



WHAT IS DELAY ANALYSIS

Delay analysis may be understood as an analysis of time. More specifically, it is the systematic study of events, activities, and project circumstances that are said to have affected the planned progress of the works.

Its primary focus is usually critical delay: delay that affects the contractual completion date, rather than delay that merely affects an isolated activity without affecting completion. Not every late activity causes delay to completion. A project may contain many activities that finish later than planned, but only some of those activities may sit on the critical path. Delay analysis therefore asks not only whether something happened late, but whether that lateness mattered in the contractual and evidential sense.

The Society of Construction Law, Delay and Disruption Protocol defines delay analysis as a procedure used to support extension of time claims by demonstrating whether there is entitlement to a revised completion date. It may also be used to seek relief from liquidated damages, or to support claims for compensation for time-related costs.¹

AACE (Association for the Advancement of Cost Engineering) describes the term forensic schedule analysis

to describe what is commonly called delay analysis. It defines this as the study and investigation of events using the Critical Path Method (CPM) or other recognised calculation methods to determine how actual events interacted within a complex model.²

At a broad level, delay analysis may be undertaken prospectively or retrospectively. The Society of Construction Law Delay and Disruption Protocol adopts this distinction in practical terms, recognising that delay may be assessed either by considering the likely impact of an event at the time it occurs, or by examining its actual impact after the event.

AACE International's Recommended Practice No. 29R-03 develops the analysis further by classifying forensic schedule analysis methods according to whether they are observational or modelled, and whether they use static or dynamic logic, additive or subtractive modelling. In simple terms, observational methods examine existing programme data, while modelled methods

THE NINE FORENSIC SCHEDULE ANALYSIS MIPs				
Method Implementation Protocols (MIPs)				
MIP	Technical Path	Category	What It Does	Common Name / Typical Use
OBSERVATIONAL METHODS				
3.1	Gross	Observational	Total-project comparison of planned and actual performance.	As-Planned vs. As-Built
3.2	Periodic	Observational	Compares planned and actual performance in segmented windows.	Windowed As-Planned vs. As-Built
3.3	Contemporaneous As-Is	Observational	Evaluates original schedule updates in their unaltered state.	Uses updates as originally issued
3.4	Contemporaneous Split	Observational	Bifurcates schedule updates to separate work progress from logic changes.	Separates progress from revisions
3.5	Modified or Recreated	Observational	Uses recreated or corrected updates when originals are missing or unreliable.	Reconstructed update analysis
MODELED METHODS				
3.6	Single Base	Modeled	Adds delay events to one fixed network to measure impact.	Impacted As-Planned
3.7	Multiple Base	Modeled	Inserts delay events chronologically into successive schedule updates.	Time Impact Analysis
3.8	Single Simulation	Modeled	Extracts delays from one as-built model to calculate a but-for completion date.	Collapsed As-Built
3.9	Multiple Base	Modeled	Extracts delays from periodic updates for a more dynamic but-for simulation.	Periodic / dynamic but-for simulation
Observational methods examine schedules as-is. Modeled methods simulate scenarios by adding or extracting delays.				

¹ Society of Construction Law, Delay and Disruption Protocol

² AACE International, Recommended Practice No. 29R-03: Forensic Schedule Analysis

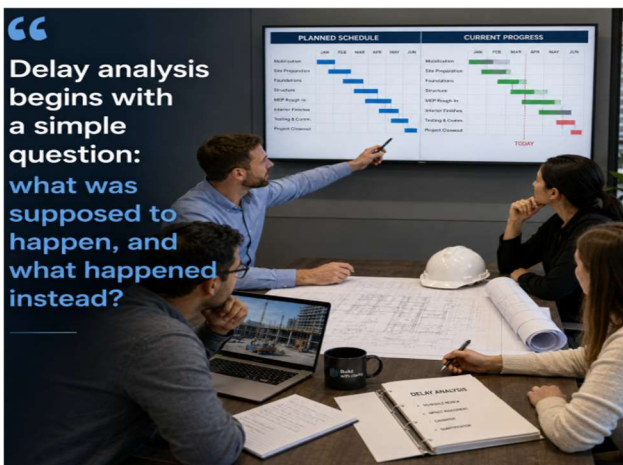


test the effect of inserting or removing delay events. This is where the familiar labels sit: impacted as-planned analysis, time impact analysis, windows analysis, as-planned versus as-built analysis, retrospective longest path analysis, and collapsed as-built analysis.

The SCL Protocol and AACE guidance are therefore useful reference points, but they perform different functions. SCL gives a practical framework for addressing delay and disruption issues in construction disputes; AACE provides a more technical taxonomy for forensic schedule analysis. Neither removes the need to ask the more fundamental question: whether the analysis proves causation, criticality, entitlement, and contractual consequence.

HOW IS DELAY ANALYSIS CONDUCTED?

Delay analysis begins with a simple question: what was supposed to happen, and what



happened instead?

That question cannot be answered from the programme alone. The programme is important, but it is not the whole picture. A proper delay analysis must start with the contract, because the contract identifies the completion obligation, the events that may entitle a party to relief, the notice requirements, and the consequences of delay. Without that framework, the analysis may describe time but fail to explain entitlement.

The next question is evidential. What records exist to show how the works were planned, progressed, altered, and delayed? The baseline programme, progress updates, revised programmes, site records, correspondence, notices, instructions, variation records, meeting minutes, and progress reports may all become relevant. The purpose is not simply to collect documents. It is to understand the actual sequence of the works and to test whether the alleged delay event affected the route to completion.

The SCL Protocol recognises that the appropriate method of delay analysis depends on the circumstances, including the available records, the nature of the dispute, and the purpose of the analysis.³ That is a practical point. There is little value in selecting a method that the records cannot properly support. Equally, there is little value in producing an elaborate analysis that does not answer the issue in dispute.

AACE International approaches the question by classifying forensic schedule analysis methods more technically. Its Recommended

³ Society of Construction Law, Delay and Disruption Protocol



Practice No. 29R-03 distinguishes between observational and modelled methods, static and dynamic logic, and additive and subtractive modelling.⁴ That taxonomy is useful, but it should not obscure the basic exercise. The analyst is either examining the programme and records as they exist or modelling the effect of adding or removing delay events in order to test their impact.

The method chosen should follow the question being asked. If the question is what the parties could reasonably assess at the time an event occurred, the analysis will tend to be prospective.

If the question is what actually delayed completion, the analysis will tend to be retrospective. If reliable contemporaneous updates exist, they may be central. If they do not, the analysis may have to be reconstructed, but that reconstruction will need to be treated with care.

At its core, delay analysis is conducted by comparing planned progress with actual progress, identifying the events said to have caused delay, and testing whether those events affected the critical path to completion.

The exercise then has to be brought back to the contract. A delay event is not enough. A late activity is not enough. The analysis must explain whether the delay mattered, who bore the risk of it, and what contractual consequence follows.

WHAT MUST DELAY ANALYSIS PROVE?

A delay analysis is only useful if it proves the right thing.

It is not enough to show that the project was late. Nor is it enough to show that a delaying event occurred. The relevant question is whether that event caused delay in a way that matters under the contract.

That usually requires proof of causation. The party relying on the delay must show a connection between the event complained of and the delay to completion. This is often where delay claims become difficult.

A project may have many problems occurring at the same time. There may be late information, variations, poor sequencing, resource shortages, weather events, defective work, approval delays, and revised access arrangements. The task is to identify which events actually affected the critical path, and which merely occurred during the same period.

Criticality is therefore central. Delay analysis must distinguish between an activity that is late and an activity that delays completion. A non-critical activity may finish later than planned without affecting the completion date. By contrast, delay to a critical activity may move the completion date and engage the contractual machinery for an extension of time, liquidated damages, or prolongation costs.

⁴ AACE International, Recommended Practice No. 29R-03: Forensic Schedule Analysis



The analysis must also prove entitlement. This is a separate question from factual delay. A party may prove that an event delayed the works, but still fail if the event is not one for which the contract gives relief, or if the contractual process for claiming that relief has not been followed. Notice provisions, time bars, conditions precedent, and the wording of the extension of time clause may therefore be as important as the programming analysis itself.

For that reason, delay analysis must be disciplined. It must identify the event, locate it in time, test its effect on the critical path, connect it to the contractual entitlement, and explain the consequence that follows. Without that chain, the analysis may remain a narrative of project difficulty rather than proof of delay.



WHY DELAY ANALYSIS MATTERS IN DISPUTES?

Delay analysis matters because delay usually carries a contractual consequence.

A contractor may rely on it to claim an extension of time, resist liquidated damages, or recover prolongation costs. A principal may rely on it to argue that the contractor was already in delay, that the alleged event did not affect completion, or that liquidated damages remain recoverable.

The issue is therefore not simply whether the project finished late. The more important question is what caused the delay that mattered. Was it an employer-risk event, contractor default, a neutral event, concurrent delay, or some combination of those matters?

This distinction matters in adjudication, arbitration, and litigation. Each forum has its own limits. The case law considered below shows that decision-makers test delay analysis against the contract, the critical path, the pleaded issues, the notice machinery, the available records, and the limits of the chosen forum.

Delay analysis is therefore not merely technical. It is consequential. It can affect time, money and liability. The practical question is whether delay can be proved in a way that the contract recognises and the forum can act upon.

UNITED KINGDOM: CONCURRENCY, CAUSATION, AND CONTRACT WORDING

There is some useful English case law that show that delay analysis is not assessed in isolation from the contract. The analysis of delay is closely tied to the extension of time machinery, the treatment of concurrent delay, and the causal link between the alleged delaying event and completion.

The usual starting point on concurrent delay is the approach associated with *Henry Boot Construction (UK) Ltd v Malmaison Hotel*



*(Manchester) Ltd.*⁵ Where two causes of delay operate concurrently, and one is a contractual relevant event, the contractor may be entitled to an extension of time for the period caused by the relevant event, notwithstanding the concurrent effect of another cause. The point is not simply one of programming. It is a question of how the contract treats competing causes of delay.

*Walter Lilly & Company Ltd v Mackay*⁶ is important because it shows the need for a disciplined causal analysis. The court rejected an overly simplistic retrospective approach that merely identifies the last delaying event and treats that as the cause of the overall overrun. The enquiry must be directed to what critically delayed the works as events unfolded.

For delay analysis, this is a practical warning: a persuasive report must do more than describe delay after the event. It must explain criticality, sequence, and causation.

*North Midland Building Ltd v Cyden Homes Ltd*⁷ adds a further qualification. If the contract contains clear wording allocating the risk of concurrent delay, the court will give effect to that bargain. Protocol guidance and general principles cannot override express drafting. A contractor who relies on general concurrency principles without first confronting the wording of the contract may therefore be answering the wrong question.

*Energy Works (Hull) Ltd v MW High Tech Projects UK Ltd*⁸ reinforces the same theme. The court's task was to ask whether the proven breaches affected the date of completion and, if so, what extension was fair and reasonable under the contract. That requires a causal route from event to completion impact. A broad assertion that the project was late, or would have been late in any event, is unlikely to be enough unless it is tied to the programme, the critical path, and the contractual allocation of responsibility.

The practical lesson from the UK cases is relatively clear. Delay analysis must identify the critical path, explain the causal effect of the relevant event, and then test that conclusion against the wording of the contract. In cases of concurrent delay, the answer may depend less on the preferred methodology and more on whether the contract preserves, modifies, or excludes the ordinary position.

SINGAPORE: PLEADINGS, NATURAL JUSTICE, AND PROCEDURAL DISCIPLINE

The Singapore authorities are useful because they show that delay analysis must be kept within the dispute the parties have actually submitted for decision.

This is particularly important for arbitrators and adjudicators. Delay analysis can be highly technical, and it may be tempting to treat it as a matter that can be resolved by the decision-

⁵ *Henry Boot Construction (UK) Ltd v Malmaison Hotel (Manchester) Ltd* (1999) 70 Con LR 32.

⁶ *Walter Lilly & Company Ltd v Mackay* [2012] EWHC 1773 (TCC).

⁷ *North Midland Building Ltd v Cyden Homes Ltd* [2018] EWCA Civ 1744.

⁸ *Energy Works (Hull) Ltd v MW High Tech Projects UK Ltd* [2022] EWHC 3275 (TCC).



maker's own construction experience or by a broad assessment of fairness. The Singapore cases caution against that approach. Where delay analysis is relied upon to support or resist an extension of time, liquidated damages, prolongation costs, or a payment claim, the decision-maker must first ask: what case has actually been pleaded, referred, or raised in response?

That question matters because delay analysis does not operate in the abstract. A party may rely on one delay theory and not another. It may plead an extension of time claim, but not a prevention or time-at-large argument. It may advance a specific period of delay, a specific delaying event, or a specific critical path case. The opposing party is entitled to know the case it has to meet. If the tribunal or adjudicator decides the dispute on a different delay theory, procedural unfairness may arise.



In *Fairmount Development Pte Ltd v Soh Beng Tee & Co Pte Ltd*⁹, the arbitrator rejected the contractor's extension of time claims because the evidence was insufficient, but then found that acts of prevention had put time at large. The problem was not simply the conclusion.

The problem was that this was not the case the parties had pleaded or argued. The decision was set aside because the respondent had been deprived of the opportunity to address the point.

The same principle appears in *CAI v CAJ* and *CAJ v CAI*¹⁰. The tribunal granted an extension of time even though the EOT issue was not pleaded, was not within the terms of reference, and was not included in the agreed issues. The Singapore courts held that the tribunal had exceeded its jurisdiction and breached natural justice. Importantly, the tribunal could not rely on its own experience of construction extension of time matters as a substitute for the parties' pleaded cases, evidence, and submissions.

For delay analysis, the lesson is clear. An arbitrator may understand construction programming. An adjudicator or arbitrator may have experience with delay claims. But that experience does not permit the decision-maker to decide a case that the parties have not advanced. The analysis must remain anchored to the issues properly before the forum.

*Bintai Kindenko Pte Ltd v Samsung C&T Corp*¹¹ makes the point from the other direction. In adjudication, a decision-maker must deal with the essential arguments that have been

⁹ *Fairmount Development Pte Ltd v Soh Beng Tee & Co Pte Ltd* [2006] SGHC 189.

¹⁰ *CAI v CAJ* [2021] SGHC 21; *CAJ v CAI* [2021] SGCA 102.

¹¹ *Bintai Kindenko Pte Ltd v Samsung C&T Corp* [2018] SGCA 39.



properly raised. If delay-related back charges, withholding grounds, liquidated damages, set-offs, or other reduction arguments are material to the payment dispute, they cannot simply be ignored.

*Shanghai Tunnel Engineering Co Ltd v Econ-NCC Joint Venture*¹² also shows that some delay questions will be treated as factual matters for the tribunal. Where the issue is the actual number of days of delay, or the factual effect of an event on the works, an appellate court may be slow to interfere. That reinforces the importance of presenting the delay case properly at first instance, with the necessary records, programme evidence, and expert explanation.

The practical point from Singapore is therefore procedural as much as technical. Delay analysis must be pleaded, submitted, and answered. It must not be invented by the tribunal, assumed from experience, or left unaddressed where it forms part of a material claim or defence. For arbitrators and adjudicators, the safest course is to identify the delay issues clearly, confirm the case each party is advancing, and ensure that any delay theory relied upon has been put to the parties for proper submissions.

AUSTRALIA: NOTICE, PREVENTION, AND RESERVE EOT POWERS

The Australian authorities are useful because they show how closely delay analysis depends

on the structure of the extension of time clause.

It is not enough to ask whether a delaying event occurred, or whether the contractor can demonstrate an impact on completion. The further question is whether the contract provides a route to relief. That question becomes particularly important where the contractor has failed to give notice, where the delay was caused by the principal, or where the superintendent or principal has a reserve power to extend time.

*Gaymark Investments Pty Ltd v Walter Construction Group Ltd*¹³ is often discussed in this context. The case is known for the proposition that where employer-caused delay occurred, but the contractor failed to comply with the contractual notice requirements for an extension of time, time could be set at large and liquidated damages could become unavailable. Whether that approach should be applied more generally is a separate question. The important point for delay analysis is that a technical analysis of delay will not be enough if the contract also requires strict procedural compliance.

*Peninsula Balmain Pty Ltd v Abigroup Contractors Pty Ltd*¹⁴ is a useful counterpoint. There, the existence of a reserve power to extend time, and the superintendent's obligation to act honestly and fairly, affected the analysis. The case illustrates that missed notice requirements do not always produce

¹² *Shanghai Tunnel Engineering Co Ltd v Econ-NCC Joint Venture* [2010] SGHC 252; *Econ Piling Pte Ltd v Shanghai Tunnel Engineering Co Ltd* [2010] SGHC 253.

¹³ *Gaymark Investments Pty Ltd v Walter Construction Group Ltd* [1999] NTSC 143.

¹⁴ *Peninsula Balmain Pty Ltd v Abigroup Contractors Pty Ltd* [2002] NSWCA 211.

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the same result. Much depends on the wording of the EOT clause, the role of the superintendent, and whether the contract gives a mechanism for preserving the completion date despite principal-caused delay.

More recently, *Growthbuilt Pty Ltd v Modern Touch Marble & Granite Pty Ltd*¹⁵ shows the importance of careful drafting. Where the relevant power was expressed as an absolute discretion, the court was not prepared to imply an obligation to exercise that power for the contractor's benefit. The practical point is that not all reserve EOT powers operate in the same way. A delay analysis must therefore be read with the clause, not apart from it.

*Alstom Ltd v Yokogawa Australia Pty Ltd (No 7)*¹⁶ adds a more technical dimension. It shows the legal significance of accurate and updated programmes. Programme logic, progress updates, and the communication of programme information may become central to determining delay, causation, and contractual responsibility. In that sense, the programme is not simply an expert tool prepared for the dispute. It may be part of the evidence of how the project was administered at the time.

For adjudication, *Seabay Properties Pty Ltd v Galvin Constructions Pty Ltd*¹⁷ illustrates another limit. In Victoria, liquidated damages

claimed by a respondent in a payment schedule were treated as excluded amounts and could not be taken into account by the adjudicator. That matters because delay analysis may be relevant to a liquidated damages argument, but the chosen forum may not permit that argument to be determined in the way the respondent expects.

The Australian cases therefore point to a practical conclusion. Delay analysis must be matched to the contract and the forum. Notice requirements, prevention arguments, reserve EOT powers, programme evidence, and adjudication limits may all affect whether the analysis produces any legal consequence. The question is not only whether delay can be

shown. It is whether the contractual machinery and the dispute process allow that delay to matter.



NEW ZEALAND: ADJUDICATION, PAYMENT SCHEDULES, AND DELAY RISK

The New Zealand authorities are useful because they show how delay issues can arise within payment disputes and adjudication, not only in final arbitration or litigation.

¹⁵ *Growthbuilt Pty Ltd v Modern Touch Marble & Granite Pty Ltd* [2021] NSWSC 290.

¹⁶ *Alstom Ltd v Yokogawa Australia Pty Ltd (No 7)* [2012] SASC 49.

¹⁷ *Seabay Properties Pty Ltd v Galvin Constructions Pty Ltd* [2011] VSC 183.



In New Zealand, delay analysis is often deployed defensively: to resist payment, justify liquidated damages or set-off, answer a liquidated damages claim, or support an extension of time. The issue is not only whether the analysis is persuasive, but whether it has been raised in the correct form and within the limits of the process being used.

*SOL Trustees Ltd v Giles Civil Ltd*¹⁸ illustrates the importance of proper payment responses. The dispute involved delay, extensions of time, and liquidated damages. However, the employer's responses to later payment claims were terse and did not satisfy the statutory requirements for a valid payment schedule. The practical point is straightforward. A party may have a delay or liquidated damages argument, but it may be ineffective in a payment dispute if it has not been properly set out in the statutory response.

*Concrete Structures (NZ) Ltd v NZ Windfarms Ltd*¹⁹ shows a related point about contractual process. The contractor relied on matters including winter working and delay consequences, but the court emphasised the need to follow the contractual machinery. The case also illustrates that the absence of a liquidated damages clause does not necessarily mean the absence of delay risk. A contractor may still face consequences for failing to complete on time, even if the contract does not provide for liquidated damages.

*Rees v Firth*²⁰ is important for understanding the limits of adjudication review. The Court of Appeal confirmed that judicial review of adjudication determinations should be rare. For delay disputes, this means parties should not assume that an imperfect adjudication outcome can easily be reopened by judicial review. If delay analysis is to be relied upon in adjudication, it needs to be presented properly at that stage.

*Sam Pemberton Civil Ltd v Robertson*²¹ is particularly useful in the modern New Zealand context. The case confirms that a respondent may use set-off or abatement defensively to reduce or extinguish a claimant's claim, but a respondent seeking affirmative recovery for its own claim should bring its own adjudication and, where appropriate, seek consolidation or coordinated determination. This distinction matters for delay analysis because liquidated damages may be used as a shield in one context but require a separate process if being pursued as a positive monetary claim.

The practical lesson is that delay analysis in New Zealand must be matched to the process. Payment schedules must be properly particularised. Contractual procedures must be followed. Adjudication has real force, but also real limits. A delay argument that is sound in principle may still fail if it is raised too late, raised in the wrong form, or used to seek relief that the chosen process cannot properly grant.

¹⁸ *SOL Trustees Ltd v Giles Civil Ltd* [2014] NZHC 1813; *SOL Trustees Ltd v Giles Civil Ltd* [2014] NZCA 539.

¹⁹ *Concrete Structures (NZ) Ltd v NZ Windfarms Ltd* [2014] NZHC 2118.

²⁰ *Rees v Firth* [2011] NZCA 668.

²¹ *Sam Pemberton Civil Ltd v Robertson* [2024] NZHC 272.



COMPARATIVE LESSONS FOR ADJUDICATORS, ARBITRATORS, AND PARTIES

The cases point to a consistent theme: delay analysis is not judged by methodology alone. A recognised method may assist, but it must still answer the issue that matters under the contract and in the chosen forum. That usually means proving causation, criticality, entitlement, and consequence.

Four points follow.

First, contract wording matters. Extension of time clauses, notice requirements, liquidated damages provisions, reserve powers, and concurrency clauses may all affect the result.

Secondly, evidence matters. The analysis must be supported by programmes, updates, records, notices, and progress data. It must show why the event affected completion, not merely that it occurred.

Thirdly, procedure matters. In arbitration, the issue must be pleaded or submitted for decision. In adjudication, it must sit within the adjudicator's jurisdiction and the relevant statutory or contractual process.

Finally, forum matters. Some delay issues may be suitable for adjudication. Others may require arbitration or litigation, particularly where causation is complex or affirmative recovery is sought.

The practical lesson is that delay analysis must be built for its purpose. The method should fit

the contract, the records, the relief claimed, and the forum.

PRACTICAL CONSIDERATIONS BEFORE RELYING ON DELAY ANALYSIS

Before relying on delay analysis, the first question should be whether the analysis is answering the right issue.



That requires more than selecting a recognised method. The party relying on the analysis should identify the contractual basis for the claim or defence, the completion date said to be affected, the delay events relied upon, and the relief being sought.

The quality of the records should then be tested. Baseline programmes, progress updates, revised programmes, notices, site records, correspondence, meeting minutes, instructions, and variation records may all become important. If the records are incomplete or inconsistent, that does not necessarily prevent analysis, but it may affect the weight that can safely be placed on it.

The chosen methodology should also be proportionate to the dispute. A complex forensic model may be unnecessary for a narrow adjudication point. Equally, a broad



narrative may be inadequate where the dispute turns on critical path causation or competing delay events.

Parties should also consider timing. A delay analysis prepared during the project may serve a different function from one prepared after completion. A prospective analysis may assist with contract administration and extension of time decisions. A retrospective analysis may be necessary where the question is what actually delayed completion.

Finally, the analysis should be tested against the forum. An adjudicator, arbitrator, or court may not be able to decide every delay issue in the same way. The analysis must therefore fit the claim, the evidence, the contractual machinery, and the procedural limits of the process being used.

CONCLUSION: DELAY ANALYSIS AS PROOF, NOT PRESENTATION

Delay analysis is not simply a programming exercise. It is a means of proving whether time-related events affected completion in a way that matters under the contract.

The method selected is important, but it is not decisive. The analysis must be supported by records, directed to the critical path, and connected to the entitlement or defence being advanced. It must also sit within the limits of the process in which it is used.

The cases show this clearly. Courts, adjudicators, and arbitrators will engage with delay analysis, but they will also test it against

contract wording, notices, pleadings, jurisdiction, natural justice, and the available evidence.

The practical lesson is that delay analysis should not begin with the question: which method should be used?

It should begin with a more disciplined question: what must be proved, under this contract, on these facts, in this forum?