P. J. KEANE & A. F. CALETKA

SECOND EDITION

Delay Analysis in Construction Contracts

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2nd Edition

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About the Authors

Dr P John Keane, PhD, MSc, FCIOB, FCIArb, DipArb, has 35 years of experience in the construction industry and is currently the principal of a private consultancy practice. Following training as a quantity surveyor, he graduated in construction and commercial management practice, subsequently holding executive directorships within contracting and professional consulting firms.

In the last 25 years, **John** specialised in the area of dispute resolution and has represented parties in arbitration, adjudication and mediation. He has extensive experience in the United Kingdom as well as in international environments, particularly in the preparation and delivery of expert witness testimony with regard to delay and programming disputes. He is an experienced arbitrator, author and speaker. He also lectures to undergraduate and postgraduate students on construction law-related topics.

Anthony F. Caletka, PE, CFCC, CCM is a civil engineer with over 25 years of experience in construction project and programme management, particularly in large civil engineering projects within the energy, mining, power, and utility sectors, and is a principal with a leading professional services firm. He establishes governance frameworks, contract strategies, project control systems and tools aligned with global best practice, which in turn contribute to the avoidance and resolution of disputes.

Tony is a recognised expert in critical path programming, forensic scheduling, earned value and risk management. He has extensive experience in the delivery of expert witness testimony and advising parties in all dispute resolution forums. He is a frequent speaker and lecturers to post-graduate students on project management and forensic scheduling. He was a member of the drafting committee that produced the SCL Delay and Disruption Protocol.

Preface to the Second Edition

Accurate delay analysis is an important element in the construction management of projects. For example, early identification of delay events or issues affords an opportunity to manage and mitigate the potential impact on a project. It is also a requirement in post-contract situations where liability and cost impacts for parties have to be identified. The first edition of this book, which was published in 2008, was designed principally to serve as a practical guide to the evolving practice of forensic delay analysis, including a critical review of the main delay analysis techniques available.

Since the publication of the first edition, the evolution of digital technology in processing and communications has been significant. For example, the unfolding technology of 'cloud' based data management and transmission offers significant potential benefits to project management and collaboration in terms of identifying, avoiding, tracking, recording and analysing delay issues in real time by multi-disciplined teams based in different locations. Additionally, the volume of information available to delay analysts has increased dramatically, with emails and social media platforms becoming accepted forms of day-to-day communication to facilitate efficiencies in the work flow on most major projects, especially for those in remote locations. To a lesser extent, there have been a number of legal cases that have livened up the debate on certain aspects of delay analysis, for example, float ownership and the principle of apportioning delay.

The feedback we have received on the first edition has been welcome and of assistance in the drafting of this second edition. The new edition has been restructured into a seven-chapter format to balance up the topic areas. The topic of delay analysis techniques is now contained in a separate chapter – Chapter 5. Problematic Issues are now reviewed in Chapter 6, which also includes a modest update to our case law references in order to frame further discussion on a number of subjective issues, which will continue to feed the debates that drive alternative interpretations by delay analysts. Chapter 7 contains updated material regarding delay analysis presentation approaches.

We are once again grateful to those who assisted in the preparation of this new edition. We extend our special thanks to Dr. Paul Sayer, Harriet Konishi and the team at Wiley-Blackwell Publishing for their encouragement and guidance.

John Keane
Tony Caletka

Preface to the First Edition

Construction delay claims are a common occurrence in projects. When they arise, they need to be evaluated quickly and managed efficiently. However, the whole topic of delay and the various analytical techniques available is one that provokes much debate and controversy due to the seemingly complex and sometimes conflicting guidance provided on these techniques. The purpose of this book is to serve as a practical guide to the process of delay evaluation and includes an in-depth review of the primary delay analysis methodologies available.

The chapters flow logically from an overview of construction programmes in Chapter 2 through to the identification and analysis of delays in Chapters 3 and 4. Due to the complexity of construction contracts and the varying levels of familiarity with programmes or delay analysis, problematic issues arise from time to time when preparing or reviewing claims for additional time. The more common problematic issues are reviewed in Chapter 5, followed by a commentary on some recommended presentation approaches and a case study in Chapter 6.

The views we express are based on combined experience of over fifty years working on a wide range of projects and dealing with programming and delay issues. In practice, most projects are delivered within acceptable time and cost parameters. However, when there is disagreement over the responsibility for unacceptable delays to project completion, major disputes can arise due to the failure to manage the impact of change and claims for additional time in a timely or effective manner during the course of the project. In these situations, there is a requirement for reliable analysis and assessment of the delay impact, which addresses qualitative, quantitative and entitlement perspectives to facilitate an agreement. Much of course turns on the selection and implementation of the most appropriate delay analysis technique. Currently there is little by way of formal instruction in the understanding and application of these techniques with many practitioners being self-taught. Accordingly, one main purpose of this book is to assist those construction professionals responsible for assessing delays by way of explaining some of the underlying assumptions and difficulties that may be faced when using some of the more popular and widely used delay analysis techniques.

As we were trained and practised mainly in the UK and US construction industries, respectively, we have sought to identify and include in this book best practice guidance from these countries. In addition, our experience gained on major civil engineering, building and infrastructure projects around the world provided us with a broad perspective of the nature of delay analysis in practice, which in turn, we have reflected in the approaches and recommendations included in this text.

Delay analysis, which involves both the study and investigation of historic events, also entails assessing which of those events actually affected the completion of a project. This function is fundamental to the success of traditional construction management activity when potential delays must be identified and managed to prevent or reduce their impact on the project's duration and out-turn cost. When carried out forensically, the process takes on a higher significance due to the accumulation of legal and consulting fees, interest on capital and other related costs as well as diversion of key management and operational staff. While forensic delay analysis may take on a higher relevance in the legal forum, it is important for construction and project management staff to familiarise themselves with the prevailing trends regarding the use of critical path method (CPM) programming and project management software as well as recent case law relevant to delay claims and the recovery of time-related damages. This should assist when attempting to settle negotiations over the impact of change and unforeseen events, at the earliest opportunity.

Delay analysis is practised internationally across multinational jurisdictions. We have refrained from including extensive commentary on case law or legal doctrines relevant to compensation for time-related costs. With regard to project management and delay analysis terminology, we have tended, for consistency, to follow traditional UK terminology. For example, although 'scheduling' is the common term used in US CPM network analysis, the term scheduling traditionally has a different meaning in the United Kingdom. Although the term 'scheduling' is being used more widely for CPM applications in the United Kingdom, we have elected to use the terms 'planning' or 'programming' for consistency with prevailing UK guidance, texts, terminology and case law.

It is important to note that forensic delay analysis, like many technical fields requiring analysis, is a combination of science and art and requires many subjective decisions and assumptions by the analyst along the way. The methods described in this book do not represent every possible application of the techniques described nor does the book attempt to address every available technique. The appropriate method, and the appropriate application of that method, will depend largely on the circumstances and facts relevant to the case or project at hand. For example, deducing an as-built critical path cannot be computed using computer-based CPM software alone and requires a diligent and objective analysis of the body of information available to the analyst. Any method of delay analysis used should be transparent, forward looking and, most importantly, consistent with and based on a reliable body of factual evidence.

We are indebted to friends and colleagues in the fields of construction and law who through discussion, argument and general banter have contributed in the preparation of this work. We are also grateful to Julia Burden and her team at Wiley-Blackwell for their encouragement and guidance. Finally, last but not least, we thank our families who have patiently endured our absence and supported us most during the writing of this book.

John Keane
Tony Caletka

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Chapter 1
Introduction

1.1 General

Construction output[1] in the United Kingdom represents approximately 7% of the UK Gross Domestic Product (GDP[2]). In the United States, the proportion for construction output, including manufacturing and mining, constituted 17% of the GDP output[3] for 2013 with construction output alone valued at around $900 billion.[4] Construction is a unique industry due to it being a fast-moving, complex and dynamic process which depends on the successful coordination of multiple discrete business entities – including professionals, tradesmen, manufacturers, trade unions, investors, local authorities, specialist trade contractors and so on to ensure the delivery of a project on time, within budget and of the required quality. This coordination is dependent on the application of sound planning, programming and project controls, allied to the implementation of tried and tested management techniques. Much of this work is carried out using increasingly sophisticated computer applications that are continually advancing by offering more and more capabilities to the end user.

A survey[5] carried out among UK contractors in the mid-1990s found that 49% of contractors did not use computers on construction site locations. Now, not only are computers commonplace in one form or another, but also the use of specialist planning software is common as is computer-aided delay analysis.

Risk is an inherent feature of construction, and it is well known that 'no construction project is risk free. Risk can be managed, minimised, shared, transferred or accepted. It cannot be ignored[6]'. If it is accepted that risk is inherent in construction, then it must also be accepted that the likelihood of delays is also inherent in the process and should

[1] Estimated annual volume of construction output in 2013 was £112.6 billion [online] Available at http://www.ons.gov.uk [Accessed 26 May 2014].

[2] UK GDP forecast for 2013 is £1581.2 billion [online] Available at www.ukpublicspending.co.uk [Accessed 26 May 2014].

[3] United States GDP Growth Rate [online] Available at www.tradingeconomics.com/united-states/gdp-growth [Accessed 26 May 2014].

[4] Wiggins T., 2014. *U.S. Construction Outlook for 2014.*

[5] Keane P. J., 1994. *Survey on Computer Usage in Construction Claims Management.*

[6] Sir Michael Latham, 1994. *Constructing the Team.* Final Report. HMSO.

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therefore be anticipated, managed and treated in a similar fashion as risk. When delays are experienced, this is not necessarily an indication that the process or management team is breaking down. Delays are often simply the result of an event which must be managed by a systematic process so as to anticipate the impact of that event on the programme and to minimise the risk of further delay. Systematic management of delay during the course of a project also ensures that the cause of that delay is identified, and documented, at the earliest opportunity. When there is a requirement to identify the cause and effect of delay to establish entitlement to additional time or money, the results of any relevant analysis should be capable of being presented in a clear and unambiguous way.

The most significant unanticipated cost in most construction projects is the financial impact associated with delay and disruption to the works. Assessing the impact of delay and disruption and establishing a direct causal link from a delay event ('cause') to its impact ('effect'), the liability and resulting damages, can be difficult and complex. Contractors and subcontractors require these skills for successful evaluation and presentation of time delay claims. The employer's professional team also requires similar skills and techniques when analysing and evaluating extension of time entitlements under a construction contract. Where these delay issues are not resolved by the contract administrator and contractor in the normal commercial way, then such issues are often left to be decided by third parties in arbitration or adjudication, before dispute review boards or, ultimately, in litigation. All these steps within the dispute resolution hierarchy have different timetables and expectations regarding the evidence required to demonstrate cause and effect. In selecting the most appropriate technique to suit the project and to ensure proportionality is maintained, the following factors must be considered: the relevant facts, the timetable, the nature and number of delay events and the size of the potential dispute.

1.1.1 Purpose of this book

The purpose of this book is to provide a practical guide to the process of delay analysis for programmers and delay analysts and to inform non-programmers of the nuances of delay analysis techniques available. The book also considers the assumptions which underlie the precise calculations of a quantitative delay analysis, in order to 'level the playing field' for non-programmers and experts alike. This entails an in-depth review of the primary methods of delay analysis in use today, along with some familiar secondary methods. The timing and purpose of delay analysis is also discussed, together with a review of the fundamentals of critical path method (CPM) programming. The 'project control cycle' is also described in detail. Contemporaneous programming evidence, whether flawed or not, will usually be preferred to retrospectively created programme data, so the emphasis should be on establishing and maintaining an accurate and effective CPM programme throughout the performance of the works.

This book is intended for project and construction management practitioners, contract and legal advisors and programming consultants alike, who not only seek an understanding of the principles, techniques and methodologies involved in the process of delay analysis but also want to understandw the techniques and underlying processes

in some detail. Such individuals include those employed by project owners (employers), contractors/subcontractors, legal experts and consultants who often find the need to manage extension of time or delay claims.

The techniques discussed in the book can be used on projects under all forms of construction contract, both domestic and international. Disputes involving delay entitlement and quantification, and which have to be resolved by the intervention of a third party trier of fact, are a frequent occurrence in the construction industry. Over the years, judicial decisions on several key aspects of delay dispute have been handed down by the courts, which have assisted, to some extent, in shaping the way in which delay analysis is undertaken in certain aspects. However, while the implications of these decisions clearly have a great bearing on the work of a delay analyst, it must be remembered that most, if not all, decisions regarding delay analysis are made not necessarily on the method of analysis, but rather on the underlying facts presented and relied upon.

The courts are only presented with delay issues after the event, and therefore decisions handed down mainly provide guidance on retrospective delay analysis techniques which demand, and rely upon, a high level of accuracy and detail with regard to the as-built programme. Notwithstanding the influence of the courts on the process of developing claims for delay and disruption, in order to accord with the ethos of this book, and the actual circumstances and facts many construction professionals find themselves managing, the authors have restricted the use of case law references to a minimum; for instance, where a principle has clearly been established and is commonly referred to in delay claims. Where cases have been referred to, this has not only been restricted to English case law but also includes a small number of significant US cases which are relevant to topics addressed. The US courts have accepted the concept of CPM programming and computer-generated delay analysis submissions since the early 1970s. The English courts appear to lean in the direction of 'common sense', whereby the method of analysis is secondary, whether CPM programming techniques were relied upon or not.

It is important that a delay analyst should not become blinkered or be constrained by past judicial decisions in devising and applying delay analysis techniques prospectively in a live project environment. If a delay analyst adopts an unorthodox approach which is acceptable by both parties and resolves a time entitlement claim, then that is to be commended. In the same vein, it is important not to get too hung up on 'named' approaches; this is largely another spin-off from judicial involvement in the development of delay analysis. Such named approaches include 'time impact analyses', 'as-planned versus as-built' and 'collapsed as-built' (CAB). These names really only start to have any significance when used as expert evidence to provide a general indication of the approach being adopted by the delay analyst. Even so, there has been little guidance, until recently, as to how each method should be carried out. The primary named methods are often misused in court proceedings, arbitrations and adjudications.

Court decisions and arbitral awards sometimes indicate either a lack of willingness to come to grips with the issues and terminology or a difficulty in fully grasping the intricacies of sophisticated delay analyses. This is entirely understandable as judges are not usually presented with easy issues. The complexity of even the simplest of construction processes often proves to be extremely difficult to convey. Also courts, along with parties' legal advisers, are not always assisted by delay analysts who misdescribe or misapply

these techniques and opposing experts who do not take one another's approach 'head on'. When two opposing party appointed experts refuse to engage the other's method of analysis, this leaves a void where agreed programming evidence should be. These cases often conclude by the tribunal making an assessment based on the facts.

In summary, it is somewhat arbitrary to 'badge' and thereby restrict a piece of analysis, and while reference is made in this book to the primary delay analysis approaches, the authors urge caution in becoming too prescriptive because even these primary methods have secondary derivatives and many variations as to how they can be carried out. Also, for this reason, the authors have restricted the use of case law references to a minimum, to allow the site-based practitioner to make informed judgement calls when developing a delay claim rather than simply discounting one method of delay analysis over another, based on his or her understanding of the latest judicial decision mentioning a method of delay analysis being applied by either party.

This book discusses delay analysis techniques and approaches, with their appropriateness under given circumstances, and demonstrates how a combined, or hybrid, approach can be applied, complete with worked examples and case studies. Delay analysis is becoming an increasingly complex activity and there is continual debate and commentary on the primary approaches available. This book brings together the main techniques available in comprehensive primary and secondary categories. The particular techniques described in this book have been successfully tried and tested by the authors in both the commercial environment and in dispute resolution proceedings: adjudication, arbitration, dispute review boards and litigation. This book will serve as a resource guide for those practitioners, advisors, clients or contractors preparing or responding to construction delay claims.

1.1.2 Guidance

Two major guides have been produced on both sides of the Atlantic to assist those dealing with time extension claims and delay analysis. The first is the Society of Construction Law's Delay and Disruption Protocol, published by the Society in October 2002[7] (SCL Protocol). The stated aim of the SCL Protocol is to provide useful guidance on some of the common issues that arise on construction contracts, where one party wishes to recover from another an extension of time and/or compensation for the additional time spent and the resources used to complete the project. The second more recent guide was published by the Association for the Advancement of Cost Engineering International (AACEI) in the form of its 'Recommended Practice No. 29R-03 *Forensic Schedule Analysis*[8]' (RP-FSA). This document, issued on July 1, 2007 was officially launched on July 15,

[7] The SCL protocol can be downloaded from http://www.eotprotocol.com.

[8] Association for the Advancement of Cost Engineering International – Recommended Practice No. 29R-03 *Forensic Schedule Analysis*.

2007. The RP-FSA is primarily focused on the terminology and the application of forensic analysis and is a much more technical document than the SCL Protocol, although it does not address as broad a spectrum as the Protocol. The stated purpose of the RP-FSA is to provide a unifying technical reference for the forensic application of CPM scheduling and to reduce the degree of subjectivity involved in the current 'state-of-the-art' concept while the state of the art in the United States differs from the state of the art in England. Both of these documents are discussed and contrasted in Chapter 4.

1.1.3 Construction planning and programming

Most construction projects will benefit from CPM programming. Only the most basic of projects can and should be planned and managed intuitively. The rest require systematic planning and control. Over the past 30 years, planning and programming have been fundamental building blocks in any project management and control system and, in some organisations, are given equal weight with the budgeting and cost management functions.

CPM is the planning technique most commonly used in the construction industry today and is based on the same critical path analysis principles established in the 1950s. In Chapter 2, the principles of construction planning and programming are explained. These techniques are fundamental in enabling a project to be successfully managed. CPM programming is a tried and tested method and is today essentially unchanged from the earliest applications almost 60 years ago. The chapter describes the essential elements of a successful project through the planning and programming phase and identifies the pre-construction tasks which not only are prerequisites to effectively planning a project but also, conversely in the case of insufficient pre-construction planning, can result in programmes being developed which contain inherent delays.

The stages and life cycle of a construction project are described in detail. The project planning stage is the most important to the development of an effective baseline programme. During the planning stage, the project definition is established. Executing a successful project requires a significant pre-construction effort which questions the underlying assumptions and business case for the project. During this stage, the professional team considers such issues as whether a project is feasible and buildable, whether any new or novel method of construction will be required and whether there are technical, geographical, time and/or financial constraints which would prevent the success of a project.

Chapter 2 also discusses the process of preparing a construction programme, the creation of a work breakdown structure and the fundamentals of CPM programming.

A significant aspect of delay analysis is the interrogation of records upon which reliance will be placed in analysis output. Accordingly, the need for good records and the various categories of required record keeping are explained. Finally, there is a cautionary note on predatory programming practices which should be avoided, along with advice as to how to detect and defend against each.

1.2 Construction delays

1.2.1 Identifying delays

The identification and assessment of delay entitlement can be difficult and time-consuming. When any degree of complexity is introduced to the mix, it can become particularly difficult for project staff who are often overworked dealing with site issues and other project demands, and who may also be untrained in forensic analysis or programming skills. This often manifests itself as a poor strike rate in achieving extensions of time entitlements by contractors. When the employer's team lacks these skills and awareness, the risk is created of granting inadequate or excessive extensions of time to contractors. To be successful, a time extension claim should adequately establish causation and liability and assist in demonstrating the extent of time-related damages or disruption costs experienced as a direct result of the delay events relied upon. The purpose of delay analysis is to satisfy the causation requirement in such a way that it can be used to assess the resulting damages.

Establishing a basis for identifying delay is the first topic dealt with in Chapter 3. This chapter also deals with the construction phase of a project, as that is generally where the bulk of a project budget is usually dedicated. The construction phase is also the phase in which design delays, or lack of sufficient pre-construction planning, will often culminate into critical delays to completion, as measured by delays to site activities.

Delays may be categorised as excusable, non-excusable, compensable and non-compensable. When demonstrating that a delay is both excusable and compensable, the delay must be shown to be critical, by reference to a reliable critical path analysis. The tests which must be satisfied for a delay to be considered excusable and compensable are described and discussed in Chapter 3.

The carrying out of a successful delay analysis requires the preparation of a reliable as-planned programme and an accurate as-built programme. The effectiveness of delay analysis techniques can be greatly increased when it can be demonstrated that the as-planned programme was reasonable. Further discussion on as-planned programmes is also to be found in Chapter 2. The as-planned or baseline programme is useful contemporaneous evidence of a contractor's original intentions and should serve as the starting point when identifying delays. Unfortunately, there are many ways in which as-planned and progress programmes can be manipulated. Chapter 3 highlights checks that should be made to validate the reliability of such a programme before it should be used for any method of delay analysis.

One of the main objectives of delay analysis is the establishment of a factual matrix and a chronology of the events which actually delayed the project's completion date. One important use of this data is to assist in the preparation and/or validation of an as-built programme. In the ideal situation, an as-built programme will have been prepared and maintained during the course of the works. The data required to periodically maintain and update a project programme can also be relied upon when forensically constructing an as-built programme. The primary sources of raw data required for the compilation of an as-built programme are discussed in Chapter 3, together with a cautionary note about the use of lazy scheduling practices, such as the overuse of constraints, negative