# Geotechnical Engineering and Commercial Services Pty Ltd

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## Methods of Delay Analysis

In a previous article we looked at the steps required for delay analysis. One of the steps is the selection and use of a method to identify and measure the delay to the critical path.

Delay analysis is often required during and after projects involving ground engineering works. The requirement for delay analysis arises from the following considerations:

- Most baseline schedules are optimistic
- Schedules are often complex with a lot of moving elements and overlapping activities
- There are a lot of risks in ground engineering works that can impact progress
- Oftentimes there is a lack of strong production controls
- Foundation works are expensive – there is a lot of money at stake
- Delay and disruption are the main causes of budget overruns

This article addresses the concepts of three delay analysis methods that are typically used in construction claims.

### Why is Delay Analysis Necessary?

Construction contracts universally require a delay to affect a critical path activity for critical milestone dates or the date for completion to be varied, figure 1 below shows a critical path delay.

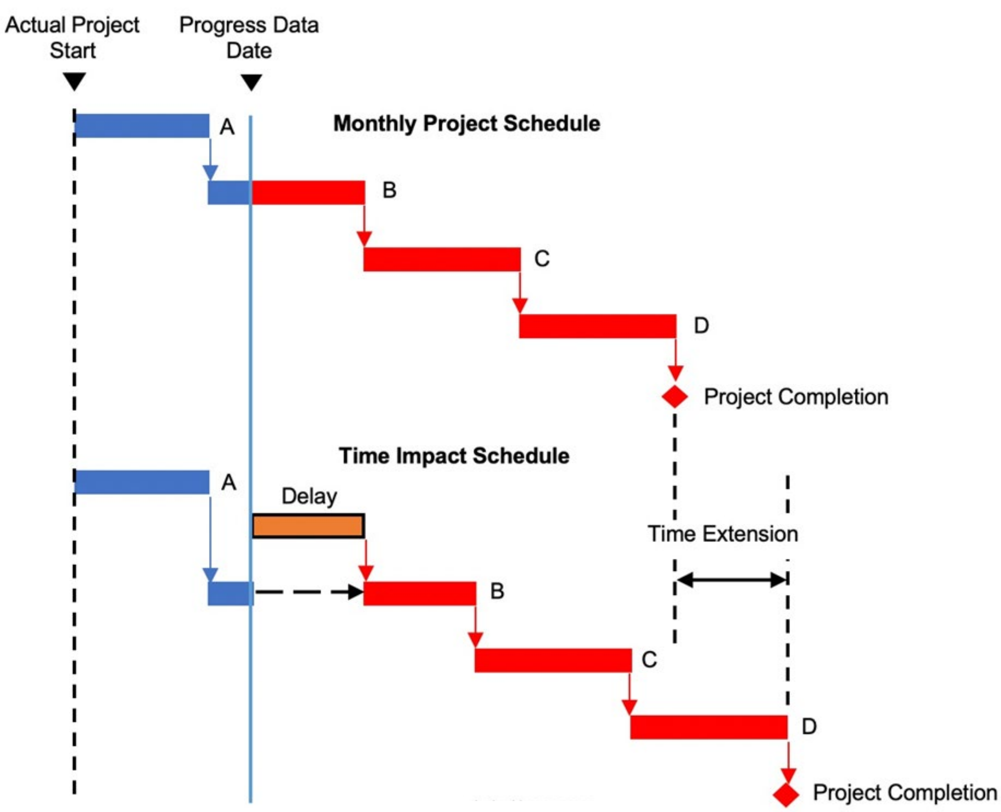


*Figure 1: Critical path delay*

This concept is consistent with industry practice, as stated in the Society of Construction Law (SCL) Delay and Disruption Protocol[1]:

> *"Unless there is express provision to the contrary in the contract, where there is remaining total float in the programme at the time of an Employer Risk Event, an EOT [Extension of Time] should only be granted to the extent that the Employer Delay is predicted to reduce to below zero the total float on the critical path affected by the Employer Delay to Completion (i.e. if the Employer Delay is predicted to extend the critical path to completion)."*

Further, the AACE[2] addresses this requirement:

> *"In order for a claimant to be entitled to an extension of contract time for a delay event (and further to be considered compensable), the delay must affect the critical path. This is because before a party is entitled to time-related compensation for damages it must show that it was actually damaged. Because conventionally a contractor's delay damages are a function of the overall duration of the project, there must be an increase in the duration of the project."*

These references address the question of "who owns the float", if the effect of adding any delays to the schedule is that float is consumed, but no actual delay to the completion of the project results from adding the delays, then the Contractor has no entitlement to an extension of time.

### Methods of Delay Analysis

There are a considerable number of delay analysis methods available. The SCL Delay and Disruption Protocol[3] lists six common methods described in table 1 below.

| Method of Analysis | Analysis Type | Critical Path Determined | Delay Impact Determined | Requires |
|---|---|---|---|---|
| Impacted As-Planned | Cause & Effect | Prospectively | Prospectively | • Logic linked baseline programme<br>• A selection of delay events to be modelled |
| Time Impact | Cause & Effect | Contemporaneously | Prospectively | • Logic linked baseline programme<br>• Updated programmes or progress information with which to update the baseline programme<br>• A selection of delay events to be modelled |
| Time Slice Windows | Effect & Cause | Contemporaneously | Retrospectively | • Logic linked baseline programme<br>• Updated programmes or progress information with which to update the baseline programme |
| As-Planned Versus As-Built Windows | Effect & Cause | Contemporaneously | Retrospectively | • Baseline programme<br>• As-built data |
| Retrospective Longest Path | Effect & Cause | Retrospectively | Retrospectively | • Baseline programme<br>• As-built programme |
| Collapsed As-Built | Cause & Effect | Retrospectively | Retrospectively | • Logic linked as-built programme<br>• A selection of delay events to be modelled |

*Table 1: Delay analysis methods according to SCL Delay & Disruption Protocol*

The AACE International Recommended Practice No.29R-03 lists nine different methods described in table 2 below.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | RETROSPECTIVE | | | | | | | | | | | | | | |
| | 2 | OBSERVATIONAL | | | | | | | MODELED | | | | | | | |
| | 3 | Static Logic | | | Dynamic Logic | | | | Additive | | | | Subtractive | | | |
| Taxonomy | 4 | 3.1 Gross | 3.2 Periodic | | Contemporaneous Updates (3.3 As-Is or 3.4 Split) | | 3.5 Modified / Reconstructed Updates | | 3.6 Single Base | | 3.7 Multi Base | | 3.8 Single Simulation | | 3.9 Multi Simulation | |
| | 5 | | Fixed Periods | Variable Windows | All Periods | Grouped Periods | Fixed Periods | Variable Windows | Global Insertion | Stepped Insertion | Fixed Periods | Variable Windows or Grouped | Global Extraction | Stepped Extraction | Fixed Periods | Stepped Extraction |
| Common Names | | As-Planned vs As-Built | Window Analysis | | Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis | Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis | Contemporaneous Period Analysis, Time Impact Analysis | Windows Analysis, Time Impact Analysis | Impacted As-Planned, What-If | Time Impact Analysis, Impacted As-Planned | Time Impact Analysis | Window Analysis, Impacted As-Planned | Collapsed As-Built | Time Impact Analysis, Collapsed As-Built | Time Impact Analysis, Collapsed As-Built | Time Impact Analysis, Window Analysis, Collapsed As-Built |

*Table 2: Delay Analysis methods according to AACE*

Let us now review the concepts of three of the most used methods.

**Time Slice Window Analysis**

Time Slice Windows Analysis is an observational, windows-based methodology that focuses on comparing as-planned, updated and as-built project schedules to identify and quantify delays to the critical path of the project. This methodology is a retrospective analysis that uses the project schedule updates to quantify the slippage to the critical path during a select period.

Once all critical path activity delays have been quantified, the origins and causes of each delay are determined. The responsibility for each delay is then apportioned to either the Contractor, Owner, a third party, if appropriate, or to force majeure or other excusable delays defined by the contract.

The steps to performing a time slice window analysis are:

1. Select schedule windows;
2. Identify the critical path;
3. Perform a detailed review of the schedules selected for analysis;
4. Determine the changes made between the schedules selected for the schedule windows;
5. Develop variance tables to calculate date and duration variances; and
6. Research activity impacts and allocate responsibility for delays.

Figure 2 below illustrates how the method works. In the first window, the delay is quantified by comparing the planned finish date and the actual finish date of Activity A.

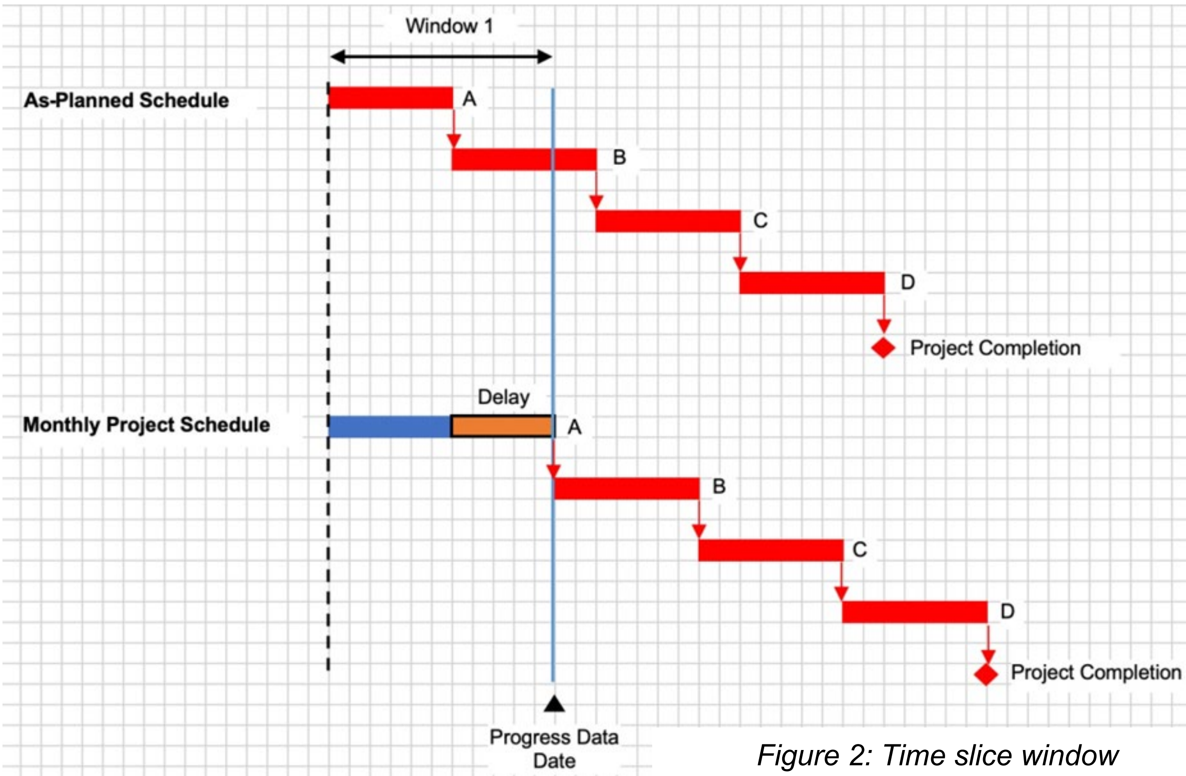


*Figure 2: Time slice window analysis example*

**Time Impact Analysis**

Time Impact Analysis is a schedule delay analysis technique that adds delays or changes to the schedule, which are updated up to the day before the delay occurred. This type of analysis can be used:

- To determine whether the overall completion date of the project is delayed, or remains the same as a result of the delays;
- To demonstrate a Contractor's entitlement to an extension of time;
- To demonstrate a potential schedule acceleration; or
- To demonstrate an Owner's entitlement to receive liquidated damages.

The steps to performing a time impact analysis are:

1. Develop a fragnet to model the delay;
2. Obtain the approved schedule, which is updated up to the day before the delay occurred;
3. Insert the fragnet into the approved schedule update and link to the impacted activities;
4. Recompute the schedule and note a change in the project completion date; and
5. Determine the amount of project delay.

Figure 3 below illustrates how the time impact analysis method works. After identifying the right monthly project schedule, the delay is added to the schedule to impact the project completion date. The variance of project completion date between the monthly project schedule and the time impact schedule is the time extension.

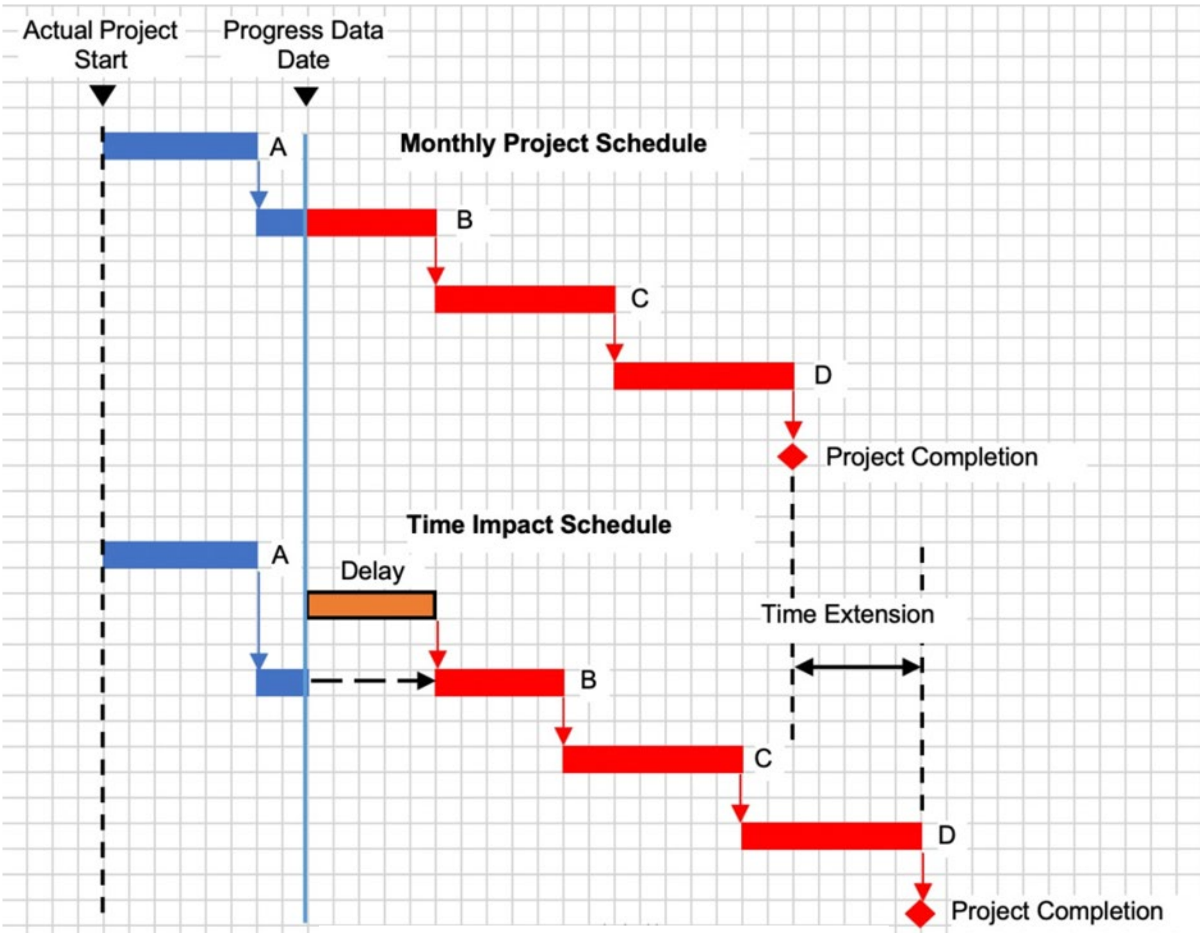


*Figure 3: Time impact analysis example*

**Collapsed As-Built / As-Built But-For Analysis**

Collapsed as-built analysis is a retrospective schedule delay analysis technique that determines the earliest date that the project completion date, or a required milestone, could have been achieved but-for the owner-caused / contractor-caused delays that occurred during the project. This type of analysis can be used to determine the compensable time extension by taking into account the concurrent delay situation.

The collapsed as-built analysis that removes the contractor-caused delays is used to determine the time period between the actual completion date and the collapsed as-built completion date for assessment of liquidated damages by the owner.

The steps to performing a time impact analysis are:

1. Develop a model of the as-built schedule, which is called the as-built calculation schedule;
2. Identify the owner-caused or contractor-caused delay; and
3. Interpret the results of removing delays from the as-built calculation schedule.

Figure 4 below illustrates how the collapsed as-built analysis method works. The as-built calculation schedule incorporates both owner-caused and contractor-caused delays. The period between the as-planned schedule and the as-built calculation schedule is the overall time extension. After removing the owner-caused delay, the as-built calculation schedule completion date collapses to an earlier completion date. The period between the as-built calculation schedule and the collapsed as-built schedule is the time extension resulting from owner-caused delay.

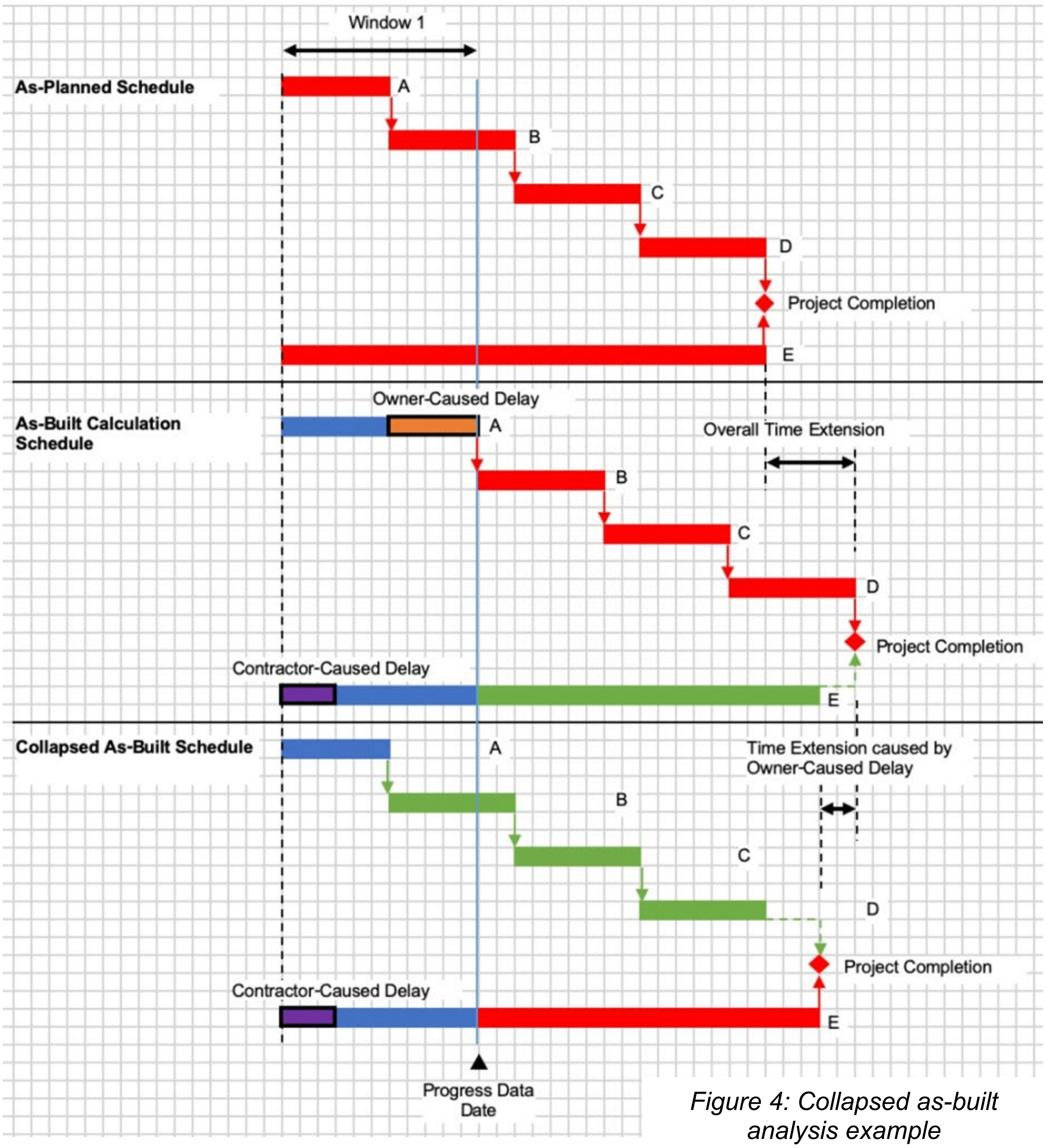


*Figure 4: Collapsed as-built analysis example*

### Conclusions

This article has introduced and provided examples of three methods commonly used to analyse project delays. These methods can serve a multitude of purposes – not only for claims but also to improve the decision-making process around acceleration and project optioneering. Robust, but not necessarily overly complex, delay analysis is an essential requirement for the success of claims for extensions of time and delay and disruption costs.

For assistance with delay analysis, variations and claims please email us at info@geoecs.com.au.

### Footnotes

[1] SCL Delay and Disruption Protocol, 2edn, page 6
[2] AACE International Recommended Practice No. 29R-03, page 18
[3] SCL Delay and Disruption Protocol 2nd Edition Guidance Part B, paragraph no. 11

 