Project Services Pty Ltd

ASSESSING DELAY AND DISRUPTION TRIBUNALS BEWARE

Presented at

Hilton Hotel, Sydney
16th – 18th June 2011

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Abstract:

A key area of claim present in most contractual disputes involves assertions of delay with associated disruption and/or acceleration costs[1]. Adjudicator's determinations have been successfully challenged based on the failure of the Adjudicator to allow parties to comment on the methodology used to determine the delay.

This paper is designed to help ADR and legal professionals understand the options available to disputants in assessing 'delay' to help them quickly cut through the fog of expertise present in many major disputes to achieve a speedy determination. The paper will:

- Outline the current 'state of play' with regards to the practice of scheduling.
- Describe the origins, strengths and weaknesses of 'Critical Path' scheduling.
- Describe the nine models and four primary approaches to delay analysis, their strengths, and weaknesses:
  - As-Built v As-Planned
  - Impacted As-Planned
  - Collapsed As-Built
  - Window Analysis and its variant, Time Impact Analysis
- Describe the type of record needed to support each type of analysis
- Consider the impact of *Costain Ltd v Charles Haswell & Partners Ltd [2009] EWHC B25 (TCC) (24 September 2009)* on some of these analyses.
- Differentiate between delay and disruption
  - Disruption without delay to the overall project
  - Delay without disruption
  - Delay causing disruption
- Suggest some questions a tribunal may choose to direct to various scheduling experts appearing before them to ascertain the robustness of the evidence being presented to help turn the mass of data typically accumulated in a 'claim' into information.

Whilst the arena belongs to the parties, a knowledgeable tribunal can help achieve a quicker, more just outcome. This presentation will be written to help non-experts see through the 'smoke and mirrors' of schedule claims to understand what's likely to be real, what's feasible and what's hyperbole.

Introduction

Most contracts include an explicit promise that the contractor will complete the works within a specified period and an implicit requirement that the client will avoid delaying the work of the contractor. Where delays do occur, there are implicit, and frequently explicit, requirements to compensate the disadvantaged party. These legal principles have been firmly established for well over 100 years, what is less well established is an effective means of determining the extent of a delay that is simple, effective, and impartial. This lack of precision

[1] The cost aspects of a claim are discussed in ***Delay, Disruption and Acceleration Costs***: https://mosaicprojects.com.au/PDF_Papers/P035_Disruption.pdf

has led to a plethora of approaches supported by experts that can confuse the most experienced tribunal.

The late completion of a contract is usually obvious! Consequently, the assessment of delays tends to focus on firstly identifying the specific cause of each individual delay throughout the life of the project, then assessing the extent of each delay, and then finally attributing responsibility for the delay.

This paper is based on the ***AACE® International Recommended Practice 29R-03 Forensic Schedule Analysis***[2](R29-03). Its purpose is to provide a unifying reference of basic technical principles and guidelines for the application of critical path method (CPM) scheduling in forensic schedule analysis. In providing this reference, R29-03 will foster competent schedule analysis and furnish the industry as whole with the necessary technical information to categorize and evaluate the varying forensic schedule analysis methods.

R29-03 discusses certain methods of schedule delay analysis, irrespective of whether these methods have been deemed acceptable or unacceptable by courts or government boards in various countries around the globe. R29-03 is not intended to establish a standard of practice, nor is it intended to be a prescriptive document applied without exception. Therefore, a departure from the recommended protocols should not be automatically treated as an error or a deficiency provided such departure is based on a conscious and sound application of schedule analysis principles.

This paper is designed to offer a brief summary of the various ways an assessment of each delay and/or disruption can be accomplished and then highlight the strengths and weaknesses of each method defined in R29-03; and yes, different methodologies will produce different answers!

The Legal Framework

A fundamental tenet of natural justice is the parties to a dispute have a right to know the basis any decision made by a tribunal. This means being made aware of the case put by the opposing party and any independent assessment made by the tribunal. The cases below should be contrasted with the approach taken by the Judge in *White Constructions Pty Ltd v PBS Holdings Pty Ltd [2019] NSWSC 1166* concerning an alleged delay in the construction of a 100-lot subdivision on the NSW South Coast resulting from delays in approving the sewer design. Delay experts were engaged by the parties, but the evidence of the experts was mutually contradictory. The presiding Judge, Justice Hammerschlag noted:

[18] Plainly, both experts [Mr Shahady and Mr Senogles] are adept at their art. But both cannot be right. It is not inevitable that one of them is right.

[22] The expert reports are complex. To the unschooled, they are impenetrable. It was apparent to me that I would need significant assistance to be put in a position to critically evaluate their opinions and conclusions.

[2] The other primary reference for assessing delay and disruption is The Society of Construction Law ***Delay and Disruption Protocol*** (2nd edition). The similarities and differences in approach between the SCL Protocol and AACEi RP 29-03 is the subject of ***Assessing Delay – the SCL Options***: https://mosaicprojects.com.au/PDF_Papers/P216_Assessing_Delay_The_SCL_Options.pdf

As a consequence, the Court used its powers to appoint Mr Ian McIntyre as its expert. But, this was done with the knowledge and agreement of the parties, and both parties had the opportunity to respond to the report prepared by Mr McIntyre.

St Hilliers Contracting Pty Limited v Dualcorp Civil Pty Ltd [2010] NSWSC 1468 6th December 2010

Sourced from The Arbitrator and Mediator, April 2011, p104

One of the grounds for the Adjudicator's decision being put aside was the failure of the Adjudicator to demonstrate in her reasoning the basis for her determination that the work of Dualcorp had been delayed by variations. Dualcorp had not demonstrated it was delayed and had not provided a contract program or demonstrated any impact on the critical path. The Court stated:

> *[The Adjudicator's] approach discloses no logical or rational reasoning process for the conclusion the delay was at least in part attributable to variations and in my view reflects a failure by the Adjudicator….*

Balfour Beatty Construction Limited v The Mayor and Burgess of the London Borough of Lambeth [2002] EWHC 597 (TCC)s

His Honour Judge Humphrey Lloyd QC

51. Before looking at the "final as-built programmes" exhibited by Balfour Beatty (BB), Lambeth would make passing reference to the delay analysis methods most widely recognised and used:

    (I) Time Impact Analysis (or "time slice" of "snapshot" analysis). This method is used to map out the impacts of particular delays at the point in time at which they occur permitting the discrete effects of individual events to be determined.

    (II) Window analysis. For this method the programme is divided into consecutive time "windows" where the delay occurring in each window is analysed and attributed to the events occurring in that window.

    (III) Collapsed as-built. This method is used so as to permit the effect of events to be "subtracted" from the as-built programme to determine what would have occurred but for those events.

    (IV) Impacted plan where the original programme is taken as the basis of the delay calculation, and delay defaults are added into the programme to determine when the work should have finished as a result of those delays.

    (V) Global assessment. This is not a proper or acceptable method to analyse delay.

52. It is Lambeth's case that the programme of BB does not conform or comply with any of the recognised and accepted delays analysis methods. Further all that it has provided by BB is a claim in the most global of natures.

However, without using any of the above methods, the Adjudicator was able to determine:

6.41 I consider that the above analysis is such as could have been carried out by the Architect in the absence of the detailed particulars that should always be preferred.

6.43 I determine that the Referring Party is entitled to an extension of time of thirty-five weeks and one day, creating a Date For Completion, in the terms of the contract, of 10 April 2001, some six weeks and two days prior to the Date of Practical Completion.

Lambeth argued successfully:

21. On the facts Mr. Acton Davis submitted that the adjudicator had not acted impartially or had been in breach of the rules of natural justice since:

(1) Neither party had presented a critical path analysis to the adjudicator.

(2) Lambeth had submitted to the adjudicator that the material provided by BB did not establish its claim.

(3) The adjudicator himself constructed or had constructed for him a chart (an "as-built programme") which combined the as-built record on one sheet and had drawn on that chart a representation of a critical path through the work as actually carried out.

(4) That conclusion from the as-built chart had not been presented to the parties for their comment.

(5) The decision and the extension of time had been based on that critical path since the decision contained numerous references to "critical" and "non-critical" matters.

(6) In addition, the adjudicator apparently adopted a "collapsed as-built" analysis from which he arrived at his conclusion as to what was "critical" and "non-critical" for the purposes of his decision.

(7) Lambeth was not given any opportunity to comment on the propriety of such an analysis which the adjudicator elected to adopt or on its use even though it had in its submissions drawn attention to the fact that there were four possible ways of analysing the delay.

(8) Finally, Lambeth were not given the opportunity to deal with the conclusions which the adjudicator intended to draw or in fact drew from the application of that analysis.

The other key requirement is to prove the claim! An extension of time to the completion date of a contract requires the delay to the completion to be proved. A delay in the middle of a distributed project[3] requires the mapping of the consequences through to completion.

[3] The challenge of assessing delay to a project that has a number of discrete elements that can be built in almost any sequence is considered in ***Schedule control in Agile and Distributed projects***: https://mosaicprojects.com.au/PMKI-SCH-010.php#Issues-A+D

Costain Limited -and- Charles Haswell & Partners Limited 2009] EWHC B25 (TCC)

Richard Fernyhough QC

Summary [of the delay claims]

200. For the reasons set out above, I have reached the following conclusions on the disputed issues as to the correct basis for calculation of the critical delay to the project caused by the late decision to pile the foundations on the RGF and IW:-

(i) I prefer the application of the agreed methodology made by Mr. Purbrick over that of Mr. Crane. It seems to me to be more in accordance with a Time Impact Analysis approach.

(ii) I find that it has not been shown by Costain that the critical delay caused to the project by the late provision of piled foundations to the RGF and IW buildings necessarily pushed out the contract completion date by that period or at all. Nor has Costain established that all activities on the Lostock site were delayed between October 2002-January 2003 by the delaying events. No investigation has been carried out by the experts to establish that one way or the other so, as matters presently stand, it is simply a matter of speculation.

(iii) I am not satisfied that mitigation measures to reduce the existing critical delay to the TWR were put in place or became effective prior to the decision to pile the foundations on 25 October 2002. That being so, it seems that, prior to that date, no critical delay was caused to the project by any matters for which Haswell is responsible.

(vii) I find that the case advanced on behalf of Costain in relation to winter working fails on the basis that it is purely theoretical and not supported by any firm evidence or opinion from the experts.

Author's Commentary

Based on the above judgements, the precedence is now quite clear:

1. Both the Balfour Beatty and St Hilliers judgements support the view that a delay must be assessed using a reasonable methodology that is defined and preferably agreed (the focus of this paper).
2. The Costain judgement adds the requirement that the effect of a delay needs to be traced through to the project completion (or a key interim milestone).

   Despite establishing liability against Haswell, Costain failed to provide sufficient evidence to show that the delay to a small part of the overall project while the piled foundations were installed had resulted in a similar delay to the project completion date.

   The parties had each engaged programming experts. Both experts agreed that a "time impact" analysis was the most appropriate method to assess delay and they agreed upon a baseline programme and the as-built data. Both experts agreed that the construction of the piled foundations was on the critical path and had resulted in a critical delay to the project and both agreed that, in the absence of subsequent mitigation or acceleration by Costain, the delays caused by Haswell's negligent design would result in a similar length of delay to the project as a whole.

   However, both experts had only considered the period up to the time when the design and installation of the piled foundations was complete. They had not conducted any

analysis of the impact on the project completion date of a number of other causes, which were not the responsibility of Haswell and which had affected other structures on the site[4]. Costain was therefore unable to satisfy the Court that Haswell's negligence was the cause of an equivalent period of delay to the project completion date, Richard Fernyhough QC:

> *"In the absence of any analysis between all the operative delays from the start to the finish, which is absent in this case, in my judgment it is simply not possible for the Court to be satisfied on the balance of probabilities that the assumption upon which this part of Costain's case depends, is correct."*

Consequently, Costain failed in its claim for time related prolongation costs and only recovered the additional costs of installing the piled foundations.

The Critical Path Method

Origins

The Critical Path Method (CPM) of schedule development and analysis was invented in 1957, long after most of the legal precedents concerning liquidated damages, delay and disruption costs were firmly established.

The advantage of CPM over earlier time management tools was firstly, the logical interconnection of activities are shown in a simplified model that allowed the flow of work to be defined and the work that directly affected the completion date (the critical path) to be separated from work that had a degree of scheduling flexibility (float). The second key advantage was the ability of the model to calculate the effect of a change. This was seen as a huge advantage over static representations such as bar-charts that had been used for the previous century[5].

Strengths and weaknesses of CPM

CPM is not perfect; it is a simplified model that will result in different outcomes depending on the choices made by the schedule developer. Some of the subjective decisions built into every schedule include:

- Determining the way each of the tasks defining the work will be interconnected.
- Determining the duration for each task[6].

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4 The 'Costain' project can be described as a 'distributed project' involving several independent structures spread across a large site. Assessing delay and disruption requires a different approach, see ***Costain vs Haswell Revisited***: https://mosaicprojects.wordpress.com/2023/03/25/costain-vs-haswell-revisited/

5 For more on the origins of scheduling see: ***A Brief History of Scheduling*** at: https://mosaicprojects.com.au/PMKI-ZSY-020.php#Overview

6 See: ***The Cost of Time - or who's duration is it anyway?*** - https://mosaicprojects.com.au/PDF_Papers/P009_The_Cost_of_Time.pdf

- Calculating Float and the Critical Path[7].
- The choice of scheduling tool and calculation options (switches) selected[8].

This subjectivity is inherent in the CPM methodology, Tribunals need to be aware of the subjectivity and ensure the parties have addressed the issue.

The CPM approach to scheduling models the project's workflow by defining activities and their logical dependencies. However, the capacity to actually do the work is a factor of the recourses available to the project, how they are deployed and the efficiency of their use. Very few of the currently available scheduling tools analyse resource requirements effectively and the 'resource levelling' process generates unpredictable outcomes. Different software tools apply different rules to smooth out resource demand. The rules may be simple, *allocate scarce resource to critical activities first* or they may be complex decision tables; most software has 100s of combinations of options that produce different results from the same data.

A resource levelled schedule balances resources (not tasks) therefore any change in the timing of any task may unbalance the resource levelling and cause disruption, therefore arguably, there can be no 'float' in a resource levelled schedule (even if the task is scheduled before the time analysis late dates). It is necessary to re-analyse the schedule to test the consequences of shifting a task in time.

The critical flow of work is determined by the movement of the critical resources not the logic of the schedule. The schedule logic remains a constraint on the sequencing of work, but it is the resource availability that determines the actual timing of the work. There may be spare resource capacity, but not CPM time based 'float'.

CPM does not have a defined concept of resource critical paths. Consequently, defining the 'resource critical path' is difficult, and the path is often discontinuous - driven by movements of resources. Assessing claims for delay and disruption become very difficult in this situation; but you can't ignore resources, they do the work!

Current use of CPM

Studies have consistently shown the use of CPM and effective practices in the management of the use of time are at a low ebb. The demand for skilled schedulers significantly exceeds availability and many organisations simply fail to develop or use effective schedules to assist with the management of time within their projects[9]. As a consequence, for many disputes, the schedules being used by the parties' experts are created after the event making them subjective views of what may have been intended or occurred rather than the contemporaneous views of the parties at the time – hind-sight is always going to bias opinion.

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7 See: ***Float - Is It Real?*** - https://mosaicprojects.com.au/Mag_Articles/P005_Float_is_it_real.pdf

8 For more on schedule calculations see: ***Core Scheduling Paper #7*** (pages 18 & 19) - https://mosaicprojects.com.au/PDF-Gen/Schedule_Calculations.pdf

9 Mosaic is part of an international effort to remedy this situation, develop scheduling certifications and train schedulers. See: ***The need for good scheduling practice*** - https://mosaicprojects.com.au/PMKI-SCH-007.php

Methods of delay analysis

As with decisions on how to construct the schedule, the selected method of delay analysis will provide different information and usually different net results. Experts tend to want to select the option best suited to their client's objectives. The Balfour Beatty judgement above suggests this is a key point to resolve early.

The forms of assessment discussed below are based on the AACE® International Recommended Practice No. 29R-03, ***Forensic Schedule Analysis*** (RP29-03)[10]. Published 25th April 2011, RP29-03 is the standard guidance used in construction law within the USA court systems[11]. The UK courts and many Commonwealth jurisdictions, including Australia, are increasingly tending to prefer the ***Society of Construction Law Delay and Disruption Protocol, 2nd edition*** (SLC Protocol)[12].

It is important to recognise different methodologies suit different situations, depending largely on the information available. It is also important to recognise the difference between prospective assessments made during the course of the project, and retrospective assessments made at the end.

- **Prospective** analyses are performed in real-time prior to the delay event or in real-time, contemporaneous with the delay event. In all cases prospective analysis consists of the analyst's best estimate of future events. This type of analysis is usually by the superintendent, client, or engineer, based on a claim submitted by the contractor. Contracts typically require both the claim and the assessment to be made within relatively short time periods after the delay event occurs.
- **Retrospective** analyses are performed after the delay event has occurred and the impacts are known. The timing may be soon after the delay event but prior to the completion of the overall project, or after the completion of the entire project.

RP29-03 focuses on the methods suitable for use at the end of a project, the normal time for a dispute to have occurred and made its way into an arbitration, or court of law. In most situations there appears to be a strong consensus across most forensic analysis expert that a well-constructed CPM schedule is the optimum way to model delays. RP29-03 at clause 1.3.h. states *"This RP deals with CPM-based schedule analysis methods. It is not the intent of the RP to exclude analyses of simple cases where explicit CPM modeling may not be necessary, and mental calculation is adequate for analysis and presentation."*

The recommended practice defines nine methods for analysing delay[13]:

- 3.1. Observational / Static / Gross (MIP 3.1) *As-planned vs. as-built*

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[10] A copy of International Recommended Practice No. 29R-03 may be purchased from: https://www.aacei.org/resources/publications/recommended-practices

[11] AACE® International, The Association for the Advancement of Cost Engineering, have developed a series of *recommended practices* for the assessment and management of claims. These practices are widely used by experts in the field of forensic schedule analysis, particularly in the USA. For more information see: http://www.aacei.org

[12] The similarities and differences in approach between the SCL Protocol and AACEi are the subject of other papers, see ***Assessing Delay – the SCL Options***: https://mosaicprojects.com.au/PDF_Papers/P216_Assessing_Delay_The_SCL_Options.pdf

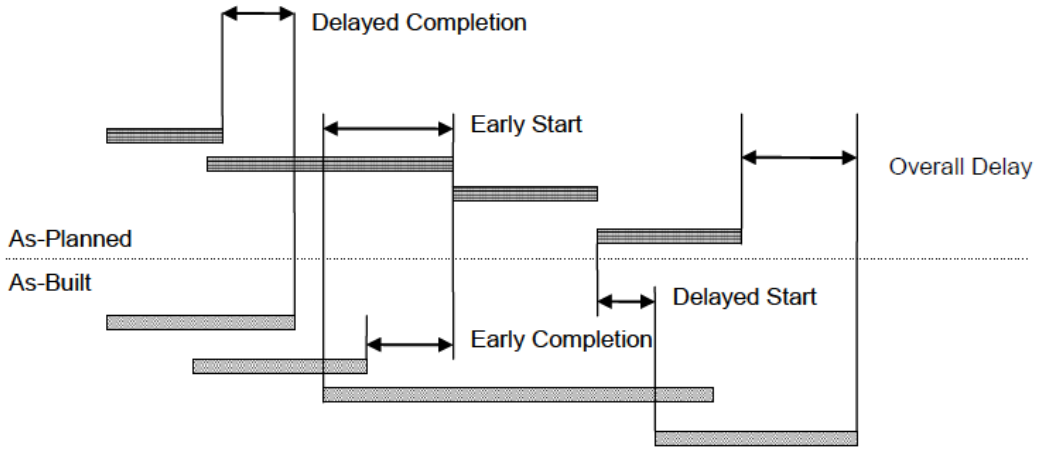
[13] **Note**: each method has several common names listed in the relevant section, the most common name is included in this table.

- 3.2. Observational / Static / Periodic (MIP 3.2) *As-planned vs. as-built 'window'*
- 3.3. Observational / Dynamic / Contemporaneous As-Is (MIP 3.3) *Update analysis ('window')*
- 3.4. Observational / Dynamic / Contemporaneous Split (MIP 3.4) *Two-stepped update analysis ('window')*
- 3.5. Observational / Dynamic / Modified or Recreated (MIP 3.5) *Reconstructed Update Analysis*
- 3.6. Modeled / Additive / Single Base (MIP 3.6) *Impacted As-Planned*
- 3.7. Modeled / Additive / Multiple Base (MIP 3.7) *Time Impact Analysis*
- 3.8. Modeled / Subtractive / Single Simulation (MIP 3.8) *Collapsed As-Built*
- 3.9. Modeled / Subtractive / Multiple Base (MIP 3.9) *Windowed Collapsed As-Built*

As-Planned v As-Built (AACE MIP[14] 3.1)

Observational / Static / Gross. This is an observational approach to determine an overall outcome. The 'as-built' schedule is compared to a baseline schedule and the differences noted.

This method can be performed using a simple graphic comparison of the as-planned schedule to the as-built schedule. The application of this methodology involves the sequential comparison of individual activities planned start and finish dates with actual start and finish dates. Through this comparison, a detailed summary of the delays and/or accelerations of activities can be identified. Generally, it is best to compare the late planned dates from a CPM schedule, rather than the early dates.



RP29-3, Figure 3 – Observational, Static, Gross Analysis Method Graphic Example

However, this approach is very limited in its ability to define separate cause and effect when there are multiple issues involved which is why it is frequently used to support ***Global Claims***

[14] **MIP** = Method Implementation Protocols (MIP)

which record all causes of delay and ascribe the overall result to a combination of these causes rather than linking particular causes to particular results.

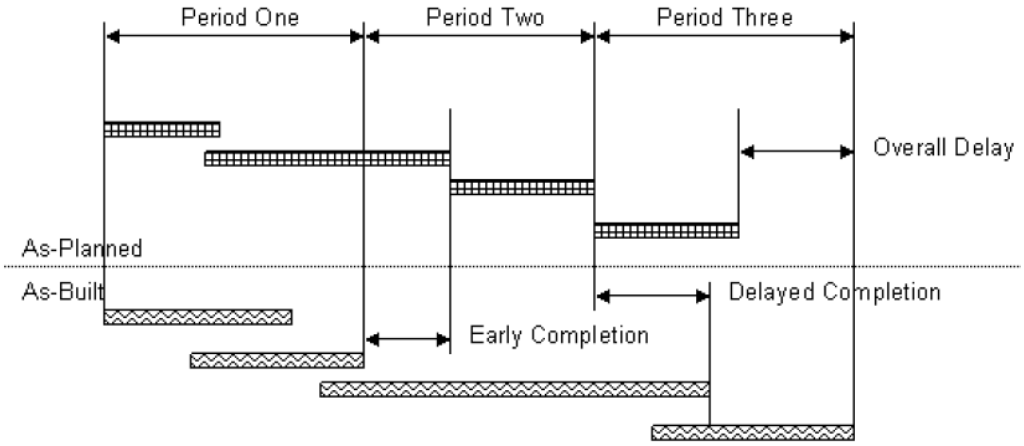
Narrative Claims are a more sophisticated version of a global claim which describes all relevant delay factors and all of the factors which prevent or inhibit mitigation acceleration or recovery and seek the maximum contract extension of time. Whilst appearing to be more informative than a *global claim*, the expert's assessment still lacks any form of rigour and therefore fails to prove (or disprove) the assertions being put.

This approach is not usually accepted as a reasonable basis of claim, particularly if the accuracy of separating complex interactions is imprecise and subjective (refer comments in Balfour Beatty above). In all but the simplest of claims, the expert's opinion will lack the supporting proof available from more rigorous methodologies. However, prior to the development of CPM in 1957, this was the only practical method for assessing delays.

As-Planned v As-Built 'Window Analysis' (AACE MIP 3.2)

Observational / Static / Periodic. This approach is similar to the overall approach described in MIP 3.1 above.

The key difference is the assessment is made within specific windows (usually analysed sequentially) so that the effect of different rates of progress in different phases of the project can be assessed. This methodology still has many of the limitations outlined above.



RP29-3, Figure 4 – Observational, Static, Periodic Method Graphic Example

Update Analysis (AACE MIP 3.3)

Observational / Dynamic / Contemporaneous As-Is. This approach uses a contemporaneous update of the schedule 'as-is' to identify changes (usually delays) to date and assign causes. As with the first two methods outlined above this is an 'observational' approach rather than an analytical approach.

This method is useful for dealing with assessments of delays during the course of the project, relying on the schedule 'as-planned' to the left of the data date to assess the effect on the

overall completion date. However, a contemporaneous schedule update is essential if this methodology is to be applied.

Two-Step Update Analysis (AACE MIP 3.4)

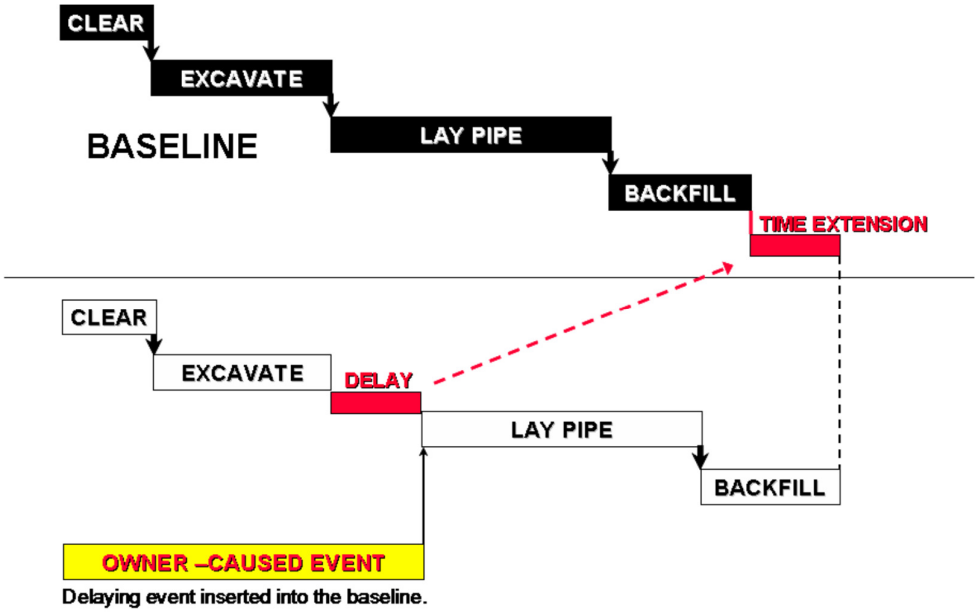
Observational / Dynamic / Contemporaneous Split. This method is a dynamic adaptation of MIP 3.3. The key difference in approach is initially the schedule is simply updated with progress data and a version stored (Step 1). Then the schedule logic is adjusted to optimise future work and reflect the actual work as-preformed. (Step 2)[15]. By splitting these processes more information and insight is available to the analyst to determine the cause and effect of delays. This is probably the best of the contemporaneous assessment methodologies for use in the month-by-month assessment of delays.

Reconstructed Update Analysis (AACE MIP 3.5)

Observational / Dynamic / Modified or Recreated. This approach is similar to MIP 3.3 and 3.4 but uses reconstructed updates. It is only valid if there are no contemporaneous updates and lacks the advantage of direct cause-and-effect analysis described in some of the methodologies below.

Impacted As-Planned (AACE MIP 3.6)

Modeled / Additive / Single Base. This approach is based on the as-planned CPM model and inserts the delay event to calculate the effect on overall completion.



RP29-3, Figure 5 – Graphic Example: Modeled, Additive, Single Base

[15] This approach to statusing then updating the schedule is consistent with recommended best practices in effective time management, see: ***Managing for Success - The power of regular updates*** – download from: https://mosaicprojects.com.au/PMKI-SCH-014.php#Process6

The methodology can be applied holistically (globally inserting all events or incrementally (inserting one event at a time) and demonstrates the effect of the inserted events. The primary limitation with this approach is the inability to model the effect of other delaying events (usually caused by the contractor) which may override the effect of the identified events. Consequently, the outcome is a hypothetical view of 'what may have been' assuming the rest of the project was undertaken exactly 'as-planned'.

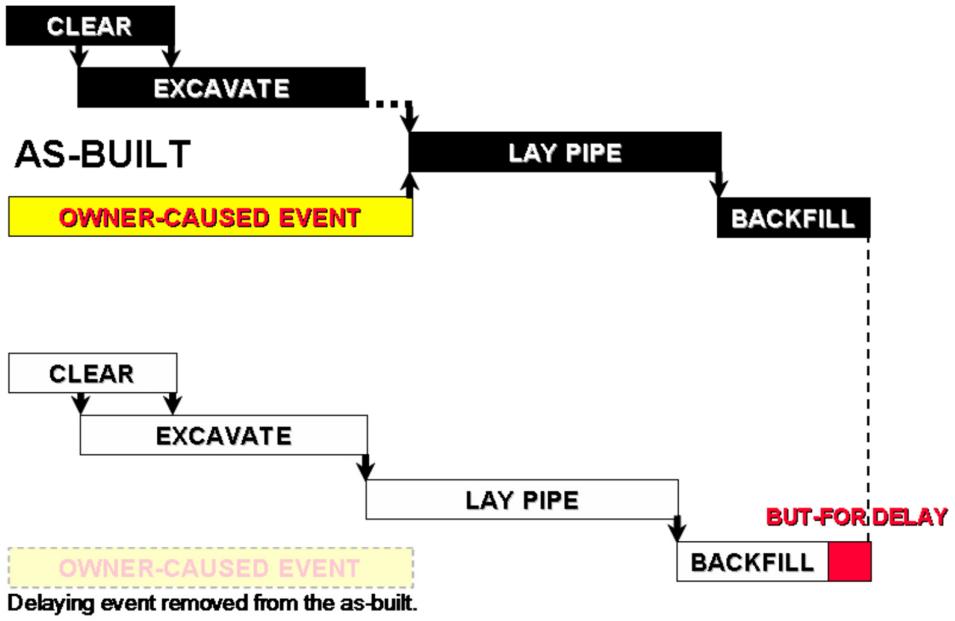
Time Impact Analysis (AACE MIP 3.7)

Modeled / Additive / Multiple Base. This methodology is similar to MIP 3.6 but the intervening event is applied to an updated schedule that represents the status of the project immediately prior to the event occurring. This is a form of 'windows' analysis as the effect of the delay is assessed based on a contemporaneous baseline and multiple actual baselines may be used for different delays at different stages of a project.

This is probably the most accurate of the forward-looking delay assessment options available during the course of the work being based on a dynamic model that has been accurately updated to reflect the current situation prior to the occurrence of the intervening event.

Collapsed As-Built (AACE MIP 3.8)

Modeled / Subtractive / Single Simulation. This methodology is the best of the retrospective assessment options. Based on an accurate as-built schedule that reflects what actually happened on the project, activities are removed or activity durations reduced to remove the effect of a delaying event. The resulting reduction in the overall duration of the schedule is the net effect of the delays.



RP29-3, Figure 6 – Graphic Example: Modeled, Subtractive, Single Simulation

To calculate the true effect of an intervening event it is usually necessary to consider contemporaneous delays. These are delays in other parts of the network that are independent of the intervening event but may represent issues such as 'pacing delays' where the contract slowed down other work to minimise disruption caused by the intervening event or simply an area of work where the contractor failed to operate as-planned but the delay was not the controlling delay.

Windowed Collapsed As-Built (AACE MIP 3.9)

Modeled / Subtractive / Multiple Base. This methodology is identical to MIP 3.8 with the exception the as-built schedule used is an accurately updated schedule, updated at the point, or shortly after the delaying event finished. This provides an accurate option for assessing the contemporaneous effect of a delay either shortly after the event or retrospectively. This approach removes issues such as subsequent acceleration of parts of the work from the assessment of the actual delay.

Unlike MIP 3.3 and 3.4, there is no reliance on an 'as-planned' element of the schedule to assess the impact of the delay.

Best Option to use?

AACE provide the following table outlining the appropriate us of the various methodologies (MIP #).

Forensic Use of Analysis	METHOD								
	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9
Non-Compensable Time Extension	OK	OK	OK	OK	OK	OK	OK	OK	OK
Compensable Delay	OK	OK	OK	OK	OK			OK	OK
Right to Finish Early Compensable Delay								OK	OK
Entitlement to Early Completion Bonus	OK	OK	OK	OK	OK	OK	OK	OK	OK
Disruption Without Project Delay	OK	OK	OK	OK	OK	OK	OK		
Constructive Acceleration				OK		OK	OK		

In Australia and the UK my feeling is the use of options 3.1 and 3.2 (As-Planned v As-Built) would only develop a supportable claim in the simplest of circumstances. Options 3.3, 3.4 and 3.5 based on schedule updates are likely to be more reliable but are still 'observational' rather than analytical.

Options 3.6 and 3.7 based on adding delays to the 'as-planned' schedule are limited to assessing factors that do not incur delay related costs when used retrospectively. However, this is the only effective way to assess delays prospectively (ie, the anticipated effect of a delay in the future).

Options 3.8 and 3.9 based on the collapsed As-Built provide the most rigorous assessment of the actual impact of delay claims but the modified nature of the CPM model used in this assessment prohibits their use for assessing acceleration and disruption to the planned course of work.

Deciding on the best approach to use requires expertise and should be consistent between the work done 'on site' by the project controls staff and the expert brought in to provide expert testimony at trial[16]. If divergent approaches are used, the reason for the difference needs to be explained by the expert.

Authoritative References

Applying any of the methodologies described above requires skill and to a greater or lesser extent, all of the options are open to manipulation. The 'Windowed Collapsed As-Built' is probably the most reliable option but is reliant on an accurately updated schedule to reflect the work as-built at a point shortly after the intervening event occurred. There are a range of references available to assist both experts and tribunals in determining the appropriateness of the approaches used. This paper is based on three current documents:

1. ***AACE® International Recommended Practice No. 29R-03 FORENSIC SCHEDULE ANALYSIS*** (April 2011 edition). Available for downloading from https://web.aacei.org/. This practice note formed the basis of the paper and the 'MIP' references.
   Note: 29R-03 contains significant advice and commentary beyond the summary included in this paper.
2. ***Forensic Scheduling Body of Knowledge*** written by Gui Ponce de Leon and published by PMA consultants LLC. This book augments the AACE ***Practice Note*** with useful advice on the practice of developing and assessing claims.
3. ***The Delay and Disruption Protocol*** (2nd Edition) published by the Society of Construction Law (UK). Available for downloading from https://www.scl.org.uk/resources/delay-disruption-protocol. This protocol sets out a useful framework for evaluating delays and the cost of disruption.

[16] Expert testimony rules in the USA based on Daubert v Merrell Dow Pharmaceuticals Inc., 549 US 579 (1993) requires:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education, may testify thereto in the form of an opinion or otherwise if
(1) the testimony is based upon sufficient facts or data,
(2) the testimony is the result of reliable principles and methods, and
(3) the witness has applied the principles and methods reliably to the facts of the case.

This requirement is likely to significantly limit the use of observational assessments (3.1 to 3.5 above) in the American courts and is likely to advise considerations in other jurisdictions.

Supporting a claim or assessment

Intervening events are occurrences that were not originally planned that may adversely affect productivity and/or progress. The effect of many intervening events will be initially identified as a delay to progress identified during a schedule update.

For the purpose of management of time, it is important to consider all such events, irrespective of liability and, if disputes are to be avoided, all intervening events and their consequences should be agreed on a rolling basis.

The recording of the event and its effect will require capture of the following information[17]:

- a unique event identifier;
- description of the event;
- originator and/or authoriser;
- relevant contract clauses providing for extension of time (if any);
- relevant contract clauses providing for compensation (if any);
- date upon which the event is instructed/occurred;
- responsible parties;
- the activities added, changed or omitted in the schedule;
- the labour and plant resources for each added or changed activity;
- the date and timing of the added or changed activities;
- the location in which any added work was carried out;
- the work-flow process adopted in carrying out the change.

It is also necessary to clarify whether events have happened sequentially, in parallel, concurrently, or simply to keep pace with other work[18]. This will assist in distinguishing the effect of one event from that of another, and;

- will determine the calendar date after which an event can possibly have an effect;
- may determine the point from which a notice under the contract may be required to be given;
- may determine the time at which statutory limitation of liability provisions commence.

Concurrent delays are a normal occurrence. When assessing liability determining which delay is the 'controlling delay' and which are secondary is critical. Consequently, the logic of each intervening event should be set out clearly, together with the activity that it affects, and the way the event affected it.

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[17] This recommended set of information is derived from ***The Guide to Good Practice in the Management of Time in Complex Projects*** and is covered in detail in Mosaic's publication ***Easy CPM***: https://mosaicprojects.com.au/shop-easy-cpm.php

[18] The assessment of concurrent delays adds significant complexity to the overall delay assessment process. For a discussion of the issues see Mosaic White Paper ***WP1064 Concurrent and Parallel Delays***: http://www.mosaicprojects.com.au/WhitePapers/WP1064_Concurrent-Delays.pdf

Delay -v- Disruption

Following the publication of ***The Delay and disruption Protocol***, most authorities have recognised the entitlement to an extension of time (EOT) to compensate for a delay, and entitlement to recompense for the disruption caused as a consequence of a delay are not automatically linked.

A delay may be sub-critical and not cause an entitlement to an EOT but cause significant cost in relocating workers and reorganising the work. Conversely, a fully justifiable EOT may cause virtually no disruption because the contractor had no-one engaged in the area subject to the delay[19].

Three key questions for Tribunals

1. **Voracity of the schedule model** - has the schedule model been shown to accurately represent the work that occurred during the course of the project? If the schedule model is not reasonable and agreed, any computation will be meaningless.
2. **Balfour Beaty / St Hilliers** - has an appropriate methodology been defined and used to assess the delays? *'Global claims'* are probably not appropriate in the current age and if an undefined or flawed methodology is used, the basis of claim is largely meaningless.
3. **The Costain's question** - have the effects of the delays been traced through to the completion of the project? Disruption may be caused by a delay that has no overall effect on completion, but for an Extension Of Time (EOT) to be granted that may give rise to prolongation costs and/or relief from damages, the delay must affect the actual completion of the project (or a contracted interim Milestone).

If there are sensible answers to these three questions the basis of claim is likely to be reasonable and therefore a decision on the merits of the issues can be safely made[20].

Conclusions

There is a significant amount of work being undertaken around the world on developing standardised approaches to the assessment of delay and disruption on projects, primarily in the construction and engineering industries but by no means limited to this type of project. The experts in this field are making a significant effort to align ideas and approaches.

Unfortunately, far too many contractors ignore the need for effective time management and fail to maintain effective contemporaneous records to assist in the definition, understanding and assessment of delay claims. The question not answered by this paper is how much

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[19] For more on the cost implications of delay and disruption see: ***Delay, Disruption and Acceleration Costs*** - http://www.mosaicprojects.com.au/PDF_Papers/P035_Disruption.pdf

[20] **Note**: The prerequisite for applying any of the analysis options discussed in this paper is a well-constructed CPM schedule. This is unlikely to be found in agile and distributed projects, CPM is simply not an effective paradigm in projects where the flow of work is open to regular change. For this type of project see: ***Assessing Delays in Agile & Distributed Projects***: https://mosaicprojects.com.au/PDF_Papers/P215_Assessing_Delays_In_Agile_+_Distributed_Projects.pdf

leniency should be allowed by a Tribunal to offset the poor practices of a contractor attempting to establish a delay claim? My personal view is tending towards requiring an effective proof of delay based on rigorous analysis – no proof, no payment!

First Published 17 June 2011 – Augmented and Updated