The Interviews

A.3.1 Characteristics of Interviewees

The interviewees, a total of 10, were purposively selected mainly using snowballing technique and in line with the Purposive Sampling strategy as described earlier in Chapter 2. The majority of the interviewees were claims and delay analysts with civil engineering and quantity surveying background, with a single case of a practicing construction lawyer. All of them were having academic and professional qualifications required in their respective disciplines; most possessed higher degree of law and at least 04 of them were 'Fellows' of the Chartered Institute of Arbitrators. Accordingly, there were 05 civil engineers, 04 quantity surveyors, and 01 construction lawyer among the interviewees, who are well experienced professionals in the construction claims industry.

A.3.2 General Background of Project Delays & Causes

General causes of delay

- The results indicated four most cited causes of construction delays as (1) Design uncertainty at tender;(2) Interfacing problems, i.e. multiple contractors operating on a same site, including 'Access Delays'; (3) Inadequate time allocation for projects; and (4) Traditions and culture unfamiliarity of contractors from outside of region.
- These issues are to be adequately concerned in framing any improvements which intend to minimise delay claims.

General rate of success in completion of projects

- All the interviewees were in consensus that no project was successfully completed without delays and within its original contract period, though they experienced various percentages of such delays due to variance of factors.

A.3.3 Awareness

Concurrent Delays – Applicability in Contracts (Apportioning time and cost)

- All the interviewees confirmed agreement to the principle that the contractor should not be deprived of his right to time extension, even if he is in a concurrent delay with excusable delays. Thus, in this case there was a consensus between all the interviewees that, as proposed by the SCL Protocol (2002, Section 1.4.1), time extension should not be affected by concurrent delays;
- The majority of the interviewees did not support the contentious proposition that the 'concurrency' of delays should not be considered when the contractor gets extension of time and then he should automatically entitle to the cost as well. Thus, when the concurrent excusable delay is compensable as well, they expected apportionment of cost (subject to segregation);
- Thus, in both 'time' and 'cost' issues, the majority of the interviewees were in agreement with the principles of the SCL Protocol in that regard.

Concurrent Delays – 'True Concurrency' and 'Concurrent Effects'

- The consensus among the majority of the interviewees was high as to the principle that both 'concurrent causes' and 'concurrent effects' are having equal potency for extension of time (SCL Protocol, 2002, App.A; Bamble and Callahan, 2000).; At least to the extent of the majority consensus (70%), these results show a somewhat divergent position from the findings in Literature Review that there is still no universal position as to the definition of 'concurrent' delays (Livengood, 2007d; Peters, 2003). This situation may be exceptional due to the relatively above average knowledge that these interviewees possess as specialists/experts in the claims field;

Ownership of 'Float'

- Almost all the interviewees were in favour of the SCL Protocol principle that 'it is belonged to the project' and can be used on first come first served basis.

Measuring 'criticality' in forensic scheduling

- The overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' school. Thus, if the contract explicitly or implicitly infers that the point of measuring criticality is the prevailing contract completion date and not the project completion date, then the Longest Path approach cannot be implemented under such situation.
- Also, the majority agreed the principle that after passing the contract completion date all delays become critical, and therefore, there is automatic entitlement to extension of time due to employer's delays on day-for-day basis. This position was also consistent with the SCL Protocol's principle on this issue and the 'Total Float' theory.
- This high percentage (80%) of supporting the 'Total Float' theory may be explained as due to that most of the bespoke contract forms in the UAE require EOT or 'Penalty' to be determined against 'contract completion date', with no reference to 'predicted completion date' which otherwise would have required 'Longest Path' approach.

Criteria to measure fairness

- Most of the interviewees who discussed this issue agreed to that the criteria to measure fairness in apportioning liabilities have to be the agreed terms (intentions) of the parties at the time of entering into the Contract. (RP-FSA, 2009).

Suitability of SCL Protocol

- The majority of the interviewees who discussed this issue were supportive of applying SCL principles in the local settings. However, some were supportive but only with reservations.

A.3.4 Adopted Practices

Use of CPM Programme

- The majority of the interviewees suggested that use of CPM Programme in projects was pretty high but a minority of interviewees were in the opinion that the rate of use of CPM Programme in projects was at a less than 50% rate. Also, most of the interviewees observed that although the CPM Programmes was used in projects, their usage in the delay claims resolution was not at an effective level;
- Although a CPM programme was submitted as it was a mandatory requirement in the contract, most of the time it was left un-updated and considered as a cosmetic feature by the contractors without understanding the real use or significance of it in project administration and claims management. This may be explained in the light of the fact that contractors' most used MDA is Impacted-As-Planned method (ref. Tables A.9 & A.10) and that requires no updated programme.
- This would potentially become a problematic situation for both claims establishment by the contractors and claims assessment by the consultants, despite that the rate of use of CPM Programme in projects seems to be fairly high.

Programme Updating

- A majority of the interviewees who discussed this issue opined that the contractors generally carried out updates of the programme; but the others opined such updates were either irregular or improperly done or with 'doctored' information to conceal possibly slipping performance or defaults of the contractors.

Contractors' most preferred MDA

- The majority of the interviewees who discussed this issue agreed that the most preferred MDA of the contractors was Impacted As Planned. This is consistent with the observations made in the Literature Review as IAP is probably the most common analysis technique used by contractors on most projects (Livengood, 2007e).

Consultants' most preferred MDA

- The majority of the interviewees who discussed this issue agreed that the most preferred MDA of the consultants was Time Impact Analysis (TIA) but the others maintained that depending on circumstances the consultants may use either Time Impact method or other method.

  Considering the foregoing results as to the use of MDA by the contractors and consultants, there appears to be a clear divergence between the two groups.

Suitability & effectiveness of MDA

- The majority of interviewees held that suitability or effectiveness of an MDA depended on the circumstances under which it was used. This position appears to be more practical and realistic. However, there was a minority of interviewees who preferred a specific MDA at their choice; Accordingly, some interviewees considered Time Impact Analysis would give better accuracy of all MDAs in any circumstances, while another preferred less sophisticated methods like Impacted-As-Planned in view of the less time needed to get the results. This minority position may be explained due to the presence of personal allegiance to this or that MDA which was found among some interviewees.

Presence of Conditions precedent in bespoke contracts

- Almost all interviewees confirmed the presence of conditions precedent with regard to compliance requirements in bespoke contract forms. These requirements are generally related to submitting Notices and Particulars within a prescribed time and manner and set out the consequences which may lead to forfeiting /time barring the contractor's right to claim extension of time/cost.

Compliance with Conditions precedent in bespoke contracts

- A majority opinion of the interviewees confirmed a high rate of failure to comply by the contractors.

Implementing Conditions precedent in bespoke contracts

- Although the failure rate was high to comply with conditions precedent, some interviewees confirmed that while some employer organizations take a lenient approach to use the failures as a negotiation tool in settling the claims, probably because UAE Federal Law seems giving no published position yet on this issue.

However, some other organisations seem strictly imposing the right to forfeit /bar the claims if such failures occur.

Employer requirement of approval prior to engineer's determination

- All the interviewees agreed that there was invariably a strict requirement in bespoke contract forms that there should be an approval obtained from the employer prior to engineer's determination of extension of time.
- However, the majority of the interviewees agreed that the employers' approval did not come promptly. Some interviewees confirmed that such employer-approval delays could be a major cause of dispute as the 'wait & see' policy may create a 'gap' between the contract completion date and the project completion date.

Delay in engineer's determination

- Although in some bespoke forms of contract, there is a prescribed time for the engineer to make his determination, almost all the interviewees agreed that this was not complied by the engineers in view of various reasons e.g. contractors' own delays in giving information, lack of consultants' resources, employer-delays to give approval, employers requiring to have further review on engineer's assessment and so on.

Rate of request for engineer's Decision

- It appears in average 40%-50% of the contractors seek engineer's Decision when they disagree with the outcome of engineer's Determination on an EoT claim. Others seem to proceed to non-confrontational options like amicable settlement with a few proceeding to mediation and arbitration.

A.3.5 Problematic Situations

The main areas of problematic situations are identified as follows:

Disputes arising from analysis outcome

- Disagreement and disputes arising when establishing delay effects of the apportioned liabilities of the parties; Generally the reasons are mutual suspicions due to use of different MDA by the parties, lack of transparency in assessments, and ignorance , high level of subjectivity in claims content, and lack of expertise from contractor's side as to MDAs and resulting different outcomes;

Deficiency in claims submissions

- Majority of deficiencies in contractors' claims are in the failure to establish entitlement. The other deficiencies are related to non-submission of claims particulars until very late stages, quantum/ methodology issues and denial of own concurrent delays; these will result in protracted delay claims resolution process and possible escalation of disputes to advanced levels (arbitration, litigation);

Non-availability of definitions

- Perplexed issues like 'concurrency', 'float ownership', theory of 'criticality' are still lacking universally permanent industry standards, definitions and also legal positions. Further, nature of particulars and records to be used in delay claims submission and assessment, defined time period for assessment and employer approval of EOT, and other procedural /technical issues (e.g. mandatory keeping of objective, contemporaneous project records, regular and genuine updates to programme and so on) also become potential dispute areas due to lack of clarity/definitions on same in the contract documents. These also possibly contribute to protracted delay claims resolution process and possible escalation of disputes to a large degree;

Employer's undue influence

- This kind of undue influence may come from habitual 'wait & see' policy of employers, who would directly or indirectly exert pressure on the consultant to be 'biases against contractors. This can be a major potential area of dispute escalation in delay claims resolution process;

A.4 Summary

This Appendix – A has presented the data analysis and the results of the semi-structured interviews conducted with 10 selected delay claims experts/practitioners in the Dubai Emirate.

In line with the main research objectives (Chapter 1), these semi-structured interviews were conducted with the main purposes of

i. Investigating the practitioners' responses to issues regarding current awareness, experience, and approaches as to such legal, contractual, and technical issues related to apportioning liabilities in delay claims resolution;
ii. Identifying potential problematic situations in these practices related to apportioning liabilities in delay claims resolution;
iii. Seeking suggestions for improvements to contract documentation and claim administration in order to eliminate or at least to reduce the negative effects of such problematic situations;

On the other hand, the data captured through these interviews permitted the expected triangulation as the main advantage of employing mixed methods which is the chosen inquiry strategy for this study.

In conclusion, a summary of the main findings is as follows:

1. The Majority of the interviewees were claims and delay analysts with civil engineering and quantity surveying background, with a single case of a practicing construction lawyer. Accordingly, there were 05 civil engineers, 04 quantity surveyors, and 01 construction lawyer among the interviewees, who are well experienced professionals in the construction claims industry. Considering their credentials and experience in the delay claims field, their responses carry a high level of credibility for the data collected and analysed;
2. The results indicated four most cited causes of construction delays as (1) Design uncertainty at tender;(2) Interfacing problems, i.e. multiple contractors operating on a same site, including 'Access Delays'; (3) Inadequate time allocation for projects; and (4) Traditions and culture unfamiliarity of contractors from outside of region. These issues are to be considered in framing any improvements which intend to minimise delay claims.
3. With regard to the issues of concurrent delays, i.e. definition as to concurrent causes and concurrent effects, and 'time' and 'cost' apportionment the majority of the interviewees were in agreement with the principles of SCL Protocol(2002);
4. As for the 'Float Ownership', almost all the interviewees were in favour of the SCL Protocol principle that 'it is belonged to the project' and can be used on first come first served basis;

5. With regard to measuring 'criticality' in forensic scheduling, the overall majority of the interviewees were in favour of the position taken by the 'Total Float Value' school;
6. The majority also agreed to the principle that 'after passing the contract completion date all delays become critical, and therefore, regardless of contractor is in a critical delay, there is automatic entitlement to extension of time due to employer's delays on day-for-day basis'. This position was also consistent with the SCL Protocol's principle on this issue;

The above interview results under item 03 – 06 have displayed a greater consensus on the awareness on some theory i.e. i) apportioning time and cost in concurrent delays (ii) true concurrency' and 'concurrent effects (iii) 'ownership of the float' and (iv) theory of 'criticality'. However, it also shows a minority which perceive differently from the majority. To this extent it may be said that these results only <u>partially</u> endorse the research proposition that

- *"The tacit or explicit awareness on essential theory, concepts, legal position and Methods of Delay Analysis applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and clients)".*

7. The majority of the interviewees suggested that use of CPM Programme in projects was pretty high but many opined that when it comes to updates, they were either irregular or improperly done or with 'doctored' information to conceal possibly slipping performance or defaults of the contractors;
8. As to the use of MDA by the contractors and consultants, there appeared a clear divergence between the contractors and consultants. The Impacted-As-Planned was the mostly used method amongst the contractors and the Time Impact Analysis was the most used one by the consultants;
9. Disagreement and disputes arise when establishing delay effects of the apportioned liabilities of the parties; Generally the reasons are mutual suspicions due to use of different MDA by the parties, lack of transparency in assessments, and ignorance , high level of subjectivity in claims content, and lack of expertise from contractor's side as to MDAs and resulting different outcomes;

The above results as to use of MDAs seem strongly support the research proposition:

- *In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust.*

10. The majority of interviewees held that suitability or effectiveness of an MDA depended on the circumstances under which it was used. This position appeared to be more practical and realistic. However, there was a minority of interviewees who preferred a specific MDA at their choice;
11. A majority opinion of the interviewees confirmed a high rate of failure to comply with conditions precedent by the contractors; Although the failure rate was high to comply with conditions precedent, some employer organizations took a lenient approach to use the failures as a negotiation tool in settling the claims, probably because UAE Federal Law showed no published position yet on this issue; However, some other organisations seemed strictly imposing the right to forfeit /bar the claims if such failures occur;
12. All the interviewees agreed that although in some bespoke forms of contract there was a prescribed time for the engineer to make his determination, it was not complied by the engineers in view of various reasons e.g. contractors' own delays in giving information, lack of consultants' resources, employer-delays to give approval, employers requiring to have further review on engineer's assessment and so on;
13. The majority of the interviewees agreed that the employers' approval did not come promptly. Some interviewees confirmed that such employer-approval delays could be a major cause of dispute;
14. Majority of deficiencies in contractors' claims are in the failure to establish entitlement. The other deficiencies are related to non-submission of claims particulars until very late stages, quantum/ methodology issues and denial of own concurrent delays; these will result in protracted delay claims resolution process and possible escalation of disputes to advanced levels (arbitration, litigation);

These findings as to the claims submission, assessment and employer's performance may conform the research proposition :

- *Generally, there is no promptness among the contractors, consultants and clients in their contractually obligated actions required for efficient delay claims resolution.*

15. Non-availability of 'definitions' as to issues like 'concurrency', 'float ownership', theory of 'criticality', nature of particulars and records to be used in delay claims submission and assessment, defined time period for assessment and employer approval of EOT, and other procedural /technical issues (e.g. mandatory keeping of objective, contemporaneous project records, regular and genuine updates to programme and so on) may also contribute to protracted delay claims resolution process and possible escalation of disputes to a large degree;
16. Majority of the interviewees confirmed the contractors' dissatisfaction over the undue influence and 'wait & see' policy of the employers. This seems to be confirming the research proposition that:

    - *Usually, there is significant amount of undue pressure and interference from client-organisations over the engineers' (consultants) when determining the entitlement to extension of time;*
17. Some suggestions as to improvements to the identified problematic situations were made by some interviewees. These suggestions will be described in the 'Proposed Improvements' in Chapter 9;

As the next step for the mixed methods process, these results are compared with the results of the in-depth survey presented in the Appendix - B, in order to examine how they are complementing or not to the survey results. This comparison is carried out in the form of a discussion in the Chapter 8 which presents the merged outcome of the results of both Appendices A & B.

APPENDIX – B

(ANALYSIS OF PILOT STUDY AND SURVEY RESULTS)

APPENDIX – B

B.0 THE SURVEY RESULTS

B.1 Introduction

This Appendix-B presents the analysis and results of the data collected through the responses of experts /practitioners to a Pilot Study and an in-depth survey. The Pilot Study was conducted for the purpose of investigating *the need* for carrying out this research study. In order to find answers to the research propositions, the in-depth survey was aimed to investigate the current practices and problematic situations, which might stem from the practices in the delay claims resolution processes. This investigation was carried out through a survey-questionnaire , the questions of which were largely informed by the relevant Literature Review in Chapters 4 -7. The survey-questionnaire inquired the practitioners' responses to matters related to current awareness, experience, and approaches regarding legal, contractual, and technical issues of apportioning liabilities in delay claims resolution.

There was also a modest inquiry that was carried out among a few peers prior to sending out the in-depth Questionnaire, for a feedback on aspects such as lay-out of the questions, clarity and appropriateness of wording, adequacy of the questions in conveying the desired meaning, and the time needed to complete. Their opinions and suggestions were used for necessary refinements to the Questionnaire.

Both, Pilot Study and the in-depth survey, were conducted in the local settings of the UAE. (The Pilot Study and the survey-questionnaire templates are included in the Appendix-E)

Further two Questionnaires were prepared towards advanced stages of the inquiry for the sole purpose of investigating the validity of the proposed 'Framework of Improvements' and the Model, which are presented in Chapters 9 and 10, respectively. The results of these surveys are included in Chapter 11.

The content of this Appendix-B is in three parts. The first part contains an *Introduction* and the *Pilot Study*. The second part presents the data analysis of the responses to the survey-questionnaire . These responses were received, under the following headings: *An Overview of*

Responses; Characteristics of Respondents; Resources–in-use; Awareness on Delay Claims Theory and Scheduling; Awareness, Use, Effectiveness and Disputes in the use of MDA; Use of As-built Records and Software in Delay Analysis; Promptness in Delay Claims Submission, Assessment and Settlement; Obstacles for Using an Appropriate MDA; Dispute Contribution Factors; Delay Claims Avoidance; and Selection of Optimum MDA. In the final part, it contains the results of the data analysis of the in-depth survey. The Appendix-B concludes with a Summary of the main findings.

Later on, both Appendix-A (Interview Results) and this Appendix-B will provide the essential information for the Chapter 8 "Outcome of Merged Data Analysis and Discussion".

It is noted that all the statistical Tables (including calculations for related statistical tests) in this Appendix-B are included in the Appendix-C. Thus, in the majority of places, the text of the Appendix-B has referred to Appendix -C for the related Tables and calculations.

B.2 Pilot Study

The inquiry strategy of this research first involved a Pilot Study which was carried out initially in order to investigate the need for carrying out this research study.

Eighteen experts/practitioners involved in construction claims were selected as potential respondents in the Pilot Study. Altogether 12 responses were received from these 18, and hence the response rate was 66%. Among these, there were 08 practitioners from consultancies, 01 from contractor organizations, and 03 from developer organizations. Sector wise, 64% of respondents were from 'claims management', 27% from 'QS and commercial management', and 9% from 'civil engineering' background. Of all the respondents, 84% were from 'middle management', 8% from 'lower management', and another 8% from 'top management' level. All twelve respondents consented to further participation of the research, and indeed responded to the subsequent survey-questionnaire .

There were 07 propositions submitted to the respondents for their opinions. In all propositions, the respondents' opinions were sought using a 5-point scale ('Strongly Disagree', 'Disagree', 'Neutral', 'Agree', and 'Strongly Agree'), and the frequency for each option was considered as a percentage of the total frequency of responses.

The Table PS-1 shows (ref. Appendix - C) the responses received to the proposition "Dubai construction industry represents the most advanced characteristics and growth rate in the industry of whole of the Middle East region".
Accordingly, the results have been that 50% 'strongly agreed' and 42% 'agreed' while 8% were 'neutral' to the proposition.

The Table PS-2 shows (ref. Appendix - C) the responses received to the proposition "Delay claims remain a major source of dispute in Dubai construction industry, requiring prompt resolution to avoid escalation to major, complex dispute situation".
Accordingly, of all the respondents 58% 'strongly agreed' and 34% 'agreed' while 8% were 'neutral' to the proposition.

The Table PS-3 (ref. Appendix - C) indicates the responses received to the proposition "Delay claims resolution process in Dubai construction industry is generally protracted and often happens near to or even after the completion of projects".
For the above proposition, the results have been 42% 'strongly agreed' and 58% 'agreed'.

The Table PS-4 (ref. Appendix - C) indicates the responses received to the proposition "Absence of prompt resolution of the delay claims generally escalates those claims to major dispute levels".
For this proposition, the results have been 17% 'strongly agreed' and 75% 'agreed' while 8% 'disagreed'.

The Table PS-5 shows (ref. Appendix - C) the responses received as to the proposition "Between the contractors and the developers/engineers, for delay analysis there is no consensual selection of analysis method that is most appropriate under given circumstances of a project".
Accordingly, of all the respondents 17% 'strongly agreed' and 67% 'agreed' while 8% disagreed and another 8% were 'neutral' to the proposition.

The Table PS-6 shows (ref. Appendix - C) the responses received as to the proposition "In order to make delay claims resolution process in Dubai industry more efficient, transparent, equitable and fairer, there is a strong need to identify the current practices, their problematic situations and necessary remedies/improvements required to them".

For the above proposition, the results have been 75% 'strongly agreed' and 25% 'agreed'.

The Table PS-7 (ref. Appendix - C) indicates the results of the responses received as to the proposition "Such, remedies and improvements would possibly bring corporate benefits for both developers and contractors, reducing delay situations escalating to dispute levels such as engineer's Decisions/Arbitration/ Litigation".

For this proposition, also, the results have been 75% 'strongly agreed' and 25% 'agreed'.

B.3 Results of Pilot Study

According to the foregoing findings, the results of the Pilot Study can be summarized as follows:

In their responses, an overwhelming majority (considering the combined results of 'Agreed' and 'Strongly Agreed' options) of the responding practitioners confirmed that:

- Delay claims remained a major source of dispute in the local construction industry (91%);
- The resolution process of these claims was inordinately protracted (100%), and consequently escalated those claims to major dispute levels (92%);
- Between the opposing parties in the claims resolution process, there was no consensual selection of analysis method that could be the most appropriate under given circumstances of a project (84%);
- A strong need was existing to investigate the current practices, identifying their problematic situations and necessary remedies/improvements required for making the claims resolution process more efficient, transparent, equitable and fairer (100%);
- Such, remedies/improvements could possibly bring corporate benefits for both developers and contractors, reducing delay situations escalating to further dispute levels (100%).

In conclusion, these results of the Pilot Study provided a firm need and inspiration to undertake the current research study and formulate its aim and objectives.

B.4 In-Depth Survey: Data Analysis

B.4.1 An Overview of Responses

The Pilot Study was followed by an in-depth survey, which provided a main vehicle to capture the data for the research. The in-depth survey was conducted using a comprehensive survey-questionnaire which was circulated among practitioners in the local construction industry. The questionnaire was expected to answer certain 'what' and 'how' questions related to delay claims resolution practices and procedures. The questions were appropriately framed to investigate the practitioners' responses to issues regarding current awareness, experience, and approaches as to legal, contractual, and technical issues related to apportioning liabilities in delay claims resolution.

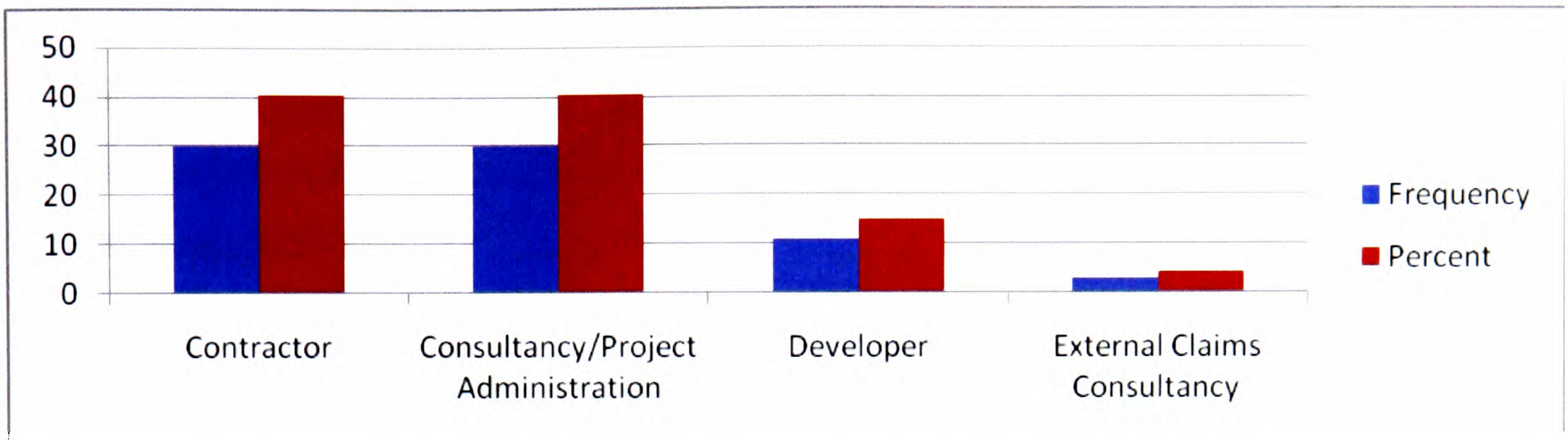
Initially, 520 potential respondents across the industry in Dubai/UAE were earmarked for this web-linked survey-questionnaire . However, when attempted to contact, over 200 mails returned undelivered, reducing the potential responses to about 300. Yet, the overall responses received were 85 only. However, among these, 11 responses were of questionable nature for the respondents' actual involvement in delay claims resolution at any level. In order to preserve validity of the survey results these responses were discarded. Thus, the eligible respondents (i.e. those who actually involved in delay claims resolution) were 74. Thus, when compared with the anticipated number (300), the overall response rate (eligible) is around 25%. Nevertheless, this is not a so unexpected rate considering the vast number of employees who were laid off in the Dubai/UAE construction industry, since the 'economic crisis' started in the last quarter of 2008. Further, if there were any missing responses to any of the Questions they were also discounted in order not to compromise the test results.

The 74 respondents were from the categories of contractors, consultants, developers, external experts (freelance), and construction lawyers, who were actively involved in the delay claims resolution process.

The Table B.1 (N=74) shows the distribution of these respondents background:

Table B.1 Distribution of Respondents Background

Respondent Category	Frequency	Percent	Valid Percent	Cumulative Percent
contractor	30	40.5	40.5	40.5
Consultancy/Project Administration	30	40.5	81.0	81.0
Developer	11	14.9	14.9	95.9
External Claims Consultancy	3	4.1	4.1	100.0
Total	74	100.0	100.0	

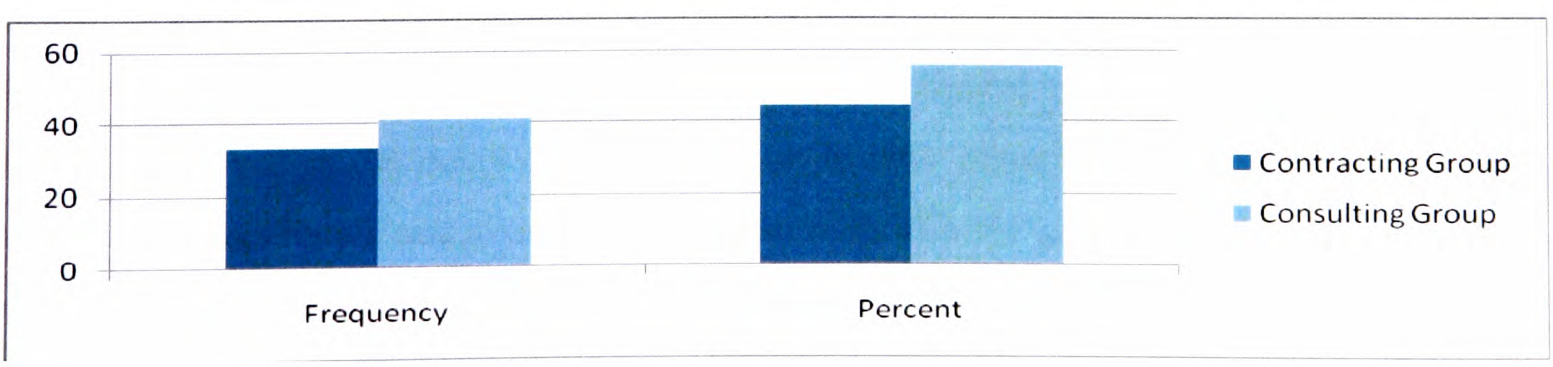


Although a separate category was allocated in the Questionnaire for 'Developer' organizations, strictly speaking the practitioners in that category can also be considered homogeneous with 'Consultancy' category as both are on the same side of the 'barrier'. On the other hand, the services of the members of the 'External Claims Consultancy' category are normally rendered to contractor organizations (for claims preparation), as the client organizations generally have their own consultants defending delay claims. Accordingly, it would be more meaningful to treat the responses from the categories of 'Consultancy/Project Administration' and 'Developer' in one single group and the 'External Claims Consultancy' along with the 'contractor' category in another group.

Therefore, from now on the data analysis would treat the data gathered through the survey-questionnaire under two generic groups i.e. **'Contracting Group'** and **'Consulting Group'.** Accordingly, the above percentages of responses can be re-arranged as Table B.2 (N=74) below:

Table B.2 Composition of Two Groups

Respondent Category	Frequency	Percent	Valid Percent	Cumulative Percent
Contracting Group	33	44.6	44.6	44.6
Consulting Group	41	55.4	55.4	100.0
Total	74	100.0	100.0	



According to these re-arranged data of the 74 responses, 45% and 55% of the respondents/practitioners are considered under the 'Contracting Group' and 'Consulting Group', respectively.

B.4.2 Characteristics of Respondents

The summary results in Tables B.3 (N=74), B.4 (N=69), and B.5 (N=74), which related to the survey Questions nos. 1 to 7, show the profile of both the respondents and their organizations. According to the results in Table B.3 (ref. Appendix - C), the vast majority (68%) were involved in the entities whose core business was in the Building and Civil engineering works. The entities which undertook either Building or Civil engineering works was just within a combined percentage of 32%.

The approximate annual turn-over of these organisations reflects their 'size' in the industry. As shown in Table B.4 (ref. Appendix - C), within the Consulting Group 64% of respondents were engaged in delay claims for very large organisations, and about 36% were engaged by medium to small-size entities. Within the Contracting Group, however, the engagement of practitioners was almost equally distributed amongst very large/large firms (combined 51%) and medium/small firms (combined 49%).

A summary of results in Table B.5 (N=74) shows (ref. Appendix - C) that the three disciplines of Quantity Surveying/Commercial Management, Contracts Management and Claims Management were mainly responsible for the carrying out of delay claims resolution in both Contracting (91%) and Consulting (88%) Groups. Notably, the category of Quantity Surveying/Commercial Management was responsible for the largest contribution of responses within both Groups (in Contracting Group 58% and Consulting Group 44%). It is evident that the claims resolution is exclusively handled by these specialist disciplines with their contractual, commercial and forensic programme analysis abilities. Any involvement by design or administrative/management disciplines was relatively insignificant, and it is also an indication that the vast majority of the responses have come from the practitioners who were actually involved in the delay claims resolution in their organisations. In this instance, the three disciplines mentioned above constitute the most directly involved practitioners in delay claims resolution who are around 90% or 66 of the total 74 respondents. The remaining 08 were considered to be possibly having a secondary and supporting role in delay claims. All respondents who did not answer the Question no.03 to indicate the nature of their primary job within any of these disciplines were considered not eligible to participate in the survey and excluded altogether from the raw data and further consideration. This was a measure essential to ensure the validity of the findings and the results of the data analysis.

The summary results in Tables B.6 (N=58) and B.7 (N=59) below present the practitioners' direct experience in delay claims resolution process. Accordingly, 58 respondents and 59 respondents were having experience in directly dealing with claims preparation (for contractors) and claims evaluation (for developers), respectively. These figures constitute all the Contracting Group respondents (33 nos.) and all the Consulting Group respondents (41 nos.) being experienced in either claims preparation or claims evaluation or both. In their respective core activities of claims preparation and claims evaluation, the average experience of both Contracting and Consulting Groups was around 10 years.

The summary results in Tables B.8 (N=30), B.9 (N=58), B.10 (N=26), B.11 (N=27), and B.12 (N=17), show (all ref. Appendix - C) the practitioners' experience in other areas related to delay claims resolution process. Generally, an average of nearly 8 years for their experience in Forensic Schedule Analysis, Commercial Negotiation, Project Planning, Dispute Resolution and Legal Support is observed. This reflects that the respondents were generally experienced and involved in almost all aspects of delay claims resolution process, and therefore, their responses carry a reasonable level of credibility and validity.

Table B.6 Claims Preparation (For contractors)

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	10	10	3	5	5	33	325.0	**9.8**
Consulting Group	15	4	4	2	0	25	152.5	6.1
Total	25	14	7	7	5	58	477.5	8.2

Table B.7 Claims Evaluation (For developers)

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	6	7	3	1	1	18	142.5	7.9
Consulting Group	16	5	10	4	6	41	392.5	9.6
Total	22	12	13	5	7	59	535.0	9.1

Two further questions were asked in the Questionnaire in order to find out the respondents designation and the position they held in their respective firms. Tables B.13 and B.14 contain a summary of results with regard to these two issues.

According to the Table B.13 (N=73) (ref. Appendix - C), the mostly used designation is 'Commercial Manager' (28.8%) which is closely followed by 'Quantity Surveyor' (21.9%), and then 'Contracts Manager'(16.4%) and 'Claims Consultant/Specialist/Analyst' (14.9%). It is observed that these designations are consistent with the mostly involved disciplines in the delay claims resolution as observed above (see Table B.5).

Table B.14 (N=74) shows (ref. Appendix - C) a summary of results that majority of these respondents (64%) were in the middle management of their respective organisations, while about one-fifth were in the upper and decision making level. This situation also adds further validity and credibility to the data collected from their responses.

The respondents were asked about the level of expert resources used to undertake the delay claims, submission or assessment, as the case may be, in their respective organisations (Questions Nos. 13 & 14). Table B.15 (N=59) indicates (ref. Appendix - C) that all submissions and assessment of delay claims were carried out by the organisations' in-house resources and outsourcing of such assignments was very minimal in either Groups.

The summary of results in Tables B.16 and B.17 reflect (ref. Appendix - C) the general status of deployment of such in-house resources. Using a 5-point Likert scale (where '1 = Never' to '5=Always') and scores being 'normalized', the ranking suggests (in ascending order) that the mostly deployed categories in both Groups were the Quantity Surveyors and Contracts Administrators. It appears the Lawyers were the least engaged by both Groups, while the engagement of Claims Specialists was also relatively low. These findings appear more or less consistent with the previously observed situation of the job/designation categories of the practitioners.

B.4.3 Awareness on Delay Claims Theory and Forensic Scheduling

The research study has focussed on both aspects involved in delay claims resolution, namely the assignment of delay responsibilities and the forensic scheduling methods used for quantification of effects of responsibilities. The legal theory involves both of these aspects. Thus, the legal principles are considered to the extent they would affect the establishing entitlement (or liability) and the selection of the appropriate forensic scheduling methods.

Arditi and Pattanakitchamroon (2006, p.146) submitted that *"A number of factors may influence the result of delay analysis regardless of which delay analysis method is used. These factors...include concurrent delays, float ownership, the theories of critical path, and scheduling software options"*. Thus, informed by the Literature Review, the current study considers that (1) Concurrent Delays, (2) Float Ownership, and (3) Critical Path theory in the context of the 'Longest Path' theory and 'Total Float' approaches are the key factors that could influence the outcome of a present-day delay analysis.

Accordingly, in order to inquire how the two Groups perceive and implement these essential concepts and theory, the survey-questionnaire contained four particular questions (Question nos. 08, 09, 10 and 11) for the respondents.

Perception on 'Concurrency'

The investigation is aimed to find out whether the respondent tends to treat **(i)** only such effects of 'true concurrency' (where delaying events should occur at the same time) as 'concurrent' and having merits to award extension of time, or **(ii)** the 'true concurrency' apart, the 'concurrent effects' (where delaying events occur sequentially but their effects being felt at the same time) are also having similar merits to award extension of time (Question no. 8).

The summary of results in Table B.18 (N=62) shows (ref. Appendix - C) that the majority of the two Groups (60% and 54% of Contracting and Consulting Groups, respectively) considered that both 'true concurrency' and 'concurrent effects' equally merit entitlement to extension of time; however, a substantial minority (40% and 38% of Contracting and Consulting Groups, respectively) believed only 'true concurrency' should carry entitlement. The data were subject to a Chi-Square Test for Independence using SPSS (sample $x^2 = 2.14 <$ Critical $x^2 = 5.99$ at .05, df=2, p=.343 > p=.05). These results show that there is no statistically significant association (difference) between the perceptions of the two Groups on these concepts. *Phi* ϕ (.186) and Cramer's V (.186) also show that the strength of association between the variables is weak.

Thus, these results suggest that the both Groups, whether the majority or the minority, mostly shared similar perceptions. To this extent, there is no significant association (differences) of perception between the two Groups as to the concepts of 'True Concurrency' and 'Concurrent Effects'. However, at the same time these results show a very significant division of the opinions due to a substantial percentage of minority position (overall 39%) and to that extent the results confirm the findings in Literature Review that there is still no universal position as to the definition of 'concurrent' delays, which is the most perplexed issue in delay analysis and apportioning liabilities (Livengood, 2007d; Peters, 2003).

Apportioning Time and Cost on 'concurrency'

It is observed in the Literature Review that there has been no universal consensus amongst the practitioners when the entitlement to time and cost has to be dealt with in concurrent delay situations (Arditi and Robinson, 1995; Peters, 2003; Wilson, 2004;) Considering such divergent approaches, the respondents were asked to submit their perception (if the contract is silent about a specific approach) on the contracting parties' entitlement as to time and cost in critical concurrent delays (Question no. 9).

The following scenarios were presented:

Where one delay is caused by the employer and the other by the contractor;
Where two delays are caused by the employer;
Where two delays are caused by the contractor;
Where two delays are caused by neutral causes;
Where one delay is caused by the employer and the other by a neutral cause, and
Where one delay is caused by the contractor and the other by a neutral cause.

The summary of results in Table B.19 (N=65) shows (ref. Appendix - C) that "where one delay is caused by the employer and the other by the contractor", the majority of the Consulting Group (62%) perceived that the contractor was entitled to time and cost (the cost only if clearly segregated by the contractor) while the majority of the Contracting Group (75%) viewed that the entitlement was to 'time' only. The results of Chi-Square Test for Independence show that there is high statistically significant association between the perceptions of the two Groups on these concepts (sample x^2 = 26.08> Critical x^2 = 16.27 at .001, *df*=3, p <.001). *Phi* ϕ (.633) and Cramer's V (.633) also show that the strength of this association between the variables is substantial. Thus, these results suggest that both Groups did not share a similar perception on the scenario concerned. To this extent, there is significant association between the Groups' perceptions.

The summary of results in Table B.20 (N=66) shows (ref. Appendix - C) that "where two delays are caused by the employer", the vast majority of the Consulting Group (92%) and of the Contracting Group (86%) were in agreement as to the contractor's entitlement to both time and cost. The Chi-Square Test for Independence shows that there is no statistically significant association (differences) between the perceptions of the two Groups on this issue (sample x^2 = 1.42 < Critical x^2 = 5.99 at .05, *df*=2, p=.491>.05). *Phi* ϕ (.147) and Cramer's V (,147) also show that the strength of any association between the variables is very weak. Thus, these results may suggest that the vast majority of both Groups shared a similar perception on the scenario concerned. To this extent, there is no significant association (differences) between the Groups' perceptions.

A summary of results of the Table B.21 (N=66) shows (ref. Appendix - C) that "where two delays are caused by the contractor", the vast majority of the Consulting Group (97%) and of the Contracting Group (100%) were in agreement as to the contractor's non-entitlement to either time or cost. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this matter (sample x^2 = 0.796 < Critical x^2 = 3.84 at .05, *df*=1, p=.372>.05). *Phi* ϕ (.110) and Cramer's V (.110) also show that the strength of any association between the variables is very weak. Thus, these results may suggest that the vast majority of both Groups share a similar perception on the matter and to this extent, there is no significant association (differences) of perceptions between the Groups.

A summary of results of Table B.22(N=65) shows (ref. Appendix - C) that "where two delays are caused by neutral causes", the vast majority of the Consulting Group (84%) and of the Contracting Group (93%) were in agreement to that the contractor's entitlement was to time only. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this (sample sample x^2 = 4.61 < Critical x^2 = 7.82 at .05, *df*=3, p=.202 >.05). *Phi* ф (.266) and Cramer's V (.266) also show that the strength of this association between the variables is weak. Thus, these results may suggest that the vast majority of both Groups shared similar perceptions and to this extent, there is no significant association (differences) of perceptions between the two Groups.

The Table B.23 (N=65) (ref. Appendix - C) indicates that, in the case "where one delay is caused by the employer and other is by a neutral cause", the majority of the Consulting Group (62%) viewed the option 'Both time and cost' as the correct approach whereas the majority of the Contracting Group (57%) favoured 'Time Only' option. The Chi-Square Test for Independence shows that there is a statistically significant association between the perceptions of the two Groups (sample x^2 = 14.383 > Critical x^2 = 11.34 at .01, *df*=3, p=.002 <.01). *Phi* ф (.470) and Cramer's V (.470) also show that the strength of this association between the variables is moderate. Thus, these results suggest that both Groups did not share similar perception on this issue. To this extent, there is significant association (differences) of between the Groups' perceptions.

The summary of results of Table B.24 (N=65) shows (ref. Appendix - C) that, in the case "where one delay is caused by the contractor and other is by a neutral cause", the majority of the Consulting Group (78%) and of the Contracting Group (75%) were in agreement as to the contractor's entitlement to time only. The Chi-Square Test for Independence shows that there is no statistically significant association (difference) between the perceptions of the two Groups on this (sample x^2 = 4.06 < Critical x^2 = 11.07 at .05, *df*=5 p=.540 >.05). *Phi ф* (.250) and Cramer's V (.250) also show that the strength of this association between the variables is weak. Thus, these results suggest that the majority of both Groups shared a similar perception and to this extent, there is no significant association (differences) of perceptions between the Groups as to the issue.

The foregoing indicates that, in more complicated aspects of apportioning in concurrent delays, the survey results are consistent with the findings in Literature Review that there is hardly any convergent position between the experts' opinions on the issues associated with remedies for 'concurrent delays' (Peters, 2003; Livengood, 2007d; Keane and Caletka, 2008). However, on the other hand, the survey results show that there is a majority agreement between the two groups in less complicated aspects of apportioning in concurrent delays. Thus, to that extent there is a degree of divergence between the survey results and the Literature review's findings.

Perception on 'Float Ownership'

As discussed in the Literature Review there are varied positions as to float ownership and of those the SCL Protocol takes a more pragmatic position without giving exclusive right to ownership of 'float' to either party, when the contract did not explicitly refer to the approach to be taken. Accordingly, in order to inquire what the respondents perceive and practise as to the issue of 'who owns the float', a specific question was asked in the Questionnaire (Question no. 10).

A summary of results of Table B.25 (N=66) shows (ref. Appendix - C) that the majority of the Consulting Group (73%) and of the Contracting Group (62%) were in agreement that if the contract was silent about it then 'float' should belong to the project (SCL Protocol, 2002). Next to these percentages, 34% of the Contracting Group and 19% of the Consulting Group held that the 'float' should belong to the contractor. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this (sample x^2 = 3.41< Critical x^2 = 7.82 at .05, *df*=3 p=.333 >.05). *Phi* ϕ (.227) and Cramer's V (.227) also show that the strength of any association between the variables is weak. Thus, these results suggest that the both Groups, whether the majority or the minority, mostly shared similar perceptions. To this extent, there is no significant association (differences) of between the Groups' perceptions as to the concept concerned. On the other hand the majority position (overall 68%) seems to be consistent with the SCL Protocol's pragmatic position.

Perception on 'Longest Path' and 'Total Float' theories

In order to inquire what the respondents perceive and practise as to the issue of measuring 'criticality' in forensic scheduling, the Questionnaire (Question no. 11) asked whether 'criticality' to be measured against prevailing contract completion date or the project (or predicted) completion date (as determined by the longest path), when the contract did not explicitly refer to the approach to be taken.

A summary of results of the responses is presented (ref. Appendix - C) in Table B.26 (N=65). These results show that the majority of the Consulting Group (54%) and of the Contracting Group (68%) wanted to be in agreement with the 'Total Float' approach (Keane and Caletka, 2008); RP-FSA, 2007), although a substantial minority of respondents (Consulting Group – 41%; Contracting group- 29%) took the 'Longest Path' theory (Wickwire *et al.*, 2003; Keane and Caletka, 2008; RP-FSA, 2007) as their approach. However, a higher percentage of Contracting Group respondents seemed to be with the 'Total Float' theory than the Consulting Group. The Chi-Square Test for Independence shows that there is no statistically significant association between the perceptions of the two Groups on this issue (sample x^2 = 1.27 < Critical x^2 = 5.99 at .05, df=2 p=.531 >.05). *Phi* ϕ (.140) and Cramer's V (.140) also show that the strength of this association between the variables is quite weak. The position of majority in both Groups (overall 60%) favouring 'Total Float' theory may be due to that most of the bespoke contract forms in the UAE require EOT or 'Penalty' to be determined against 'contract completion date', with no reference to 'predicted completion date' which otherwise would have required 'Longest Path' approach.

As both Groups shared similar perceptions *within* the majority and the minority, to that extent, there is no significant association (differences) of perceptions between the Groups.

B.4.4 Awareness, Use, Effectiveness and Disputes in the use of MDA

Apart from inquiring about the respondents' awareness on delay claims theory and forensic scheduling, the research examined the respondents' level of awareness of the mostly used MDAs, frequency of their usage, the perceived level of reliability attributed on them for successful results, and the experience of dispute arising out of their usage. (These were inquired through Question no. 12, 17, 18 and 19).

As informed by the Literature Review the current research has selected the following four mostly known primary methods for this inquiry:

- Impacted As-Planned (IAP);
- Collapsed As-Built (CAB);
- As-Planned versus As-Built (APvAB); and
- Time Impact Analysis (TIA).

These are contemporaneously used MDAs in the local setting, and also often examined in major publications as the primary methods (Keane and Caletka, 2008; SCL Protocol, 2002; Arditi and Pattanakitchamroon, 2006). Accordingly, the research study has focused on these four MDAs with one additional technique i.e. *Global Claims* method which is also used in the local industry.

Awareness on MDAs

Table B.27 (Qno.12, max. valid responses = 66) reflects (ref. Appendix - C) a summary of the general level of respondents' awareness of the MDAs concerned. Using a 5-point Likert scale (where '1 = Unaware' to '5=Thorough') and scores being 'normalized' with "Weighted Averages", the 'Awareness Index' is ranked in ascending order.

Quite understandably, the ranking suggests that, within both Groups, the highest level of awareness was about the simplest methods, namely *As-Planned vs. As-Built* and *Impacted-As-Planned.* However, the Consulting Group showed a higher level of awareness than the Contracting Group as for the more sophisticated methods of *Time Impact Analysis* and *Collapsed-As-Built.* This is also understandable because, as it would be seen, the Consulting Group's most preferred method was *Time Impact Analysis.* From the test statistics (Kendall's $W = 0.87 >$ Critical $W = 0.84$; For N=5 and k=3, at significance level $\alpha = 0.01$, df=4) it can be concluded with considerable confidence that the agreement or concordance amongst the rankings of the respondents of the two Groups is higher than it would be by chance had the scores and their rankings been random or independent.

Frequency of Use of MDA

Table B.28 (Qno.17, max. valid responses = 56) indicates (ref. Appendix - C) a summary of the general level of respondents' use of the MDAs concerned. Using a 5-point Likert scale (where '1 = Never' to '5=Always') and scores being 'normalized' with "Weighted Averages", the 'Frequency of Use Index' is ranked in ascending order.

The ranking suggests that, the *Impacted-As-Planned* [IAP] (followed by *As-Planned vs. As-Bu*ilt and *Global Claims*) was the mostly used method amongst the respondents of Contracting Group. This is consistent with the observations made in the Literature Review as IAP is probably the most common analysis technique used by contractors on most projects

(Livengood, 2007e). However, the *Time Impact Analysis* was the most used one in the Consulting Group. The Collapsed-As-Built was the least used by the Contracting Group and the second-least by the Consulting Group; The test statistics (Kendall's W = 0.71 <; Critical W = 0.72; For N=5 and k=3, at significance level α= 0.05, *df*=4) show the rankings attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

Further, in order to test whether there is any association exists amongst the rankings of the respondents as to the level of 'awareness' and the extent of ' use' of each of the MDA, *Spearman Rank Order Correlation* is used. Computation of correlations has been done using SPSS software, within each Group.

The Table B.29 (see Appendix - D for calculation) below presents a summary of the results. Accordingly, a statistically significant, strong, and positive association (with the exception of APvAB and Global Method for Consultants' Group) between the rankings is generally seen. This may suggest that the use of the MDAs by the practitioners within the Groups was generally corresponding to the level of awareness of the MDAs. Within the Contracting Group this association was more prominent for the less sophisticated MDAs (Global, APvAB and IAP) and in Consulting Group it is visible in the 'sophisticated' MDAs (TIA and CAB).

Table B.29 Awareness versus Use *(Spearman Rank Order Correlation)*

	As-Planned v. As-Built	Impacted-As-Planned	Collapsed-As-Built	Time Impact Analysis	Global Claims
Respondent Group	Awareness v. Use	Awareness v. Use	Awareness v. Use	Awareness v. Use	Awareness v. Use
Contractors' Group	.685**	.561**	.400*	.264**	.798**
Consultants' Group	0.215	.434**	.542**	.622**	-0.058

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Effectiveness in the Use of MDA

Table B.30 (Qno.18, max. valid responses = 58) indicates (ref. Appendix - C) a summary of the general level of respondents' perceived effectiveness of use of the MDAs concerned. Using a 5-point Likert scale (where '1 = None' to '5= Very High') and scores being 'normalized' with "Weighted Averages", the 'Effectiveness Index' is ranked in ascending order.

The ranking suggests that the both Groups perceived that Time Impact Analysis was the most effective MDA followed by Impacted-As-Planned method. For the Contracting Group the lowest effectiveness was with the Collapsed-As-Built and for the Consulting Group it was the Global Claims method. The test statistics (Kendall's W = 0.77 >; Critical W = 0.72; For N=5 and k=3, at significance level α= 0.05, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Level of Dispute against Use of MDA

Table B.31 (Qno.19, max. valid responses = 56) shows (ref. Appendix - C) a summary of the experienced level of contest or dispute arising against the use of the MDAs concerned. Using a 5-point Likert scale (where '1 = Never' to '5= Always') and scores being 'normalized' with "Weighted Averages", the 'Dispute Index' is ranked in ascending order.

The ranking suggests that the both Groups perceived that the more sophisticated MDAs like *Collapsed As-Built* and *Time Impact Analysis* would draw a least contest or dispute for their use in the delay analysis. On the other hand, the Contracting Group ranked simpler MDAs like Global Claims as the most susceptible MDA to contest or dispute, while the Consulting Group ranked another simpler MDA like As-Planned vs. As-Built method as the most vulnerable to dispute. The test statistics (Kendall's W = 0.87 >; Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.4.5 Use of As-built Records and Software in Delay Analysis

Use of Programmes & Updates

The survey-questionnaire also sought respondents' response as to how frequently they use CPM based baseline and 'consented' programmes, as-built updates of such programmes and other contemporaneous records in delay claims preparation and assessment of same (Question no. 15 and 16).

Table B.32 (Qno.15, max. valid responses = 59) indicates (ref. Appendix - C) a summary of the general level of use of such information in the delay claims resolution. Using a 5-point Likert scale (where '1 = Never' to '5= Always') and scores being 'normalized' with "Weighted Averages", a 'Use Index' is ranked in ascending order. (See Appendix - C for calculation of Test Statistics).

The ranking suggests that the both Groups used CPM based baseline programmes (including the 'consented' programme) giving highest priority. This may be understandable as the mostly used MDA of both the contractors (i.e. Impacted As Planned) and the consultants (i.e. Time Impact Analysis) essentially require CPM based baseline programmes (including the 'consented' programme). However, particularly the Contracting Group seems to have considered updating the consented programme with as-built data is of least importance. This may be due to that, for using Impacted As Planned method, which is the most preferred MDA of the Contracting Group, one does not have to rely on such as-built data. The test statistics (Kendall's W = 0.87 >; Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Use of Software

For the level of sophistication of software used in delay claims resolution, the comparison was made between 'Primavera' software which is more advanced and effective than 'MS Project' software. Tables B.33 (max. valid responses = 60) and B.34 (max. valid responses = 50) have summarized the results (ref. Appendix - C).

The summary of results indicates that with a more than 90% overall frequency, both Groups preferred using 'Primavera' to 'MS Project', whereas nearly 50% respondents never used the latter. This is understandable as the most projects in the region use 'Primavera' software as a standard for the CPM based construction programmes for project planning and progress monitoring.

B.4.6 Promptness in Delay Claims Submission, Assessment and Settlement

Inquiring about problematic situations that may impede the delay claims resolution process was given a high significance in the Questionnaire. A main focus in this regard was on the level of promptness in claims submission, their assessment and settlement (or awarding extension of time). Accordingly, the relevant questions were asked covering these three areas (Question no. 24, 25, 26 & 27).

Promptness in Submission

In order to measure the level of promptness performed by the contractors in their submissions of delay claims, the respondents were asked to indicate disagreement or agreement based on five possible scenarios based on specific propositions to that effect.

Table B.35 (Qno.24, max. valid responses = 54) indicates (ref. Appendix - C) a summary of the respondents' perceived ratings of the following propositions:

> "contractors submit their delay analysis claims with adequate details enabling consultants' assessment:
>
> - long after the project is completed;
> - After the effects of ALL the claimed 'events' are ceased;
> - After the effects of the particular 'event' is ceased;
> - Contemporaneously and promptly; and
> - Not submitting at all".

Using a 5-point Likert scale (where '1 = Strongly Disagree' to '5= Strongly Agree') and scores being 'normalized' with "Weighted Averages", a 'Promptness Index' is ranked in ascending order.

The ranking suggests divergent opinions between the two Groups. For the Consulting Group it was most likely that the contractors' claims submissions were made '*long after the project is completed*' (which is followed by the second highest as '*After the effects of ALL the claimed 'events' are ceased*'). However, according to the Contracting Group the highest ranked scenario was that the contractors' claims submissions were made '*Contemporaneously and promptly*' (followed by second highest as '*After the effects of the particular 'event' is ceased*'). Both Groups agreed that the scenario '*Not submitting at all*' was less likely to happen. So the two Groups were very divergent on this issue. The test statistics (Kendall's W = 0.56 <; Critical W = 0.72; For N=5 and k=3, at significance level α= 0.05, *df*=4) show the rankings attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

Promptness in Assessment

Next issue inquired was how promptly the consultants assess or determine the submitted delay claims. In order to measure the level of promptness performed by the consultants, five scenarios were presented for the respondents' opinion. These scenarios are corresponding to those tested against the contractors' promptness in claims submissions. Table B.36 (Qno.25, max. valid responses = 53) indicates (ref. Appendix - C) a summary of the respondents' perceived ratings of the following propositions:

"Consultants (assessors) determine claimed entitlement to extension of time:

- long after the project is completed;
- After the effects of ALL the claimed 'events' are ceased;
- After the effects of the particular 'event' is ceased;
- Contemporaneously and promptly; and
- Not determining at all".

Using a 5-point Likert scale (where '1 = Strongly Disagree' to '5= Strongly Agree') and scores being 'normalized' with "Weighted Averages", a 'Promptness Index' is ranked in ascending order.

The ranking suggests that it is most likely that the consultants' determination of the entitlement was made '*after the effects of ALL the claimed 'events' are ceased*' as both Groups ranked this scenario as the highest. Further, both Groups agreed that the "Not determining at all" was less likely to happen. The test statistics (Kendall's W = 0.87 >; Critical W = 0.84; For N=5 and k=3, at significance level α= 0.01, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Promptness in Award of Entitlement

As most bespoke forms of contract in the region provides the employers to have a final 'say' in the matters of extension of time, a particular question was included for the respondents to confirm this or otherwise with regard to the local situation.
Table B.37 (Qno.26, max. valid responses = 51) presents (ref. Appendix - C) a summary of the result for this question where overall 92% respondents have confirmed that in most of the projects in the UAE, the contract provisions require approval of the employer prior to awarding extension of time to the contractor.

Next question asked was how promptly such approval was given by the employers. In order to measure the level of promptness performed by the employers in this regard, five scenarios (similar to those tested against the contractors' and consultants' promptness) were presented for the respondents' opinion.
Table B.38 (Qno.27, max. valid responses = 49) indicates (ref. Appendix - C) a summary of the respondents' perceived ratings of the following propositions:

"Such employer approval is normally given:

- long after the project is completed;
- After the effects of ALL the claimed 'events' are ceased;
- After the effects of the particular 'event' is ceased;
- Contemporaneously and promptly; and
- Not approving at all."

Using the 5-point Likert scale (where '1 = Strongly Disagree' to '5= Strongly Agree') and scores being 'normalized' with "Weighted Averages", a 'Promptness Index' is ranked in ascending order.

The Contracting Group ranked *"long after the project is completed"* as the highest scenario though it was not corroborated with the Consulting Group. For the Consulting Group, mostly, that approval came either after the effects of all the events or of the particular event were ceased. Nevertheless, the summary results (ranking) suggest that it is agreeable for both Groups that the client's approval for extension of time award was made '*After the effects of ALL the claimed 'events' are ceased*' as both Groups ranked this scenario as the second highest. This seems to be the consensually more likely situation for both Groups. Also, both Groups agreed that the last two scenarios (i.e. "Contemporaneously and promptly" and "Not determining at all") were less likely to happen. The test statistics (Kendall's W = 0.81 > Critical W = 0.72; For N=5 and k=3, at significance level α= 0.05, *df*=4) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.4.7 Obstacles for Using an Appropriate MDA

Possible problematic situations encountered by the practitioners could be either of obstructive type for taking appropriate measures in claims resolution or of contributory type towards escalating the existing disputes to more advanced levels. Many of such problematic situations may arise when attempting to quantify delay effects using an appropriate MDA. In this case, nine factors, which were generally informed by the various literature reviewed (RP-FSA, 2009; Arditi and Pattanakitchamroon, 2006; Braimah and Ndekugri, 2007; Kumaraswamy and Yogeswaran, 2003), were identified as potential obstacles for using an appropriate MDA (Question no. 20). Accordingly, the Questionnaire inquired from the respondents, in their experience, how frequently these factors would become such obstacles. The Questionnaire also requested to cite any further factors of similar category, but there were no further suggestions made.

MDA – Obstacle Factors

Table B.39 (Qno.20, max. valid responses = 56) shows (ref. Appendix - C) a summary of the frequency of these factors becoming obstacles for using an appropriate MDA. Using a 5-point Liker scale (where '1 = Never' to '5= Always') and scores being 'normalized' with "Weighted Averages", an 'Obstacles Index' is ranked in ascending order. As N>7, necessary computation was done using expression: $\boldsymbol{x^2=k(N-1)W}$ to obtain sample value *x2* to compare with the corresponding critical value *x2*; also necessary adjustment was made as to tied-numbers in the ranks.

The ranking suggests that both Groups considered 'lack of skills in programming software', and 'cost and time-consumption for using an appropriate MDA' were less frequently encountered obstacles than the others. For Consulting Group the most frequent obstacle was the 'lack of as-built updates of the programme', though for the Contracting Group it was the 'lack of consented programme'. This may be understandable as the mostly used MDAs of both the contractors and the consultants essentially require this information (i.e. consented programme for Impacted As Planned and as-built updates of the programme for Time Impact Analysis) for their implementation. Thus, it appears that there was a degree of consensus between the two Groups as to availability of a proper CPM based baseline programme, its consented version, the updates of this programme and the necessary site records is having a high importance in selection of the appropriate MDA. The test statistics (Kendall's W = 0.89; Sample x^2 = 21.36> Critical x^2 = 15.51; For N=9 and k=3, at significance level α= 0.05, *df*=8) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.4.8 Dispute Contribution Factors

With regard to problematic factors contributing towards escalating the existing disputes to more advanced levels, twelve such factors, which were generally informed by Literature Review, were identified (Question no.21). Accordingly, the Questionnaire inquired from the respondents, in their experience, how frequently these factors would contribute t/o further escalation of existing disputes. The Questionnaire also requested to cite any further factors of similar category, but there were no further suggestions submitted.

Table B.40 (Qno.21, max. valid responses = 54) indicates (ref. Appendix - C) a summary of the frequency of these factors contributing to escalate the disputes over matters involved in delay claims resolution. Using a 5-point Likert scale (where '1 = Never' to '5= Always') and scores being 'normalized' with "Weighted Averages", an 'Obstacles Index' is ranked in ascending order. As N>7, necessary computation was done using expression: $\boldsymbol{x^2=k(N-1)W}$ to obtain sample value *x2* to compare with the corresponding critical value *x2*; also necessary adjustment was made as to tied-numbers in the ranks.

For both Contracting Group and the Consulting Group the most contributing factor to dispute escalation was the 'Global Claims' (factorno.6). According to the Consulting Group the next two factors mostly contributing to escalation of disputes are the failure to comply with the prescribed time for submission of delay claims 'notices' (factorno.4) and their 'particulars' (factorno.5). However, for the Contracting Group the next two factors mostly contributing were the failure to establish 'liability' (factorno.7) and 'quantum' (factor no.8) which were

closely followed by 'Delay analysis method used by one party being disagreed/challenged by other party' (factorno.9). As for
the Consulting Group, these three factors (no.7, 8, & 9) stood as the third most contributing cluster (of factors) to escalation of dispute.

As for the remaining six factors, which are related to contract documentation (factors no.1. *Discrepancies and ambiguities within tender/contract documents*; no.2. *Lack of risk distribution between the parties, in the Contract*; no.3. *Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.);* and no.10. *Absence of definition in the contract as to 'float ownership'*; no.11. *Absence of definition of approach to be used at measuring 'criticality' of a delay;* and no.12. *Absence of definition in the contract as to approach for 'Concurrent delay situations'.*) some association between the rankings of the two Groups was observed.

The test statistics (Kendall's W = 0.89; Sample x^2 = 29.38> Critical x^2 = 24.72 (For N=12 and k=3, at significance level α= 0.01, *df*=11) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.4.9 Delay Claims Avoidance

It is suggested that the organisations should have a *"claim*[s] *prevention policy*" rather than a *"claim*[s] *cure policy"*. (Jones, 1988, pp. 8-23). The respondents were requested to rate their perceived importance on certain factors which were based on the discussion undertaken in the Literature Review. The rating was requested on two sets of questions: The first set (Question no.22) consisted of seven factors which were to be rated according to their 'importance' in reducing/preventing delay claims in construction projects. The second set (Question no.23), which largely associated with the first set, comprised eleven factors for potentially enhancing the efficiency of claims resolution process. The respondents were also provided to suggest any other factors which they thought were applicable in these sets, but none was submitted.

Claims Prevention Factors

Table B.41 (Qno.22, max. valid responses = 52) indicates (ref. Appendix - C) a summary of 'Prevention Index' of these factors contributing to reducing/preventing delay claims in construction projects. Using a 5-point Likert scale (where '1 = Negligible' to '5= Extremely

Important') and scores being 'normalized' with "Weighted Averages", a 'Prevention Index' is ranked in ascending order; also necessary adjustment was made as to tied-numbers in the ranks.

Summary results of Table B.41 indicates that from the Contracting Groups' viewpoint the most important contribution for reducing or preventing the delay claims came from 'engineer's impartiality'against own faults or outside pressure (factorno.06) and availability of a contractually stipulated mechanism to resolve delay claims at site level on day-to-day basis (factorno.07).

On the other hand, the Consulting Group seemed to have opined that the pre-contract related measures like allowing sufficient time to complete design (factorno.01) together with a dispute resolving mechanism at site level on day-to-day basis (factorno.07) would be more effective and important to reduce/prevent causes of post-contract delay claims. In any case, there seemed to be a strong agreement between the two Groups on factorno.01 and no.07 for their high importance.

The other 'factors' considered were *no.2. Establish high level quality control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents; no.3. Clear distribution of risk between the parties, in the Contract; no.4. Clear cut definition in the contract as to 'float ownership'; no.5. Clear cut definition in the contract as to 'automatic entitlement to EoT for delays occurring after passing prevailing contract completion date'.*

The test statistics (Kendall's W = 0.86 > Critical W = 0.74; For N=7 and k=3, at significance level α= 0.01, *df*=6) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Delay Claims Efficiency Factors

The Question no. 23 was presented to the respondents for this purpose with 11 factors which were to be rated according to their 'importance' in expediting and making efficient the prevailing delay claims resolution process. The respondents were also provided to suggest any other factors they think were applicable in these sets, but none was submitted.

Table B.42 (Qno.23, max. valid responses = 53) indicates (ref. Appendix - C) a summary of 'Importance Index' of these factors contributing to expediting/making efficient the process of delay claims resolution. Using a 5-point Likert scale (where '1 = Negligible' to '5= Extremely Important') and scores being 'normalized' with "Weighted Averages", an 'Importance Index' is ranked in ascending order; also necessary adjustment was made as to tied-numbers in the ranks. As N>7, necessary computation was done using expression: $x^2=k(N-1)W$ to obtain sample value $x2$ to compare with the corresponding critical value x^2; also necessary adjustment was made as to tied-numbers in the ranks.

The summary results of Table B.42 show that there is a strong agreement between the two Groups with regard to the three most important factors; in the descending order they are : engineer's impartiality in apportioning liability (factorno.11); Prompt and timely award of extension of time (factorno.10); and a clear mechanism for delay claims presentation by contractors for establishing 'liability' and quantum stipulated in the contract (factorno.01). That apart, a close relationship between the two Groups is also seen as for the importance of factor no.09, i.e. 'Presentation and assessment of delay claims carried out on a analysis method mutually agreed on an objective basis'.

The other 'factors' considered were *no.2. Stipulation in contract as to the basic and minimum required documents to be presented; no.3. Submission of 'notification' of delay claim event within contractually prescribed time; no.4. Submission of 'particulars' of delay claim event within contractually prescribed time; no.5. Clear cut definition in the contract for the approach as to 'concurrent delays'; no.6. Clear cut definition in the contract for the approach as to 'float ownership'; no.7. Clear cut definition in the contract for delay analysis methodology to be used in delay claims presentation and evaluation; and no.8. Clear cut definition in the contract for approach to be used at measuring 'criticality' of a delay (Zero Float or longest path).*

The test statistics (Kendall's W = 0.90; Sample x^2 = 26.95> Critical x^2 = 23.21 (For N=11 and k=3, at significance level α= 0.01, df=10) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.4.10 Selection of Optimum MDA

The Questions no. 28 and 29 in the survey-questionnaire were instrumental for investigating how the practitioners of the two Groups would rank the significance of the 'Criteria', and importance of the 'Attributes' used in the Model for selection of optimum MDA. Addition to this, Question no.30 was used to investigate the ranking of suitability/necessity of each of the 'Alternatives' (i.e. the four MDAs used in the Model) in relation to the actual presence of the 'Attributes'. The 'Criteria' and 'Attributes' which have been identified to be used in the Model are largely informed by the Literature Review (SCL Protocol, 2002; RP-FSA, 2009; Arditi and Pattanakitchamroon, 2006; Braimah and Ndekugri, 2007) and its findings.

The rankings of the survey respondents according to their perceived significance/ importance are converted into 'Normalised Weights' and used in the calculations at Level 2 and 3 of the final building of the Model. Thus, this investigation through Questions no. 28, and 29 was mainly for that purpose.

However, the Question no.30 was for the purpose of testing the level of the 'concordance' between the rankings of the two Groups, only. This is because the required input at Level 4 of the Model is to be made by the Decision Maker who would use the Model, and that input is based on the suitability/necessity of each of the 'Alternatives' (i.e. the four MDAs used in the Model) in relation to the actual presence of the 'Attributes' under actual circumstances of the project.

Significance Index – Criteria

There were 07 nos. 'Criteria' (at Level 2 of the Model) as follows: 1). Contractually Specified Requirements as for Delay Analysis – **CCR;** 2). Project Constraints (Magnitude, Complexity Etc.) – **PC;** 3). Claims Magnitude and Complexity – **CMC;** 4). Records Availability – **Reca;** 5). Proof Of Causation (Transparency of Analysis) – **Profc;** 6). Time and Cost of Analysis - **T&C;** and 7). Legal Admissibility (By Triers) – **Ladms.**

The Table B.43 (Qno.28, max. valid responses = 53) shows (ref. Appendix - C) the summary results of how the respondents ranked the relative significance of the 'Criteria' used (at Level 2) in the selection of an optimum MDA. For both Groups, "Records Availability" (Criterion no.4) was the most significant of the seven Criteria concerned. In a decending order of significance, the Contracting Group considered the 5th, 1st, and 3rd as the next most significant three Criteria. In the same order, 5th, 7th,and 1st Criteria were the next most significant three Criteria for the Consulting Group. For both Groups, project magnitude and its complexity (Criterion no.2), or the time and cost of analysis (Criterion no.6) were of low significance. This is somewhat surprising when considering the higher importance attributed to these factors as seen in the Literature Review (RP-FSA, 2009; Braimah and Ndekugri, 2007; Arditi and Pattanakitchamroon, 2006 ;) and may require further (future) inqury. It was noticeable that 'Legal Admissibility' of the MDA was the least significant for the Contracting Group whereas it was the third most significant Criterion for the Consulting Group.

The test statistics (Kendall's W = 0.85 > Critical W = 0.74; For N=7 and k=3, at significance level $\alpha = 0.01$, *df*=6) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Importance Index – Attributes

There were 23 nos. 'Attributes' (at Level 3 of the Model) as follows: 1). Concurrency & Float Ownership Defined in the Contract **(C&F)**; 2). Analysis Method Defined In The Contract **(AM)**; 3). Value of the Project - **(PV)**; 4). Size of the Project- **(PS)**; 5). Duration of the Project- **(PD)**; 6). Status (prevailing stage) of the project -**(PCS)**; and 7). Complexity of the Project-**(PC)**; 8). Amount Of Time Claimed-**(MT)**; 9). Amount of cost (of prolongation) claimed-**(MC)**; 10). Number Of Events Claimed And To Be Analysed - **(NE)**; 11) Obscurity And Sophistication Of Issues In Prolongation Claims -**(OBS)**; 12). Baseline Programme Availability - **(ABP)**; 13). Baseline programme type (e.g. CPM) - **(TBP)**; 14). As-Built Periodical Updates Of Programme - **(AB)**; 15). As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**; 16). Availability of other records (e.g. Daily Records Etc.) - **(AOR)**; 17). High quality of transparency (Clearly Established Causation) - **(LTR)**; 18). Need of Showing Concurrent Delays/ Mitigation - **(NC)**; 19). Need to Illustrate Isolated Delay Effects - **(IEE)**; 20). Need of sequential (chronological) analysis - **(COA)**; 21). Expert skills (For Analysis Method) - **(XS)**; 22). Concern for Cost of Analysis Method - **(CA)**; 23). Concern for Time to Be Spent For Analysis - **(TSA)**.

The Table B.44 (Qno.29, max. valid responses = 52) (ref. Appendix - C) presents the summary results of how the respondents ranked the relative importance of the 'Attributes' used (at Level 3) in the Model. For both Groups, the most important 'Attributes' for the selection of an optimum MDA were those related to the Baseline Programme, its periodical updates, and availability of other contemporary records (Attributes nos. 12 to 16). For the Consulting Group those Attributes related to 'need of finding concurrent delays' (Attribute no. 18), 'chronological analysis of events' (Attribute no. 20), 'contractual definition for concurrency and float ownership' (Attribute no. 1), and 'high transparency' (Attribute no. 17)

were the next most important Attributes. The Contracting Group considered 'concurreny' and 'transparency' related Attributes were moderately significant.
The Contracting Group also thought if the contract was to define the MDA to be used in the analysis that would be the 6th most important Attribute as it might avoid or minimise a lot of differences between the parties on the selection of MDA. However, the Consulting Group did not attribute that with such importance.

The test statistics (Kendall's W = 0.92; Sample x^2 = 60.53> Critical x^2 = 48.27 (For N=23 and k=3, at significance level α= 0.001, *do*=22) show with considerable confidence that the agreement or concordance between the rankings of the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Suitability/Necessity Index – Alternative MDAs

As for the Question number 30, the main purpose was to measure the relation or association of rankings of the two Groups for each of the four Alternative MDAs in relation to each of the 23 'Attributes' (plus 01 'criterion' i.e. **Ladms**) mentioned above. The rankings were attributed in terms of suitability/necessity of each of the 'Alternative' MDAs in the presence of each of the 'Attributes' in a given project.

The four Tables B.45, B.46, B.47 and B.48 (ref. Appendix - C) show the summary results of measure of agreement between the rankings of respondents of the two groups. In summary, except in the case of 'Collapsed-As-Built method' where such rankings are mostly unrelated [i.e. are independent], in other three MDAs it was shown with a considerable confidence that the agreement between the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Table Ref.	Measure of Agreement/concordance between the rankings attributed for:	Test statistics
Table B.45	Suitability/Necessity Index for 'As-Planned v As-Built method' against the availability of Attributes	Kendall's W = 0.65; Sample χ^2 = 44.91> Critical χ^2 = 41.64 (For N=24 and k=3, at significance level α= 0.01, *df*=23
Table B.46	Suitability/Necessity Index for 'Impacted-As-Planned method' against the availability of Attributes	Kendall's W = 0.52; Sample χ^2 = 36> Critical χ^2 = 35.17 (For N=24 and k=3, at significance level α= 0.05, *df*=23
Table B.47	Suitability/Necessity Index for 'Collapsed-As-Built method' against the availability of Attributes	Kendall's W = 0.47; Sample χ^2 = 32.73< Critical χ^2 = 35.17 (For N=24 and k=3, at significance level α= 0.05, *df*=23
Table B.48	Suitability/Necessity Index for 'Time Impact Analysis method' against the availability of Attributes	Kendall's W = 0.67; Sample χ^2 = 46.57> Critical χ^2 = 35.17 (For N=24 and k=3, at significance level α= 0.05, *df*=23

Table B.45 test statistics. show that the rankings in the Suitability/Necessity Index of 'Collapsed-As-Built method' against the Attributes as assigned by the two groups are unrelated [i.e. are independent] and the observed value of 'W' (Kendall's 'W'= .47) differs from zero only by chance.

However, test statistics in all other three Tables show with considerable confidence that the agreement between the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

B.5 Results of the In-Depth Survey

B.5.1 Characteristics of Respondents

The results of the findings based on the responses received to the inquiry (through Question No. 1 to 7 and 13 & 14 of the survey-questionnaire) can be summarized as follows:

- Quantity Surveying/Commercial Management, Contracts Management and Claims Management were the mainly responsible disciplines for carrying out delay claims resolution in both Contracting (91%) and Consulting (78%) Groups;
- More than 90% of the practitioners in both Groups were engaged in-house by their respective organisations. This may indicate a very low level of external in-put of expertise in delay claims preparation and evaluation;
- The majority of the respondents were dealing with claims preparation (for contractors) and claims evaluation (for developers). Their overall average experience in claims preparation and evaluation was around 10 years. They had an average

experience in peripheral fields like Forensic Schedule Analysis, Commercial Negotiation, Project Planning, Dispute Resolution and Legal Support which was also well above 8 years. These results reflected that the respondents were experienced and involved in almost all aspects of delay claims resolution process. Therefore, their responses would carry a reasonable level of credibility;

- The majority (64%) of the respondents were in the middle management of their organisations; another 22% were in the upper and decision making level. This stature also added a further credibility to the data collected from their responses;
- The above findings mainly confirm that the respondents who participated in this in-depth survey are from a sample of practitioners who are having hands-on experience in delay claims resolution and their responses carry a reasonable level of credibility and validity for the findings and results of this research inquiry.

B.5.2 Awareness on Delay Claims Theory and Forensic Scheduling

As for the legal theory, the inquiry was mainly focused on how the two Groups perceived to implement the essential concepts and theory. Three key factors of the legal theory that could influence the outcome of a delay analysis were selected as informed by Literature Review. These were (1) Concurrent Delays, (2) Float Ownership, and (3) Critical Path theory. The results of the findings based on the responses received to the inquiry (through Question no. 8 to 11 of the survey-questionnaire) are summarized as follows:

Perception on 'Concurrency'

- The majorities of the Contracting Group and Consulting Group had a ***similar*** patterns of perception that both effects of delays in 'true concurrency' and effects of sequential delays which are felt at the same time ('concurrent effects') equally merit entitlement to extension of time;
- However, a substantial minority of respondents (overall 39%) believed only 'true concurrency' should carry entitlement. To that extent the results are consistent with that there is still no universal position as to the definition of 'concurrent' delays.

Apportioning Time and Cost on 'concurrency'

In more complicated aspects of apportioning in concurrent delays, the survey results are consistent with the findings in Literature Review that there is hardly any convergent position between the experts' opinions on the issues associated with remedies for 'concurrent delays' (Peters, 2003; Livengood, 2007d; Keane and Caletka, 2008). However, the survey results also show that there is a majority agreement between the two groups in less complicated aspects of apportioning in concurrent delays. Thus, to that extent there is a degree of divergence between the survey results and the Literature review's findings.

Perception on 'Float Ownership'

- The SCL Protocol's position on 'float ownership' has been that if the contract is silent about it then float should belong to the project or it is decided on 'first-come first-served' basis. The majority position (overall 68%) seems to be consistent with this position. However, still there is a substantial minority (overall 26%) who think otherwise (that 'float belongs to the contractor').

Perception on 'Measuring Criticality in Forensic Scheduling

- A main factor having a great impact on the outcome of delay analysis is the analyst's approach as to scheduling options with regard to the 'Longest Path' theory and the 'Total Float' theory. The central issue related to the two theories is whether the 'criticality' of an effect of a delaying event to be measured against the 'Projected(Predicted) Completion Date' set by the programme's longest path or the prevailing 'Contract Completion Date' as considered by the 'Total Float' theory.
- The position of majority in both Groups (overall 60%) favours the approach of 'Total Float' theory. This may be due to that most of the bespoke contract forms in the UAE require EOT or 'Penalty' to be determined against 'contract completion date', with no reference to 'predicted completion date' which otherwise would have necessitated 'Longest Path' approach. However, there was also a substantial minority (overall 35%) in the two Groups who considered the 'Longest Path' theory as their approach.

On the issues of 'float ownership' and Critical Path theory, and more straight forward concepts as to 'concurrent delays', there has been a similarity in perceptions within the majority among the two Groups. However, there has also been a substantial minority with differing perceptions as to these theory and concepts. To this extent, these results may be viewed as consistent with the research proposition '*The tacit or explicit awareness of essential theory, concepts, legal position and Methods of Delay Analysis (MDA) applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers)*'.

B.5.3 Awareness, Use, Effectiveness and Disputes in the use of MDA

Awareness on MDAs

- In both Groups, the highest level of awareness was found for the simplest methods, namely *As-Planned vs. As-Built* and *Impacted-As-Planned.* However, the Consulting Group showed a higher level of awareness than the Contracting Group for the more sophisticated methods of *Time Impact Analysis* and *Collapsed-As-Built.* This may be understandable as generally the Consultants are inclined to use more robust methods in order to defend their findings/decisions in the claim resolution process.

Frequency of Use of MDA

- The *Impacted-As-Planned* (followed by *As-Planned vs. As-Built* and *Global Claims*) was the mostly used method among the Contracting Group. This may suggest that the Contracting Group often prefers less sophisticated methods;
- The *Time Impact Analysis* was the most used one with the Consulting Group and that may be, as mentioned above, for their preference to use a more sophisticated, robust and recognised method;
- These opposing preferences to use MDAs by the practitioners of the two competing groups may result in producing divergent outcomes in the claims submission and their assessment. In turn, there could be a lack of or no agreement between the two opposing groups on these outcomes;

The *Spearman Rank Order Correlation* (***rs***) generally showed a statistically significant, strong, positive association between almost all the rankings of '<u>awareness</u>' and the extent of '<u>use</u>' of each of the MDA by the practitioners within the Groups. This may also confirm the research proposition that selection of a Method of Delay Analysis (MDA) by the practitioners (for claiming or defending) is generally influenced by the practitioner's particular level of knowledge of a MDA.

Effectiveness in the Use of MDA

- Both Groups perceived *that Time Impact Analysis* was the most effective MDA; this may suggest that although the Contracting Group often prefers less sophisticated methods, they still reckon the Time Impact Analysis as the most effective method regardless of its being a more sophisticated technique than their mostly used simpler methods. However, their use of Impacted-As-Planned as the principal MDA remains a paradox to this perception and a source of problem, producing conflicting outcomes of delay analysis with those of *Time Impact Analysis* which is the principal MDA used by the Consulting Group.

- For the Contracting Group the lowest perceived effectiveness was with the *Collapsed-As-Built* and for the Consulting Group it was the *Global Claims* method.

Level of Dispute against Use of MDA

- Both Groups perceived that the *Collapsed As-Built* and *Time Impact Analysis* were the MDAs which would draw a least contest or dispute for their use in the delay analysis;
- The Contracting Group ranked *Global Claims* as the most susceptible MDA to contest or dispute; the Consulting Group ranked *As-Planned vs. As-Built* method as the most vulnerable to dispute;
- This may suggest that both Groups agree that more sophisticated MDAs are the least vulnerable when challenged while simpler methods are susceptible to defend.

These results on 'Awareness, Use, Effectiveness and Disputes in the use of MDAs' seem strongly supporting the research proposition:

> *"In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust".*

B.5.4 Use of As-built Records and Software in Delay Analysis

Use of Programmes & Updates (Table B.32).

- Both Groups used CPM based baseline programmes (including the 'consented' programme) with the highest frequency of use;
- However, the Contracting Group seemed to have considered updating the consented programme with as-built data was of least importance. This may be due to that the Contracting Group's most used MDA was Impacted –As-Planned method which does not require as-built updates. This may also be a substantial problematic situation at delay claims resolution as the information to be used in claims submission by the contractors lacks the objectivity of actual or as-built status;

- The prominence given to CPM based baseline programmes (including the 'consented' programme) and as-built programme updates (mutually agreed) by the Consulting Group may also be understood as due to essential requirements of their mostly used MDA (i.e. Time Impact Analysis);

Use of Software

- With more than 90%, both Groups preferred using more sophisticated software for delay analysis. This is understandable as the most projects in the region use 'Primavera' software as a standard for the CPM based construction programmes for project planning and progress monitoring.

B.5.5 Promptness in Delay Claims Submission, Assessment and Settlement

Promptness in Submission

- A prompt submission of delay claims by the contractors with adequate details enabling a meaningful assessment by the consultants is regarded as a prime factor enhancing the efficiency of delay claims resolution process. As for the level of promptness performed by the contractors, both Groups had divergent views on the 'time' of such submissions, though they agreed *'Not submitting at all'* was the least likely to happen;
- However, both groups agreed to *'After the effects of ALL the claimed 'events' are ceased'* as the second most likely 'timing' for contractor's submissions. Therefore, it may be regarded as the more realistic scenario of general timing of claims submission; but it could also be an incomplete and insufficient submission (Kumaraswamy and Yogeswaran, 2003; Keane and Caletka, 2008) merely aiming to avoid consequence for non-compliance with conditions precedent in the contract;

Promptness in Assessment

- Once the contractor's submission of delay claim is received the consultant's prompt action to evaluate it is essential for the efficiency of delay resolution process.
- As for the level of promptness performed by the consultants, both Groups agreed to that the most likely scenario would be the consultants' determination of the entitlement to be made *'after the effects of ALL the claimed 'events' are ceased'*.

- Both Groups agreed that '*Not determining at all*' was the least likely to happen.

Promptness in Award of Extension of Time

- As most bespoke forms of contract in the local use require, the employer's approval for the engineer's (consultant's) determination of award of extension of time is mandatory. This pre-requisite was confirmed by 92% of the respondents. As this factor has an impact on the timely resolution of delay claims, the respondents were asked about the promptness of the client's approval;
- The Contracting Group ranked "*long after the project is completed*" as the highest scenario which was only the third possibility according to the ranking of Consulting Group. However, for both groups, it was second most likely that the employer's approval for extension of time award was made '*After the effects of ALL the claimed 'events' are ceased*'. Therefore, it may be regarded as the more realistic scenario of general timing of
- Both Groups agreed that the two scenarios "Contemporaneously and promptly" and "Not determining at all" were less likely to happen;

Thus, these results show that it is most likely that claims submission, assessment and employer's approval for EOT award generally take place <u>not contemporaneously</u> as encouraged for efficient delay claims resolution (SCL Protocol, 2002) but '*After the effects of ALL the claimed 'events' are ceased*'.

In summary, the survey results confirm the research proposition "*Generally, there is no promptness among the contractors, consultants and clients in their contractually obligated actions required for efficient delay claims resolution*".

B.5.6 Obstacles for Using an Appropriate MDA

MDA – Obstacle Factors

In the investigation of problematic situations that may impede the delay claims resolution, the respondents' views were sought as to the factors which would mostly act obstructively in taking appropriate measures in claims resolution or towards escalating the existing disputes to more advanced levels.

The outcome of the findings is as follows:

- For Consulting Group the three most frequent obstacles were the 'lack of as-built updates of the programme', absence of 'proper CPM based Baseline Programme' and 'consent for such Programme'; for the Contracting Group they were the absence of 'proper CPM based Baseline Programme' and 'consent for such Programme', and 'lack of site records'; Since *Impacted-As-Planned* and *As-Planned vs. As-Built* were the most used MDAs by Contracting Group, whereas *Time Impact Analysis* was the most used MDA by Consulting Group these responses seem to have been determined according to the type of MDAs that are mostly preferred/used by the respective Group.
- Both Groups have considered that 'lack of skills in programming software', and factors concerning cost and time-consumption for using an appropriate MDA were the least encountered obstacles;

B.5.7 Dispute Contribution Factors

- According to the survey results, the two groups consensually identify the following as the most contributing factors (among the 12 factors considered) to further disputes in delay claims:
  - Submission of Global Claims (and their potential rejection for inadequacy and lack of proof);
  - Failure to comply with conditions precedent for admission of claims for assessment, and resulting denial of admission;
  - Failure to establish other party's 'liability' through chain of proof;
  - Failure to link liabilities with effects (delay impact) using appropriate methodology to quantify;
  - Absence of consensual approach to use appropriate MDA and agreement to outcome of each other's MDAs used due to absence of such consensual approach/ objective basis.

In summary, the above results are consistent with the previous findings under items B.5.3 (Awareness, Use, Effectiveness and Disputes in the use of MDA), B.5.4 (Use of As-built Records in Delay Analysis) and B.5.6 (Obstacles for Using an Appropriate MDA), together with the associated research propositions.

B.5.8 Delay Claims Avoidance

Claims Prevention Factors

The rating was requested on seven factors which were to be rated according to their 'importance' in reducing/preventing delay claims in construction projects.

- The survey results are indicative that the two Groups consider the following factors can mostly contribute to minimise/ prevent delay claims if implemented:
    - 'engineer's impartiality'against own faults or outside pressure;
    - Availability of a contractually stipulated mechanism to resolve delay claims at site level on day-to-day basis;
    - Allowing sufficient time to complete design;
    - Control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;
    - Pre-defining contentious issues in contract documents.

Efficiency Factors

Along with delay claims prevention, it is also important to seek ways to improve the existing practices in delay claims resolution process by expediting it and making more efficient. The rating was requested on eleven factors which were to be rated according to their 'importance' in reducing/preventing delay claims in construction projects.

- The two Groups have agreed that the following can foremostly contribute to enhance efficiency in the delay claims resolution.
    - engineer's impartiality;
    - Prompt and timely award of extension of time;
    - A clear mechanism for delay claims presentation by contractors for establishing 'liability' and quantum defined in the contract; and
    - Consensual approach to select MDA for delay analysis.

In both Prevention Factors and Efficiency Factors above, 'engineer's Impartiality' with reference to any undue influences was ranked with the highest score/rank by both Groups (ref. Summary results of Tables B.41 and B.42). This displays a strong agreement among all the survey respondents as to the research proposition:

Usually, there is significant amount of undue pressure and interference from client-organisations over the engineers' (consultants) when determining the entitlement to extension of time.

These findings over delay claims avoidance and efficiency are extensively considered in the development of the 'Framework' and the Model presented in this research.

In summary, the above results indicate the areas, which need improvements to enable minimizing the problematic situations that are found in this inquiry. Generally, these improvements seem to be required through both pre-contract and post-contract related measures, involving related contract documentation (pre-contract) and claims administration procedures (post-contract). The improvements presented in Chapter 9 'Framework of Improvements' mainly consists of such measures.

B.5.9 Selection of Optimum MDA

The final two Questions (nos. 28 and 29) in the survey-questionnaire aimed at investigating the respondents' rating (ranking) of significance of seven 'Criteria' and the importance of twenty three 'Attributes'. These Criteria and Attributes are the Level 2 and Level 3 components of the proposed Model for selection of most optimum MDA for delay claims analysis (as presented in Chapter 10). The rankings of the survey respondents according to their perceived significance/ importance are converted into 'Normalised Weights' and used in the calculations at Level 2 and 3 of the final building of the Model. Thus, this investigation through Questions no. 28 and 29 was mainly for that purpose.

The Question no. 30 was for the purpose of testing the level of the 'concordance' between the rankings of the two Groups, only. For measuring the level of 'concordance' among the rankings of the two Groups, therefore, 'Kendall Coefficient of Concordance W' was used.

Significance Index – Criteria (at Level 2 of the Model)

- For both Groups, "Records Availability" was the most significant 'Criterion' of the seven Criteria concerned;
- For both Groups, project size and its complexity, or the time and cost of analysis were of low significance;
- 'Legal Admissibility' of the MDA was the least significant for the Contracting Group whereas it was the third most significant Criterion for the Consulting Group. This

may suggest that, as viewed by many Interviewees, most of the time the contractors in the local setting tend to get their claims settled through negotiation with the other party before developing into arbitration or litigation stages. However, in the consultants' role they have to act contractually and concern the possibility of having to defend their assessments in a more legal forum. This is consistent with the previously observed fact that the Consulting Group's mostly used MDA was Time Impact Analysis which seems to be the most legally admissible out of the four MDAs as informed by the Literature Review.

- The test statistics showed a considerable agreement or concordance among the ranks assigned by the practitioners in the two Groups. (N=7, K=3, Kendall's W= 0.85 > Critical W = 0.74 at significance level α= 0.01, *df*=6)

Importance Index – Attributes (at Level 3 of the Model)

- For both Groups, the most important 'Attributes' for the selection of an optimum MDA were those related to the Baseline Programme, its periodical updates, and availability of other contemporary records; For the Consulting Group those Attributes related to need of finding concurrent delays, chronological analysis of events, contractual definition for concurrency and float ownership, and high transparency of analysis process were the next most important Attributes. This may be consistent with the Contracting Groups most preferred MDA being the Time Impact Analysis method.
- Although the Contracting Group considered concurreny and transparency related Attributes are moderately significant, they thought if the contract defined the MDA to be used in the analysis that would be the most important Attribute as it might avoid or minimise a lot of differences between the parties on the selection of MDA. However, the Consulting Group did not consider it with same importance and it may be in view of that such pre-definitions as to MDA is not a regular occurrence due to the complexities in construction contracts.
- The test statistics showed a very strong agreement or concordance among the ranks assigned by the practitioners in the two Groups. (N=23, K=3, Kendall's W=.92; Sample x^2 = 60.53 > Critical x^2 = 48.27 at α= 0.001, *df*=22).

Suitability/Necessity Index – Alternative MDAs (at Level 4 of the Model)

In order to measure the agreement or concordance between the rankings of the two Groups, each MDA was separately tested for its suitability/availability against the alternative MDAs vs listed 'Attributes'. In each case, the following is found:

'As-Planned v As-Built method': The test statistics showed a moderate agreement or concordance (N=24, K=3, Kendall's W=.65; Sample $x^2 = 44.91 >$ Critical $x^2 = 41.64$ at $\alpha = 0.01$, *df*=23) among the ranks assigned by the practitioners in the two Groups (Table B.45).

'Impacted-As-Planned method': The test statistics showed a moderate agreement or concordance (N=24, K=3, Kendall's W=.52; Sample $x^2 = 36 >$ Critical $x^2 = 35.17$ at $\alpha = 0.05$, *df*=23) among the ranks assigned by the practitioners in the two Groups (Table B.46).

'Collapsed-As-Built method': The test statistics showed no agreement or concordance (N=24, K=3, Kendall's W=.47; Sample $x^2 = 32.73 <$ Critical $x^2 = 35.17$ at $\alpha = 0.05$, *df*=23) among the ranks assigned by the practitioners in the two Groups (Table B.47).

'Time Impact Analysis method': The test statistics showed a strong agreement or concordance (N=24, K=3, Kendall's W=.67; Sample $x^2 = 46.57 >$ Critical $x^2 = 35.17$ at $\alpha = 0.05$, *df*=23) among the ranks assigned by the practitioners in the two Groups (Table B.48).

In summary, the above results indicate that, with considerable confidence, there has been an agreement or concordance (which is higher than it would be by chance had the scores and their rankings been random or independent) among the two Groups with regard to their ranking of the components used in the Model (except in the case of 'Collapsed-As-Built method' where such rankings are mostly unrelated and independent). This allows to use, supported by a substantial consensus across the two contesting Groups, the same elements of 'Criteria' and 'Attributes' at Levels 2 and 3 respectively in the proposed Model.

B.6 Summary

This Appendix-B has presented the data analysis and the results of same of a Pilot Study and an in-depth survey.

In line with the main research objectives (Chapter 1), this in-depth survey was conducted with the main purposes of:

i. Investigating the practitioners' responses to issues regarding current awareness, experience, and approaches as to such legal, contractual, and technical issues related to apportioning liabilities in delay claims resolution;
ii. Identifying potential problematic situations in these practices related to apportioning liabilities in delay claims resolution;
iii. Collecting essential data for developing a decision-making Model to enable practitioners (Decision Makers) to objectively and reliably select the most optimal Method of Delay Analysis appropriate to given circumstances of a project.

The Pilot Study which was conducted at the early stages of this Research among some practitioners (N=12) who were involved in delay claims resolution in the UAE indicated that a strong need was existing to investigate the current practices, identifying their problematic situations and finding necessary remedies/improvements. These results provided the need and initial inspiration to undertake the current research study and formulate its aim and objectives.

The in-depth survey was purported to answer certain 'what' and 'how' questions related to delay claims resolution practices and procedures. These questions were prepared with the intention to investigate practitioners' current awareness, experience, and approaches related to apportioning liabilities in delay claims resolution. For this, the investigation focused on certain selected issues of legal, contractual, and technical nature, which were informed by the Literature Review.

The data collected through the survey-questionnaire were subject to several statistical tests (frequencies, Chi-Square Test for Independence, Symmetric Measures of *Phi* ϕ and Cramer's V, Spearman rank-order correlation coefficient 'r_s', Kendall coefficient of oncordance W). (For survey data reliability and validation, please refer to discussion under Chapter 3, Section 3.7)

Following the data analysis, the findings of the in-depth survey have been discussed in detail. On most of the issues, the survey results showed considerable conformity with the findings in Literature Review, but on a few issues, some divergence was found. While satisfying the requirements of the quantitative strand of the mixed methods approach that is selected as the inquiry method for this research, these findings of the survey data analysis are to provide answers to the central research questions, and to confirm or reject the research propositions.

In conclusion, a summary of the main findings is as follows:

1. The participating respondents were from the disciplines that mostly involved in the delay claims resolution process in both contracting and consulting background. They were experienced and involved in almost all aspects of delay claims resolution process. The majority of them were from the middle-management level and about one-fifth from the decision making level in their respective organisation. Nearly half of these organisations were very large, in terms of the annual turn-over, in the local settings. Considering these characteristics, their responses carry a reasonable level of credibility for the data collected and analysed;
2. On the issues of more straight forward concepts as to 'concurrent delays', 'float ownership' and approach to measuring 'criticality' in forensic scheduling, there was a substantial majority having similar perceptions, among the two Groups. Although a significant minority with differing perceptions was also found, particularly on more perplexed concepts as to 'concurrent delays' and forensic scheduling analysis, the foregoing results may indicate that the awareness on essential theory, concepts and legal position applicable to delay claims resolution may be divergent among the two Groups, but not as much as envisaged prior to undertaking the research inquiry;

To this extent it may be said that these results only <u>partially</u> endorse the research proposition that

- *"The tacit or explicit awareness of essential theory, concepts, legal position and Methods of Delay Analysis (MDA) applicable to delay claims resolution generally remains divergent among the practitioners of competing parties (i.e. contractors and employers)"*

3. Among both Groups, the highest level of awareness on MDAs was found for the simpler methods (example Impacted-As-Planned). However, the Consulting Group

showed a higher level of awareness for the more sophisticated MDAs (Time Impact Analysis);

4. The Impacted-As-Planned was the mostly used method amongst the respondents of Contracting Group. The Time Impact Analysis was the most used one with the Consulting Group;

The above results as to use of MDAs seem strongly support the research propositions:

- *"In delay claims resolution, claimants and defenders (or assessors) generally utilise largely different methods of delay analysis (MDA) which yield vastly contrasting outcomes between such MDA, and thereby mutual disagreement, scepticism and distrust".*

5. A statistically significant, strong, and positive association is seen between rankings of the Groups as to awareness and use of MDAs; This may suggest that the use of the MDAs by the practitioners within the Groups was generally corresponding to the level of awareness of the MDAs;

6. As to 'Effectiveness in the Use of MDA' both Groups had perceived that Time Impact Analysis was the most effective MDA. This may suggest that although the Contracting Group often prefers using less sophisticated methods, they still reckon the Time Impact Analysis as the most effective method;

7. Both Groups agreed that more sophisticated MDAs were the least contested and simpler methods were more vulnerable to be contested;

8. The two Groups inclined to use the different types of information/records in consistent with their most preferred MDAs. This may be a source of substantial problematic situation at delay claims resolution as the information to be used in claims submission by the contractors lacks the objectivity of actual or as-built status.

9. The results indicated both Groups were using highly sophisticated planning software in the delay claims analysis;

10. With regard to 'Promptness in Delay Claims Submission, Assessment and Settlement', no significant agreement or concordance amongst the rankings of the respondents of the two Groups was found; both Groups held much divergent positions as to their own and others 'promptness' in performance. However, having considered the rankings of most possible scenarios it may be inferred that all three parties, i.e. contractors, Consultants and the Employers, were unable to perform contemporaneously and promptly in their respective performance of claims submission, their assessment and settlement. Thus, these results may confirm the research proposition:

    - *"Generally, there is no promptness among the contractors, consultants and employers in their contractually obligated actions required for efficient delay claims resolution".*

11. On the 'Obstacles for Using an Appropriate MDA', 'Dispute Contribution factors' and ' Delay Claims Avoidance' factors , the test statistics showed a strong agreement or concordance between the rankings of the two Groups, and the results were generally consistent with the findings of the above areas ('Awareness, Use, Effectiveness and Disputes in the use of MDA' and 'Use of As-built Records in Delay Analysis' and the associated research propositions);

12. The survey results were indicative that the two Groups considered the following factors could mostly contribute to minimise/ prevent delay claims if implemented:
    - 'engineer's impartiality'against own faults or outside pressure;
    - Availability of a contractually stipulated mechanism to resolve delay claims at site level on day-to-day basis;
    - Allowing sufficient time to complete design;
    - Control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;
    - Pre-defining contentious issues in contract documents.

13. The two Groups have agreed that the following can foremostly contribute to enhance efficiency in the delay claims resolution.
    - engineer's impartiality;
    - Prompt and timely award of extension of time;

- A clear mechanism for delay claims presentation by contractors for establishing 'liability' and quantum defined in the contract; and
- Consensual approach to select MDA for delay analysis.

In both above items 12 and 13, 'engineer's Impartiality' with reference to any undue influences was ranked with the highest score/rank by both Groups. Thus, there was a strong agreement among all the survey respondents as to the research proposition that:

> *"Usually, there is significant amount of undue pressure and interference from employer-organisations over the engineers (consultants) when determining the entitlement to extension of time".*

14. The rankings attributed by the two Groups to Significance of the 'Criteria' (at Level 2 of the Model), the Importance of the 'Attributes' (at Level 3 of the Model) and the Suitability/Availability Index – Alternative MDAs (at Level 4 of the Model) were showing a considerable confidence that the agreement or concordance between the responding practitioners of the two groups is higher than it would be by chance had the scores and their rankings been random or independent. Accordingly, these 'rankings' are used in the building of the Model with a sufficient confidence for their accuracy.

As the next step for the mixed methods process, these results are compared with the results of the interviews, which are presented in the Appendix-A in order to examine how they are complementing or not to these survey results. This comparison is carried out in the form of a discussion in Chapter 8 "Outcome of Merged Data Analysis and Discussion".

APPENDIX – C

(DATA TABLES RELATED TO APPENDIX 'B')

APPENDIX – C

DATA TABLES RELATED TO PILOT STUDY

Table: PS- 1

PROPOSITION: "Dubai construction industry represents the most advanced characteristics and growth rate in the industry of whole of the Middle East region".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Neutral	1	8.3	8.3	8.3
Agree	5	41.7	41.7	50.0
Strongly Agree	6	50.0	50.0	100.0
Total	12	100.0	100.0	

Table: PS- 2

PROPOSITION: "Delay claims remain a major source of dispute in Dubai construction industry, requiring prompt resolution to avoid escalation to major, complex dispute situation".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Neutral	1	8.3	8.3	8.3
Agree	4	33.3	33.3	41.7
Strongly Agree	7	58.3	58.3	100.0
Total	12	100.0	100.0	

Table: PS- 3

PROPOSITION: "Delay claims resolution process in Dubai construction industry is generally protracted and often happens near to or even after the completion of projects".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Agree	7	58.3	58.3	58.3
Strongly Agree	5	41.7	41.7	100.0
Total	12	100.0	100.0	

Table: PS- 4

PROPOSITION: “Absence of prompt resolution of the delay claims generally escalates those claims to major dispute levels".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Disagree	I	8.3	8.3	8.3
Agree	9	75	75	83.3
Strongly Agree	2	16.7	16.7	100.0
Total	12	100.0	100.0	

Table: PS- 5

PROPOSITION: "Between the contractors and the developers/engineers, for delay analysis there is no consensual selection of analysis method that is most appropriate under given circumstances of a project".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Disagree	1	8.3	8.3	8.3
Neutral	1	8.3	8.3	16.7
Agree	8	66.7	66.7	83.3
Strongly Agree	2	16.7	16.7	100.0
Total	12	100.0	100.0	

Table: PS- 6

PROPOSITION: "In order to make delay claims resolution process in Dubai industry more efficient, transparent, equitable and fairer, there is a strong need to identify the current practices, their problematic situations and necessary remedies/improvements required to them".

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Agree	3	25.0	25.0	25.0
Strongly Agree	9	75.0	75.0	100.0
Total	12	100.0	100.0	

Table: PS- 7

PROPOSITION: "Such, remedies and improvements would possibly bring corporate benefits for both developers and contractors, reducing delay situations escalating to dispute levels such as engineer's Decisions/Arbitration/ Litigation"

Response to the Proposition	Frequency	Percent	Valid Percent	Cumulative Percent
Agree	3	25.0	25.0	25.0
Strongly Agree	9	75.0	75.0	100.0
Total	12	100.0	100.0	

SURVEY VALIDITY – QUESTION NO.31

Table Q#31. 1 Respondent Rate

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Contracting Group	33	44.6	44.6	44.6
	Consulting Group	41	55.4	55.4	100.0
	Total	74	100.0	100.0	

Table Q#31. 2 Clarity of Questions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	2	2.7	2.7	2.7
	High	28	37.8	37.8	40.5
	Very High	44	59.5	59.5	100.0
	Total	74	100.0	100.0	

Table Q#31. 3 Readability of Questions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	5	6.8	6.8	6.8
	High	25	33.8	33.8	40.5
	Very High	44	59.5	59.5	100.0
	Total	74	100.0	100.0	

Table Q#31. 4 Accuracy of content

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	5	6.8	6.8	6.8
	High	27	36.5	36.5	43.2
	Very High	42	56.8	56.8	100.0
	Total	74	100.0	100.0	

Table Q#31. 5 Easiness to answer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	10	13.5	13.5	13.5
	Medium	44	59.5	59.5	73.0
	High	20	27.0	27.0	100.0
	Total	74	100.0	100.0	

Table Q#31. 6 Relevance of Questions to the issue investigated

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	2	2.7	2.7	2.7
	High	22	29.7	29.7	32.4
	Very High	50	67.6	67.6	100.0
	Total	74	100.0	100.0	

Table Q#31. 7 Coverage of issue

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	2	2.7	2.7	2.7
	High	35	47.3	47.3	50
	Very High	37	50.0	50.0	100.0
	Total	74	100.0	100.0	

ALL TABLES RELATED TO APPENDIX 'B' (IN-DEPTH SURVEY RESULTS)

Table: B. 1 Distribution of Respondents Background

Respondent Category	Frequency	Percent	Valid Percent	Cumulative Percent
contractor	30	40.5	40.5	40.5
Consultancy/Project	30	40.5	81.0	81.0
Developer	11	14.9	14.9	95.9
External Claims	3	4.1	4.1	100.0
Total	74	100.0	100.0	

Table: B. 2 Composition of Two Groups

Respondent Category	Frequency	Percent	Valid Percent	Cumulative Percent
Contracting Group	33	44.6	44.6	44.6
Consulting Group	41	55.4	55.4	100.0
Total	74	100.0	100.0	

Table: B. 3 The Nature of Activities of the Organization

Respondent Category	Frequency	Percent	Valid Percent	Cumulative Percent
Building and Civil	50	67.6	67.6	67.6
Building work	16	21.6	21.6	89.2
Civil engineering work	8	10.8	10.8	100.0
Total	74	100.0	100.0	

Table: B. 4 Approximate Turnover

Respondent Group		Less than 50m AED	AED 50m - 100m	AED 101m - 500m	More than 500m AED	Total
Contracting Group	Count	5	11	9	8	33
	% within	15.2%	33.3%	27.3%	24.2%	100.0%
Consulting Group	Count	0	7	6	23	36
	% within	.0%	19.4%	16.7%	63.9%	100.0%
Total	Count	5	18	15	31	69
	% of Total	7.2%	26.1%	21.7%	44.9%	100%

Table: B. 1 Nature of Primary Job

Respondent Group		Claims Management	Contracts Management	QS/Commercial Management	Planning	Architecture	Estimating	Project Management	Programme Management.	Project Director	Structural engineer	Total
Contracting Group	Count	4	7	19	1	0	1	0	0	0	1	33
	% within Respondent Group	12.1%	21.2%	57.6%	3.0%	.0%	3.0%	.0%	.0%	.0%	3.0%	100.0%
Consulting Group	Count	9	9	18	0	1	0	2	1	1	0	41
	% within Respondent Group	12.2%	22.0%	43.9%	.0%	2.4%	.0%	4.9%	2.4%	2.4%	.0%	100.0%
Total	Count	13	16	37	1	1	1	2	1	1	1	74
	% of Total	17.6%	21.6%	50.0%	1.4%	1.4%	1.4%	2.7%	1.4%	1.4%	1.4%	100.0%

Table: B. 6 Claims Preparation (For contractors)

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	10	10	3	5	5	33	325.0	**9.8**
Consulting Group	15	4	4	2	0	25	152.5	6.1
Total	25	14	7	7	5	58	477.5	8.2

Table: B. 7 Claims Evaluation (For developers)

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	6	7	3	1	1	18	142.5	7.9
Consulting Group	16	5	10	4	6	41	392.5	**9.6**
Total	22	12	13	5	7	59	535.0	9.1

Table: B. 8 Forensic Schedule Analysis

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	8	5	1	2	2	18	145.0	**8.1**
Consulting Group	3	6	3	0	0	12	90.0	7.5
Total	11	11	4	2	2	30	235.0	7.8

Table: B. 9 Commercial Negotiation

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	8	8	5	3	1	25	215.0	**8.6**
Consulting Group	16	6	8	2	1	33	240.0	7.3
Total	24	14	13	5	2	58	455.0	7.8

Table: B. 10 Project Planning

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	4	0	3	2	1	10	102.5	**10.3**
Consulting Group	8	4	3	1	0	16	105.0	6.6
Total	12	4	6	3	1	26	207.5	8.0

Table: B. 11 - Dispute Resolution

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	4	2	2	0	0	8	50.0	6.3
Consulting Group	5	6	4	2	2	19	182.5	**9.6**
Total	9	8	6	2	2	27	232.5	8.6

Table: B. 12 Legal support

Respondent Group	less than 5 years	5-10 years	10-15 years	15-20 years	over 20 years	Total	Combined Experience (yrs)	Average Experience (yrs)
Contracting Group	4	2	2	0	0	8	50.0	6.3
Consulting Group	4	2	1	1	1	9	75.0	**8.3**
Total	8	4	3	1	1	17	125.0	7.4

Table: B. 13 Respondent Designations

Respondent Designation	Frequency	Percent	Valid Percent	Cumulative Percent
Claims	11	14.9	15.1	15.1
Forensic Schedule Analyst	2	2.7	2.7	17.8
Commercial Manager	21	28.4	28.8	46.6
Contracts Manager	12	16.2	16.4	63.0
Contracts Administrator	7	9.5	9.6	72.6
Quantity Surveyor	16	21.6	21.9	94.5
engineer	1	1.4	1.4	95.9
Architect	1	1.4	1.4	97.3
Other	2	2.7	2.7	100.0
Total	73	98.6	100.0	
Missing	1	1.4		
Total	74	100.0		

Table: B. 14 Job Placement

Respondent Designation	Frequency	Percent	Valid Percent	Cumulative Percent
Lower Management	11	14.9	14.9	14.9
Middle Management	47	63.5	63.5	78.4
Upper Management	16	21.6	21.6	100.0
Total	74	100.0	100.0	

Table: B. 15 Resources-In-Use

Respondent Group		In-house Staff	Outsourced	Total
Contracting Group	Count	26	2	28
	% within Respondent Group	92.90%	7.10%	100.00%
Consulting Group	Count	28	3	31
	% within Respondent Group	90.30%	9.70%	100.00%
Total	Count	54	5	59
	% of Total	91.50%	8.50%	100.00%

Table: B. 16 Resources Deployment (Contractors)

Resource	Never	Seldom	Some-times	Usually	Always	Total	'Normalized Weights"	Rank
Claims Specialists	13	3	7	3	2	28	2.21	3
Contracts Administrators	4	2	1	11	9	27	3.70	6
Quantity Surveyors	1	3	3	7	15	29	4.10	7
Planners	1	5	7	10	5	28	3.46	5
Engineers	4	8	11	4	1	28	2.64	4
Architects	15	6	4	1	1	27	1.78	2
Lawyers	17	7	3	0	0	27	1.48	1

Table: B. 17 Resources Deployment (Contsultants)

Resource	Never	Seldom	Some-times	Usually	Always	Total	'Normalized Weights"	Rank
Claims Specialists	3	5	6	6	10	30	3.5	2
Contracts Administrators	1	1	5	14	8	29	3.93	6.5
Quantity Surveyors	1	1	5	14	8	29	3.93	6.5
Planners	1	3	7	10	9	30	3.77	4
Engineers	2	1	5	11	10	29	3.90	5
Architects	1	3	7	12	6	29	3.66	3
Lawyers	10	7	10	2	0	29	2.14	1

Table: B. 18 Perception on "True Concurrency' and 'Concurrent Effects'

Perception on 'Concurrent' Delays in the case of "True Concurrency" or Concurrency of Causes (i.e. delaying events occurring at the same time) and "Concurrency of effects" (i.e.delaying events start sequentially and at different times but their effects are felt at the same time)

Respondent Group		**In both cases the effects of the delaying events are treated as 'concurrent' and equally potent to award extension of time.**	**Only such effects of 'True Concurrency' are treated as 'concurrent' and having merits to award extension of time.**	**Don't Know**	**Total**
Contracting Group	Count	15	10	0	25
	% within Respondent Group	60.0%	40.0%	.0%	100.0%
Consulting Group	Count	20	14	3	37
	% within Respondent Group	54.1%	37.8%	8.1%	100.0%
Total	Count	35	24	3	62
	% of Total	56.5%	38.7%	4.8%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 2.14 < Critical x^2 = 5.99 at .05, *df*=2, p=.343>.05; Symmetric Measures : *Phi* ϕ=.186, Cramer's V = .186

Table: B. 19 Apportioning : Where one delay is caused by the employer and the other by the contractor

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	21	2	3	2	28
	% within Respondent Group	75.0%	7.1%	10.7%	7.1%	100.0%
Consulting Group	Count	6	7	23	1	37
	% within Respondent Group	16.2%	18.9%	62.2%	2.7%	100.0%
Total	Count	27	9	26	3	65
	% of Total	41.5%	13.8%	40.0%	4.6%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 26.08 > Critical x^2 = 16.27 at .001, *df*=3, p<.001; Symmetric Measures : *Phi* ϕ=.633, Cramer's V = .633

Table: B. 20 Apportioning : Where two delays are caused by the employer

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	1	25	3	0	29
	% within Respondent Group	3.4%	86.2%	10.3%		100.0%
Consulting Group	Count	0	34	3	0	37
	% within Respondent Group		91.9%	8.1%		100.0%
Total	Count	1	59	6	0	66
	% of Total	1.5%	89.4%	9.1%	0	100.0%

Test statistics

Chi-Square Test for Independence: sample $x2$ = 1.42 < Critical $x2$ = 5.99 at .05, *df*=2, p=.491>.05; Symmetric Measures : *Phi* ϕ=.147, Cramer's V = .147

Table: B. 21 Apportioning : Where two delays are caused by the contractor

Respondent Group		**Time Only**	**Both Time and Cost**	**Time, but the cost only if clearly segregated by the contractor**	**No time, No cost**	**Total**
Contracting Group	Count	0	0	0	29	29
	% within Respondent Group				100.0%	100.0%
Consulting Group	Count	1	0	0	36	37
	% within Respondent	2.7%			97.3%	100.0%
Total	Count	1	0	0	65	66
	% of Total	1.5%			98.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample $x2$ = 0.796 < Critical $x2$ = 3.84 at .05, *df*=1, p=.372>.05; Symmetric Measures: *Phi* ϕ=-.110, Cramer's V = .110

Table: B. 22 Apportioning : Where two delays are caused by the neutral causes

Respondent Group		**Time Only**	**Both Time and Cost**	**Time, but the cost only if clearly segregated by the contractor**	**No time, No cost**	**Total**
Contracting Group	Count	26	0	1	1	28
	% within Respondent	92.9%		3.6%	3.6%	100.0%
Consulting Group	Count	31	4	2	0	37
	% within Respondent	83.8%	10.8%	5.4%	.0%	100.0%
Total	Count	57	4	3	1	65
	% of Total	87.7%	6.2%	4.6%	1.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample $x2$ = 4.61 < Critical $x2$ = 7.82 at .05, *df*=3, p=.202 >.05; Symmetric Measures: *Phi* ϕ=-.266, Cramer's V = .266

Table: B. 23 - Apportioning : Where one delay is caused by the employer and other is by a neutral cause

Respondent Group		Time Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Total
Contracting Group	Count	16	8	4	0	28
	% within Respondent	57.1%	28.6%	14.3%	0%	100.0%
Consulting Group	Count	5	23	8	1	37
	% within Respondent	13.5%	62.2%	21.6%	2.7%	100.0%
Total	Count	21	31	12	1	65
	% of Total	32.3%	47.7%	18.5%	1.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 14.383 > Critical x^2 = 11.34 at .01, *df*=3, p=.002 <.01; Symmetric Measures: *Phi* ϕ=-.470, Cramer's V = .470

Table: B. 24 Apportioning : Where one delay is caused by the contractor and other is by a neutral cause.

Respondent Group		Time Only	Cost Only	Both Time and Cost	Time, but the cost only if clearly segregated by the contractor	No time, No cost	Don't Know	Total
Contracting Group	Count	21	0	1	1	5	0	28
	% within Respondent Group	75.0%		3.6%	3.6%	17.9%		100.0%
Consulting Group	Count	29	1	2	2	2	1	37
	% within Respondent Group	78.4%	2.7%	5.4%	5.4%	5.4%	2.7%	100.0%
Total	Count	50	1	3	3	7	1	65
	% of Total	76.9%	1.5%	4.6%	4.6%	10.8%	1.5%	100.0%

Test statistics

Chi-Square Test for Independence: sample x^2 = 4.06 < Critical x^2 = 11.07 at .05, *df*=5 p=.540 >.05; Symmetric Measures: *Phi* ϕ=-.250, Cramer's V = .250

Table: B. 25 Who owns the 'float' if the contract is silent of it

Respondent Group		'Float' belongs to the contractor	'Float' belongs to the employer	'Float' belongs to the project (either party can consume it on first come, first served basis.)	Don't Know	Total
Contracting Group	Count	10	1	18	0	29
	% within Respondent Group	34.5%	3.4%	62.1%		100.0%
Consulting Group	Count	7	1	27	2	37
	% within Respondent Group	18.9%	2.7%	73.0%	5.4%	100.0%
Total	Count	17	2	45	2	66
	% of Total	25.8%	3.0%	68.2%	3.0%	100.0%

Test statistics

Chi-Square Test for Independence: sample $x2$ = 3.41< Critical $x2$ = 7.82 at .05, df=3 p=.333 >.05; Symmetric Measures: *Phi* ϕ=-.227, Cramer's V = .227

Table: B. 26 Approach to measure the 'criticality' of a delay effect, if the contract is silent of it.

Respondent Group		Criticality to be measured against prevailing contract completion date.	Criticality to be measured against the projected completion date (determined by the longest path).	Don't Know	Total
Contracting Group	Count	19	8	1	28
	% within Respondent Group	67.9%	28.6%	3.6%	100.0%
Consulting Group	Count	20	15	2	37
	% within Respondent Group	54.1%	40.5%	5.4%	100.0%
Total	Count	39	23	3	65
	% of Total	60.0%	35.4%	4.6%	100.0%

Test statistics

Chi-Square Test for Independence: sample $x2$ = 1.27 < Critical $x2$ = 5.99 at .05, df=2 p=.531 >.05; Symmetric Measures: *Phi* ϕ=-.140, Cramer's V = .140

Table: B. 27 Level of Awareness on MDAs

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
MDA	**Awareness Index (Weighted Average)**	**Rank**	**Awareness Index (Weighted Average)**	**Rank**	**Awareness Index (Weighted Average)**	**Rank**
As-Planned vs As-Built	4.1	5	3.44	5	3.75	5
Impacted As-Planned	4	4	3.32	4	3.62	4
Collapsed As-Built	2.57	1	2.76	2	2.68	1
Time Impact Analysis	2.96	2	3.22	3	3.11	2
Global claims	3.82	3	2.75	1	3.22	3

Test statistics

Kendall's W = 0.87 > Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4)

Table: B. 28 Frequency of Use of MDAs

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
MDA	**Frequency of Use Index**	**Rank**	**Frequency of Use Index**	**Rank**	**Frequency of Use Index**	**Rank**
As-Planned vs. As-Built	3.9	4	2.96	3	3.45	4
Impacted As-Planned	4.11	5	3.14	4	3.61	5
Collapsed As-Built	1.74	1	2.46	2	2.11	1
Time Impact Analysis	2.96	2	3.76	5	3.38	3
Global claims	3.57	3	1.96	1	2.77	2

Test statistics

Kendall's W = 0.71 <; Critical W = 0.72 (For N=5 and k=3, at significance level α= 0.05, *df*=4)

Table: B. 29 Awareness vs Use (Spearman Rank Order Correlation)

	As-Planned vs. As-Built	**Impacted-As-Planned**	**Collapsed-As-Built**	**Time Impact Analysis**	**Global Claims**
Respondent Group	Awareness Vs Use	Awareness Vs Use	Awareness Vs Use	Awareness Vs Use	Awareness Vs Use
contractors' Group	.685**	.561**	.400*	.264**	.798**
Consultants' Group	0.215	.434**	.542**	.622**	-0.058

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table: B. 30 Level of Perceived Effectiveness of Use of MDAs

	CONTRACTING GROUP		**CONSULTING GROUP**		**OVERALL**	
MDA	**Effectiveness Index (Weighted Average)**	**Rank**	**Effectiveness Index (Weighted Average)**	**Rank**	**Effectiveness Index (Weighted Average)**	**Rank**
As-Planned vs. As-Built	2.97	3	2.44	2	2.96	3
Impacted As-Planned	3.14	4	3	4	3.14	4
Collapsed As-Built	2	1	2.44	2	2.28	2
Time Impact Analysis	3.57	5	3.72	5	3.67	5
Global claims	2.04	2	1.93	1	1.93	1

Test statistics

Kendall's W = 0.77 >; Critical W = 0.72 (For N=5 and k=3, at significance level α= 0.05, *df*=4)

Table: B. 31 Level of Dispute Against the Use of MDAs

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
MDA	**Dispute Index (Weighted Average)**	**Rank**	**Dispute Index (Weighted Average)**	**Rank**	**Dispute Index (Weighted Average)**	**Rank**
As-Planned vs. As-Built	3.57	4	3	5	3.23	4
Impacted As-Planned	3.48	3	2.89	4	3.13	3
Collapsed As-Built	1.64	1	2.77	1	2.17	1
Time Impact Analysis	2.08	2	2.83	2	2.47	2
Global claims	4.28	5	2.88	3	3.57	5

Test statistics

Kendall's W = 0.87 >; Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4)

Table: B. 32 Frequency of Using Contemporaneous Records

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
Type of Records	**Use Index (Weighted Average)**	**Rank**	**Use Index (Weighted Average)**	**Rank**	**Use Index (Weighted Average)**	**Rank**
CPM Baseline programme	4.25	5	4.75	5	4.50	5
CPM Baseline programme (Consented)	3.7	4	3.72	4	1.79	4
As-built programme updates	2.14	1	3.5	2	1.09	1
As-built programme updates (mutually agreed)	2.64	2	3.6	3	1.28	2
Site records, diaries and other contemporary records	3.46	3	3.45	1	1.64	3

Test statistics

Kendall's W = 0.87 >; Critical W = 0.84 (For N=5 and k=3, at significance level α= 0.01, *df*=4)

Table: B. 33 Frequency of Using Planning Software in Delay Analysis ("Primavera")

Respondent Group		Never	Seldom	Sometimes	Usually	Always	Total
Contracting Group	Count	1	0	1	6	21	29
	% within Respondent Group	3.4%	0%	3.4%	20.7%	72.4%	100.0%
Consulting Group	Count	0	3	2	9	17	31
	% within Respondent Group	0%	9.7%	6.5%	29.0%	54.8%	100.0%
Total	Count	1	3	3	15	38	60
	% within Respondent Group	1.7%	5.0%	5.0%	25.0%	63.3%	100.0%

Table: B. 34 Frequency of Using Planning Software in Delay Analysis ("MS Project")

Respondent Group		Never	Seldom	Sometimes	Usually	Always	Total
Contracting Group	Count	14	2	5	1	2	24
	% within Respondent Group	58.3%	8.3%	20.8%	4.2%	8.3%	100.0%
Consulting Group	Count	10	2	10	4	0	26
	% within Respondent Group	38.5%	7.7%	38.5%	15.4%	0%	100.0%
Total	Count	24	4	15	5	2	50
	% within Respondent Group	48.0%	8.0%	30.0%	10.0%	4.0%	100.0%

Table: B. 35 Promptness of Claims Submission

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
PROPOSITIONS "contractors submit their claims submissions with adequate details enabling consultants' assessment".	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	1.46	2	3.67	5	2.58	2
After the effects of ALL the claimed 'events' are	2	3	3.11	4	2.6	3
After the effects of the particular 'event' is	3.89	4	2.7	2	3.46	5
Contemporaneously and promptly.	4	5	2.89	3	3.04	4
Not determining at all.	1.35	1	2.23	1	1.79	1

Test statistics

Kendall's W = 0.56 <; Critical W = 0.72; (For N=5 and k=3, at significance level α= 0.05, *df*=4)

Table: B. 36 Promptness of Claims Assessment

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
PROPOSITIONS "Consultants (assessers) determine claimed entitlement to extension of time":	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	2.08	2	2.96	4	2.53	2
After the effects of ALL the claimed 'events' are ceased.	4.04	5	3.48	5	3.75	5
After the effects of the particular 'event' is ceased.	3.16	4	2.81	3	2.98	4
Contemporaneously and promptly.	2.48	3	2.63	2	2.56	3
Not determining at all.	1.4	1	1.81	1	1.61	1

Test statistics

Kendall's W = 0.87 >; Critical W = 0.84 ; For N=5 and k=3, at significance level α= 0.01, *df*=4)

Table: B. 37 Promptness of Claims Assessment- Employer Approval

		In most of the projects in the UAE, the contract provisions require approval of the employer prior to awarding extension of time to the contractor?		
		YES	**NO**	**Total**
Contracting Group	Count	23	1	24
	% within Respondent Group	95.8%	4.2%	100.0%
Consulting Group	Count	24	3	27
	% within Respondent Group	88.9%	11.1%	100.0%
Total	Count	47	4	51
	% within	92.2%	7.8%	100.0%

Table: B. 38 Promptness of Award of Extension of Time

	CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
PROPOSITIONS "Such employer approval is normally given":	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**	**Promptness Index (Weighted Average)**	**Rank**
Long after the project is completed.	3.96	5	2.88	3	3.43	5
After the effects of ALL the claimed 'events' are ceased.	2.88	4	3.13	4.5	3	4
After the effects of the particular 'event' is ceased.	2.64	3	3.13	4.5	2.88	3
Contemporaneously and promptly.	1.52	1	2.58	2	2.04	2
Not approving /awarding at all.	1.64	2	1.96	1	1.8	1

Test statistics
Kendall's W = 0.81 >; Critical W = 0.72 ; For N=5 and k=3, at significance level α= 0.05, *df*=4)

Table: B. 39 – Frequency of obstacles for selecting an appropriate MDA

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Obstacle Factor**	**Frequency Index (Weighted Average)**	**Rank**	**Frequency Index (Weighted Average)**	**Rank**	**Frequency Index (Weighted Average)**	**Rank**
1	Absence of proper CPM based Baseline Programme	3.79	8.5	3.89	8	3.38	8
2	Absence of 'consent' for such Programme	3.79	8.5	3.68	7	3.23	7
3	Lack of as-built updates of Programme	3.32	6	3.96	9	3.63	9
4	Lack of mutually agreed as-built updates of Programme	3.26	5	3.26	6	3	5
5	Lack of site records.	3.75	7	3.21	5	2.86	4
6	Lack of awareness/skills in using an appropriate analysis	3.07	4	3.11	4	3.09	6
7	Lack of awareness/skills in using programming software.	2.71	3	2.43	1	2.57	2
8	Cost of using an appropriate analysis	2.61	1.5	2.5	2	2.55	1
9	High level of time consumption for using an appropriate analysis methodology.	2.61	1.5	3.04	3	2.82	3

Test statistics

Kendall's W = 0.89; Sample x^2 = 21.36> Critical x^2 = 15.51; (For N=9 and k=3, at significance level α= 0.05, *df*=8)

Table: B. 40 Problematic Situations Contributing to Dispute Escalation

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Problematic Situation (for escalating disputes over delay claims)**	**Obstacle Index (Weighted Average)**	**Rank**	**Obstacle Index (Weighted Average)**	**Rank**	**Obstacle Index (Weighted Average)**	**Rank**
1	Discrepancies and ambiguities within tender/contract documents.	3.73	5.5	3.07	2	3.39	5
2	Lack of risk distribution between the parties, in the Contract.	3.88	8	3.37	5	3.62	6
3	Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability'. 'quantum' etc.).	3.27	4	3.29	4	3.28	4
4	Failure of 'notification' of delay event within contractually prescribed time.	3.73	5.5	3.71	10	3.72	7
5	Failure of submission of 'particulars' of delay claim event within contractually prescribed time.	3.85	7	3.75	11	3.8	9
6	Global claims.	4.31	12	4	12	4.15	12
7	Contractor's failure to establish 'liability' for delay event based on contract provisions.	4.24	11	3.61	8.5	3.91	11
8	contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.	4.08	10	3.43	7	3.74	8
9	Delay analysis method used by one party being disagreed/challenged by other party.	4.04	9	3.61	8.5	3.81	10
10	Absence of definition in the contract as to 'float ownership'.	2.77	1	3.04	1	2.91	1
11	Absence of definition of approach to be used at measuring 'criticality' of a delay.	2.84	2	3.14	3	3	2
12	Absence of definition in the contract as to approach for 'Concurrent delay situations'.	2.92	3	3.56	6	3.25	3

Test statistics

Kendall's W = 0.89; Sample x^2 = 29.38> Critical x^2 = 24.72; (For N=12 and k=3, at significance level α= 0.01. *df*=11)

Table: B. 41 Prevention Factors

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Prevention Factor**	**Prevention Index (Weighted Average)**	**Rank**	**Prevention Index (Weighted Average)**	**Rank**	**Prevention Index (Weighted Average)**	**Rank**
1	Allow sufficient time for consultants to complete the design and contract documents before issuing for tender.	4.31	5.5	4.65	7	4.48	5.5
2	Establish high level quality control mechanism within consultants team to minimize/eradicate conflicts, discrepencies and ambiguities within tender/contract documents	4.12	3	4.20	4.5	4.13	4
3	Clear distribution of risks between the parties, in the Contract.	4.31	5.5	3.40	1	3.86	3
4	Clear cut definition in the contract as to 'float ownership'.	3.32	2	3.58	2	3.45	1
5	Clear cut definition in the contract as to 'automatic entitlement to EoT for delays occurring after passing prevailing contract completion date'	3.27	1	4.20	4.5	3.73	2
6	Engineer's impartiality (against own failures or outside pressure)	4.63	7	3.84	3	4.22	7
7	Presence of a stipulated mechanism in the Contract to resolve delay claims at site level on day-to-day basis.	4.50	6	4.46	6	4.48	5.5

Test statistics

Kendall's W = 0.86 > Critical W = 0.74 (For N=7 and k=3, at significance level α= 0.01, *df*=6)

Table: B. 42 Efficiency Factors

S/N	Efficiency Factors	CONTRACTING GROUP Importance Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Importance Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Importance Index (Weighted Average)	OVERALL Rank
1	Stipulation in the contract a clear mechanism for delay claims presentation by contractors (establishing 'liability' and quantum)	4.38	9	4.22	9	4.3	9
2	Stipulation in contract as to the basic and minimum required documents to be presented	4	6	3.74	1	3.87	5
3	Submission of 'notification' of delay claim event within contractually prescribed time	3.88	4.5	4.15	6.5	4.02	6
4	Submission of 'particulars' of delay claim event within contractually prescribed time	4.24	8	4.15	6.5	4.19	7
5	Clear cut definition in the contract for the approach as to 'concurrent delays'.	3.46	2	4.04	5	3.75	2.5
6	Clear cut definition in the contract for the approach as to 'float ownership'.	3.32	1	3.89	3.5	3.75	2.5
7	Clear cut definition in the contract for delay analysis methodology to be used in delay claims presentation and evaluation.	3.88	4.5	3.78	2	3.83	4
8	Clear cut definition in the contract for approach to be used at measuring 'criticality' of a delay (Zero Float or longest path)	3.54	3	3.89	3.5	3.72	1
9	Presentation and assessment of delay claims carried out on an analysis method mutually agreed on an objective basis.	4.19	7	4.22	8	4.21	8
10	Prompt and timely award of extension of time	4.69	10	4.33	10	4.51	10
11	Engineer's impartiality in apportioning liability	4.77	11	4.52	11	4.76	11

Test statistics

Kendall's W = 0.90; Sample $x2$ = 26.95> Critical $x2$ = 23.21; (For N=11 and k=3, at significance level α= 0.01, df=10)

Table: B. 43 Significance Index –Criteria in Level 2 of the Proposed Model

		CONTRACTING GROUP		**CONSULTING GROUP**		**OVERALL**	
S/N	**Criteria in Level 2 of the Proposed Model**	**Significance Index (Weighted Average)**	**Rank**	**Significance Index (Weighted Average)**	**Rank**	**Significance Index (Weighted Average)**	**Rank**
1	Contractually Specified Requirements As For Delay Analysis - **CCR**	4.19	5	3.74	4	3.96	5
2	Project Constraints (Magnitude, Complexity Etc.) - **PC**	3.12	2.5	2.33	1	3.13	2
3	Claims Magnitude And Complexity - CMC	3.19	4	3.56	3	3.31	3
4	Records Availability - **Reca**	4.42	7	3.96	7	4.19	7
5	Proof Of Causation (Transparency Of Analysis) - Profc	4.2	6	3.81	6	3.98	6
6	Time And Cost Of Analysis - **T&C**	3.12	2.5	2.96	2	3	1
7	Legal Admissibility (By Triers) - **Ladms**	3.04	1	3.78	5	3.38	4

Test statistics

Kendall's W = 0.85 > Critical W = 0.74; For N=7 and k=3,

at significance level α= 0.01, *df*=6)

Table: B. 44 Importance Index – Attributes in Level 3 of the Proposed Model

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Attributes in Level 3 of the Proposed Model**	**Importance Index (Weighted Average)**	**Rank**	**Importance Index (Weighted Average)**	**Rank**	**Importance Index (Weighted Average)**	**Rank**
1	Concurrency & Float Ownership Defined In The Contract **(C&F)**	3.7	16	3.74	13	3.7	16
2	Analysis Method Defined In The Contract **(AM)**	3.71	17	3.19	5.5	3.71	17
3	Value Of The Project - **(PV)**	3.06	8.5	3.44	12	3.06	8.5
4	Size Of The Project- **(PS)**	2.76	1	2.77	1	2.76	1
5	Duration Of The Project- **(PD)**	2.98	6	3.15	4	2.98	6
6	STATUS (Prevailing Stage) OF THE PROJECT **-(PCS)**	3.06	8.5	3.31	10	3.06	8.5
7	Complexity Of The Project-**(PC)**	3.25	11	3.31	10	3.25	11
8	Amount Of Time Claimed-**(MT)**	2.84	2	2.81	2	2.84	2
9	AMOUNT OF COST (Of Prolongation) CLAIMED-**(MC)**	2.86	3	2.92	3	2.86	3
10	Number Of Events Claimed And To Be Analysed - **(NE)**	3.04	7	3.19	5.5	3.04	7
11	Obscurity And Sophistication Of Issues In Prolongation Claims **-(OBS)**	3.24	10	3.28	8	3.24	10
12	Baseline Programme Availability - **(ABP)**	4.02	20	4.04	22	4.02	20
13	BASELINE PROGRAMME TYPE (e.g. CPM) - **(TBP)**	4.08	21.5	3.85	16.5	4.08	21.5
14	As-Built Periodical Updates Of Programme **-(AB)**	4.08	21.5	3.96	19.5	4.08	21.5

15	As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**	3.84	18.5	4.04	22	3.84	18.5
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records Etc.) - **(AOR)**	4.12	23	3.96	19.5	4.12	23
17	HIGH QUALITY OF TRANSPARENCY (Clearly Established Causation)- **(LTR)**	3.84	18.5	3.81	15	3.84	18.5
18	Need Of Showing Concurrent Delays/ Mitigation -**(NC)**	3.69	15	4.04	22	3.69	15
19	Need To Illustrate Isolated Delay Effects - **(IEE)**	3.37	14	3.77	14	3.37	14
20	NEED OF SEQUENTIAL (Chronological) ANALYSIS -**(COA)**	3.27	12	3.85	16.5	3.27	12
21	EXPERT SKILLS (For Analysis Method) -**(XS)**	3.34	13	3.88	18	3.34	13
22	Concern For Cost Of Analysis Method -**(CA)**	2.94	5	3.23	7	2.94	5
23	Concern For Time To Be Spent For Analysis -**(TSA)**	2.92	4	3.31	10	2.92	4

Test statistics

Kendall's W = 0.92; Sample x^2 = 60.53> Critical x^2 = 48.27 (For N=23 and k=3, at significance level α= 0.001, df=22)

Table: B. 45 Suitability Index for 'As-Planned v As-Built method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Attributes in Level 3 of the Proposed Model**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**
1	Concurrency & Float Ownership Defined In The Contract **(C&F)**	1.17	1	2.78	12.5	1.86	1
2	Analysis Method Defined In The Contract **(AM)**	2.91	20.5	2.72	10.5	2.83	19
3	Value Of The Project - **(PV)**	2.08	8	1.74	1	1.93	2
4	Size Of The Project- **(PS)**	2	6.5	1.94	2	1.98	3
5	Duration Of The Project- **(PD)**	2.23	14	2.58	6.5	2.39	10.5
6	Status (Prevailing Stage) Of The Project **-(Pcs)**	2.91	20.5	3.22	20	3.05	20
7	Complexity Of The Project- **(PC)**	1.96	5	2.3	3	2.12	5
8	Amount Of Time Claimed- **(MT)**	2.18	13	2.37	5	2.27	7
9	Amount Of Cost (Of Prolongation) Claimed- **(MC)**	2.3	17	2.58	6.5	2.43	12.5
10	Number Of Events Claimed And To Be Analysed - **(NE)**	2.14	9	2.61	8	2.35	9
11	Obscurity And Sophistication Of Issues In Prolongation Claims **-(OBS)**	2.26	16	2.78	12.5	2.49	17
12	Baseline Programme Availability **-(ABP)**	4.13	24	4.39	24	4.24	24
13	Baseline Programme Type (e.g. CPM) - **(TBP**	2.17	11.5	2.79	14.5	2.45	14.5
14	As-Built Periodical Updates Of Programme **-(AB)**	3.22	22	3.56	21	3.37	22
15	As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**	2.65	19	3.58	22	3.07	21
16	Availability Of Other Records (e.g. Daily Records Etc.) - **(AOR)**	3.7	23	3.75	23	3.72	23
17	High Quality Of Transparency (Clearly Established Causation)- **(LTR)**	2.35	18	2.95	17.5	2.62	18

18	Need Of Showing Concurrent Delays/ Mitigation -**(NC)**	1.3	2	3.16	19	2.14	6
19	Need To Illustrate Isolated Delay Effects - **(IEE)**	1.83	4	2.95	17.5	2.33	8
20	Need Of Sequential (Chronological) Analysis - **(COA)**	1.74	3	2.33	4	2	4
21	Expert Skills (For Analysis Method) -**(XS)**	2	6.5	2.94	16	2.43	12.5
22	Concern For Cost Of Analysis Method -**(CA)**	2.15	10	2.67	9	2.39	10.5
23	Concern For Time To Be Spent For Analysis -**(TSA)**	2.24	15	2.72	10.5	2.46	16
24	Admissibility Of Method By engineers/Arbitrators/Courts -**(Tadms)**	2.17	11.5	2.79	14.5	2.45	14.5

Test statistics

Kendall's W = 0.65; Sample x^2 = 44.91> Critical x^2 = 41.64 (For N=24 and k=3, at significance level α= 0.01, *df*=23)

Table: B. 46 Suitability Index for 'Impacted-As-Planned method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

		CONTRACTING GROUP		**CONSULTING GROUP**		**OVERALL**	
S/N	**Attributes in Level 3 of the Proposed Model**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**
1	Concurrency & Float Ownership Defined In The Contract **(C&F)**	1.09	1	2.67	13.5	1.78	1
2	Analysis Method Defined In The Contract **(AM)**	2.74	21	3.11	21	2.9	22
3	Value Of The Project - **(PV)**	2.08	8	1.74	1	1.93	3
4	Size Of The Project- **(PS)**	1.96	4.5	1.83	2	1.9	2
5	Duration Of The Project- **(PD)**	2.36	19	2.63	10	2.49	15.5
6	Status (Prevailing Stage) Of The Project -**(Pcs)**	3.22	22	2.44	5	2.88	21
7	Complexity Of The Project- **(PC)**	1.91	3	2.2	3	2.05	4

8	Amount Of Time Claimed- **(MT)**	2.04	6	2.37	4	2.19	6
9	Amount Of Cost (Of Prolongation) Claimed- **(MC)**	2.09	9.5	2.53	6	2.29	8
10	Number Of Events Claimed And To Be Analysed - **(NE)**	2.14	11.5	2.61	9	2.35	10
11	Obscurity And Sophistication Of Issues In Prolongation Claims -**(OBS)**	2.35	17.5	2.67	13.5	2.49	15.5
12	Baseline Programme Availability -**(ABP)**	4.52	24	4.39	24	4.46	24
13	Baseline Programme Type (e.g. CPM) - **(TBP**	2.22	14.5	3	19.5	2.56	18.5
14	As-Built Periodical Updates Of Programme -**(AB)**	2.48	20	2.56	7.5	2.51	17
15	As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**	2.17	13	2.56	7.5	2.34	9
16	Availability Of Other Records (e.g. Daily Records Etc.) - **(AOR)**	3.7	23	3.39	23	3.56	23
17	High Quality Of Transparency (Clearly Established Causation)- **(LTR)**	2.35	17.5	3.16	22	2.71	20
18	Need Of Showing Concurrent Delays/ Mitigation -**(NC)**	1.57	2	2.69	15	2.17	5
19	Need To Illustrate Isolated Delay Effects - **(IEE)**	2.09	9.5	2.89	17	2.44	12
20	Need Of Sequential (Chronological) Analysis - **(COA)**	1.96	4.5	2.65	11.5	2.25	7
21	Expert Skills (For Analysis Method) -**(XS)**	2.05	7	2.94	18	2.45	13
22	Concern For Cost Of Analysis Method -**(CA)**	2.14	11.5	2.65	11.5	2.36	11
23	Concern For Time To Be Spent For Analysis -**(TSA)**	2.24	16	2.72	16	2.46	14
24	Admissibility Of Method By engineers/Arbitrators/Courts -**(Tadms)**	2.22	14.5	3	19.5	2.56	18.5

Test statistics

Kendall's W = 0.52; Sample x^2 = 36> Critical x^2 = 35.17 (For N=24 and k=3, at significance level α= 0.05, *df*=23)

Table: B. 47 – Suitability Index for 'Collapsed-As-Built method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

S/N	Attributes in Level 3 of the Proposed Model	CONTRACTING GROUP Suitability/ Availability Index	CONTRACTING GROUP Rank	CONSULTING GROUP Suitability/ Availability Index	CONSULTING GROUP Rank	OVERALL Suitability/ Availability Index	OVERALL Rank
1	Concurrency & Float Ownership Defined In The Contract **(C&F)**	1.39	1	2.83	10.5	2.02	1
2	Analysis Method Defined In The Contract **(AM)**	3.43	21	2.78	9	3.15	17.5
3	Value Of The Project - **(PV)**	2.57	6	1.74	1	2.19	3.5
4	Size Of The Project- **(PS)**	2.39	4	1.83	2	2.15	2
5	Duration Of The Project- **(PD)**	2.78	12	2.53	4	2.67	6.5
6	Status (Prevailing Stage) Of The Project -**(Pcs)**	3.3	20	2.89	12.5	3.12	16
7	Complexity Of The Project- **(PC)**	2.78	12	2.55	5	2.67	6.5
8	Amount Of Time Claimed- **(MT)**	2.57	6	2.37	3	2.48	5
9	Amount Of Cost (Of Prolongation) Claimed- **(MC)**	2.78	12	2.68	6	2.74	10
10	Number Of Events Claimed And To Be Analysed - **(NE)**	2.73	10	2.72	8	2.73	9
11	Obscurity And Sophistication Of Issues In Prolongation Claims -**(OBS)**	2.7	9	2.83	10.5	2.76	11
12	Baseline Programme Availability -**(ABP)**	1.83	3	3.78	22	2.68	8
13	Baseline Programme Type (e.g. CPM) - **(TBP**	3.17	15.5	3.22	18	3.20	19.5
14	As-Built Periodical Updates Of Programme -**(AB)**	3.26	19	3.83	23	3.01	15
15	As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**	3.17	15.5	3.72	21	3.41	22
16	Availability Of Other Records (e.g. Daily Records Etc.) - **(AOR)**	4.7	24	4	24	4.39	24
17	High Quality Of Transparency (Clearly Established Causation)- **(LTR)**	3.64	23	3.37	20	3.51	23

18	Need Of Showing Concurrent Delays/ Mitigation -**(NC)**	1.65	2	3.11	15.5	2.19	3.5
19	Need To Illustrate Isolated Delay Effects - **(IEE)**	3.48	22	2.89	12.5	3.22	21
20	Need Of Sequential (Chronological) Analysis - **(COA)**	3.17	15.5	2.71	7	2.98	14
21	Expert Skills (For Analysis Method) -**(XS)**	3.18	18	3.11	15.5	3.15	17.5
22	Concern For Cost Of Analysis Method -**(CA)**	2.59	8	3	14	2.77	12
23	Concern For Time To Be Spent For Analysis -**(TSA)**	2.57	6	3.17	17	2.85	13
24	Admissibility Of Method By engineers/Arbitrators/Courts -(**Tadms**)	3.17	15.5	3.22	18	3.2	19.5

Test statistics

Kendall's W = 0.47; Sample x^2 = 32.73< Critical x^2 = 35.17; For N=24 and k=3, at significance level α= 0.05, *df*=23)

Table: B. 48 Suitability Index for 'Time Impact Analysis method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

		CONTRACTING GROUP		CONSULTING GROUP		OVERALL	
S/N	**Attributes in Level 3 of the Proposed Model**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**	**Suitability/ Availability Index**	**Rank**
1	Concurrency & Float Ownership Defined In The Contract **(C&F)**	4.04	18	3.89	16.5	3.98	18
2	Analysis Method Defined In The Contract **(AM)**	3.04	6	3.11	7.5	3.07	8
3	Value Of The Project - **(PV)**	3.18	9.5	1.95	1	2.61	1.5
4	Size Of The Project- **(PS)**	3.09	7.5	2	2	2.61	1.5
5	Duration Of The Project- **(PD)**	3.45	11.5	2.53	4	3.02	6
6	Status (Prevailing Stage) Of The Project **-(Pcs)**	3.45	11.5	3.32	9	3.39	12
7	Complexity Of The Project- **(PC)**	3.5	15	2.7	5	3.12	10
8	Amount Of Time Claimed- **(MT)**	2.9	4	2.47	3	2.7	3
9	Amount Of Cost (Of Prolongation) Claimed- **(MC)**	3.18	9.5	2.79	6	3	4.5
10	Number Of Events Claimed And To Be Analysed - **(NE)**	2.91	5	3.11	7.5	3	4.5
11	Obscurity And Sophistication Of Issues In Prolongation Claims **-(OBS)**	3.09	7.5	3.89	16.5	3.45	13
12	Baseline Programme Availability **-(ABP)**	4.59	24	4.32	23	4.46	24
13	Baseline Programme Type (e.g. CPM) - **(TBP**	3.5	15	3.67	13.5	3.58	15.5
14	As-Built Periodical Updates Of Programme **-(AB)**	4.27	23	4.11	21	4.2	22
15	As-Built Periodical Updates Of Programme -Mutually Agreed - **(AAB)**	3.68	17	4	20	3.83	17
16	Availability Of Other Records (e.g. Daily Records Etc.) - **(AOR)**	4.09	19	4.17	22	4.13	21
17	High Quality Of Transparency (Clearly Established Causation)- **(LTR)**	4.23	22	3.94	18.5	4.1	20

18	Need Of Showing Concurrent Delays/ Mitigation -**(NC)**	4.14	20.5	4.33	24	4.23	23
19	Need To Illustrate Isolated Delay Effects - **(IEE)**	2.82	3	3.94	18.5	3.33	11
20	Need Of Sequential (Chronological) Analysis - **(COA)**	4.14	20.5	3.88	15	4.03	19
21	Expert Skills (For Analysis Method) -**(XS)**	3.48	13	3.61	12	3.54	14
22	Concern For Cost Of Analysis Method -**(CA)**	2.76	1	3.41	10	3.05	7
23	Concern For Time To Be Spent For Analysis -**(TSA)**	2.8	2	3.44	11	3.11	9
24	Admissibility Of Method By engineers/Arbitrators/Courts -**(Tadms)**	3.5	15	3.67	13.5	3.58	15.5

Test statistics

Kendall's W = 0.67; Sample x^2 = 46.57> Critical x^2 = 35.17 (For N=24 and k=3, at significance level α= 0.05, df=23)

APPENDIX – D

(CALCULATIONS)

SPSS CALCULATIONS FOR
CRONBACH'S ALPHA AND
INTRACLASS CORRELATION COEFFICIENCY

Reliability

Scale: ALL VARIABLES

SPSS CALCULATIONS FOR CRONBACH'S ALPHA AND INTRACLASS CORR COEFFICIENCY - Tables B45-B48

Case Processing Summary

		N	%
Cases	Valid	92	100.0
	Excluded[a]	0	.0
	Total	92	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.761	2

Intraclass Correlation Coefficient

	Intraclass Correlation[a]	95% Confidence Interval	
		Lower Bound	Upper Bound
Single Measures	.614[b]	.469	.727
Average Measures	.761[c]	.639	.842

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.

b. The estimator is the same, whether the interaction effect is present or not.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Reliability

SPSS CALCULATIONS

FOR CRONBACH'S ALPHA AND INTRACLASS CORRELATION COEFFICIENCY - TableS B.27,28,30,31,32,35,36,38,39,40,41,42,43 & 44

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	109	100.0
	Excluded[a]	0	.0
	Total	109	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.934	2

Intraclass Correlation Coefficient

	Intraclass Correlation[a]	95% Confidence Interval	
		Lower Bound	Upper Bound
Single Measures	.876[b]	.823	.913
Average Measures	.934[c]	.903	.955

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.

b. The estimator is the same, whether the interaction effect is present or not.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Reliability

Scale: ALL VARIABLES

SPSS CALCULATIONS FOR
CRONBACH'S ALPHA AND INTRA-CLASS CORRELATION COEFFICIENCY

-FOR ALL TABLES ABOVE

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.942	2

Intraclass Correlation Coefficient

	Intraclass Correlation[a]	95% Confidence Interval	
		Lower Bound	Upper Bound
Single Measures	.890[b]	.857	.915
Average Measures	.942[c]	.923	.956

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. Type C intraclass correlation coefficients using a consistency definition-the between-measure variance is excluded from the denominator variance.

b. The estimator is the same, whether the interaction effect is present or not.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

CHI-SQUARE (SPSS) CALCULATIONS FOR TABLES **B.18 , B.19, B.20, B.21, B.22, B.23, B.24, B.25 & B.26**

Chi-Square SPSS Calculations for Table B.18

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.138[a]	2	.343
Likelihood Ratio	3.208	2	.201
Linear-by-Linear Association	.837	1	.360
N of Valid Cases	62		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.21.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	186	.343
	Cramer's V	.186	.343
N of Valid Cases		62	

Chi-Square Calculations for Tables from B.19 to B.24

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the employer and other is by the contractor.	65	87.8%	9	12.2%	74	100.0%
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by the employer.	66	89.2%	8	10.8%	74	100.0%

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by the contractor.	66	89.2%	8	10.8%	74	100.0%
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by neutral causes.	65	87.8%	9	12.2%	74	100.0%

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the employer and other is by a neutral cause.	65	87.8%	9	12.2%	74	100.0%
Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the contractor and other is by a neutral cause.	65	87.8%	9	12.2%	74	100.0%

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where one delay is caused by the employer and other is by the contr actor.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the employer and other is by the contractor.				
			Time Only	Both Time and Cost	Time, but the cost only if clearly seggregated by the Contractor	No time, No cost	Total
Resondent Group	Contracting Group	Count	21	2	3	2	28
		% within Resondent Group	75.0%	7.1%	10.7%	7 1%	100.0%
		% of Total	32.3%	3.1%	4.6%	3.1%	43.1%
	Consulting Group	Count	6	7	23	1	37
		% within Resondent Group	16.2%	18.9%	62.2%	2.7%	100.0%
		% of Total	9.2%	10.8%	35.4%	1.5%	56.9%
Total		Count	27	9	26	3	65
		% within Resondent Group	41.5%	13.8%	40.0%	4.6%	100.0%
		% of Total	41.5%	13.8%	40.0%	4.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.083[a]	3	.000
Likelihood Ratio	28.304	3	.000
Linear-by-Linear Association	18.879	1	.000
N of Valid Cases	65		

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 1.29.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.633	.000
	Cramer's V	.633	.000
N of Valid Cases		65	

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where two delays are caused by the employer.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by the employer.			
			Time Only	Both Time and Cost	Time, but the cost only if clearly seggregated by the Contractor	Total
Resondent Group	Contracting Group	Count	1	25	3	29
		% within Resondent Group	3.4%	86.2%	10.3%	100.0%
		% of Total	1.5%	37.9%	4.5%	43.9%
	Consulting Group	Count	0	34	3	37
		% within Resondent Group	.0%	91.9%	8.1%	100.0%
		% of Total	.0%	51.5%	4.5%	56.1%
Total		Count	1	59	6	66
		% within Resondent Group	1.5%	89.4%	9.1%	100.0%
		% of Total	1.5%	89.4%	9.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.424[a]	2	.491
Likelihood Ratio	1.792	2	.408
Linear-by-Linear Association	.235	1	.628
N of Valid Cases	66		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .44.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.147	.491
	Cramer's V	.147	.491
N of Valid Cases		66	

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where two delays are caused by the contractor.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by the contractor.		
			Time Only	No time, No cost	Total
Resondent Group	Contracting Group	Count	0	29	29
		% within Resondent Group	.0%	100.0%	100.0%
		% of Total	.0%	43.9%	43.9%
	Consulting Group	Count	1	36	37
		% within Resondent Group	2.7%	97.3%	100.0%
		% of Total	1.5%	54.5%	56.1%
Total		Count	1	65	66
		% within Resondent Group	1.5%	98.5%	100.0%
		% of Total	1.5%	98.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.796[a]	1	.372		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	1.170	1	.280		
Fisher's Exact Test				1.000	.561
Linear-by-Linear Association	.784	1	.376		
N of Valid Cases	66				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .44.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.110	.372
	Cramer's V	110	.372
N of Valid Cases		66	

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where two delays are caused by neutral causes.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where two delays are caused by neutral causes.				
			Time Only	Both Time and Cost	No time, No cost	Don't know	Total
Resondent Group	Contracting Group	Count	26	0	1	1	28
		% within Resondent Group	92.9%	.0%	3.6%	3.6%	100.0%
		% of Total	40.0%	.0%	1.5%	1.5%	43.1%
	Consulting Group	Count	31	4	2	0	37
		% within Resondent Group	83.8%	10.8%	5.4%	.0%	100.0%
		% of Total	47.7%	6.2%	3.1%	.0%	56.9%
Total		Count	57	4	3	1	65
		% within Resondent Group	87.7%	6.2%	4.6%	1.5%	100.0%
		% of Total	87.7%	6.2%	4.6%	1.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.614[a]	3	.202
Likelihood Ratio	6.460	3	.091
Linear-by-Linear Association	158	1	.691
N of Valid Cases	65		

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .43.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.266	.202
	Cramer's V	.266	.202
N of Valid Cases		65	

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where one delay is caused by the employer and other is by a neutral cause.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the employer and other is by a neutral cause.				
			Time Only	Both Time and Cost	Time, but the cost only if clearly seggregated by the Contractor	Don't know	Total
Resondent Group	Contracting Group	Count	16	8	4	0	28
		% within Resondent Group	57.1%	28.6%	14.3%	.0%	100.0%
		% of Total	24.6%	12.3%	6.2%	.0%	43.1%
	Consulting Group	Count	5	23	8	1	37
		% within Resondent Group	13.5%	62.2%	21.6%	2.7%	100.0%
		% of Total	7.7%	35.4%	12.3%	1.5%	56.9%
Total		Count	21	31	12	1	65
		% within Resondent Group	32.3%	47.7%	18.5%	1.5%	100.0%
		% of Total	32.3%	47.7%	18.5%	1.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.383[a]	3	.002
Likelihood Ratio	15.126	3	.002
Linear-by-Linear Association	11.473	1	.001
N of Valid Cases	65		

a.2 cells (25.0%) have expected count less than 5. The minimum expected count is .43.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.470	.002
	Cramer's V	.470	.002
N of Valid Cases		65	

Resondent Group * How do you decide in the following concurrent (critical) delay situations, if the Contrac t is silent about such approach? - Where one delay is caused by the contractor and other is by a neutral cause.

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the contractor and other is by a neutral cause.				
			Time Only	Cost Only	Both Time and Cost	Time, but the cost only if clearly seggregated by the Contractor	No time, No cost
Resondent Group	Contracting Group	Count	21	0	1	1	5
		% within Resondent Group	75.0%	.0%	3.6%	3.6%	17.9%
		% of Total	32.3%	.0%	1.5%	1.5%	7.7%
	Consulting Group	Count	29	1	2	2	2
		% within Resondent Group	78.4%	2.7%	5.4%	5.4%	5.4%
		% of Total	44.6%	1.5%	3.1%	3.1%	3.1%
Total		Count	50	1	3	3	7
		% within Resondent Group	76.9%	1.5%	4.6%	4.6%	10.8%
		% of Total	76.9%	1.5%	4.6%	4.6%	10.8%

Crosstab

			How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach? - Where one delay is caused by the contractor and other is by a neutral cause.	
			Don't know	Total
Resondent Group	Contracting Group	Count	0	28
		% within Resondent Group	.0%	100.0%
		% of Total	.0%	43.1%
	Consulting Group	Count	1	37
		% within Resondent Group	2.7%	100.0%
		% of Total	1.5%	56.9%
Total		Count	1	65
		% within Resondent Group	1.5%	100.0%
		% of Total	1.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.064[a]	5	.540
Likelihood Ratio	4.816	5	.439
Linear-by-Linear Association	.434	1	.510
N of Valid Cases	65		

a. 10 cells (83.3%) have expected count less than 5. The minimum expected count is .43.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.250	.540
	Cramer's V	.250	.540
N of Valid Cases		65	

Crosstabs

Chi-Square Calculations for Table B.25

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.410[a]	3	.333
Likelihood Ratio	4.145	3	.246
Linear-by-Linear Association	2.695	1	.101
N of Valid Cases	66		

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .88.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.227	.333
	Cramer's V	.227	.333
N of Valid Cases		66	

Crosstabs

Chi-Square Calculations for Table B.26

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.268[a]	2	.531
Likelihood Ratio	1.280	2	.527
Linear-by-Linear Association	1.131	1	.288
N of Valid Cases	65		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.29.

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	140	.531
	Cramer's V	140	.531
N of Valid Cases		65	

KENDALL'S 'W' CALCULATIONS FOR TABLES B.27, B.28, B.30, B.31, B.32, B.35, B.36, B.38, B.39 to B.48 (using Excel)

Table B.27
QUESTION #12
Kendall's W

Level of awareness among practitioners as to MDAs

H_0 = The awareness levels of the two groups as to the MDAs are unrelated [i.e. are independent] and the observed value of 'r_s' differs from zero only by chance.

H_1 = There exists a considerable association among the awareness levels of the two groups as to the MDAs.

	Criteria	CONTRACTING GROUP		CONSULTING GROUP		OVERALL		Rank Totals	Square of Rank Totals
		Awareness Index (Weighted Average)	Rank	Awareness Index (Weighted Average)	Rank	Awareness Index (Weighted Average)	Rank	R_i	R_i^2
1	As-Planned vs As-Built	4.1	5	3.44	5	3.75	5	15	225.00
2	Impacted As-Planned	4	4	3.32	4	3.62	4	12	144.00
3	Collapsed As-Built	2.57	1	2.76	2	2.68	1	4	16.00
4	Time Impact Analysis	2.96	2	3.22	3	3.11	2	7	49.00
5	Global claims	3.82	3	2.75	1	3.22	3	7	49.00
	Tied number		0		0		0		**483.00**
	Tied number %		0%		0%		0%		

(as Tied numbers are large adjustment made)

k = 3
N = 5

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_j$	**0**

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

W = 936 / 1080

W = 0.87	
As (k=3) N= 5, Critical Value of W for significance level α = 0.01 (ref. Table 'T')	0.84

Therefore calculated value W is > Critical value W for significance level $\alpha = 0.01$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.87
For N=5 and k=3, Critical W (0.01) =	0.84
df = N-1 =	4

Table B.32

QUESTION #15

Kendall's W

Frequncy of using contemporanous records in delay claims

H_0 = The frequencies in using contemporanous records in delay claims as attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the frequencies in using contemporanous records in delay claimsas attributed by the two groups

	Criteria	CONTRACTING GROUP		CONSULTING GROUP		OVERALL		Rank Totals	Square of Rank Totals
		Frequency Index (Weighted Average)	Rank	Frequency Index (Weighted Average)	Rank	Frequency Index (Weighted Average)	Rank	R_i	R_i^2
1	CPM Baseline programme	4.25	5	4.75	5	4.5	5	15	225.00
2	CPM Baseline programme (Consented)	3.7	4	3.72	4	1.79	4	12	144.00
3	As-built programme updates	2.14	1	3.5	2	1.09	1	4	16.00
4	As-built programme updates (mutualy agreed)	2.64	2	3.6	3	1.28	2	7	49.00
5	Site records, diaries and other contemporary records	3.46	3	3.45	1	1.64	3	7	49.00
	Tied number		0		0		0		483.00
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_i$	0

$$W = \frac{936}{1080}$$

W = 0.87

As (k=3) N= 5, Critical Value of W for significance level $\alpha = 0.01$ (ref. Table 'T')	0.84

Therefore calculated value W is >Critical value W for significance level $\alpha = 0.01$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.87
For N=5 and k=3, Critical W (0.01) =	0.84
df = N-1 =	4

Table B.28

QUESTION #17

Kendall's W

Frequency of using a particular MDA

H_0 = The frequencies of use of a particular MDA among the two groups are unrelated [i.e. are independent] and the observed value of 'r,' differs from zero only by chance.

H_1 = There exists a considerable association among the frequency of the use of a particular MDA among the two groups.

	Criteria	CONTRACTING GROUP		CONSULTING GROUP		OVERALL		Rank Totals	Square of Rank Totals
		Use Index (Weighted Average)	Rank	Use Index (Weighted Average)	Rank	Use Index (Weighted Average)	Rank	R_i	R_i^2
1	As-Planned vs As-Built	3.9	4	2.96	3	3.45	4	11	121.00
2	Impacted As-Planned	4.11	5	3.14	4	3.61	5	14	196.00
3	Collapsed As-Built	1.74	1	2.46	2	2.11	1	4	16.00
4	Time Impact Analysis	2.96	2	3.76	5	3.38	3	10	100.00
5	Global claims	3.57	3	1.96	1	2.77	2	6	36.00
	Tied number		0		0		0		**469.00**
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_i$ =	0

W = 768 / 1080

W = 0.711	
As (k=3) N= 5, Critical Value of W for significance level α = 0.05 (ref. Table 'T')	0.716

Therefore calculated value W is < Critical value W for significance level α = 0.05

Accordingly, H_0 may be supported; The use-index rankings attributed to a particular MDA by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance. (W=0 means no agreement among the raters; W=+1 complete agreement between the raters)

Test Statistics	
Kendall's W =	0.711
For N=5 and k=3, Critical W (0.05) =	0.716
df = N-1 =	4

Table B.30

QUESTION #18

Kendall's W

Level of success of using a particular MDA

H_0 = The effectiveness level of use of a particular MDA among the two groups are unrelated [i.e. are independent] and the observed value of 'r_s' differs from zero only by chance.

H_1 = There exists a considerable association among the effectiveness levels of use of a particular MDA among the two groups.

	Criteria	CONTRACTING GROUP Effectiveness Index (Weighted Average)	Rank	CONSULTING GROUP Effectiveness Index (Weighted Average)	Rank	OVERALL Effectiveness Index (Weighted Average)	Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	As-Planned vs As-Built	2.97	3	2.44	2	2.96	3	8	64.00
2	Impacted As-Planned	3.14	4	3	4	3.14	4	12	144.00
3	Collapsed As-Built	2	1	2.44	2	2.28	2	5	25.00
4	Time Impact Analysis	3.57	5	3.72	5	3.67	5	15	225.00
5	Global claims	2.04	2	1.93	1	1.93	1	4	16.00
	Tied number		0		0		0		**474.00**
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

Group$_1$	0
Group$_2$	0
Group$_3$	0
$\sum T_i$ =	0

W = 828 / 1080

W = 0.767

As (k=3) N= 5, Critical Value of W for significance level α = 0.05 (ref. Table 'T')	0.716

Therefore calculated value W is > Critical value W for significance level α = 0.05

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.77
For N=5 and k=3, Critical W (0.05) =	0.716
df = N-1 =	4

Table B.30

QUESTION #18

Kendall's W

Level of success of using a particular MDA

H_0 = The effectiveness level of use of a particular MDA among the two groups are unrelated [i.e. are independent] and the observed value of 'r,' differs from zero only by chance.

H_1 = There exists a considerable association among the effectiveness levels of use of a particular MDA among the two groups.

	Criteria	CONTRACTING GROUP Effectiveness Index (Weighted Average)	Rank	CONSULTING GROUP Effectiveness Index (Weighted Average)	Rank	OVERALL Effectiveness Index (Weighted Average)	Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	As-Planned vs As-Built	2.97	3	2.44	2	2.96	3	8	64.00
2	Impacted As-Planned	3.14	4	3	4	3.14	4	12	144.00
3	Collapsed As-Built	2	1	2.44	2	2.28	2	5	25.00
4	Time Impact Analysis	3.57	5	3.72	5	3.67	5	15	225.00
5	Global claims	2.04	2	1.93	1	1.93	1	4	16.00
	Tied number		0		0		0		**474.00**
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_i$ =	0

W = 828 / 1080

W = 0.767

As (k=3) N= 5, Critical Value of W for significance level α = 0.05 (ref. Table 'T')	0.716

Therefore calculated value W is > Critical value W for significance level α = 0.05

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.77
For N=5 and k=3, Critical W (0.05) =	0.716
df = N-1 =	4

Table B.31

QUESTION #19

Kendall's W

Frequency of dispute arising from using a particular MDA

H_0 = Frequencies of dispute arising from use of a particular MDA among the two groups are unrelated [i.e. are independent] and the observed value of 'r_s' differs from zero only by chance.

H_1 = There exists a considerable association among the frequencies of dispute arising from of use of a particular MDA by the two groups.

	Criteria	CONTRACTING GROUP Dispute Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Dispute Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Dispute Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	As-Planned vs As-Built	3.57	4	3	5	3.23	4	13	169.00
2	Impacted As-Planned	3.48	3	2.89	4	3.13	3	10	100.00
3	Collapsed As-Built	1.64	1	2.77	1	2.17	1	3	9.00
4	Time Impact Analysis	2.08	2	2.83	2	2.47	2	6	36.00
5	Global claims	4.28	5	2.88	3	3.57	5	13	169.00
	Tied number		0		0		0		**483.00**
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

Group$_1$ 0

Group$_2$ 0

Group$_3$ 0

$\sum T_i$ = 0

W = $\frac{936}{1080}$

W = 0.867

As (k=3) N= 5, Critical Value of W for significance level α = 0.01 (ref. Table 'T')	0.84

Therefore calculated value W is > Critical value W for significance level α = 0.01

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.87
For N=5 and k=3, Critical W (0.01) =	0.84
df = N-1 =	4

Table B.39

QUESTION #20

Kendall's W

Frequncy of obstruction by "factors" for selecting an optimum MDA

H_0 = The frequencies of becoming obstacles (in selecting the optimum MDA) by identified 'factors' as attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the frequencies of becoming obstacles (in selecting the optimum MDA) by identified 'factors' as attributed by the two groups

	Factors	CONTRACTING GROUP Frequency Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Frequency Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Frequency Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Absence of proper CPM based Baseline Programme	3.79	8.5	3.89	8	3.38	8	24.5	600.25
2	Absence of 'consent' for such Programme	3.79	8.5	3.68	7	3.23	7	22.5	506.25
3	Lack of as-built updates of Programme	3.32	6	3.96	9	3.63	9	24	576.00
4	Lack of mutually agreed as-built updates of Programme	3.26	5	3.26	6	3	5	16	256.00
5	Lack of site records.	3.75	7	3.21	5	2.86	4	16	256.00
6	Lack of awareness/skills in using an appropriate analysis methodology.	3.07	4	3.11	4	3.09	6	14	196.00
7	Lack of awareness/skills in using programming software.	2.71	3	2.43	1	2.57	2	6	36.00
8	Cost of using an appropriate analysis	2.61	1.5	2.5	2	2.55	1	4.5	20.25
9	High level of time consumption for using an appropriate analysis methodology.	2.61	1.5	3.04	3	2.82	3	7.5	56.25
	Tied number		4		0		0		**2503.00**
	Tied number %		17%		0%		0%		

(for Tied numbers adjustment made)

k = 3
N = 9

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)	12
$Group_2$		0
$Group_3$		0
	$\sum T_i$ =	12

W = 5736 / 6444

W = 0.89

$$X^2 = k(N-1)W$$

As N> 7 (i.e. N=9), sample Value is found through formula

Sample x^2 = 21.36

For significance level $\alpha = 0.05$ and $df = 8$ (ref. Table 'C') Critical Value of X^2 = 15.51

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.05$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.89
Sample X^2 =	21.36
Critical X^2 (0.05) =	15.51
df = N-1 =	8

Table B.40

QUESTION #21

Kendall's W

Frequny of contribution by "factors" for further escalating disputes

H_0 = The frequencies of contribution by identified 'factors' for further escalating disputes as attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the frequencies of contribution by identified 'factors' for further escalating disputes as attributed by the two groups

	Factors	CONTRACTING GROUP Obstacles Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Obstacles Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Obstacles Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Descrepencies and ambiguities withn tender/contract documents.	3.73	5.5	3.07	2	3.39	5	12.5	156.25
2	Lack of risk distribution between the parties, in the Contract.	3.88	8	3.37	5	3.62	6	19	361.00
3	Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.).	3.27	4	3.29	4	3.28	4	12	144.00
4	Failure of 'notification' of delay event within contractually prescribed time.	3.73	5.5	3.71	10	3.72	7	22.5	506.25
5	Failure of submission of 'particulars' of delay claim event within contractually prescribed time.	3.85	7	3.75	11	3.8	9	27	729.00
6	Global claims.	4.31	12	4	12	4.15	12	36	1296.00
7	Contractor's failure to establish 'liability' for delay event based on contract provisions.	4.24	11	3.61	8.5	3.91	11	30.5	930.25
8	Contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.	4.08	10	3.43	7	3.74	8	25	625.00
9	Delay analysis method used by one party being disagreed/challenged by other party.	4.04	9	3.61	8.5	3.81	10	27.5	756.25
10	Absence of definition in the contract as to 'float ownership'.	2.77	1	3.04	1	2.91	1	3	9.00
11	Absence of definition of approach to be used at measuring 'criticality' of a delay.	2.84	2	3.14	3	3	2	7	49.00
12	Absence of definition in the contract as to approach for 'Concurrent delay situations'.	2.92	3	3.56	6	3.25	3	12	144.00
	Tied number		2		2		0		5706.00
	Tied number %		9%		9%		0%		
	(for Tied numbers adjustment made)								

k = 3

N = 12

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)	6
$Group_2$	=(POWER(2,3)-2)	6
$Group_3$	=	0
		12

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

W = 13716 / 15408

W = 0.89

As N> 7 (i.e. N=12), sample Value is found through formula

$$X^2 = k(N-1)W$$

Sample x^2 = 29.38

For significance level $\alpha = 0.01$ and df = 11 (ref. Table 'C') Critical Value of X^2 = 24.72

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.01$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.89
Sample X^2 =	29.38
Critical X^2 (0.01) =	24.72
df = N-1 =	11

Table B.41

QUESTION #22

Kendall's W

Importance of contribution by "factors" for reducing/preventing delay claims

H_0 = The importance of contribution by identified 'factors' for reducing/preventing delay claims as attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the importance of contribution by identified 'factors' for reducing/preventing delay claims as attributed by the two groups

	Factors	CONTRACTING GROUP		CONSULTING GROUP		OVERALL		Rank Totals	Square of Rank Totals
		Prevention Index (Weighted Average)	Rank	Prevention Index (Weighted Average)	Rank	Prevention Index (Weighted Average)	Rank	R_i	R_i^2
1	Allow sufficient time for consultants to complete the design and contract documents before issuing for tender.	4.31	5.5	4.65	7	4.48	5.5	18	324.00
2	Establish high level quality control mechanism within consultants team to minimize/eradicate conflicts, descrepencies and amb	4.12	3	4.20	4.5	4.13	4	11.5	132.25
3	Clear distribution of risks between the parties, in the Contract.	4.31	5.5	3.40	1	3.86	3	9.5	90.25
4	Clear cut definition in the contract as to 'float ownership'.	3.32	2	3.58	2	3.45	1	5	25.00
5	Clear cut definition in the contract as to 'automatic entitlement to EoT for delays occurring after passing prevailing contra	3.27	1	4.20	4.5	3.73	2	7.5	56.25
6	Engineer's impartiality (against own failures or outside pressure)	4.63	7	3.84	3	4.22	7	17	289.00
7	Presence of a stipulated mechanism in the Contract to resolve delay claims at site level on day-to-day basis.	4.50	6	4.46	6	4.48	5.5	17.5	306.25
	Tied number		2		2		0		**1223.00**
	Tied number %		9%		9%		0%		
	(for Tied numbers adjustment made)								

k = 3
N = 7

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)	= 6
$Group_2$	=(POWER(2,3)-2)	6
$Group_3$	0	= 0
	$\sum T_i$	= 12

W = $\frac{2580}{2988}$

W = 0.86

As (k=3) N= 7, Critical Value of W for significance level α = 0.01 (ref. Table 'T')	0.74

Therefore calculated value W is >Critical value W for significance level α = 0.01

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.86
For N=5 and k=3, Critical W (0.01) =	0.74
df = N-1 =	6

Table B.42

QUESTION #23

Kendall's W

Importance of "factors" for expediting/ making efficient delay claims resolution process

H_0 = The importance level of identified 'factors' for expediting/ making efficient delay claims resolution process as attributed by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the importance of identified 'factors' for expediting/ making efficient delay claims resolution process as attributed by the two groups.

	Factors	CONTRACTING GROUP Importance Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Importance Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Importance Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Stipulation in the contract a clear mechanism for delay claims presentation by contractors (establishing 'liability' and quantum)	4.38	9	4.22	9	4.3	9	27	729.00
2	Stipulation in contract as to the basic and minimum required documents to be presented	4	6	3.74	1	3.87	5	12	144.00
3	Submission of 'notification' of delay claim event within contractually prescribed time	3.88	4.5	4.15	6.5	4.02	6	17	289.00
4	Submission of 'particulars' of delay claim event within contractually prescribed time	4.24	8	4.15	6.5	4.19	7	21.5	462.25
5	Clear cut definition in the contract for the approach as to 'concurrent delays'.	3.46	2	4.04	5	3.75	2.5	9.5	90.25
6	Clear cut definition in the contract for the approach as to 'float ownership'.	3.32	1	3.89	3.5	3.75	2.5	7	49.00
7	Clear cut definition in the contract for delay analysis methodology to be used in delay claims presentation and evaluation.	3.88	4.5	3.78	2	3.83	4	10.5	110.25
8	Clear cut definition in the contract for approach to be used at measuring 'criticality' of a delay (Zero Float or longest path)	3.54	3	3.89	3.5	3.72	1	7.5	56.25
9	Presentation and assessment of delay claims carried out on a analysis method mutually agreed on an objective basis.	4.19	7	4.22	8	4.21	8	23	529.00
10	Prompt and timely award of extension of time	4.69	10	4.33	10	4.51	10	30	900.00
11	Engineer's impartiality in apportioning liability	4.77	11	4.52	11	4.76	11	33	1089.00
	Tied number		2		4		2		**4448.00**
	Tied number %		9%		17%		9%		
	(for Tied numbers adjustment made)								

k = 3

N = 11

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)	6
$Group_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)	12
$Group_3$	=(POWER(2,3)-2)	6
	$\sum T_i$ =	24

W = $\frac{10608}{11808}$

W = 0.90

As N> 7 (i.e. N=11), sample Value is found through formula $X^2 = k(N-1)W$

Sample x^2 = 26.95

For significance level $\alpha = 0.01$ and $df = 10$(ref. Table 'C') Critical Value of X^2 = 23.21

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.01$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.90
Sample X^2 =	26.95
Critical X^2 (0.01) =	23.21
df = N-1 =	10

Table B.35

QUESTION #24

Kendall's W

Level of promptness in submission of claims by the contractors

H_0 = The perceived ratings of the respondents of two Groups on the propositions concerned are unrelated [i.e. are independent] and the observed value of 'r,' differs from zero only by chance.

H_1 = There exists a considerable association between the ratings of the two Groups on the propositions concerned

	PROPOSITIONS "Contractors submit their delay calism submissions with adequate details enabling consultants' assessment:	CONTRACTING GROUP Promptness Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Promptness Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Promptness Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Long after the project is completed".	1.46	2	3.67	5	2.58	2	9	81.00
2	After the effects of ALL the claimed 'events' are ceased".	2	3	3.11	4	2.6	3	10	100.00
3	After the effects of the particular 'event' is ceased".	3.89	4	2.7	2	3.46	5	11	121.00
4	Contemporaneously and promptly"	4	5	2.89	3	3.04	4	12	144.00
5	Not submitting at all.	1.35	1	2.23	1	1.79	1	3	9.00
	Tied number		0		0		0		455.00
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_i$ =	0

W = 600 / 1080

W = 0.556

As (k=3) N= 5, Critical Value of W for significance level α = 0.05 (ref. Table 'T')	0.716

Therefore calculated value W is < Critical value W for significance level α = 0.05

Accordingly, H_0 may be supported; The use-index rankings attributed to a particular MDA by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.(W=0 means no agreement among the raters; W=+1 complete agreement between the raters)

Test Statistics	
Kendall's W =	0.56
For N=5 and k=3, Critical W (0.05) =	0.716
df = N-1 =	4

Table B.36

QUESTION #25

Kendall's W

Level of promptness in determining claims by the consultants

H_0 = The perceived ratings of the respondents of two Groups on the propositions concerned are unrelated [i.e. are independent] and the observed value of 'r_s' differs from zero only by chance.

H_1 = There exists a considerable association between the ratings of the two Groups on the propositions concerned

	PROPOSITIONS "Consultants (assessers) determine claimed entitlement to extension of time":	CONTRACTING GROUP Promptness Index (Weighted Average)	Rank	CONSULTING GROUP Promptness Index (Weighted Average)	Rank	OVERALL Promptness Index (Weighted Average)	Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Long after the project is completed".	2.08	2	2.96	4	2.53	2	8	64.00
2	After the effects of ALL the claimed 'events' are ceased".	4.04	5	3.48	5	3.75	5	15	225.00
3	After the effects of the particular 'event' is ceased".	3.16	4	2.81	3	2.98	4	11	121.00
4	Contemporaneously and promptly"	2.48	3	2.63	2	2.56	3	8	64.00
5	Not determining at all.	1.4	1	1.81	1	1.61	1	3	9.00
	Tied number		0		0		0		**483.00**
	Tied number %		0%		0%		0%		
	(as Tied numbers are large adjustment made)								

k = 3
N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$	0
$Group_2$	0
$Group_3$	0
$\sum T_i$ =	0

W = 936

1080

W = 0.867	
As (k=3) N= 5, Critical Value of W for significance level α = 0.01 (ref. Table 'T')	0.84

Therefore calculated value W is < Critical value W for significance level α = 0.01

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.87
For N=5 and k=3, Critical W (0.01) =	0.84
df = N-1 =	4

Table B.38

QUESTION #27

Kendall's W

Level of promptness in awarding extension of time by the clients

H_0 = The perceived ratings of the respondents of two Groups on the propositions concerned are unrelated [i.e. are independent] and the observed value of 'r,' differs from zero only by chance.

H_1 = There exists a considerable association between the ratings of the two Groups on the propositions concerned

	PROPOSITIONS "Consultants (assessers) determine claimed entitlement to extension of time":	CONTRACTING GROUP Promptness Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Promptness Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Promptness Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	Long after the project is completed".	3.96	5	2.88	3	3.43	5	13	169.00
2	After the effects of ALL the claimed 'events' are ceased".	2.88	4	3.13	4.5	3	4	12.5	156.25
3	After the effects of the particular 'event' is ceased".	2.64	3	3.13	4.5	2.88	3	10.5	110.25
4	Contemporaneously and promptly"	1.52	1	2.58	2	2.04	2	5	25.00
5	Not awarding at all.	1.64	2	1.96	1	1.8	1	4	16.00
	Tied number		0		2		0		**476.50**
	Tied number %		0%		9%		0%		
	(as Tied numbers are large adjustment made)								

k = 3

N = 5

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

For tied observations:

$Group_1$		0
$Group_2$	=(POWER(2,3)-2)	6
$Group_3$		0
	$\sum T_i$ =	6

W = $\frac{858}{1062}$

W = 0.808

As (k=3) N= 5, Critical Value of W for significance level α = 0.05 (ref. Table 'T')	0.716

Therefore calculated value W is > Critical value W for significance level α = 0.05

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.81
For N=5 and k=3, Critical W (0.05) =	0.716
df = N-1 =	4

Table B.43

QUESTION #28

Kendall's W

Significance Level of "criteria" judged by practitioners for selecting an optimum MDA

H_0 = The importance rankings attributed to 'criteria' by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the importance ranking attributed to 'criteria' by the two groups .

	Criteria	CONTRACTING GROUP		CONSULTING GROUP		OVERALL		Rank Totals	Square of Rank Totals
		Significance Index (Weighted Average)	Rank	Significance Index (Weighted Average)	Rank	Significance Index (Weighted Average)	Rank	R_i	R_i^2
1	CONTRACTUALLY SPECIFIED REQUIREMENTS AS FOR DELAY ANALYSIS - CCR	4.19	5	3.74	4	3.96	5	14	196.00
2	PROJECT CONSTRAINTS (Magnitude, complexity etc.) - PC	3.12	2.5	2.33	1	3.13	2	5.5	30.25
3	CLAIMS MAGNITUDE AND COMPLEXITY - CMC	3.19	4	3.56	3	3.31	3	10	100.00
4	RECORDS AVAILABILITY - RecA	4.42	7	3.96	7	4.19	7	21	441.00
5	PROOF OF CAUSATION (Transparency of analysis) - PrOfC	4.2	6	3.81	6	3.98	6	18	324.00
6	TIME AND COST OF ANALYSIS - T&C	3.12	2.5	2.96	2	3	1	5.5	30.25
7	LEGAL ADMISSIBILITY (By Triers) - Ladms	3.04	1	3.78	5	3.38	4	10	100.00
	Tied number		2						**1221.50**
	Tied number %		9%		0%		0%		
	(for Tied numbers adjustment made)								

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

k = 3

N = 7

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2) =	6
$Group_2$		0
$Group_3$		0
	$\sum T_i$ =	6

W = $\frac{2562}{3006}$

W = 0.85

As (k=3) N= 7, Critical Value of W for significance level α = 0.01 (ref. Table 'T')	0.74

Therefore calculated value W is >Critical value W for significance level $\alpha = 0.01$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.85
For N=7 and k=3, Critical W (0.01) =	0.74
df = N-1 =	6

Table B.44

QUESTION #29

Kendall's W

Importance Level of "Attributes" judged by practitioners for selecting an optimum MDA

H_0 = The importance rankings attributed to 'Attributes' by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the importance ranking attributed to 'factors' by the two groups.

	Attributes	CONTRACTING GROUP Importance Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Importance Index (Weighted Average)	CONSULTING GROUP Rank	OVERALL Importance Index (Weighted Average)	OVERALL Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	CONCURRENCY & FLOAT OWNERSHIP DEFINED IN THE CONTRACT (C&F)	3.7	16	3.74	13	3.7	16	45	2025.00
2	ANALYSIS METHOD DEFINED IN THE CONTRACT (AM)	3.71	17	3.19	5.5	3.71	17	39.5	1560.25
3	VALUE OF THE PROJECT - (PV)	3.06	8.5	3.44	12	3.06	8.5	29	841.00
4	SIZE OF THE PROJECT- (PS)	2.76	1	2.77	1	2.76	1	3	9.00
5	DURATION OF THE PROJECT- (PD)	2.98	6	3.15	4	2.98	6	16	256.00
6	STATUS (prevailing stage) OF THE PROJECT -(PCS)	3.06	8.5	3.31	10	3.06	8.5	27	729.00
7	COMPLEXITY OF THE PROJECT-(PC)	3.25	11	3.31	10	3.25	11	32	1024.00
8	AMOUNT OF TIME CLAIMED-(MT)	2.84	2	2.81	2	2.84	2	6	36.00
9	AMOUNT OF COST (of prolongation) CLAIMED-(MC)	2.86	3	2.92	3	2.86	3	9	81.00
10	NUMBER OF EVENTS CLAIMED AND TO BE ANALYSED - (NE)	3.04	7	3.19	5.5	3.04	7	19.5	380.25
11	OBSCURITY AND SOPHISTICATION OF ISSUES IN PROLONGATION CLAIMS -(OBS)	3.24	10	3.28	8	3.24	10	28	784.00
12	BASELINE PROGRAMME AVAILABILITY -(ABP)	4.02	20	4.04	22	4.02	20	62	3844.00
13	BASELINE PROGRAMME TYPE (e.g. CPM) - (TBP)	4.08	21.5	3.85	16.5	4.08	21.5	59.5	3540.25
14	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - (AB)	4.08	21.5	3.96	19.5	4.08	21.5	62.5	3906.25
15	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - Mutually Agreed - (AAB)	3.84	18.5	4.04	22	3.84	18.5	59	3481.00
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records etc.) - (AOR)	4.12	23	3.96	19.5	4.12	23	65.5	4290.25
17	HIGH QUALITY OF TRANSPARENCY (clearly established Causation)- (LTR)	3.84	18.5	3.81	15	3.84	18.5	52	2704.00
18	NEED OF SHOWING CONCURRENT DELAYS/ MITIGATION -(NC)	3.69	15	4.04	22	3.69	15	52	2704.00
19	NEED TO ILLUSTRATE ISOLATED DELAY EFFECTS (IEE)	3.37	14	3.77	14	3.37	14	42	1764.00
20	NEED OF SEQUENTIAL (chronological) ANALYSIS - (COA)	3.27	12	3.85	16.5	3.27	12	40.5	1640.25
21	EXPERT SKILLS (for analysis method) -(XS)	3.34	13	3.88	18	3.34	13	44	1936.00
22	CONCERN FOR COST OF ANALYSIS METHOD -(CA)	2.94	5	3.23	7	2.94	5	17	289.00
23	CONCERN FOR TIME TO BE SPENT FOR ANALYSIS - (TSA)	2.92	4	3.31	10	2.92	4	18	324.00
	Tied number		6		6		6		**38148.50**
	Tied number %		26%		26%		26%		
	(for Tied numbers adjustment made)								

k = 3
N = 23

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
$Group_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
$Group_3$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
	$\sum T_i$ =	**54**

$$W = \frac{100086}{109134}$$

W = 0.92

$$X^2 = k(N-1)W$$

As N> 7 (i.e. N=23), sample Value is found through formula

Sample x^2 = 60.53

For significance level $\alpha = 0.001$ and $df = 22$ (ref. Table 'C') Critical Value of X^2 = 48.27

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.001$

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.92
Sample X^2 =	60.53
Critical X^2 (0.001) =	48.27
df = N-1 =	22

Table B.45

QUESTION #30-a

Kendall's W

Suitability Index for 'As-Planned v As-Built method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

H_0 = The Suitability of 'As-Planned v As-Built method' against the availability of Attributes as ranked by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the ranking attributed by the two groups.

	Attributes	CONTRACTING GROUP Suitability/ Availability Index (Weighted Average)	CONTRACTING GROUP Rank	CONSULTING GROUP Suitability/ Availability Index (Weighted Average)	CONSULTING GROUP Rank	Overall Suitability/ Availability Index (Weighted Average)	Overall Rank	Rank Totals R_i	Square of Rank Totals R_i^2
1	CONCURRENCY & FLOAT OWNERSHIP DEFINED IN THE CONTRACT (C&F)	1.17	1	2.78	12.5	1.86	1	14.5	210.25
2	ANALYSIS METHOD DEFINED IN THE CONTRACT (AM)	2.91	20.5	2.72	10.5	2.83	19	50	2500.00
3	VALUE OF THE PROJECT - (PV)	2.08	8	1.74	1	1.93	2	11	121.00
4	SIZE OF THE PROJECT- (PS)	2	6.5	1.94	2	1.98	3	11.5	132.25
5	DURATION OF THE PROJECT- (PD)	2.23	14	2.58	6.5	2.39	10.5	31	961.00
6	STATUS (prevailing stage) OF THE PROJECT -(PCS)	2.91	20.5	3.22	20	3.05	20	60.5	3660.25
7	COMPLEXITY OF THE PROJECT-(PC)	1.96	5	2.3	3	2.12	5	13	169.00
8	AMOUNT OF TIME CLAIMED-(MT)	2.18	13	2.37	5	2.27	7	25	625.00
9	AMOUNT OF COST (of prolongation) CLAIMED-(MC)	2.3	17	2.58	6.5	2.43	12.5	36	1296.00
10	NUMBER OF EVENTS CLAIMED AND TO BE ANALYSED - (NE)	2.14	9	2.61	8	2.35	9	26	676.00
11	OBSCURITY AND SOPHISTICATION OF ISSUES IN PROLONGATION CLAIMS -(OBS)	2.26	16	2.78	12.5	2.49	17	45.5	2070.25
12	BASELINE PROGRAMME AVAILABILITY -(ABP)	4.13	24	4.39	24	4.24	24	72	5184.00
13	BASELINE PROGRAMME TYPE (e.g. CPM) - (TBP)	2.17	11.5	2.79	14.5	2.45	14.5	40.5	1640.25
14	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - (AB)	3.22	22	3.56	21	3.37	22	65	4225.00
15	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - Mutually Agreed - (AAB)	2.65	19	3.58	22	3.07	21	62	3844.00
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records etc.) - (AOR)	3.7	23	3.75	23	3.72	23	69	4761.00
17	HIGH QUALITY OF TRANSPARENCY (clearly established Causation)- (LTR)	2.35	18	2.95	17.5	2.62	18	53.5	2862.25
18	NEED OF SHOWING CONCURRENT DELAYS/ MITIGATION -(NC)	1.3	2	3.16	19	2.14	6	27	729.00
19	NEED TO ILLUSTRATE ISOLATED DELAY EFFECTS (IEE)	1.83	4	2.95	17.5	2.33	8	29.5	870.25
20	NEED OF SEQUENTIAL (chronological) ANALYSIS - (COA)	1.74	3	2.33	4	2	4	11	121.00
21	EXPERT SKILLS (for analysis method) -(XS)	2	6.5	2.94	16	2.43	12.5	35	1225.00
22	CONCERN FOR COST OF ANALYSIS METHOD -(CA)	2.15	10	2.67	9	2.39	10.5	29.5	870.25
23	CONCERN FOR TIME TO BE SPENT FOR ANALYSIS - (TSA)	2.24	15	2.72	10.5	2.46	16	41.5	1722.25
24	Admissibility of method by Engineers/Arbitrators/Courts - (TAdms)	2.17	11.5	2.79	14.5	2.45	14.5	40.5	1640.25
	Tied number		6		10		6		**40475.25**
	Tied number %		26%		43%		26%		

(for Tied numbers adjustment made)

k = 3
N = 24

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

Group$_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
Group$_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**30**
Group$_3$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
	$\sum T_i$	**66**

W = $\frac{80703}{124002}$

W = 0.65

As N> 7 (i.e. N=24), sample Value is found through formula

$$X^2 = k(N-1)W$$

Sample x^2 = 44.91

Critical x^2 = 41.64

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.01$ 41.64

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.65
Sample X^2 =	44.91
Critical X^2 (0.01) =	41.64
df = N-1 =	23

Table B.46

QUESTION #30-b

Kendall's W

Suitability Index for 'Impacted-As-Planned method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

H_0 = The Suitability of 'Impacted-As-Planned method' against the availability of Attributes as ranked by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the ranking attributed by the two groups .

		CONTRACTING GROUP		CONSULTING GROUP		Overall		Rank Totals	Square of Rank Totals
	Attributes	Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	R_i	R_i^2
1	CONCURRENCY & FLOAT OWNERSHIP DEFINED IN THE CONTRACT (C&F)	1.09	1	2.67	13.5	1.78	1	15.5	240.25
2	ANALYSIS METHOD DEFINED IN THE CONTRACT (AM)	2.74	21	3.11	21	2.9	22	64	4096.00
3	VALUE OF THE PROJECT - (PV)	2.08	8	1.74	1	1.93	3	12	144.00
4	SIZE OF THE PROJECT- (PS)	1.96	4.5	1.83	2	1.9	2	8.5	72.25
5	DURATION OF THE PROJECT- (PD)	2.36	19	2.63	10	2.49	15.5	44.5	1980.25
6	STATUS (prevailing stage) OF THE PROJECT -(PCS)	3.22	22	2.44	5	2.88	21	48	2304.00
7	COMPLEXITY OF THE PROJECT-(PC)	1.91	3	2.2	3	2.05	4	10	100.00
8	AMOUNT OF TIME CLAIMED-(MT)	2.04	6	2.37	4	2.19	6	16	256.00
9	AMOUNT OF COST (of prolongation) CLAIMED-(MC)	2.09	9.5	2.53	6	2.29	8	23.5	552.25
10	NUMBER OF EVENTS CLAIMED AND TO BE ANALYSED - (NE)	2.14	11.5	2.61	9	2.35	10	30.5	930.25
11	OBSCURITY AND SOPHISTICATION OF ISSUES IN PROLONGATION CLAIMS -(OBS)	2.35	17.5	2.67	13.5	2.49	15.5	46.5	2162.25
12	BASELINE PROGRAMME AVAILABILITY -(ABP)	4.52	24	4.39	24	4.46	24	72	5184.00
13	BASELINE PROGRAMME TYPE (e.g. CPM) - (TBP)	2.22	14.5	3	19.5	2.56	18.5	52.5	2756.25
14	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - (AB)	2.48	20	2.56	7.5	2.51	17	44.5	1980.25
15	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - Mutually Agreed - (AAB)	2.17	13	2.56	7.5	2.34	9	29.5	870.25
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records etc.) - (AOR)	3.7	23	3.39	23	3.56	23	69	4761.00
17	HIGH QUALITY OF TRANSPARENCY (clearly established Causation)- (LTR)	2.35	17.5	3.16	22	2.71	20	59.5	3540.25
18	NEED OF SHOWING CONCURRENT DELAYS/ MITIGATION -(NC)	1.57	2	2.69	15	2.17	5	22	484.00
19	NEED TO ILLUSTRATE ISOLATED DELAY EFFECTS (IEE)	2.09	9.5	2.89	17	2.44	12	38.5	1482.25
20	NEED OF SEQUENTIAL (chronological) ANALYSIS - (COA)	1.96	4.5	2.65	11.5	2.25	7	23	529.00
21	EXPERT SKILLS (for analysis method) -(XS)	2.05	7	2.94	18	2.45	13	38	1444.00
22	CONCERN FOR COST OF ANALYSIS METHOD -(CA)	2.14	11.5	2.65	11.5	2.36	11	34	1156.00
23	CONCERN FOR TIME TO BE SPENT FOR ANALYSIS - (TSA)	2.24	16	2.72	16	2.46	14	46	2116.00
24	Admissibility of method by Engineers/Arbitrators/Courts - (TAdms)	2.22	14.5	3	19.5	2.56	18.5	52.5	2756.25
	Tied number		10		8		4		**39140.75**
	Tied number %		43%		35%		17%		
	(for Tied numbers adjustment made)								

k = 3

N = 24

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**30**
$Group_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**24**
$Group_3$	=(POWER(2,3)-2)+(POWER(2,3)-2)	**12**
	$\sum T_i$	**66**

W = $\frac{64689}{124002}$

W = 0.52

As N> 7 (i.e. N=24), sample Value is found through formula

$$X^2 = k(N-1)W$$

Sample x^2 = **36.00**

Critical x^2 = 35.17

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.05$ 35.17

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.52
Sample X^2 =	36.00
Critical X^2 (0.05) =	35.17
df = N-1 =	23

Table B.47

QUESTION #30-c

Kendall's W

Suitability Index for 'Collapsed-As-Built method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

H_0 = The Suitability of 'Collapsed-As-Built method' against the availability of Attributes as ranked by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the ranking attributed by the two groups.

		CONTRACTING GROUP		CONSULTING GROUP		Overall		Rank Totals	Square of Rank Totals
	Attributes	Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	R_i	R_i^2
1	CONCURRENCY & FLOAT OWNERSHIP DEFINED IN THE CONTRACT (C&F)	1.39	1	2.83	10.5	2.02	1	12.5	156.25
2	ANALYSIS METHOD DEFINED IN THE CONTRACT (AM)	3.43	21	2.78	9	3.15	17.5	47.5	2256.25
3	VALUE OF THE PROJECT - (PV)	2.57	6	1.74	1	2.19	3.5	10.5	110.25
4	SIZE OF THE PROJECT- (PS)	2.39	4	1.83	2	2.15	2	8	64.00
5	DURATION OF THE PROJECT- (PD)	2.78	12	2.53	4	2.67	6.5	22.5	506.25
6	STATUS (prevailing stage) OF THE PROJECT -(PCS)	3.3	20	2.89	12.5	3.12	16	48.5	2352.25
7	COMPLEXITY OF THE PROJECT-(PC)	2.78	12	2.55	5	2.67	6.5	23.5	552.25
8	AMOUNT OF TIME CLAIMED-(MT)	2.57	6	2.37	3	2.48	5	14	196.00
9	AMOUNT OF COST (of prolongation) CLAIMED-(MC)	2.78	12	2.68	6	2.74	10	28	784.00
10	NUMBER OF EVENTS CLAIMED AND TO BE ANALYSED - (NE)	2.73	10	2.72	8	2.73	9	27	729.00
11	OBSCURITY AND SOPHISTICATION OF ISSUES IN PROLONGATION CLAIMS -(OBS)	2.7	9	2.83	10.5	2.76	11	30.5	930.25
12	BASELINE PROGRAMME AVAILABILITY -(ABP)	1.83	3	3.78	22	2.68	8	33	1089.00
13	BASELINE PROGRAMME TYPE (e.g. CPM) - (TBP)	3.17	15.5	3.22	18	3.20	19.5	53	2809.00
14	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - (AB)	3.26	19	3.83	23	3.01	15	57	3249.00
15	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - Mutually Agreed - (AAB)	3.17	15.5	3.72	21	3.41	22	58.5	3422.25
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records etc.) - (AOR)	4.7	24	4	24	4.39	24	72	5184.00
17	HIGH QUALITY OF TRANSPARENCY (clearly established Causation)- (LTR)	3.64	23	3.37	20	3.51	23	66	4356.00
18	NEED OF SHOWING CONCURRENT DELAYS/ MITIGATION -(NC)	1.65	2	3.11	15.5	2.19	3.5	21	441.00
19	NEED TO ILLUSTRATE ISOLATED DELAY EFFECTS (IEE)	3.48	22	2.89	12.5	3.22	21	55.5	3080.25
20	NEED OF SEQUENTIAL (chronological) ANALYSIS - (COA)	3.17	15.5	2.71	7	2.98	14	36.5	1332.25
21	EXPERT SKILLS (for analysis method) -(XS)	3.18	18	3.11	15.5	3.15	17.5	51	2601.00
22	CONCERN FOR COST OF ANALYSIS METHOD -(CA)	2.59	8	3	14	2.77	12	34	1156.00
23	CONCERN FOR TIME TO BE SPENT FOR ANALYSIS - (TSA)	2.57	6	3.17	17	2.85	13	36	1296.00
24	Admissibility of method by Engineers/Arbitrators/Courts - (TAdms)	3.17	15.5	3.22	18	3.2	19.5	53	2809.00
	Tied number		4		6		8		38652.50
	Tied number %		17%		26%		35%		

(for Tied numbers adjustment made)

k = 3

N = 24

Adjustments for tied observations:		
$Group_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)	**12**
$Group_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
$Group_3$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**24**
	$\sum T_i$ =	**54**

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

W = $\frac{58830}{124038}$

W = 0.47

As N> 7 (i.e. N=24), sample Value is found through formula

$$X^2 = k(N-1)W$$

Sample x^2 = 32.73

Critical x^2 = 35.17

Therefore calculated value x^2 is< Critical Value x^2 for significance level $\alpha = 0.05$ 35.17

Accordingly, H_0 may be supported; The Suitability/Necessity rankings attributed to a particular MDA by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance. (W=0 means no agreement among the raters; W=+1 complete agreement between the raters)

Test Statistics	
Kendall's W =	0.47
Sample X^2 =	32.73
Critical X^2 (0.05) =	35.17
df = N-1 =	23

Table B.48

QUESTION #30-d

Kendall's W

Suitability Index for 'Time Impact Analysis method' against the availability of Attributes as judged by practitioners for selecting as the optimum MDA

H_0 = The Suitability of 'Time Impact Analysis method' against the availability of Attributes as ranked by the two groups are unrelated [i.e. are independent] and the observed value of 'W' differs from zero only by chance.

H_1 = There exists a considerable association among the ranking attributed by the two groups .

	Attributes	CONTRACTING GROUP		CONSULTING GROUP		Overall		Rank Totals	Square of Rank Totals
		Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	Suitability/ Availability Index (Weighted Average)	Rank	R_i	R_i^2
1	CONCURRENCY & FLOAT OWNERSHIP DEFINED IN THE CONTRACT (C&F)	4.04	18	3.89	16.5	3.98	18	52.5	2756.25
2	ANALYSIS METHOD DEFINED IN THE CONTRACT (AM)	3.04	6	3.11	7.5	3.07	8	21.5	462.25
3	VALUE OF THE PROJECT - (PV)	3.18	9.5	1.95	1	2.61	1.5	12	144.00
4	SIZE OF THE PROJECT- (PS)	3.09	7.5	2	2	2.61	1.5	11	121.00
5	DURATION OF THE PROJECT- (PD)	3.45	11.5	2.53	4	3.02	6	21.5	462.25
6	STATUS (prevailing stage) OF THE PROJECT -(PCS)	3.45	11.5	3.32	9	3.39	12	32.5	1056.25
7	COMPLEXITY OF THE PROJECT-(PC)	3.5	15	2.7	5	3.12	10	30	900.00
8	AMOUNT OF TIME CLAIMED-(MT)	2.9	4	2.47	3	2.7	3	10	100.00
9	AMOUNT OF COST (of prolongation) CLAIMED-(MC)	3.18	9.5	2.79	6	3	4.5	20	400.00
10	NUMBER OF EVENTS CLAIMED AND TO BE ANALYSED - (NE)	2.91	5	3.11	7.5	3	4.5	17	289.00
11	OBSCURITY AND SOPHISTICATION OF ISSUES IN PROLONGATION CLAIMS -(OBS)	3.09	7.5	3.89	16.5	3.45	13	37	1369.00
12	BASELINE PROGRAMME AVAILABILITY -(ABP)	4.59	24	4.32	23	4.46	24	71	5041.00
13	BASELINE PROGRAMME TYPE (e.g. CPM) - (TBP)	3.5	15	3.67	13.5	3.58	15.5	44	1936.00
14	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - (AB)	4.27	23	4.11	21	4.2	22	66	4356.00
15	AS-BUILT PERIODICAL UPDATES OF PROGRAMME - Mutually Agreed - (AAB)	3.68	17	4	20	3.83	17	54	2916.00
16	AVAILABILITY OF OTHER RECORDS (e.g. Daily Records etc.) - (AOR)	4.09	19	4.17	22	4.13	21	62	3844.00
17	HIGH QUALITY OF TRANSPARENCY (clearly established Causation)- (LTR)	4.23	22	3.94	18.5	4.1	20	60.5	3660.25
18	NEED OF SHOWING CONCURRENT DELAYS/ MITIGATION -(NC)	4.14	20.5	4.33	24	4.23	23	67.5	4556.25
19	NEED TO ILLUSTRATE ISOLATED DELAY EFFECTS (IEE)	2.82	3	3.94	18.5	3.33	11	32.5	1056.25
20	NEED OF SEQUENTIAL (chronological) ANALYSIS - (COA)	4.14	20.5	3.88	15	4.03	19	54.5	2970.25
21	EXPERT SKILLS (for analysis method) -(XS)	3.48	13	3.61	12	3.54	14	39	1521.00
22	CONCERN FOR COST OF ANALYSIS METHOD -(CA)	2.76	1	3.41	10	3.05	7	18	324.00
23	CONCERN FOR TIME TO BE SPENT FOR ANALYSIS - (TSA)	2.8	2	3.44	11	3.11	9	22	484.00
24	Admissibility of method by Engineers/Arbitrators/Courts - (TAdms)	3.5	15	3.67	13.5	3.58	15.5	44	1936.00
	Tied number		8		8		6		**40725.00**
	Tied number %		35%		35%		26%		

(for Tied numbers adjustment made)

k = 3

N = 24

$$W = \frac{12\sum R_i^2 - 3k^2N(N+1)^2}{k^2N(N^2-1) - k\sum T_j}$$

Adjustments for tied observations:

$Group_1$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**24**
$Group_2$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**24**
$Group_3$	=(POWER(2,3)-2)+(POWER(2,3)-2)+(POWER(2,3)-2)	**18**
	$\sum T_i$ =	**66**

$$W = \frac{83700}{124002}$$

W = 0.67

As N> 7 (i.e. N=24), sample Value is found through formula $X^2 = k(N-1)W$

Sample x^2 = 46.57

Critical x^2 = 35.17

Therefore calculated value x^2 is > Critical Value x^2 for significance level $\alpha = 0.05$ 35.17

Accordingly, H_0 may be rejected; We can conclude with considerable confidence that the agreement amongst the respondents of the two groups is higher than it would be by chance had the scores and their rankings been random or independent.

Test Statistics	
Kendall's W =	0.67
Sample X^2 =	46.57
Critical X^2 (0.05) =	35.17
df = N-1 =	23

SPEARMAN RANK ORDER CORRELATION (SPSS) CALCULATIONS FOR TABLES **B.29**

Nonparametric Correlations

AWARENESS v USE - TABLE B.29 - CONTRACTOR'S GROUP

Correlations

			Awareness (As-Planned vs As-Built)
Spearman's rho	Awareness (As-Planned vs As-Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33
	Use (As-Planned vs As-Built)	Correlation Coefficient	.685**
		Sig. (2-tailed)	.000
		N	33

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (As-Planned vs As-Built)
Spearman's rho	Awareness (As-Planned vs As-Built)	Correlation Coefficient	.685
		Sig. (2-tailed)	.000
		N	33
	Use (As-Planned vs As-Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33

** Correlation is significant at the 0.01 level (2-tailed).

[DataSet9] H:\PhD12-02-12\CHAPTERS- draft-01-01-2012 onwards\A-CHAPTER COLLECTION 09-01-2012\CHAPTER-5-SURVEY RESULTS\CURRENT\TEST RESULTS- CURRENT\SPSS for Spearmans\AwareVuse\Contractors\AWNSvUSE-Contractors-Q12-Q17-IAP.sav

Correlations

			Awareness (Impacted As Plan)
Spearman's rho	Awareness (Impacted As Plan)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33
	Use (Impacted As Plan)	Correlation Coefficient	.561**
		Sig. (2-tailed)	.001
		N	33

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (Impacted As Plan)
Spearman's rho	Awareness (Impacted As Plan)	Correlation Coefficient	.561
		Sig. (2-tailed)	.001
		N	33
	Use (Impacted As Plan)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33

**. Correlation is significant at the 0.01 level (2-tailed).

Nonparametric Correlations

[DataSet10] H:\PhD12-02-12\CHAPTERS- draft-01-01-2012 onwards\A-CHAPTER COLLECTION 09-01-2012\CHAPTER-5-SURVEY RESULTS\CURRENT\TEST RESULTS- CURRENT\SPSS for Spearmans\AwareVuse\Contractors\AWNSvUSE-Contractors-Q12-Q17-CAB.sav

Correlations

			Awareness (Collapsed As Built)
Spearman's rho	Awareness (Collapsed As Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33
	Use (Collapsed As Built)	Correlation Coefficient	400*
		Sig. (2-tailed)	.021
		N	33

* Correlation is significant at the 0.05 level (2-tailed).

Correlations

			Use (Collapsed As Built)
Spearman's rho	Awareness (Collapsed As Built)	Correlation Coefficient	.400
		Sig. (2-tailed)	.021
		N	33
	Use (Collapsed As Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

			Awareness (Time Impact Analysis)
Spearman's rho	Awareness (Time Impact Analysis)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33
	Use (Time Impact Analysis)	Correlation Coefficient	.264
		Sig. (2-tailed)	.138
		N	33

Correlations

			Use (Time Impact Analysis)
Spearman's rho	Awareness (Time Impact Analysis)	Correlation Coefficient	.264
		Sig. (2-tailed)	.138
		N	33
	Use (Time Impact Analysis)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33

[DataSet13] H:\PhD12-02-12\CHAPTERS- draft-01-01-2012 onwards\A-CHAPTER COLLECTION 09-01-2012\CHAPTER-5-SURVEY RESULTS\CURRENT\TEST RESULTS- CURRENT\SPSS for Spearmans\AwareVuse\Contractors\AWNSvUSE-Contractors-Q12-Q17-GLOBAL.sav

Correlations

			Awareness (Global Claims)
Spearman's rho	Awareness (Global Claims)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33
	Use (Global Claims)	Correlation Coefficient	.798**
		Sig. (2-tailed)	.000
		N	33

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (Global Claims)
Spearman's rho	Awareness (Global Claims)	Correlation Coefficient	.798**
		Sig. (2-tailed)	.000
		N	33
	Use (Global Claims)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	33

**. Correlation is significant at the 0.01 level (2-tailed).

Nonparametric Correlations

AWARENESS v USE - TABLE B.29 - CONSULTANTS GROUP

Correlations

			Awareness (As-Planned vs As-Built)
Spearman's rho	Awareness (As-Planned vs As-Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41
	Use (As-Planned vs As-Built)	Correlation Coefficient	.215
		Sig. (2-tailed)	176
		N	41

Correlations

			Use (As-Planned vs As-Built)
Spearman's rho	Awareness (As-Planned vs As-Built)	Correlation Coefficient	.215
		Sig. (2-tailed)	.176
		N	41
	Use (As-Planned vs As-Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41

Correlations

			Awareness (Impacted As Plan)
Spearman's rho	Awareness (Impacted As Plan)	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	41
	Use (Impacted As Plan)	Correlation Coefficient	.434**
		Sig. (2-tailed)	.005
		N	41

** Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (Impacted As Plan)
Spearman's rho	Awareness (Impacted As Plan)	Correlation Coefficient	434
		Sig. (2-tailed)	.005
		N	41
	Use (Impacted As Plan)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Awareness (Collapsed As Built)
Spearman's rho	Awareness (Collapsed As Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41
	Use (Collapsed As Built)	Correlation Coefficient	.542**
		Sig. (2-tailed)	.000
		N	41

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (Collapsed As Built)
Spearman's rho	Awareness (Collapsed As Built)	Correlation Coefficient	.542
		Sig. (2-tailed)	.000
		N	41
	Use (Collapsed As Built)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Awareness (Time Impact Analysis)
Spearman's rho	Awareness (Time Impact Analysis)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41
	Use (Time Impact Analysis)	Correlation Coefficient	.622**
		Sig. (2-tailed)	.000
		N	41

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			Use (Time Impact Analysis)
Spearman's rho	Awareness (Time Impact Analysis)	Correlation Coefficient	.622
		Sig. (2-tailed)	.000
		N	41
	Use (Time Impact Analysis)	Correlation Coefficient	1.000
		Sig. (2-tailed)	
		N	41

** Correlation is significant at the 0.01 level (2-tailed).

TABLE ‘C’ and TABLE ‘T’ FOR CHI-SQUARE AND KENDALL’S ‘W’ CALCULATIONS

TABLE C
Critical values of the chi-square distribution*

df	Probability under H_0 that $\chi^2 \geq X^2$													
	.99	.98	.95	.90	.80	.70	.50	.30	.20	.10	.05	.02	.01	.001
1	.00016	.00063	.0039	.016	.064	.15	.46	1.07	1.64	2.71	3.84	5.41	6.64	10.83
2	.02	.04	.10	.21	.45	.71	1.39	2.41	3.22	4.60	5.99	7.82	9.21	13.82
3	.12	.18	.35	.58	1.00	1.42	2.37	3.66	4.64	6.25	7.82	9.84	11.34	16.27
4	.30	.43	.71	1.06	1.65	2.20	3.36	4.88	5.99	7.78	9.49	11.67	13.28	18.46
5	.55	.75	1.14	1.61	2.34	3.00	4.35	6.06	7.29	9.24	11.07	13.39	15.09	20.52
6	.87	1.13	1.64	2.20	3.07	3.83	5.35	7.23	8.56	10.64	12.59	15.03	16.81	22.46
7	1.24	1.56	2.17	2.83	3.82	4.67	6.35	8.38	9.80	12.02	14.07	16.62	18.48	24.32
8	1.65	2.03	2.73	3.49	4.59	5.53	7.34	9.52	11.03	13.36	15.51	18.17	20.09	26.12
9	2.09	2.53	3.32	4.17	5.38	6.39	8.34	10.66	12.24	14.68	16.92	19.68	21.67	27.88
10	2.56	3.06	3.94	4.86	6.18	7.27	9.34	11.78	13.44	15.99	18.31	21.16	23.21	29.59
11	3.05	3.61	4.58	5.58	6.99	8.15	10.34	12.90	14.63	17.28	19.68	22.62	24.72	31.26
12	3.57	4.18	5.23	6.30	7.81	9.03	11.34	14.01	15.81	18.55	21.03	24.05	26.22	32.91
13	4.11	4.76	5.89	7.04	8.63	9.93	12.34	15.12	16.98	19.81	22.36	25.47	27.69	34.53
14	4.66	5.37	6.57	7.79	9.47	10.82	13.34	16.22	18.15	21.06	23.68	26.87	29.14	36.12
15	5.23	5.98	7.26	8.55	10.31	11.72	14.34	17.32	19.31	22.31	25.00	28.26	30.58	37.70
16	5.81	6.61	7.96	9.31	11.15	12.62	15.34	18.42	20.46	23.54	26.30	29.63	32.00	39.29
17	6.41	7.26	8.67	10.08	12.00	13.53	16.34	19.51	21.62	24.77	27.59	31.00	33.41	40.75
18	7.02	7.91	9.39	10.86	12.86	14.44	17.34	20.60	22.76	25.99	28.87	32.35	34.80	42.31
19	7.63	8.57	10.12	11.65	13.72	15.35	18.34	21.69	23.90	27.20	30.14	33.69	36.19	43.82
20	8.26	9.24	10.85	12.44	14.58	16.27	19.34	22.78	25.04	28.41	31.41	35.02	37.57	45.32
21	8.90	9.92	11.59	13.24	15.44	17.18	20.34	23.86	26.17	29.62	32.67	36.34	38.93	46.80
22	9.54	10.60	12.34	14.04	16.31	18.10	21.24	24.94	27.30	30.81	33.92	37.66	40.29	48.27
23	10.20	11.29	13.09	14.85	17.19	19.02	22.34	26.02	28.43	32.01	35.17	38.97	41.64	49.73
24	10.86	11.99	13.85	15.66	18.06	19.94	23.34	27.10	29.55	33.20	36.42	40.27	42.98	51.18
25	11.52	12.70	14.61	16.47	18.94	20.87	24.34	28.17	30.68	34.38	37.65	41.57	44.31	52.62
26	12.20	13.41	15.38	17.29	19.82	21.79	25.34	29.25	31.80	35.56	38.88	42.86	45.64	54.05
27	12.88	14.12	16.15	18.11	20.70	22.72	26.34	30.32	32.91	36.74	40.11	44.14	46.96	55.48
28	13.56	14.85	16.93	18.94	21.59	23.65	27.34	31.39	34.03	37.92	41.34	45.42	48.28	56.89
29	14.26	15.57	17.71	19.77	22.48	24.58	28.34	32.46	35.14	39.09	42.56	46.69	49.59	58.30
30	14.95	16.31	18.49	20.60	23.36	25.51	29.34	33.53	36.25	40.26	43.77	47.96	50.89	59.70

* Table C is abridged from Table IV of Fisher and Yates: *Statistical tables for biological, agricultural, and medical research*, published by Longman Group UK Ltd., London (previously published by Oliver and Boyd Ltd., Edinburgh) and by permission of the authors and publishers.

TABLE T
Critical values for the Kendall coefficient of concordance W*

N = 3

k	α .05	.01
8	.376	.522
9	.333	.469
10	.300	.425
12	.250	.359
14	.214	.311
15	.200	.291
16	.187	.274
18	.166	.245
20	.150	.221

	N = 4		N = 5		N = 6		N = 7	
k α	.05	.01	.05	.01	.05	.01	.05	.01
3	—	—	.716	.840	.660	.780	.624	.737
4	.619	.768	.552	.683	.512	.629	.484	.592
5	.501	.644	.449	.571	.417	.524	.395	.491
6	.421	.553	.378	.489	.351	.448	.333	.419
8	.318	.429	.287	.379	.267	.347	.253	.324
10	.256	.351	.231	.309	.215	.282	.204	.263
15	.171	.240	.155	.211	.145	.193	.137	.179
20	.129	.182	.117	.160	.109	.146	.103	.136

Note: For $N = 3$ and $k < 8$, no value of W has upper tail probability of occurrence less than .05

* Adapted and reproduced by permission of the publishers Charles Griffin & Co. Ltd., 16 Pembridge Road, London W11 3HL, from Appendix Table 5 of Kendall, M. G. (1970). *Rank correlation methods* (fourth edition).

APPENDIX – E

(TEMPLATES)

Research Institute for the Built and Human Environment

University of Salford
A Greater Manchester University

TO:

Nihal A. Perera

Post Box 55624, Dubai

UAE.

Date:

Dear ....

A Pilot Questionnaire to investigate the research need for investigating current practices and problem situations with regard to delay claims resolution in Dubai-UAE construction industry.

The main aim of this pilot questionnaire is to collect and assess your views as a practitioner in Dubai construction industry. The objectives of the questions are mainly **to identify a research need** for investigating current practices and problem-situations faced in delay claims resolution process in Dubai construction industry.

The outcome of the questionnaire-survey will be used to develop the necessary research design for a doctoral research undertaken at University of Salford, UK.

The answers provided will be used only for the academic purposes.

We would very much appreciate if you could please spare few minutes to complete this short questionnaire on-line. We thank you for your valued time and assistance in providing the answers requested.

Please access the questionnaire by clicking the link below:

Yours sincerely,

Nihal Perera

(Ph D Researcher)

1. SURVEY QUESTIONS

FOR ALL ANSWERS PLEASE CONSIDER TIME PERIOD UP UNTIL Mid-2008 ONLY.

PLEASE INDICATE YOUR PERCEIVED LEVEL OF AGREEMENT AS TO THE FOLLOWING PROPOSITIONS BY MARKING THE OPTIONS:

1. PROPOSITION: " Dubai construction industry represents the most advanced characteristics and growth rate in the industry of whole of the Middle East region".

- Strongly Disagree.
- Disagree.
- Neutral.
- Agree.
- Strongly Agree.

Further comment by Respondent (if any)

2. PROPOSITION: " Delay claims remain a major source of dispute in Dubai construction industry, requiring prompt resolution to avoid escalation to major, complex dispute situation".

- Strongly Disagree.
- Disagree.
- Neutral.
- Agree.
- Strongly Agree.
- Further comments by Respondent (if any)

3. PROPOSITION: " Delay claims resolution process in Dubai construction industry is generally protracted and often happens near to or even after the completion of projects".

◯ Strongly Disagree.

◯ Disagree.

◯ Neutral.

◯ Agree.

◯ Strongly Agree.

◯ Further comments by Respondent (if any)

4. PROPOSITION: " Absence of prompt resolution of the delay claims generally escalates those claims to major dispute levels".

◯ Strongly Disagree.

◯ Disagree.

◯ Neutral.

◯ Agree.

◯ Strongly Agree.

Further comments by Respondent (if any)

5. PROPOSITION: " Between the contractors and the developers/engineers, for delay analysis there is no consensual selection of analysis method that is most appropriate under given circumstances of a project".

◯ Strongly Disagree.

◯ Disagree.

◯ Neutral.

◯ Agree.

◯ Strongly Agree.

Further comments by Respondent (if any)

6. PROPOSITION: "In order to make delay claims resolution process in Dubai industry more efficient, transparent, equitable and fairer, there is a strong need to identify the current practices, their problematic situations and necessary remedies/improvements required to them."

◯ Strongly Disagree.

◯ Disagree.

◯ Neutral.

◯ Agree.

◯ Strongly Agree.

Further comments by Respondent (if any)

7. PROPOSITION: "Such, remedies and improvements would possibly bring corporate benefits for both developers and contractors, reducing delay situations escalating to dispute levels such as Engineer's Decisions/Arbitration/ Litigation"

- ◯ Strongly Disagree.
- ◯ Disagree.
- ◯ Neutral.
- ◯ Agree.
- ◯ Strongly Agree.

Further comments by Respondent (if any)

2. DETAILS OF RESPONDENT

8. Your organisation is best described as:

- As a Contractor Organisation
- As a Consultancy/ Project Administration
- As a Developer Organisation
- As an external Claims Consultancy
- As a Legal Practice
- Other

Other (please specify)

9. Nature of your primary job in the organisation?

- Claims Management
- Contracts Management
- Site Management
- Quantity Surveying/ Commercial Management
- Planning
- Legal Support
- Other

Other (please specify)

10. Your position in the organisation?

- Lower Management Level
- Middle Management Level
- Top Management Level (Decision Making)
- Other

Other (please specify)

3. RESEARCH PARTICIPTION.

11. We are thankful and very much appreciate your current support in this research. Would you be able to kindly participate in a further stage of this research?

- ◯ Yes
- ◯ No

Other Comments

Ref. [PhD/Ethics/consent/..]　　　　　　　　　　　Date:[ ]

[Address of Participant]

Dear Sir/ Madame

RE: Ethics Approval Requirements for Doctoral Research Project

I have currently undertaken a Doctoral Research Project with the University of Salford, United Kingdom. A brief background with the aims of the Research Project is as follows:

> The delay claims presentation, analyzing and settlement processes involving the contractor and client organizations in the UAE appear to be sub-efficient, protracting and also giving inequitable results relative to the best practices in the construction industry of other developed countries.
>
> The aims of this Research Project are to bring forth possible strategic corporate advantages for both contractor and client organizations, through identifying specific problem areas in current practices and introducing better solutions in order to deliver more efficient and equitable resolution process of delay claims in the UAE construction sector.

Identifying any such flawed areas in delay claims presentation, analyzing and settlement processes is intended to be empirical, and through necessary interviews, archival study, questionnaires and case studies with the participants.

The Ethical Approval requirements of the University require necessary 'consent' be obtained from the participants for having any interviews, archival study etc. with them. Accordingly, I would seek your kind consent and willingness to allow for necessary participation of you / your organization in interviews/ archival study assisting to achieve the said aims of the Research project. This consent is sought on a written undertaking by me, as the researcher, that the use of all such data is for academic purpose only, and the collection, analyzing, and disseminating the results of data will be used strictly confidential, without being detrimental to the participant in any way and within the Data Protection (Amendment) Act -UK (2003).

Thus, I would be extremely grateful if you could kindly complete and sign the attached which contains my written undertaking as described above and your consent as requested.

Thanking you,
Yours truly,

Nihal A Perera *LL. M, MSc., FRICS, FCIArb.*

(PhD Student - Research Institute For The Built And Human Environment; School of Construction and Property Management, The University of Salford, UK)

University of Salford
A Greater Manchester University

Research Institute for the Built and Human Environment

PARTICIPANT INTERVIEW CONSENT FORM

RESERACH TITLE : "Apportioning Liability in Construction Delay Claims: A Critique of Contemporary Practices in the UAE and Proposal for Improvements"

RESEARCHER : **Nihal A Perera** *LL. M, MSc., FRICS, FCIArb.*

SUPERVISOR : **Dr. Monty Sutrisna** *MBA, PhD, PGCertHEPR, FHEA. MInstCES*
(University of Salford, UK)

CO-SUPERVISOR : **Brodie McAdam** *Solicitor, MSc, FCIArb, FHEA*
(University of Salford, UK)

LOCAL SUPERVISOR: **Prof. Indrawansa Samaratunga** *PhD, DSc., FRICS, FAIQS, FIQSSL, FCIArb, FCIOB, FCMI, FASI, FBEng*

It is a pleasure to have your participation as a key interviewee within the above research programme.

The requested form of participation / contribution is by interview which will take around 1 hour. Signing this form acknowledges your permission to be interviewed. The interview will be voice recorded to be transcribed later on. These transcriptions WILL NOT be included in the study without your review and consent. During the interview you may ask to stop recording in order to make comments off the record. Your identity may be revealed, but only with your consent. Based on the information gathered, written reports will be prepared and these may be published as study findings in various formats.

You are free to refuse to answer any question and to withdraw your consent at any time.

....	....	....
Participant Signature	**Print Name**	**Date**
....	....	....
Researcher Signature	**Print Name**	**Date**

University of Salford
A Greater Manchester University

Research Institute for the Built and Human Environment

ARCHIVAL STUDY CONSENT FORM

RESERACH TITLE : "Apportioning Liability in Construction Delay Claims: A Critique of Contemporary Practices in the UAE and Proposal for Improvements"

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It is a pleasure to have your participation for archival study within the above research programme.

The requested form of participation / contribution is through your granting permission to study the archive of records relevant to above mentioned research programme. Signing of this form acknowledges your permission. The archival study will be performed by taking notes and /or copies of related documents. None of the content of the documents studied will be included in the research without your consent. Based on the information gathered, written reports will be prepared and these may be published as study findings in various formats.

You are free to refuse disclosing any documents and to withdraw your consent at any time.

....	....	....
Participant Signature	Print Name	Date

University of Salford
A Greater Manchester University

Research Institute for the
Built and Human Environment

....	....	....
Researcher Signature	Print Name	Date

Research Institute for the Built and Human Environment

University of Salford
A Greater Manchester University

TO:

N. A. Perera

University of Salford

Dear ....

A Questionnaire-Survey to investigate the current practices and problem situations with regard to delay claims resolution in UAE construction industry.

The main aim of this questionnaire is to collect and assess your views as a professional and practitioner in the construction industry. The objectives of the questions are mainly to investigate current practices and problem-situations faced in delay claims resolution process in Dubai construction industry, towards developing necessary improvements/solutions for such problems.

The outcome of the survey will be used in a doctoral research undertaken at University of Salford, UK.

The answers provided will be used only for the academic purposes.

At the completion of the research study, the survey findings will be available for the benefit of future researchers in the field.

We would very much appreciate if you could please spare few minutes to complete this questionnaire on-line which is targeted to be concluded by **10th July 2010**.

We thank you for your valued time and assistance in providing the answers requested.

Please access the questionnaire by clicking the link (URL) given below:

http://www.surveymonkey.com/s/785PGM7

(To complete the overall response, please click the **'Done'** tab after the last [30th] question)

Yours sincerely,

N.A. Perera

(Ph D Researcher)

1. The nature of activities of your organisation?

	Building work	Civil Engineering work	Building and Civil Engineering work
As a contractor organisation	○	○	○
As a consultancy/project administration	○	○	○
As a developer organisation	○	○	○
As an external claims consultancy	○	○	○
As a legal practice	○	○	○
Other	○	○	○

Other (please specify)

2. Approximate annual turn-over of your organisation?

3. Nature of your primary job in the organisation?

- ○ Claims Management
- ○ Contracts Management
- ○ Site Management
- ○ Quantity Surveying/Commercial Management
- ○ Planning
- ○ Legal support
- ○ Other

Other (please specify)

4. Nature of your secondary job(s),if any,in the organisation?

- ☐ Not Applicable
- ☐ Claims Management
- ☐ Contracts Management
- ☐ Site Management
- ☐ Quantity Surveying/Commercial Management
- ☐ Planning
- ☐ Legal support
- ☐ Other

Other (please specify)

5. Your work experience of the following functions?

	None	<5 years	5-10 years	10-15 years	15-20 years	>20 years
Claims Preparation(For contractors)	◯	◯	◯	◯	◯	◯
Claims Evaluation(For developers)	◯	◯	◯	◯	◯	◯
Forensic Schedule Analysis	◯	◯	◯	◯	◯	◯
Commercial Negotiation for claims resolution	◯	◯	◯	◯	◯	◯
Project Planning	◯	◯	◯	◯	◯	◯
Dispute Resolution	◯	◯	◯	◯	◯	◯
Legal support	◯	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯	◯

Other (please specify)

6. Which of the following best describes your current designation?

- ◯ Claims Consultant/Specialist/Analyst
- ◯ Forensic Schedule Analyst
- ◯ Planning Engineer
- ◯ Commercial Manager
- ◯ Contracts Manager
- ◯ Contracts Administrator
- ◯ Quantity Surveyor
- ◯ Engineer
- ◯ Architect
- ◯ Construction Lawyer
- ◯ Other

Other (please specify)

7. Your job level in the organisation structure?

- ◯ Lower Management
- ◯ Middle Management
- ◯ Upper Management/Decision Making
- ◯ Other

Other (please specify)

8. Your perception on 'Concurrent' Delays in the case of "True Concurrency" or Concurrency of Causes (i.e. delaying events occurring at the same time) and "Concurrency of effects" (i.e.delaying events start at different times but their effects are felt at the same time):-

- ◯ In both cases the effects of the delaying events are treated as 'concurrent' and equally potent to award extension of time.
- ◯ Only such effects of 'True Concurrency'are treated as 'concurrent' and having merits to award extension of time.
- ◯ Don't Know

9. How do you decide in the following concurrent (critical) delay situations, if the Contract is silent about such approach?

	Time only	Cost only	Both time and cost	Time, but the cost is only if clearly seggregated by the contractor.	No time, No cost	Don't know
Where one delay is caused by the employer and other is by the contractor.	◯	◯	◯	◯	◯	◯
Where two delays are caused by the employer.	◯	◯	◯	◯	◯	◯
Where two delays are caused by the contractor.	◯	◯	◯	◯	◯	◯
Where two delays are caused by neutral causes.	◯	◯	◯	◯	◯	◯
Where one delay is caused by the employer and other is by a neutral cause.	◯	◯	◯	◯	◯	◯
Where one delay is caused by the contractor and other is by a neutral cause.	◯	◯	◯	◯	◯	◯

Other (Please specify)

10. Your approach as to 'float ownership' if the contract is silent of it?

- ◯ 'Float' belongs to the contractor
- ◯ 'Float' belongs to the employer
- ◯ 'Float' belongs to the project (either party can consume it on first come, first served basis.
- ◯ Don't Know

Other (please specify)

11. Your approach to measure the 'criticality' of a delay effect, if the contract is silent of it?

- ◯ Criticality to be measured against prevailing contract completion date.
- ◯ Criticality to be measured against the projected completion date (determined by the longest path).
- ◯ Don't Know.

Other (please specify)

12. Your level of awareness of the following delay analysis methods?

	Unaware	Low	Average	High	Thorough
As-Planned vs As-Built	◯	◯	◯	◯	◯
Impacted As-Planned	◯	◯	◯	◯	◯
Collapsed As-Built	◯	◯	◯	◯	◯
Time Impact Analysis	◯	◯	◯	◯	◯
Global claims	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

13. Is the preparation or evaluation (as the case may be) carried out by in-house staff or is it outsourced?

- ◯ In-house staff
- ◯ Outsourced

14. Frequency of involvement of the following in your organisation in delay claims preparation or evaluation (as the case may be)?

	Never	Seldom	Sometimes	Usually	Always
Claims Specialist(s)	◯	◯	◯	◯	◯
Contract Administrator(s)	◯	◯	◯	◯	◯
Quantity Surveyor(s)	◯	◯	◯	◯	◯
Planner(s)	◯	◯	◯	◯	◯
Engineer(s)	◯	◯	◯	◯	◯
Architect(s)	◯	◯	◯	◯	◯
Lawyer(s)	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

15. How frequently do you use the following in Delay Analysis?

	Never	Seldom	Sometimes	Usually	Always
CPM Baseline programme	◯	◯	◯	◯	◯
CPM Baseline programme (Consented)	◯	◯	◯	◯	◯
As-built programme updates	◯	◯	◯	◯	◯
As-built programme updates (mutualy agreed)	◯	◯	◯	◯	◯
Site records, diaries and other contemporary records	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

APPORTIONING LIABILITY IN DELAY CLAIMS

16. How frequently do you use the following planning software in Delay Analysis?

	Never	Seldom	Sometimes	Usually	Always
Primavera	○	○	○	○	○
MS Project	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

17. Frequency of your using of the following Delay Analysis Methods?

	Never	Seldom	Sometimes	Usually	Always
As-Planned vs As-Built	○	○	○	○	○
Impacted As-Planned	○	○	○	○	○
Collapsed As-Built	○	○	○	○	○
Time Impact Analysis	○	○	○	○	○
Global Claims	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

18. Your perceived level of success in claims resolution by using the following analysis methods?

	None	Low	Average	High	Very high
As-Planned vs As-Built	○	○	○	○	○
Impacted As-Planned	○	○	○	○	○
Collapsed As-Built	○	○	○	○	○
Time Impact Analysis	○	○	○	○	○
Global Claims	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

19. How frequently have you met a dispute situation with the other party due to using the following methods?

	Never	Seldom	Sometimes	Usually	Always
As-Planned vs As-Built	◯	◯	◯	◯	◯
Impacted As-Planned	◯	◯	◯	◯	◯
Collapsed As-Built	◯	◯	◯	◯	◯
Time Impact Analysis	◯	◯	◯	◯	◯
Global claims	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

20. How frequently do the following factors become obstacles for using an appropriate delay analysis methodology?

	Never	Seldom	Sometimes	Usually	Always
Absence of proper CPM based Baseline Programme	◯	◯	◯	◯	◯
Absence of 'consent' for such Programme	◯	◯	◯	◯	◯
Lack of as-built updates of Programme	◯	◯	◯	◯	◯
Lack of mutually agreed as-built updates of Programme	◯	◯	◯	◯	◯
Lack of site records.	◯	◯	◯	◯	◯
Lack of awareness/skills in using an appropriate analysis methodology.	◯	◯	◯	◯	◯
Lack of awareness/skills in using programming software.	◯	◯	◯	◯	◯
Cost of using an appropriate analysis methodology.	◯	◯	◯	◯	◯
High level of time consumption for using an appropriate analysis methodology.	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

21. How frequently do the following contribute to further escalating disputes over delay claims resolution process?

	Never	Seldom	Sometimes	Usually	Always
Descrepencies and ambiguities withn tender/contract documents.	○	○	○	○	○
Lack of risk distribution between the parties, in the Contract.	○	○	○	○	○
Lack of clear mechanism in contract for delay claims presentation by contractors (for establishing 'liability', 'quantum' etc.).	○	○	○	○	○
Failure of 'notification' of delay event within contractually prescribed time.	○	○	○	○	○
Failure of submission of 'particulars' of delay claim event within contractually prescribed time.	○	○	○	○	○
Global claims.	○	○	○	○	○
Contractor's failure to establish 'liability' for delay event based on contract provisions.	○	○	○	○	○
Contractor's failure to establish 'quantum' of delay effects by using a fitting analysis method.	○	○	○	○	○
Delay analysis method used by one party being disagreed/challenged by other party.	○	○	○	○	○
Absence of definition in the contract as to 'float ownership'.	○	○	○	○	○
Absence of definition of approach to be used at measuring 'criticality' of a delay.	○	○	○	○	○
Absence of definition in the contract as to approach for 'Concurrent delay situations'.	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

22. How imporatnt could the following be in reducing / preventing delay claims in construction projects?

	Negligible	Slightly important	Important	Very important	Extremely important	Unable to comment
Allow sufficient time for consultants to complete the design and contract documents before issuing for tender.	○	○	○	○	○	○
Establish high level quality control mechanism within consultants team to minimize/eradicate conflicts, descrepencies and ambiguities withn tender/contract documents.	○	○	○	○	○	○
Clear distribution of risks between the parties, in the Contract.	○	○	○	○	○	○
Clear cut definition in the contract as to 'float ownership'.	○	○	○	○	○	○
Clear cut definition in the contract as to 'automatic entitlement to EoT for delays occurring after passing prevailing contract completion date'.	○	○	○	○	○	○
Engineer's impartiality (against own failures or outside pressure)	○	○	○	○	○	○
Presence of a stipulated mechanism in the Contract to resolve delay claims at site level on day-to-day basis.	○	○	○	○	○	○
OTHER 1	○	○	○	○	○	○
OTHER 2	○	○	○	○	○	○

Other (please specify)

23. How important could the following be to expedite and make efficient the delay claims resolution process?

	Negligible	Slightly important	Important	Very important	Extremely important	Unable to comment
Stipulation in the contract a clear mechanism for delay claims presentation by contractors (requirement of establishing 'liability', quantum of impact of claimed delay event on contract milestones/contract completion date).	◯	◯	◯	◯	◯	◯
Stipulation in contract as to the basic and minimum required documents to be presented for consultant's evaluation process of EoT entitlement.	◯	◯	◯	◯	◯	◯
Submission of 'notification' of delay claim event within contractually prescribed time	◯	◯	◯	◯	◯	◯
Submission of 'particulars' of delay claim event within contractually prescribed time	◯	◯	◯	◯	◯	◯
Clear cut definition in the contract for the approach as to 'concurrent delays'.	◯	◯	◯	◯	◯	◯
Clear cut definition in the contract for the approach as to 'float ownership'.	◯	◯	◯	◯	◯	◯
Clear cut definition in the contract for delay analysis methodology to be used in delay claims presentation and evaluation.	◯	◯	◯	◯	◯	◯
Clear cut definition in the contract for approach to be used at measuring 'criticality' of a delay (whether all activities having total float less than or equal to zero are critical OR only those activities having the maximum negative float (i.e. longest path) are critical)	◯	◯	◯	◯	◯	◯
Presentation and assessment of delay claims carried out on a analysis method mutually agreed on an objective basis.	◯	◯	◯	◯	◯	◯
Prompt and timely award of extension of time	◯	◯	◯	◯	◯	◯

Engineer's impartiality in apportioning liability	◯	◯	◯	◯	◯	◯
OTHER 1	◯	◯	◯	◯	◯	◯
OTHER 2	◯	◯	◯	◯	◯	◯

Other (please specify)

24. Please indicate your perceived rating of agreement/disagreement to the following proposition[Note: Please use either 'Agree' or 'Strongly Agree' option only once]:

"Contractors submit their delay analysis claims with adequate details enabling consultants' assessment:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Long after the project is completed.	◯	◯	◯	◯	◯
After the effects of ALL the claimed 'events' are ceased.	◯	◯	◯	◯	◯
After the effects of the particular 'event' is ceased.	◯	◯	◯	◯	◯
Contemporaneously and promptly.	◯	◯	◯	◯	◯
Not submitting at all.	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

Other (please specify)

25. Please indicate your perceived rating of agreement/disagreement to the following proposition [Note: Please use either 'Agree' or 'Strongly Agree' option only once]:

"Consultants (assessers) determine claimed entitlement to extension of time :

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Long after the project is completed.	○	○	○	○	○
After the effects of ALL the claimed 'events' are ceased.	○	○	○	○	○
After the effects of the particular 'event' is ceased.	○	○	○	○	○
Contemporaneously and promptly.	○	○	○	○	○
Not determining at all.	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

26. In most of the projects in the UAE, the contract provisions require approval of the employer prior to awarding extension of time to the contractor?

○ Yes

○ No

27. (If the answer to above is 'Yes') Please indicate your rating of agreement/disagreement to the proposition that "such employer approval is normally given:
[Note: Please use either 'Agree' or 'Strongly Agree' option only once]

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Long after the project is completed.	○	○	○	○	○
After the effects of ALL the claimed 'events' are ceased.	○	○	○	○	○
After the effects of the particular 'event' is ceased.	○	○	○	○	○
Contemporaneously and promptly"	○	○	○	○	○
Not approving at all.	○	○	○	○	○
Other	○	○	○	○	○

Other (please specify)

28. For selecting an optimum delay analysis method how significant are the following criteria for your consideration?

	Insignificant	Slightly Significant	Significant	Very Significant	Extremely Significant
A contract having specified precise requirements for Delay Analysis [CCR]	◯	◯	◯	◯	◯
Project Constraints [magnitude, complexity etc.] [PC]	◯	◯	◯	◯	◯
Claims' magnitude and Complexity [CMC]	◯	◯	◯	◯	◯
Records Availability [RecA]	◯	◯	◯	◯	◯
Proof of Causation (Transparency of Analysis) [PrfC]	◯	◯	◯	◯	◯
Legal admissibility (by triers)[TAdms]	◯	◯	◯	◯	◯
Time and Cost of Analysis [T&C]	◯	◯	◯	◯	◯
OTHER	◯	◯	◯	◯	◯

Other (please specify)

29. Please indicate your ranking for the following factors based on your perceived degree of IMPORTANCE, in selection of an optimum delay analysis method.

	Negligible	Slightly Important	Important	Very Important	Extremely Important
Matters like Concurrency and Float ownership are already defined by Contract [C&F]	◯	◯	◯	◯	◯
"Longest Path" is defined in the contract as the Analysis Method [AM]	◯	◯	◯	◯	◯
Value of the project[PV]	◯	◯	◯	◯	◯
Size of the project [PS]	◯	◯	◯	◯	◯
Duration of the project [PD]	◯	◯	◯	◯	◯
Status (prevailing stage) of the project [PCS]	◯	◯	◯	◯	◯
Complexity of the project [PC]	◯	◯	◯	◯	◯
Amount of time claimed [MT]	◯	◯	◯	◯	◯
Amount of cost (of prolongation) claimed [MC]	◯	◯	◯	◯	◯
Number of events claimed and to be analysed [NE]	◯	◯	◯	◯	◯
Obscurity and sophistication of issues in prolongation claim(s) [OBS]	◯	◯	◯	◯	◯
Baseline Programme - Availability [ABP]	◯	◯	◯	◯	◯
Baseline Programme - Type (e.g. Critical path Method based) [TBP]	◯	◯	◯	◯	◯
As-built periodical updates of programme[AB]	◯	◯	◯	◯	◯
As-built periodical updates of programme- Mutually Agreed [AAB]	◯	◯	◯	◯	◯
Availability of other records (e.g. daily records etc.)[AOR]	◯	◯	◯	◯	◯
High quality of Transparancy required to be demonstrated (clearly established causation) [LTR]	◯	◯	◯	◯	◯
Need of showing 'concurrent' delays/ mitigation.[NC]	◯	◯	◯	◯	◯
Need of illustrating delay impact(effect) isolated for each event separately	◯	◯	◯	◯	◯

(need to avoid "sphagetty effects")[IEE].					
Need of sequential (chronological) analysis [COA]					
Need of expert skills (for analysis) [XS]					
Cost of analysis method [CA]					
Time to be spent for analysis [TSA]					
OTHER 1					
OTHER 2					

Other (please specify)

30. Using the drop-down scale, please indicate your ranking of NECESSITY OF AVAILABILITY of the following factors to implement the analysis methods shown. (For example, "As-built periodical updates of programme" is not a necessity for using "Impacted As-Planned" method)

	As-Planned vs As-Built	Impacted As-Planned	Collapsed As-Built	Time Impact Analysis	Other
Concurrency and Float ownership defined by Contract [C&F]					
"Longest Path" is defined in the contract as the Analysis Method [AM]					
Value of the project[PV]					
Size of the project [PS]					
Duration of the project [PD]					
Status (prevailing stage) of the project [PCS]					
Complexity of the project [PC]					
Amount of time claimed [MT]					
Amount of cost (of prolongation) claimed [MM]					
Number of events claimed and to be analysed [NE]					
Obscurity and sophistication of issues in prolongation claim(s)[OBS]					
Baseline Programme - Availability [ABP]					
Baseline Programme - Type (e.g. Critical path Method based) [TBP]					
As-built periodical updates of programme[AB]					
As-built periodical updates of programme- Mutually Agreed [AAB]					
Availability of other records (e.g. daily records etc.) [AOR]					
High quality of Transparancy required to be demonstrated (clearly established causation)[LTR]					
Need of showing 'concurrent' delays/ mitigation.[NC]					
Need of illustrating delay impact(effect) isolated for each event separately (need to avoid "sphagetty					

effects")[IEE].					
Admissibility of method by Engineers/Arbitrators/Courts. [TAdms]					
Need of sequential (chronological) analysis [COA]					
Need of expert skills (for analysis) [XS]					
Cost of analysis method [CA]					
Time to be spent for analysis [TSA]					
OTHER 1					
OTHER 2					

Other (please specify)

APPORTIONING LIABILITY IN DELAY CLAIMS

31. Please give your rating for the above questionnaire with reference to the following (Please use ranks 1=Very Low, 2= Low , 3= Medium, 4= High and 5= Very High)

	Very Low	Low	Medium	High	Very High
Clarity of Questions	○	○	○	○	○
Readability of Questions	○	○	○	○	○
Accuracy of content	○	○	○	○	○
Easiness to answer	○	○	○	○	○
Relavance of Questions to the issue investigated	○	○	○	○	○
Coverage of issue	○	○	○	○	○

Other (please specify)

Research Institute for the
Built and Human Environment

University of Salford
A Greater Manchester University

TO:

N. A. Perera

University of Salford

Date:

Dear ....

EXPERT VALIDATION OF A 'FRAMEWORK OF IMPROVEMENTS' TO DELAY CLAIMS RESOLUTION PROCESS

A research inquiry to investigate current practices and problem-situations faced in delay claims resolution process in Dubai construction industry was recently conducted, under the sponsorship of the University of Salford. Based on the findings of that study, certain problem areas in this domain were identified and a 'Framework of Improvements' has been developed mainly on the suggestions of the practitioners, who participated in the research, to address these problems.

The attached 'Matrix of Framework of Improvements' contains these suggested improvements and the related problems. Primarily, they intend to set out clear definitions and risk distribution in the contract documents leading to certain changes in currently adopted practices as to apportioning liability in delay claims resolution.

However, these 'improvements' are required to be validated, ideally by expert-validation. Therefore, this letter requests your kind assistance to enable this task towards ensuring the validity of the suggested 'Improvements'. In this respect, the following have been enclosed:

1. A short Questionnaire for your opinions as to conceptual and operating validity of the proposed 'improvements'; this Questionnaire is to be accessed through clicking the link **(URL)** given below:

2. This questionnaire is based on the attached 'Matrix of Framework of Improvements'.

The outcome of the survey and the answers provided will be used only for the academic purposes.

At the completion of the research study, the survey findings will be available for the benefit of future researchers in the field.

Research Institute for the Built and Human Environment

University of Salford
A Greater Manchester University

We would be most obliged if you could please spare few minutes to complete this questionnaire on-line which is targeted to be concluded in a few days.

We thank you for your valued time and assistance in providing the answers requested.

Yours sincerely,

N.A. Perera

(Ph D Researcher)

FRAMEWORK OF IMPROVEMENTS - VERIFICATION & VALIDATION SURVEY

Please refer to the 'Matrix of Framework of Improvements' attached to the e-mail. The responses requested below are expected to be based on the content of this Matrix.

1. Please state your opinion on the level of clarity and readability of the content of the 'Suggested Best Practice Improvements' for a user.

- ○ CONTENT IS VERY CLEAR AND READABLE
- ○ CONTENT IS REASONABLY CLEAR AND READABLE
- ○ CONTENT IS TOO COMPLICATED AND UNCLEAR
- ○ NOT SURE

Further Comments (if any)

2. Please state your opinion on the breadth of knowledge represented by the 'Suggested Best Practice Improvements' regarding the related topics and domain.

- ○ HIGHLY ADEQUATE
- ○ REASONABLY ADEQUATE
- ○ NOT ADEQUATE
- ○ NOT SURE

Further Comments (if any)

3. Please state your opinion on the accuracy and credibility of knowledge represented by the 'Suggested Best Practice Improvements' regarding the related topics and domain.(The accuracy and credibility of knowledge may be measured against current best practices, for example the UK / US industry practices and legal position)

- ◯ HIGHLY ADEQUATE
- ◯ REASONABLY ADEQUATE
- ◯ NOT ADEQUATE
- ◯ NOT SURE

Further Comments (if any)

4. Please state your opinion on the level of potential adaptability of the 'Suggested Best Practice Improvements' in the local industry and current practices (The current practices as represented by both contractor and employer/engineer entities)

- ◯ EASILY ADAPTABLE
- ◯ ADAPTABLE BUT MAY TAKE TIME
- ◯ DIFFICULT BUT NOT IMPOSSIBLE
- ◯ NOT SURE

Further Comments (if any)

5. Please state, in your knowledge, whether any of the 'Suggested Best Practice Improvements' is/are already implemented in the general practices in the local industry [Please give only the reference number to the applicable 'Improvement'; for example, 1.a), 1.b),...2.a), 2.b)..and so on]

6. In your opinion, if adopted, would the 'Suggested Best Practice Improvements' significantly be able to contribute to enhance certainty in risk distribution in contracts and considerably minimize /avoid dispute situations in delay claims resolution?

- ◯ SIGNIFICANTLY HIGH CONTRIBUTION IS EXPECTED
- ◯ A GENERAL CONTRIBUTION IS EXPECTED
- ◯ NO SIGNIFICANT CONTRIBUTION IS EXPECTED
- ◯ NOT SURE

Further Comments (if any)

7. Please make any suggestion to further develop/refine the 'improvements' submitted in the Matrix.

*8. Respondent's Details

1.Name of Practitioner/Expert (Optional):	
2.Professional Qualifications:	
3.Academic Qualifications:	
4.Profession:	
5.Designation:	
6.Work experience in delay claims resolution:	
7.Organization (Optional):	
8.Nature of Business (of organization):	

MATRIX OF THE 'FRAMEWORK OF IMPROVEMENTS'

	Problematic Situations	Problem Area	Suggested Best Practice Improvements
1	**Disputes arising from analysis outcome**	• Selection of most optimum MDA for delay analysis under specific circumstances of a project.	• Developing a 'Model' to select the most optimum MDA under objective circumstances – See Chapter 10
2	**Deficiency in claims submissions**	• Compliance with conditions precedent/ timely submission of notice and particulars • Establishing causation (or avoidance of Global Claims, unless essential conditions exist)	• Following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording: 1. The requirements of the 'notifying' of a relevant delay event, the precise number of days within which such 'notice' to be given from the happening of the relevant delay event, the mode of the communication of 'notice' , the addressee of the 'notice'; similarly define the procedure and the timing for submission of 'particulars' (final or interim particulars); 2. The form and content of the full particulars (final and/or interim) of the delay claim to be submitted which shall not be limited to (i) identification of the event, (ii) liability for the event, (iii) reference to contractual entitlement arising from the relevant 'event' for which the employer has contractually assumed responsibility for the risk of time and or cost, (iv) the details of contractor's actual progress at the time of the event, (v) detailed description and the length of the effects arising from the relevant 'event', and (vi) demonstration of the effects of the event upon the consented programme. For continuing effects the fully detailed claim shall be considered interim, and the claimed effects are to be considered as accumulated delay at the time of the submission of interim claim. 3. If the contractor fails to comply with ANY of the above requirements, it will lose its right to an EOT (and cost) under the contract and the employer will be discharged from all liability in connection with any such event.
		• Keeping proper records to establish 'liability' for prove entitlement;	• Following improvements to the contract documents are recommended to be incorporated in clearly defined terms of contract in properly drafted wording:

		• Use of proper baseline programme and updates for establishing 'liability' and quantum	1. It is the contractor's responsibility to maintain a CPM Programme during the lifecycle of the project, providing periodic (preferably monthly if not fortnightly) enabling the employer's consultants to monitor and record the actual progress of the works; 2. The maximum number of days within which the contractor has to submit the detailed CPM Programme for the consultant's approval/consent; 3. The maximum number of days within which the consultant should, in writing, either approve or reject with reasons and return for re-submission of the submitted programme. If this does not happen, then the consultant is deemed to have accepted the programme as submitted; 4. The maximum number of days within which the contractor has to re-submit the programme in the case of consultant's rejection; 5. The consequences for the contractor's failure to abide by the above requirements (for example, NEC3 Conditions of Contract Clause 50.3 allows the employer to retain one quarter of amounts due as interim payments where the contractor fails to submit a first programme for acceptance - if none is identified in the contract data); 6. The requirements of maintaining software copies of the consented programme and the periodical updates of the same, including any revised versions of the original (agreed or to be agreed), jointly by the contractor and consultant. The original and its updated programmes should consist of all relevant activities, related to design, manufacturing, procurement and on-site construction. It should also clearly identify the long-lead procurement items and the information the contractor reasonably requires from the employer or his consultant, and when it is required and all employer or consultant activities and constraints (such as approvals and employer-supplied services or materials). 7. The Accepted Programme and its Updated Programmes should be the means by which actual against planned progress is monitored, and used as a tool for determining EOT. If the amount of progress the contractor considers it has achieved is disagreed by the consultant, it should be notified to the contractor by the consultant, and both should then attempt to reach agreement. If they do not agree, the consultant's view should prevail unless and until overturned under the contract dispute resolution procedures, as to the updates and the use of same in the delay claims analysis.

			8. Mandatory keeping of objective, contemporaneous project records. A simple clause for 'keeping records' as proposed by SCL Protocol is re-produced below as guidance for such contract terms: "The employer and the contractor agree that there shall be [daily] [weekly] records kept [by the contractor] identifying generally the activities on site, labour on site, plant on site, sub-contractor work on site, delivery of material to the site, list of any instructions given, weather conditions encountered, and any delays encountered which shall be submitted regularly to the CA or the employer on a [weekly] [monthly] basis". 9. The contract should require from the contractor fully detailed method statements, cross referenced to the programme, displaying how he intends to construct the works, and the resources it intends to deploy; 10. It may be beneficial to all parties if there would be a pre-submission joint discussion or workshop in order to ensure the programme is complying with the information required by the contract and fully reflecting the contract work scope; the operational methods are realistic and practical; the resources allocated are realistic to achieve the contract milestones.
3	**Non-availability of definitions**	• Pre-defining contentious issues in contract documents (for issues of Concurrency, Float, Criticality)	• The following principles (which are mainly sourced from SCL Protocol, 2002 and current legal positions in the UK and US jurisdictions) are recommended to be incorporated in the terms of contracts in properly drafted wording: **Issues on 'concurrent' delays and apportioning delay liabilities:** 1. Where contractor delay to completion (i.e. "non-excusable" delay) occurs concurrently with employer delay to completion (i.e. "excusable and compensable" delay), the contractor's concurrent delay should not reduce any EOT due; 2. Where employer risk events and contractor risk events occur (on separate critical paths) sequentially but have concurrent effects, here again any contractor delay should not reduce the amount of EOT due to the contractor as a result of the employer delay; 3. Where an excusable and compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, the contractor's concurrent delay should not reduce any EOT due; the EOT entitlement must be on 'net' basis only, added to the prevailing

			contract completion date; 4. Where an excusable but non-compensable employer risk event occurs after the contract completion date while the contractor is in a culpable delay, no EOT or compensation is due; 5. The 'but-for', 'dominant cause', 'First-in-line', 'Devlin' and similar approaches are rejected for dealing with apportioning liabilities in concurrent delay situations; 6. The entitlement to EOT is an estimated prolongation and may not exactly be tallying with the actual prolongation at the completion of project; however, the compensation must be on the basis of actual costs only; 7. There is no automatic entitlement to 'cost' where the contractor is entitled to EOT; If the contractor incurs additional costs that are caused both by employer delay and contractor delay, then the contractor should only recover compensation if he is able to separate the additional costs caused by the employer delay from those caused by the contractor delay; corresponding to this, the employer's right to recover segregated unliquidated damages for the contractor delay is to be preserved. **Issue of 'Float Ownership':** 8. The 'float' (i.e. without differentiating to 'network float' and 'project float' or 'terminal float') is owned by the project and the 'float' is there to be used by whichever party needs it first; there will be no entitlement to EOT or LD unless all the 'float' is consumed. **Issue of 'Pacing' Delays** 9. The claiming party has to cogently and convincingly show that it had the contemporaneous ability to resume progress at a normal, un-paced rate and it could have completed the schedule activity on time if necessary; 10. The claiming party has to submit evidence of contemporaneous intent (e.g. giving 'notice' for adopting 'pacing' measures in view of the already on-going other party's delay) for showing that the 'pacing' was a conscious and deliberate decision that was made at the time of pacing. 11. For any consideration for a 'pacing' delay claim, submission of the foregoing contemporaneous evidence is an absolute necessity. **Issue of 'Measuring criticality' in forensic scheduling**

			12. If the requirement is to use 'Longest Path' approach, then clearly set out that the critical delays are to be found only on those delays on the 'Longest Path' and all delays on subordinate paths are non-critical relative to the project (predicted) completion date set by the Longest Path. 13. If the requirement is to measure criticality against the contract completion date, then clearly set out that to treat all delays having negative floats on the subordinate paths, along with the delays on the Longest Path, as 'critical' delays to the contract completion date; for this the contract requires to specifically set out the contract completion date or contractual milestones.
4	**Employer's undue influence**	• Measures for 'engineer's impartiality' - against own faults or outside pressure	In order to avoid or minimise such undue influence on the consultants' impartiality in delay claims resolution process the following measures are suggested: **Dispute Resolution Mechanism for Day-to-day Site Issues** 1. Where FIDIC Clause 67 of 'Red Book' 4th edition 1987 or 1992 version is still in use, replace it with the mechanism stipulated under Clauses 20.2 – 20.8 of FIDIC 1999 'Red Book' which describes the appointment and functioning of Dispute Adjudication Board (DAB), decision making, amicable settlement, arbitration and so on; 2. In this case, it must be clearly defined that DAB is making 'decisions' and not merely 'recommendations' (as in the case of an ordinary Dispute review Board); 3. The prime purpose of a DAB is to 'nip in the bud' problems before they escalate to dispute level; therefore, to enable its full advantages, a DAB should be appointed at the commencement of a project and stay in place until its conclusion;
5	**Insufficient time for pre-contract design and documentation**	• Absence of allowing sufficient time to complete design and a control mechanism within consultants team to minimize/eradicate discrepancies and ambiguities within tender/contract documents;	In order to avoid or minimise such unnecessary and unwarranted 'hurry' the following improvements to the practices of pre-contract procedures are suggested: 1. Developers (employers) should realistically assess 'fast-track' requirements based on objective aims of a project before deciding on the approach of procurement; if not in dire need, only for the sake of impressing investors of potential 'fast returns', putting a project on 'fast-track' must be strictly avoided; these initial but decisive tasks of project appraisal must be carried out by competent professional advisers rather by the financiers or non-technical investors; 2. Developers should appreciate that even when a project is decided to be on fast-track, there are certain minimum pre-requisites to be firmly determined (for example determining exact

<table>
<tr><td></td><td></td><td></td><td>requirements to be built, sufficiency of design preparation and availability of site for construction and so on);
3. Allocation of sufficient time for the consultants to complete conceptual and detailed design stages;
4. Realistic time allocation for initial planning and particularly inter phasing, if multi- phases of construction and multiple contractors are involved on same site;
5. Allocation of sufficient and realistic construction time;
6. Allocation of sufficient time for reviewing the design, drawings, specifications and other tender documentation prior to calling for bids;
7. Strict quality controlling of the tender documents, in order to ensure avoiding conflicts, ambiguities, 'gaps' and so on for minimising post-contract time/cost claims; primarily this is the responsibility of the consultants, but the final approval must be given by the employer, preferably after a further quality assurance by his in-house professional staff wherever it is possible;
8. Strict quality controlling of the contract documents at award stage, to ensure the intentions of the final position (including possible negotiations and final agreed positions) are truly reflected and without having conflicts, ambiguities, 'gaps' and so on. Again, the employer's final approval to these contract documents must be given as given to the tender documents.</td></tr>
<tr><td>6</td><td>Promptness in assessment / settlement</td><td>• Pre-defining time period for assessment and award of extension of time;
• Avoiding 'wait & see' policy</td><td><u>Prompt review and Assessment</u>
1. In order to avoid or minimise such delay to the assessment by the consultants in delay claims resolution process it would be best incorporating a specific time period (from the time sufficient interim or final particulars are submitted by the contractor for an interim determination or a final determination) in the contract within which the engineer should form his assessment in principle (in an interim determination) or assessment with specific entitlement to EOT and formally notify the outcome of the entitlement to EOT;
<u>Prompt Award/Settlement</u>
2. If possible, employer's approval requirement for the consultant's determination of EOT should be done away altogether; this will ensure the consultant's impartiality on the matter and if the employer disagrees with the consultant's evaluation outcome he may proceed to the formal dispute resolution mechanism (specified in the contract or otherwise);</td></tr>
</table>

			3. If the employer's 'approval' requirement is retained, then define in clear language that prior to issuing formal determination of entitlement to EOT, the employer should be notified of it; however, the employer's approval is required for issuing the same and not for the content of the engineer's determination; preferably, there may be a prescribed time within which such approval or disagreement should be given and it should not be withheld out of any 'bad faith'; in any case, the engineer's formal determination of the EOT entitlement should be independently notified, whatever the employer's decision is; 4. The contractor's claims for EOT should be made and dealt with as close in time as possible to the delay event that gives rise to the application.
7	**Dispute Resolution**	• Considering alternative to current ADR mechanism	See 'Dispute Resolution Mechanism for Day-to-day Site Issues' suggested above

Research Institute for the Built and Human Environment

University of Salford
A Greater Manchester University

TO: N. A. Perera

University of Salford

Date:

Dear ....

EXPERT VALIDATION OF A SIMULATED MODEL FOR SELECTING OPTIMUM METHOD OF DELAY ANALYSIS.

An in-depth survey to investigate current practices and problem-situations faced in delay claims resolution process in Dubai construction industry was conducted in 2010, under the sponsorship of the University of Salford. Based on the findings of that survey, a particular problem area in the practitioners' (experts') selection of an optimum method of delay analysis (MDA) was identified; the problem exists mainly due to the intuitive decision making for the use of analysis techniques in delay claims preparation as well as in their evaluation. Consequently, a practical need is recognized for having a decision making aid based on a more objective and tenable basis in order to minimize mutual scepticism between the parties and add fairness and efficiency to delay claims resolution process as a whole.

In an attempt to address this need, a simulated Model is proposed in the wider research area. It is hoped that this Model would be a useful device for the practitioners of either side, in order to justify the selected MDA for claimed delays on an objective and defendable basis.

However, the Model is required to be validated prior to its use in practice, ideally by expert-validation. Therefore, this letter requests your kind assistance to enable this task towards ensuring the validity of the proposed Model. In this respect, the following have been enclosed:

1. A short Questionnaire for your opinions as to conceptual and operating validity of the proposed Model; this Questionnaire is to be accessed through clicking the link **(URL)** given below:
2. A Worked Example based on a case study to illustrate the application of the proposed Model;
3. A soft copy of the proposed Model in full functional and interactive mode; necessary interaction is allowed through the pull down menus of "Attributes" that appear in the worksheet entitled 'Decision Maker's Input'; please note the current data in the Model are based on the Worked Example and with reference to the Questionnaire attached; for using the Model with your own case study(ies) it is advisable to save the current application prior to such use.)

Research Institute for the Built and Human Environment

University of Salford
A Greater Manchester University

The outcome of the survey will be used in a doctoral research undertaken at University of Salford, UK.

The answers provided will be used only for the academic purposes.

At the completion of the research study, the survey findings will be available for the benefit of future researchers in the field.

We would be most obliged if you could please spare few minutes to complete this questionnaire on-line which is targeted to be concluded within the next two weeks.

We thank you for your valued time and assistance in providing the answers requested.

Yours sincerely,

N.A. Perera

(Ph D Researcher)

MODEL VERIFICATION & VALIDATION SURVEY

Please refer to the Worked Example (softcopy) of the Model provided with a Case Study. The responses requested below are expected to be based on this Worked Example as well as the Respondent's experience in using the Model on his own case study(ies).

1. Please state your opinion on the wholeness of the "Criteria" used as necessary for selection of the optimum Method of Delay Analysis: (Please refer to Worked Example softcopy worksheet "LIST-CRITERIA-ATTRIBS-ALTvs")

Wholeness of "Criteria" is

- ◯ HIGHLY ADEQUATE
- ◯ REASONABLY ADEQUATE
- ◯ NOT ADEQUATE
- ◯ NOT SURE

Further Comments (if any)

2. Please state your opinion on the wholeness of the "Attributes" used to measure the eligibility of each Method of Delay Analysis:(Please refer to Worked Example softcopy worksheet "LIST-CRITERIA-ATTRIBS-ALTvs")

Wholeness of "Attributes" is

- ◯ HIGHLY ADEQUATE
- ◯ REASONABLY ADEQUATE
- ◯ NOT ADEQUATE
- ◯ NOT SURE

Further Comments (if any)

3. Please state your opinion on 'PARAMETERS' as given under each Attribute:(Please refer to Worked Example softcopy worksheet "DECISION MAKER- INPUT")

The explained PARAMETERS are

- ◯ VERY REALISTIC
- ◯ GENERALLY REALISTIC
- ◯ NOT REALISTIC
- ◯ NOT SURE

Further Comments (if any)

4. Please state your opinion on the suitability of the scales used to measure the eligibility of each Method of Delay Analysis against the corresponding 'Attributes' : (Please refer to Worked Example softcopy worksheet "DECISION MAKER-INPUT"). The scales are

- ◯ VERY SUITABLE
- ◯ GENERALLY SUITABLE
- ◯ NOT SUITABLE
- ◯ NOT SURE

Further Comments (if any)

5. Do you think a Decision Maker's position would be stronger, more tenable and objective when he uses the Model to select the Method of Delay Analysis (MDA) than when he selects MDA intuitively?

- ◯ MODEL PROVIDES A STRONGER, MORE TENABLE AND OBJECTIVE POSITION.
- ◯ NO, DON'T THINK THERE IS A DIFFERENCE
- ◯ NOT SURE

Further Comments (if any)

6. In your opinion, would the Model significantly be able to contribute to minimize mutual skepticism between the parties in selection of a Method of Delay Analysis suitable for a given project.

- ◯ SIGNIFICANTLY HIGH CONTRIBUTION IS EXPECTED
- ◯ A GENERAL CONTRIBUTION IS EXPECTED
- ◯ NO SIGNIFICANT CONTRIBUTION IS EXPECTED
- ◯ NOT SURE

Further Comments (if any)

7. Under changing input (based on varying case study scenarios), how do you find the output behaviour in the Model?

- ◯ OUTPUT IS VERY CONSISTENT AND ACCURATE FOR THE INTENDED PURPOSES OF MODEL
- ◯ OUTPUT IS GENERALLY CONSISTENT AND ACCURATE FOR THE INTENDED PURPOSES OF MODEL
- ◯ OUTPUT IS NOT CONSISTENT AND NOT ACCURATE FOR THE INTENDED PURPOSES OF MODEL
- ◯ NOT SURE

Further Comments (if any)

8. Please state your opinion on the level of simplicity, comprehensiveness and clarity of the content of the Model for a user.

- ◯ CONTENT IS VERY SIMPLE, COMPREHENSIVE AND CLEAR FOR A USER
- ◯ CONTENT IS REASONABLY SIMPLE, COMPREHENSIVE AND CLEAR FOR A USER
- ◯ CONTENT IS TOO COMPLICATED AND UNCLEAR FOR A USER
- ◯ NOT SURE

Further Comments (if any)

9. Please state your opinion whether the Model can be used without requiring special skills or costly resources, but with ordinary computer skills of a competent delay analyst.

- ◯ USE OF THE MODEL REQUIRES NORMAL SKILLS ONLY
- ◯ USE OF THE MODEL REQUIRES NORMAL SKILLS BUT A BRIEF PRIOR TRAINING
- ◯ USE OF THE MODEL REQUIRES SPECIAL SKILLS AND COSTLY RESOURCES
- ◯ NOT SURE

Further Comments (if any)

10. Does Model's automated process run smoothly with no clashes and implement the Model with no abnormal behaviour?

- ◯ AUTOMATED PROCESS IS STABLE AND RUNS SMOOTHLY WITH NO ABNORMAL BEHAVIOUR
- ◯ AUTOMATED PROCESS IS UNSTABLE AND REQUIRES CORRECTION
- ◯ NOT SURE

Further Comments (if any)

11. Respondent's use of the Model

Have you used this Model with any of own case study (ies)?

If the answer is 'yes', how many?

12. Have you used any Model/ device similar to the current for selection of method of delay analysis?

- ◯ Yes
- ◯ No

If answer is 'Yes' please briefly describe the other Model/Device

13. Please cite any limitation/ difficulty you have expreienced in the concepts or implementation of the Model and describe your suggestions, if any, to improve the Model.

***14. Respondent's Details**

1.Name of Practitioner/Expert (Optional):

2.Professional Qualifications:

3.Academic Qualifications:

4.Profession:

5.Designation:

6.Work experience in delay claims resolution:

7.Organization (Optional):

8.Nature of Business (of organization):

Case study - A Worked Example

The following is a real-world project to be considered as the case study scenario for illustrating the application of the proposed Model.

The form of contract is a bespoke version of modified FIDIC Form 4th edition (1987).

The project's contract sum is circa AED 318 Million (approximately £53 million). The final account is expected to be around AED 340 million (approximately £56.7 million).

The scope of work is to construct a Central Utility Complex of approximately 6000 M^2 for an expansion of an existing international Airport. The work consists of construction of a reinforced concrete and steel framed Chiller Hall, Cooling Towers complete with all mechanical, electrical and plumbing services associated with the buildings including the provision of a building management system (BMS) internal services, 11kV/400V transformers, 11kV standby generators, with all associated medium voltage switchgear, panel boards, and cabling and distribution networks and external works.

The overall completion of the project with four separate contractual milestones was to achieve within 618 days.

The work was, however, substantially completed after 789 days from the commencement date, with 171 days of time over-run.

The Contractor has notified 27 major delaying events and 30 other secondary events. The claimed causes of these events are variations, suspension of works, late issue of information, access delays caused by other interface-contractors working on the site etc. The overall claim is for 200 days of entitlement to extension of time with cost of prolongation and acceleration which is circa AED 15 million (£2.5 million). No claim for cost of 'disruption' has been submitted.

The Contractor submitted the final particulars of his claims after the substantial completion of the works. Thus, he has not complied with the prescribed time of the Contract for submission of such particulars although almost all his 'notices' were given within prescribed time.

In spite of these procedural failures or technicalities, the Engineer's evaluation has revealed that had the Contractor complied with the requirements of such technicalities he would have been entitled to extension of time in principle.

The Contractor has used 'Impacted As Planned' analysis method to establish his entitlement. In the submission, the Contractor has not shown any of his own delays. According to the Engineer's staff, there have been many delays of the contractor's own due to lack of resources, slow rate of progress, delayed submission of shop drawings, delayed material procurement, defective works etc.

The Contractor's Baseline Programme was submitted as required by the Contract provisions (Clause 14.1). This was a CPM based Programme. The Employer's consent for this Programme was promptly given as required by the contract.

In spite of the substantial delays to the original completion date(s), however, no revised programme was required or submitted.

During the construction, the contractor regularly submitted a 'look-ahead' programme in every fortnight. Additionally, there have been monthly updates of the Activities of the programme submitted to the Engineer. It is noted that although at the early months these updates were verified and mutually agreed between the contractor and the engineer, that practice did not continue. However, there are no records of the engineer's objection to such unverified updates either.

Site records are reasonably kept. These include daily records of productivity, Inspection Requests, Site Instructions issued, submittal logs etc.

The engineer's office has a separate team of delays and claims analysts. Recently, the engineer informed the contractor of the non-acceptance of the MDA used in the claims submission, as it did not consider and base on what actually happened on site. The Engineer considers the MDA should be on a more objective basis. The contractor disagreed. According to the contractor, his method used (Impacted As Planned) is based on CPM, and has clearly established the cause and effect of the employer caused delays, and therefore the entitlement to extension of time.

In view of this situation, the engineer's delay analyst ought to select the optimum MDA under the existing circumstances. Such selection should be logical, objective and defendable against possible onslaught from the contractor's side.

Other pertinent facts of the circumstances are:

- The applicable form of contract does not define a MDA or concept of concurrency. However, it states that the project 'float' is not exclusively owned by either party, but can be consumed on 'first come first served' basis. This means the 'float' is owned by the project.

- The form of contract requires the engineer to secure prior approval from the employer as to the matters of extension of time. The employer has a panel appointed to consider the engineer's recommendation for such extension of time based on the assessed entitlement of the contractor. The panel always insist on:

    - Clearly established causation;

    - Concurrent effects of the delays when prolongation costs claims are present;

    - Use of a robust, tenable MDA and outcome.

- As for interim claims submissions there is a provision in the contract for the engineer to notify his 'Interim Determination' in principle of the contractor's entitlement to extension of time, within 56 days. However, there is no such time constrain as to the final determination.

Application Parameters:

The application of the Model is to select the best amongst the following 04 MDAs, which are the mostly used by the practitioners as found in the Interviews and in-depth questionnaire survey:

1. As Planned vs As Built (APvAB);

2. Impacted As Planned (IAP);

3. Collapsed As Built (CAB), and
4. Time Impact Analysis (TIA).

The Model is applied to all these 04 MDAs at the same time. These are called the 'Alternatives' in the terminology used in the Model.

The Decision Making Tool used in this Model is the 'Simple Additive Weighting' [SAW] method.

Elements of the Model:

There are 01 Supreme Goal, 07 Criteria, 23 Attributes and 04 Alternatives (MDAs) as the elements of this Model, described under 1.6 above.

Stage I of the Model processing:

The respective Weighted Averages for each of the Criteria and Attributes were calculated from the Likert scale based rating of the importance of them as expressed by the respondents to the Questions 28 – 30 of the Questionnaire Survey.

These Weighted Averages were converted into the respective Normalized Weights as described under Step 1 above. In the Step II, 'Importance Weight' (W) for each Attribute was computed by multiplying its Normalized Weight by the Normalized Weight of its corresponding Criterion.

Stage II of the Model processing:

Step I and Step II described above belong to Stage I of the Model processing, and have been completed before the Stage II which is the interactive variable part of the Model.

At the Step III the Decision Maker, who actually uses this Model, inputs his rating of each Alternative against the corresponding Attribute. These inputs are interactively made through answering the 'questions' posed in the Model's worksheet ("Decision Maker's Input"). For each of the 24 Attributes there is a 'Question' to be 'answered' by the Decision Maker under given parameters and scenarios; then, depending on the answer each of the 04 Alternatives is scored with an appropriate rating. These ratings will be automatically converted into comparable Normalized Values of the Alternatives against each Attribute by using Linear

Normalization. In the Step IV, these Normalized Values will be multiplied by the Important Weight of the coprresponding Attribute in order to obtain the Value Functions of the Alternatives.

At the Step V, all the Value Functions of each Alternative are totaled together in order to obtain the Aggregated Value Function of that Alternative. The Alternative which obtains the highest Aggregated Value Function is considered the most suitable MDA to be used under the specific circumstances of the project. Under the case study scenario considered above, the Time Impact Analysis (TIA) has the maximum Aggregated Value Function of all three Alternatives, closely followed by Collapsed As Built method of delay analysis.

All the calculations in the Model are seamlessly done in a discreet automated mode.