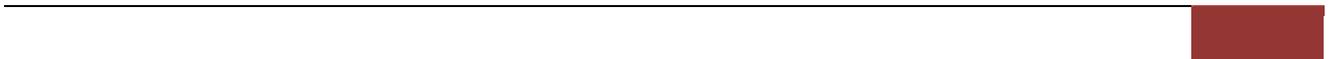


# **CPM Really Gets Interesting When You Consider Activity Status**

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## Introduction

There are many instances where the improper or imprecise definition of activity status has caused conflict between project stakeholders. Sometimes activities are unnecessarily statused as having started early and out of planned sequence, causing critical path and float concerns. Cost loaded scheduling sometimes leaves nearly every activity as being statused incomplete until project punchlist.

In a claims situation, the evaluation of quantum is in part dependent upon the status assessment of active activities and hence the status of the schedule. We should properly define the meaning of 'activity status' to standardize the reading of it. It is important to the scheduling industry for consistency of application so that each scheduler will provide a similar answer to the same situation.

## Activity Status

Statusing a schedule is something the performance recorder does. Statusing refers quite literally to the process of posting to the execution schedule the current progress of any activities that have been active during the reporting period. Status depends upon a clear definition of the activity scope. [1]

The three main reasons for updating project schedules are to, [2]

- Reflect the current project status,
- Restore the schedule's usefulness as a management tool, and
- Evaluate the work procedures and performances and any delays and associated causes.

An activity's status can be in one of the three conditions; not started, in-progress, or finished. Not-started activities may be said to be 0% complete, finished activities are said to be 100% complete, and in-progress activities must be somewhere between 0 and 100 percent complete.

There is an alternative concept of activity status other than the one presented here. The concept of "activity status" can also mean the comparison of actual progress against the plan to determine variance and corrective action. [3]

## Not Started Activities

Activities that have not started should not indicate an actual start date (and time,) nor an actual finish date (and time.) Actual dates that do not include a time element are assumed to have the workday start time for an actual start date and the workday finish time for an actual finish. Any discussion of a date in this paper assumes these times unless specifically stated otherwise.

Actual start dates may affect the computation of scheduled dates, and thus forecasted project completion. Accurate start dates are essential to properly analyze delay issues and to properly compute earned value.

Nominal preparatory work should not generate an actual start date. A symptom of this is an actual start with no reduction in remaining duration. The actual start of incurring cost or earning revenue should not automatically cause an actual start to be generated. [4]

On the other hand, an activity may correctly be statused as having begun without any work being visible on the production site. It is possible that work was pre-fabricated at an off-site location and will be transported to the work site later. In cases such as these, an explanation for the non-observed status should be included with the submittal.

## In-Progress Activities

Before an activity can start, there are two constraining forces; logical predecessors, and administrative requirements. Administrative requirements include such things as,

- Workers showing-up,
- Required materials and tools being present,
- Access to the work area,
- Availability of required utilities,
- Useable plans, and
- Supervision.

Most CPM schedules do not include the administrative predecessors in their logic. [1]

An in-progress activity must have an actual start date. It is not sufficient to simply indicate that an activity has started, an actual date must be provided if using CPM calculations to predict project status.

The reverse is also true; if remaining duration is decreasing, then an actual start date should be assigned. If an activity has zero remaining duration, then an actual finish date

should be assigned. Besides just being good practice, failure to assign actual dates can affect CPM schedule calculations, especially if relationship lags exist. [4]

Knowing the full scope of an activity is essential in order to be able to status it. When the scope changes or when it becomes better understood, then status can change non-linearly (grow or shrink drastically.) An example of this is when one uncovers an unknown utility while digging foundations. The work is interrupted (or perhaps disrupted) due to the 'added scope'. Had the existence of the utility been known prior to the beginning of foundation work, then this could have been its own task and not part of the scope of foundation work.

The status of an in-progress activity should be numerically assessed by estimating the activity's remaining duration, not by assessing activity percent complete. Status can be estimated by remaining duration or remaining labor hours. It should not be a measure of original duration minus elapsed time or by percent complete.[4][5] The reviewing scheduler should accept the remaining duration as being the opinion of the contractor, requiring some form of backup verification only if it appears to be seriously in error. [4]

Since an activity's reported remaining duration is just an estimate, it might also be called the Expected Remaining Duration (ERD.) ERD is influenced by a number of issues related to the current project situation. Productivity is the major factor since it affects the daily production, and therefore, forecast progress rate. Also, the current resource availability may influence the estimate of remaining duration. [6]

### Percent Complete Measurements

Some scheduling programs only accept percent complete as the status updating mechanism (such as Asta Powerproject™ until 2015) or work best when using percent complete as the updating mechanism (such as with Microsoft Project.) For these, it is recommended that status still be taken by estimating remaining duration and converting this into a percent complete as a ratio of remaining duration to original duration and entering this. [7] Some scheduling programs allow the calculation of percent complete to be independent of remaining duration. Once such use for this is the tracking of cost percent complete independently of tracking activity remaining duration. [8]

Leaving activities at 99% complete to cover punchlist work is a bad practice. When an activity's work is done with everything except for punchlist-type efforts, the activity should be statused as complete. The 5% - 10% retainage of funds due typically listed as part of the contract's provisions should cover the cost of the remaining punchlist work. [9]

## Relationship Lag Status

Activities typically experience non-linear, uneven progress. Most types of relationship lags assume even, planned progress and thus may be out of sync with actual activity status. These lags measure the passage of time rather than progress of reducing the remaining duration of the activity.

Activity statusing also involves the re-estimation of any lag durations. A start-to-start lag can either be computed based on the actual start of an activity or on the remaining lag duration based upon the data date. Some scheduling software packages allow the scheduler to choose which setting to use.

Other than reevaluating the remaining lag duration, statusing of an activity does not involve logic changes, even to match actual work plan changes. Statusing of a project does include the changing of logic to match the actual logic used. One source refers to project statusing as 'updating' instead of 'statusing.' [1] Changing the logic in a project relating unstarted activities is considered a schedule revision.

## Status Front-End Loading

Status can be said to be front-end loaded when an un-proportionally large amount of status is 'earned' or declared shortly after the activity has started. When the contractor is compensated for the portion of completed work or there is a threat of adverse reaction to a delay, there is a tendency to over-report the progress of a newly started activity. This is generally to be avoided but there are circumstances where this practice may be acceptable, depending on circumstance and intent.

A possible instance on acceptable status front-loading may involve the ordering and delivery of major equipment that is not immediately reimbursable. In this case, the installation of that equipment may 'earn' a significant amount of status on the day that it is delivered, even if installation is a long process.

Status of an activity may be earned in a time-wise, uneven manner. Learning curve, interruptible work, delays, uneven technical difficulties, and varying manpower are all reasons for status to be a non-linear measurement over time.

## Finished Activities

For an activity to be statused 100% complete, it must have an actual finish date that reflects substantial completion of the work described. It is not sufficient to just indicate a finish; an actual finish date must be supplied. Actual finish dates may affect the computation of the schedule dates and float, and thus forecasted project completion. Accurate finish dates are essential to properly analyze delay issues.

Remaining minor or cosmetic repair work, typically considered punchlist work, should not delay the reporting of an actual finish date. Holdbacks for costs unrelated to the start of successor activities should not delay the assignment of an actual finish date. [4]

## The Parts of Activity Status

A typical activity undergoes a lifecycle composed of many parts. See Figure 1 for a diagram of this lifecycle. Administrative requirements and logical predecessor work must be complete before the substantial start of an activity can occur. This is also marked by the Actual Start Date of the activity. Minor preparatory work for the activity may occur prior to this time.

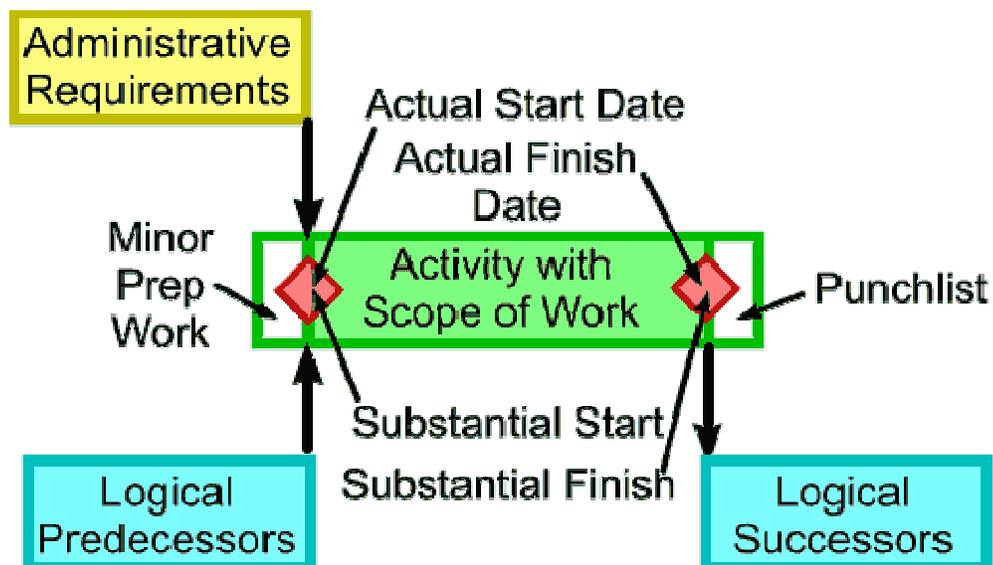


Figure 1 – The Parts of Activity Status

Once the activity is substantially finished, all logical successors may begin without interference. This marks the activity's actual finish date. Minor repair work (often called punchlist) may occur after the Actual Finish Date but prior to the completion of the project.

## Frequency of Statusing

It is an 'open question' of how often the scheduler should record status. As a minimum, the contractor should status the schedule immediately prior to any contractually required reporting of the project status. Some say that status should not be recorded more often than it is published due to 'wasted effort' and the possibility of corrupting the schedule. Caution should be made when statusing a schedule to not destroy the history of the previous update. This means that there should be a separate copy of each schedule update.

Others say that status should be taken more often than they publish an update; maintaining status on a weekly, daily, or even hourly basis. In this case, the status should be more accurate and granular if taken more often. Frequent status estimates are more useful if monitoring on-going productivity. [1]

Other than if specified by contract, the frequency of periodic project reviews may depend on the, [2]

- Occurrence of specific control events,
- Degree of uncertainty,
- Magnitude of the project,
- Time to completion, and
- Troubles encountered.

Any unexpected revision in work sequence, delivery, or activity duration estimates could be the cause for new updating. [2] The contractor's scheduler should strongly consider taking a comprehensive review of project status anytime a major delay event occurs, even if this is not part of the scheduling update timeline. The actual status of the project at the time of delay may prove to be contractually required.

## Status Involvement

In general and absent other contract language, the contractor is responsible for maintaining the assessment of activity status. In some cases, only the Contractor's scheduler is responsible for this assessment. It is preferable that the general contractor's project manager or superintendent should accompany the subcontractor's superintendent and the project scheduler to walk the job and agree upon the progress estimate. [1]

The persons responsible for in-progress work should be consulted as to the amount of time that is remaining until the activity can become substantially complete. This is a completion to the point that it does not logically delay the progress of logically subsequent work. The superintendent responsible for the immediate follow-on work may need to be consulted to

see how complete the current work must be to allow for unhindered progress and access of the successor work. In cases of delay or disputed work, it is advisable that the contractor notify the owner's representative of the date chosen as soon as possible.

Networked scheduling software systems may also allow for remote activity statusing. This process is usually restricted to the activity's designated Primary Resource. Once the status is submitted, many software systems allow the manager or scheduler to approve or reject the status update before it is actually formally applied to the activity and then to the schedule computations.

## Schedule Update Process

There are two types of schedule update processes; the status of planned work and the revision of the schedule to reflect the planned work. The revision may include the modification of the scope of work, additional new work, deleted uncompleted work, and logic changes to reflect a modified contract or a new work plan. In some projects, these two types of updates may be performed in the same submittal. In other projects these two types of updates are required to be submitted separately; first as a status-only update and then as a combined status-changed workplan schedule update.

The activities to be statused should be from the list of CPM activities in the schedule. It is recommended that the scheduler create or print out an Update Report (also called a turnaround document) that only includes those activities that were planned to begin or might have begun during the last update period as well as any on-going activities as of the last status update. The Update Report should have space or capability for mark-ups so that the new status might be annotated next to the old.

The status should be taken at the end of the workday and not over a lengthy period so as to be able to consider the status of every activity as being taken simultaneously. Pictures of the various work areas may also be taken as to further document the veracity of the status. It is advisable to date and add narration to each photograph so as to make it clear what was being documented and when.

A very easy method to document the contents of a digital picture is to use Windows Explorer and right-click on the file, select menu item 'Properties' and then the 'Details' tab. Here the scheduler can add Tags that can be searched for using Windows Explorer. The Tags may include location or responsibility information. There is also a location called 'Comments' that allows for a nearly un-limited amount of description to be included. The added Tags and Comments are incorporated into the picture file such that they cannot be

'lost' even if the picture is later copied. Contemporaneous information entered here is extremely valuable at the end of the project to schedule forensic experts.

The scheduler should save a copy of the schedule before updating the status. In some cases, this is also called, creating a Baseline Schedule. Keep a written Narrative of what was updated and any assumptions made. Establish a new data date to coincide with the date that the status was taken. The definition of a data date is the very first moment that new or continuing work can be scheduled to begin. This is different than the date that the status was taken but can logically be treated as if it were the same thing.

If statusing activity resource hours or costs, the scheduler should be careful that the software does not automatically status the activity as well, as this can cause inaccuracies. For example, Oracle Primavera P6 Professional™ (P6 Pro) resource actual dates must fall within the activity actual dates or the existing activity actual dates will be automatically adjusted to match.

The scheduler using P6 software should not recalculate the CPM until all activities needing updating are statused. Activities that are not marked as having started will have their calculated dates advanced past the Data Date and thus, their Planned Dates will also advance. Statusing the actual start at that point will freeze the Planned Start date at a meaningless new date and not the date previously calculated at the last update. This Planned date is frequently shown as the Baseline date for an activity. Marking an activity as Started automatically freezes the Planned Start date at the date last calculated for the activity's Early Start. [10]

In assessing the status of deliveries, the contractor should communicate with the manufacturer and receive an update of the delivery status with every schedule update. This communication can potentially help defend the contractor should a delivery delay occur and the supplier is found to have deliberately, or even negligently, misrepresented the current status of an open order. For mission critical deliveries, the contractor may have legal authority to require such accurate updates from the vendor. [4]

The statusing of design preparation is both important and difficult. Drawing status may be evaluated in the following methods,

- Weighted drawing count,
- Averaged base manhours per drawing,
- Percent complete,
- Status calculation,
- Evaluation by discipline, and
- Evaluation of percent complete of earned versus spent. [11]

All activity pacing delays should be announced and re-iterated in each schedule update. Pacing delays are experienced when the contractor is not aggressively pursuing the execution of the contract work due to another on-going delay creating a situation where this work is no longer critical.

Once the status of the project has been taken, it is in everyone's best interest to update and publish the project schedule as soon as reasonably possible. The opportunity to correct problems and delays to the project become less possible and more expensive as the time gap between the status and the publishing the result grows. In addition, parts of the update may need to be revised and re-published once the updated schedule has been reviewed. It is very important that the revision and re-publish process does not run into the next cycle's updating process.

## Reviewing Status

Upon receiving a schedule update from the contractor, the owner's representative should summarize and review all changed status for accuracy and completeness. The accuracy of the status assessment is the responsibility of the contractor but it is in the owner's best interest to question any status that appears inaccurate, especially when the activity in question is on the critical path or subject to a disruption or delay issue.

The reviewer should verify the reasonability of actual dates. Once such check one can make is to note any activity that has started out of the logical sequence of its predecessors. This may be the result of an error in determining the actual date or may be the result of a work plan change.

In addition to the explicit logic evident in the schedule, there are undocumented restrictions that can delay the start of any activity such as missing resources, documents, or access.

Sources for confirming status accuracy exist besides just personal observations. Dated jobsite photos are an excellent source of status verification. Other sources also include, [12]

- Meeting minutes,
- Inspection logs,
- Certified workhour submittals,
- Emails,
- Daily reports,
- Weekly or Monthly progress reports,
- Change Order files including labor and material cost estimated man-hours required to perform the changed work,

- Pay application data,
- Productivity reports,
- Installed quantities reports,
- Deficiency reports,
- Material receiving logs,
- Transmittal logs,
- Drawing logs,
- Superintendent diaries,
- Project correspondence,
- Field notes and timeline data, and
- System turnover data.

The reviewer should look for activities with an actual start date and remaining duration equal to its original duration. This indicates that no progress was made and the actual start should be questioned for reasonableness. The reviewer should look for an activity that is reporting 100% complete but without an actual finish date being posted. This is likely a case of a missing actual finish date. Activities reporting 100% complete without an actual finish date may behave differently in a CPM network than those with one.

The reviewer should address all formally suspended activities. On-going suspensions should be reviewed to ensure that no progress changes were made without an accompanying statement in the update submittal. In most cases, progress should not be indicated without an accurate resume dated supplied.

### **Actual Dates in the Future**

The reviewer should look for actual start or actual finish dates that are later than or equal to the data date, also known as actual dates in the future. This condition is especially problematic for CPM schedules that use out of sequence calculation mode of Retained Logic or Progress Override. In those cases, successor activities to the ‘completed’ activity will begin on the schedule’s data date and not following the activity that is stasured as having ‘completed’ sometime in the future of the data date.

Software that uses the actual dates in the CPM computational process such as Microsoft Project™ and P6 Pro with the Actual Dates setting will schedule successors to activities with actual dates in the future in a more CPM-like fashion. Many schedulers believe that actual dates should never be assigned that are later than the schedule’s data date, even if they were actually started or completed as the dates listed.

It should be pointed out that inserting an actual start or actual finish date on the schedule's data date is an instance of actual dates in the future. The data date is typically one day later than the status date.

## **Negative Progress**

The issue of 'negative progress' is a difficult one to simply resolve. This is the case where remaining duration increases from the last reported duration instead of remaining the same or decreasing. This especially becomes problematic when the remaining duration estimate becomes greater than the original duration. One line of reasoning says that the original duration should be increased to match the new remaining duration while other method leaves original duration unchanged due to Earned Value concerns.

Negative progress may be the result of a revised workplan or scope, better understanding of the work to be performed, delay or disruption, or an accident causing damage to the work performed. All such cases of negative progress should be explained in the submitted narrative.

## **Delays**

Every time that a Notice of Potential Delay is issued, both the contractor and owners representatives should make a non-scheduled status assessment. It is important to status all near-critical activities, not just the one involved in the delay notice. This dated and signed status assessment should be filed in a delay folder assigned for the Notice of Potential Delay.

In addition to a status update, both scheduling representatives should note any potential concurrent delay and notifications of pacing.

Accurate As-Built dates are very important for successful Time Extension Requests. The inaccuracy of such dates can completely invalidate any such analysis or at least the extent of the delay. Key project information needed for measuring and proving quantifiable schedule delay is primarily based upon available and reliable as-built dates for the start and finish of all schedule activities. [12]

It is preferable for the delay analyst to rely on the as-built date information within the contemporaneous schedule updates as an accurate source of as-built dates unless the dates are shown to be inaccurate. [12] Actual dates verified at the time of delay carry more weight than those researched at a later date by parties who were not on the project at the time of the issue. It is also normally far less expensive to the owner to verify accurate

as-built dates during the project than to hire a 3<sup>rd</sup> party to perform this same service at a later time.

## PROJECT STATUS

Once the status of each activity has been entered, the schedule's CPM dates can be re-computed. The earliest date that the last activity in the schedule is predicted to finish is the project's status. This date is compared to the earliest computed project finish date of the approved baseline schedule in order to estimate whether the entire project is ahead, on-time, or behind planned completion.

## CONCLUSION

The application of status to a CPM schedule adds a whole new level of complexity to project scheduling. It is essential that this be done often enough to keep the schedule current and useable as a predictive tool.

Properly statusing a CPM schedule is critical to being able to use it to correctly report progress of a project as well as forecasting project completion. Procedures for doing so should be uniformly applied so as to be able to create reproducible results.

A lot of time and expense can be saved if the project schedulers take the time to properly document and validate the accuracy of actual dates entered into the schedule. Schedule analyses can only be reliable if the date information that they are based upon are also accurate.

It is notable that practically all courses that teach CPM scheduling fail to demonstrate these calculations on a schedule displaying status. Issues such as out-of-sequence progress and actual dates in the future are not normally demonstrated to new schedulers. That is why CPM scheduling only really gets interesting when you consider activity status.

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