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Construction Delay Analysis Methods

BY JAMIL SOUCAR

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Construction projects often suffer from delays due to a wide variety of reasons, which can have severe financial impact on the project. As a result, delay claims may be filed. The analysis of the delay impact with the causes and effects of the delaying activities is one of the most complicated types of claims analysis. It requires an expert with extensive knowledge of construction projects, means and methods, scheduling and the ability to develop a sound methodology to conduct the analysis. Most of these delay claims reach the expert after completion of the project. This results in a detailed intensive research of the documents to verify schedules, events, sequence of work, changes during construction and the delay impact.

This article will address these challenges and the various delay analysis methods.

Below is a list of common delay causes encountered on construction projects. One of the complications of a delay analysis is that the delays can be caused by few of these listed causes or a complex mix of these causes. The time of their occurrence and who caused what delay add to the difficulty of the analysis.

Errors and omissions in the contract documents:

- Missing information.
- Not having a phasing plan in the bid documents when the site work has to be done in phases.
- Conflicting information that need design revisions.

Contractor caused delays for reasons under their control:

- Not having enough labor force on site.
- Contractual problems between the prime contractor and subcontractors.
- Cash flow issues.
- Lack of proper planning and management of the project.

Delays for reasons beyond the contractor or owner's control:

- Strikes
- Out of state manufacturer's shut down.
- A subcontractor going out of business in the middle of the project.
- Unusual weather conditions.

Owner caused delays for reasons under their control:

- Scope changes.
- Limiting contractor's access to parts of the site.
- Cash flow.
- Late processing of contractor's requests for clarifications and change orders.
- A higher level political factor that impacted the project's progress.

Personality conflicts between the project's team.

- Unfortunately, sometimes this factor results in the team making things difficult on site that cause delays. In this case each party blames the other for the delay.

One of the main steps in the delay analysis is to research the project's documents to identify causes like the above that delayed the project. The methodology used to determine the impact of these factors is the heart of the difficulty of this type of analysis. To better understand the level of difficulty involved, please note the following basic concepts that have to be factored in:

CRITICAL, NON-CRITICAL DELAYS AND FLOAT

The project activities in a schedule are 2 types, critical and non critical. The non critical activities have certain number of days (float) where the activity can be delayed without delaying the whole project. For example five days float means that the activity can be delayed up to five days without delaying the whole project. The critical activities have zero or less float which means that each delay day will delay the whole project. Determining which activities are critical and non critical depends on the durations and logic of the sequence of activities. Rebuilding the schedule after the fact, determining which activities are critical and which ones are non critical and establishing the logic, which usually changes through the project, takes a highly technical research of the documents. Some assumptions and judgments may have to be taken during the analysis.

EXCUSABLE AND NON-EXCUSABLE DELAYS

Excusable delays simply mean delays at no fault to the contractor. In this case a time extension is owed to the contractor. Non-excusable delays are delays due to the contractor's fault. A detailed revision of the contract's terms and conditions is critical to properly classify the type of each delay identified in the analysis.

COMPENSABLE AND NON-COMPENSABLE DELAYS

Compensable delays are delays where the delayed party is owed money to compensate for the loss due to the delay. Non-compensable delay is a delay where a time extension is owed but no compensation is owed to the delayed party. For example, some contracts specify that delays due to reasons beyond the control of the owner and the contractor are delays where a time extension is granted but no compensation is paid to the delayed party. A good understanding of the contract terms is critical to the expert analyzing the delay claim.

CONCURRENT DELAYS

Some analysts simply list the delays, calculate the number of days for each delay, add them up and claim the total as the total number of delay days. Well, that is far from being an accurate analysis. The timing of each of these delays is important. We may have three delay causes that occurred during overlapping time periods or within the same period. The schedule and the actual site events have to be examined at the start date of each one of these delays to analyze its impact. We may find that only one of the three concurrent delays had an impact on the critical path of the project. After plugging that in the updated schedule, we can find out the new completion date of the whole schedule.

Using Critical Path Method scheduling (CPM) provides analysts the needed tools to conduct a proper analysis. To understand the tremendous advantage of having CPM technology, please allow me to give you

analysis. To understand the tremendous advantage of having CPM technology, please allow me to give you a primer on the basic principles of CPM scheduling.

Prior to CPM scheduling, owners, contractors and any other businesses that needed schedules like large manufacturers used scheduling techniques where activities were listed and the sequence identified but the activities were not tied to logical relationships. Therefore, any delay or change of schedule needed reconstruction of the whole schedule. So, if we have a large schedule with hundreds of activities, you can imagine the cumbersome process of updating the schedule, say at 75% of the project or identifying the impact of a delay on the schedule.

The information provided in this publication should not be viewed as legal or professional advice. The publisher does not intend to provide any legal or professional advice. The CPM method and the relevant software give the user the ability to tie the schedule's activities by logic relationships. For example:

- Activity B shall start when activity A is completed.
- Activity C can start only when A and B are completed.

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A scheduler builds a schedule by performing the following basic steps:

- Define the activities.
- Assign durations for each of the activities.
- Identify the predecessor and successor activities.
- Allocate the proper relationships similar to the described above.

The software automatically performs the CPM calculations, displays the schedule, gives you the completion date and identifies the critical and non critical activities.

The CPM scheduling method helps the user do the following:

- Update the schedule and clearly note the change of the completion date.
- Manipulate the relationships and duration of activities to change the logic of the schedule to recover a delay and bring back the completion date to a desired date.
- Insert a delay factor to an activity and immediately read the new completion date.
- Identify the critical activities. These are the activities that don't have any room (float) for any delays. A 3 days delay on a critical activity delays the whole project by 3 days unless the revised logic of the schedule dictates otherwise.
- Identify non critical activities. These activities have different amounts of float. A float of 20 days means that this activity can be delayed up to 20 days without impacting the whole schedule.

When the first submitted schedule is approved, it is considered a base schedule for future updates and delay analysis. That means the project manager needs to carefully review the schedule and the critical path prior to approving the schedule. Some of the elements that need careful review are:

- Verify that the start and completion dates of the whole project match the contract dates.
- Check that the assigned durations are realistic.
- Review the logical ties between the activities.
- Look through the critical path and check what activities are critical.
- If the schedule show the phasing required.

Having introduced all these basic concepts related to delay analysis, please note below the different methods that are commonly used to analyze delays:

- As-Planned vs. As-Built method
- Impacted As-Planned method
- Collapsed As-built or "But for" method
- Window analysis method
- As-Built method
- Contemporaneous method

AS-PLANNED VS. AS-BUILT METHOD

The analyst compares the dates and durations of selected activities shown on the as-planned schedule with the actual dates and durations on an as-built schedule and considers the difference to be the delay on the job.

This is a very simplistic view of the delay claim because it ignores the following important factors:

- The cause of the delays.
- The timing of the individual delays and their impact on the schedule to be able to attribute the correct amount of delay days to the right responsible party.
- It ignores the impact of concurrent delays.
- It ignores the fact that the logic and sequence of the as-planned schedule may have changed through the project due to numerous delaying factors.

IMPACTED AS-PLANNED METHOD

In this method the analyst lists the excusable delays (or delays where time extension is owed to the contractor) and inserts the extended duration to the relevant activities. The analyst reads the revised completion date and calculated the days between this date and the as-planned completion date and determines that are the number of days owed to the contractor. The sources of error in this method are:

- It ignores the actual as-built schedule and events on site.
- It assumes that the logic of the as-planned schedule reflect the reality on site.
- It ignores the inexcusable delays that may have been concurrent to some of these inserted delays which impacts the number of days owed to the contractor.
- Since the analyst is only using the as-planned schedule, this method doesn't incorporate changes in logic and out of sequence work.

COLLAPSED AS-BUILT OR "BUT FOR" METHOD

In this method the analyst takes the actual as-built schedule and takes out the duration of all the excusable delays (delays rightfully owed to the contractor). This revision forms the collapsed as-built schedule. The analyst reads the completion date on the collapsed as built schedule and considers this date to be the

analyst reads the completion date on the collapsed as-built schedule and considers this date to be the completion date of the project had the contractor not been delayed. The analyst calculates the days between the collapsed as-built and the completion date from the as-built schedule and considers these days to be the days owed to the contractor. The sources of error in this method are:

- It depends on the as-built schedule to be accurate.
- The excusable delays removed from the as-built schedule are assumed to be excusable without a complete analysis of these delays, the causes and concurrencies. That means subjective assumptions and judgments have been taken and need to be examined.
- It doesn't factor in how the sequence of operation changed, any acceleration that took place, any recovery that took place because the as-built schedule is a representation of what really happened on site without addressing causes and effects of delays along the way.
- In some cases, where an as-built schedule does not exist, the analyst recreates the as-built schedule based on his/her research. This product does not reflect the planned logic of activities or the planned critical path.

WINDOW ANALYSIS METHOD

This method is based on analyzing the delay over the entire schedule dividing it to windows with a selected duration, most commonly used is monthly. The analyst looks at the activities within the selected window, updates the activities incorporating the delays within the selected window. Updating the selected window changes the as-planned schedule to an as-built schedule up to the end date of the selected window and becomes the basis for projecting the remaining activities from the end of the window to the completion of the project. The sources of error in this method are:

- Need to have accurate as-built information on the start and finish dates of the windows.
- The original base schedule has to be accurate.
- There may be delaying activities outside the selected window that have an impact.

AS-BUILT METHOD

This method is used in the absence of reliable schedules on the job. In this case the analyst recreates a schedule based on actual information. The analyst determines the logical ties between the activities to form a retrospective schedule which becomes the basis for analyzing the effect of the delays. Durations are given to the activities based on reasonable time to finish the various activities. The delays are then inserted in the newly created schedule and then compared with the actual as-built durations to calculate the number of delay days. The sources of error in the method:

- The analyst has to be very experienced in construction means and methods.
- There is a lot of judgment calls by the analyst that need to be examined.

CONTEMPORANEOUS METHOD

This is usually the preferred method of analyzing delays. In this method, the analyst takes a look at the schedule and actual site progress on the starting date of each delay, and then inserts the delays in the schedule. The new completion date is compared to the original completion date to determine the delay days. This way the impact of concurrent delays is incorporated, the new critical path reflects reality on site and effect of the delaying causes. The sources of error in this method:

- Having good documentation to reflect the actual site progress.
- Accurate schedule updates.

As a conclusion, the analyst has to select the method to use. Each one has its advantages and problems. Sometimes the nature of the case, available time, documents availability or budget consideration influence the method selection.

Jamil Soucar is experienced in civil engineering and has been in the construction industry since 1983. He holds a "B" general contractor license, real estate license and a certificate in project management from UCLA. He has conducted numerous training sessions on construction management topics such as principles of critical path method scheduling, construction management of public works projects, preconstruction, design management, contract administration, scheduling, change orders, construction logs, claims avoidance, claims preparation and negotiations and close out. Mr. Soucar assumed a wide variety of positions in construction including superintendent, construction manager, project manager, senior project manager for contractors and as an owner's representative managing projects from planning to close out. Mr. Soucar managed a variety of projects such as schools, libraries, community centers, transportation center, restaurants, retail, single family homes, high rise buildings, health club and dealt with a lot of public agencies and private owners.