AACE International Recommended Practice No. 53R-06

SCHEDULE UPDATE REVIEW – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION
TCM Framework: 9.2 – Progress and Performance Measurement, 10.3 – Change Management

September 21, 2007

PURPOSE

This **Recommended Practice for Schedule Update Review** is intended to provide a guideline, not to establish a standard. As a recommended practice of AACE International, this document provides guidelines for the project scheduler to create a professional schedule update or assess the reasonableness of changes to be made in a schedule due to a change of project status and progress. This recommended practice is associated with the Total Cost Management (TCM) progress and performance measurement, and change management processes on construction projects.

OVERVIEW

This recommended practice provides guidelines to assist construction entities submitting the schedule updates (the contractor) and the entity reviewing the schedule submittal (the owner or client) to respond to the submittal in a fair and reasonable manner. The use of the term "owner" also includes the work performed by their agents such as construction management. Also included is the recommended process to be followed by the schedule reviewer (reviewer.) Overall these three participants are responsible for the complete, accurate, and timely submittal, review and approval of the project schedule status update in order to benefit the project as a whole.

A schedule update occurs when a contractor assesses the status of the project that they are currently working on, enters that status into a previously prepared schedule, and then submits (shares) this updated schedule with the owner of the project. Schedule updates are an important aspect of timely project completion and this is a major reason that most construction contracts for large projects require them. They are a vital medium of communication from the contractor to the owner about project status, completed work to date and forecasts for project completion.

The schedule update should be a reflection of the contractor's intent to reach project completion. Because of this, it is created and updated by the contractor. The owner indicates their willingness to use the schedule update as a means of communication and negotiation by accepting the schedule update. There are alternative methods of managing a schedule update, but the process should honor this basic procedure. Acceptance first requires reaching agreement on the project status.

Reaching agreement on the status of the project schedule is often difficult, frequently requiring negotiation and perseverance. The successful completion of this process is the hallmark of a good scheduler using the correct process. Failure to arrive at a quick, accurate, and timely agreement of project status can cause confusion, uncertainty, and potential loss of time and/or money on many projects. A lack of timely agreement on the project schedule status could result in contractor acceleration, cost overruns, late project delivery, and disputes that frequently last well past project completion.

Assessment of the impacts of trends, deviations, changes, etc. on project schedules usually cannot be made without agreement on schedule status. If the participants agree that the schedule update submittal meets the specified standards and represents the current status and forecast using logic for the project as of the status date for the schedule update, it is understood that both the contractor and owner are in agreement on approval of the schedule submittal.

APPLICABILITY

This recommended practice is oriented to critical path method (CPM) schedule analysis and is applicable only to schedule update reviews that take place during execution of the work. Baseline schedule reviews prior to the start of execution differ greatly and require different review techniques than used in schedule

update reviews. A baseline schedule review is different from an update schedule review for the following reasons:

- Focus on quality. The focus of a baseline review is on the overall quality and completeness of the original project schedule and overall plan, and not an assessment of current progress or subsequent project schedule changes.

- Review factors. The following factors are typically considered in a baseline review that are not the focus of a schedule update review:

  - Sequence and work flow.

  - Constructability.

  - Timing and phasing.

  - Resource usage and balance.

  - Ease of understanding and use in updating and maintaining.

- Constraints. Baseline schedules should be relatively free of imposed or "mechanical" constraints. Schedule updates are more flexible in the allowance and use of (mechanical) schedule constraints than in the baseline schedule.

- Negative float. Negative float is generally not permitted in baseline schedules.

- Early project completion. In baseline schedules, the contract project completion date should be met or a clear intent and capability of delivering the project early should be demonstrated. A baseline schedule with an early project completion date typically represents a request for early project completion that should be negotiated. Once on-time completion has been demonstrated in the accepted baseline schedule, early project completion is generally dealt with as a shared project resource and is not subjected to the scrutiny that is typical for baseline schedules.

In contrast to a baseline review, an update schedule review is generally concentrated on the following issues:

- Focus on changes. The reviewer should concern itself with changes made to the schedule since the last accepted schedule update. If no accepted schedule updates exist, then this review should focus on the changes made since the accepted baseline schedule.

- The focus of a schedule update review generally falls into the following categories:

  - Status or recorded progress.

  - Changes made to the activities.

  - Changes made in logic.

  - Delays and unplanned events.

  - Constraints to the project.

  - Status and changes in resource availability and usage.

- Constraints may be added to the schedule if documented in the narrative and can be shown to not unfairly reserve available float for the exclusive use of one party. A typical example of allowable uses

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of constraints include the delay of non-critical offsite work until favorable summer weather.

- Update schedules may indicate negative float. This is a matter of status and logic and cannot be avoided if the project is running late.

- Project completion is a projection of status. If the project is running late, then project completion will be shown as a date later than the required project completion date. If the project is running ahead of schedule, then projected project completion will indicate a date earlier than the required project completion date. Once a baseline schedule is accepted that indicates on-time project completion, then early projected project completion in an update schedule typically has no effect on the status of the contract.

This process is applicable across all contract types.

RECOMMENDED PRACTICE

This recommended practice is organized into two phases; the preparation of the schedule update submittal by the contractor, and the review of this submittal by the owner. The following topics are outlined as follows:

- OVERARCHING PRINCIPLES

    - Timeliness

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- ADDITIONAL TOPICS

  - • Resource Leveled Schedules as a Submittal

  - • As-Built Schedule Submittal

OVERARCHING PRINCIPLES

The optimal processing and review of a schedule update requires timeliness, fairness, and appropriate interpretation of the contract. A schedule update submittal constitutes a notification of the status of the project and the project schedule from the contractor to the owner. Contractually, if the owner requires the contractor to submit a schedule update, then the owner of the project has a responsibility to review and comment on any required schedule update submittal in a timely manner. Comments from the owner (if any) should be made in writing and returned to the contractor.

Timeliness

The timely submittal, review and approval of schedule updates are of major importance to the construction project. For the owner to receive full value of the schedule submittal, it should be delivered within the specified time. Because the contractor requires the owner's comments from the previous schedule update in order to prepare the next schedule update submittal, the owner's comments should be returned within the agreed upon time.

Failure to comment on a schedule submittal in a timely manner may result in disruption and hinder the efficient prioritization of scheduled construction. Because failure to comment generally implies acceptance of the schedule, it is in the owner's interest to review and formally comment and/or accept the submitted schedule update.

In the absence of a specified "turn around time" (or complete submittal review cycle), the schedule should be submitted or delivered to the owner or owner's representative within a time period of one fourth (¼) of the update cycle after the schedule status ("data") date. Conversely, the owner should provide review comments and approval within one fourth (¼) of the update cycle after the schedule submittal is received. This timing is both fair and reasonable as it allows time for a re-submittal prior to the next update cycle.

It is recommended that the reviewing scheduler promptly load the electronic schedule file as soon as it is received, even if other work assignments do not allow the actual review to be performed immediately. A cursory look at the schedule will tell the reviewer that the contents are apparently whole and that the transmittal was successful. A failure in the transmittal process can still be corrected by reporting this fact in a timely manner. An unpleasant alternative to this practice would be to wait until the actual review is to begin and then have to notify the contractor of the problem with transmittal and potentially delay the review.

Fairness

The owner should respond to schedule update submittals in a fair manner that provides the contractor a clear evaluation and detailed explanation of problem areas (if any), whenever possible. Schedule submittals should be tracked and responded to in a timely manner. It is recommended to keep a log of all submittals to include dates submitted and returned and the status of the review.

The contract and the specifications accompanying that contract bind both parties to use it solely as the standard for the creation and appraisal of schedule update submittals. The schedule submittal should either be accepted as satisfying the requirements of the contract and specifications or be rejected for not meeting those requirements. Schedule submittals may be provisionally accepted by the owner with the stipulation that the contractor will correct the noted deficiencies or shortcomings with the next schedule update submittal.

Conditional owner acceptance of schedule update submittals is an accepted industry practice and allows for corrections while minimizing disruption and expense to the project. If these items are not corrected with the next schedule update, the owner has the option of again requiring their correction by the subsequent submitted update, rejecting the current update submittal, or rejecting the current and the prior update submittals and requiring resubmittals. Failure of the contractor to properly or adequately correct those shortcomings or stated deficiencies may result in the provisional acceptance of the previous schedule being removed and reclassified as non-accepted.

The current forecast status of the schedule should be realistic. Typically, it is not reasonable to require schedule update submittals to indicate on-time milestone or project completion unless this is actually the case. A recovery (or work around) schedule may be required, but this recovery schedule is usually required by the contract specification as a separate submittal and distinctly different from the periodic schedule update.

Interpretation

The reviewer should not reject a schedule update submittal unless the submittal contains errors that invalidate the accuracy of the schedule. It is reasonable (and a normal part of most schedule reviews) to note discrepancies that are not a reason for rejection of the schedule. Conversely, it is permissible to reject a schedule update when there are so many minor discrepancies or errors in the schedule that, in the reviewer's professional opinion, the aggregate of the errors severely limits the schedule's credibility and usefulness to predict future progress.

The goal should be for all project participants to effectively communicate and minimize the number of review cycles and overall review time in order to achieve timely schedule acceptance. Because of this, even when there is an observed issue that is significant enough to reject the schedule update, the reviewer should continue the review to its completion. The entire schedule review should be completed and all comments should be included in the recommendation for rejection, even if some of the comments are not about issues severe enough to reject the schedule by themselves.

It is not desirable to reject the schedule over a single issue and then later reject the re-submission over another issue that could have been noted in the first submission. However, an issue may emerge that was not observable or recognizable until previous conditions have been corrected.

Enforceability

If the schedule specification allows or prohibits a particular CPM practice, then that practice is allowed or prohibited (as the case may be) regardless of other considerations. The contractor may request that any specific schedule practice be waived and if such waiver is granted, may disregard that particular practice.

Not all scheduling specifications are worth the "cost" of enforcing them. The owner may choose to ignore selected contractual variances for the sake of project success. Because of this, specific schedule specifications are often waived by the owner. Sometimes the variance has little impact on the quality of the schedule and the specification is not applicable or relevant to the current project. Other times, the variance may have a large negative impact on the contractor and the owner will waive the variance in the interest of timeliness and in the spirit of cooperation that must exist for a project to be truly successful.

The only alternative to waiving a variance is to reject the schedule update submittal because of that variation.

Specification provisions that are not enforced at the time of reviewing the submittal should not be retroactively enforceable at a later date against the same approved submittal. Legally, it is unclear if a repeated failure to enforce a scheduling specification clause may be considered a waiver of that clause for the duration of the contract. For clarity and security, it is important for the owner to formally allow any deviations granted and state the limits of such deviations to the schedule specification with clear, written guidance. This should be done in a timely manner so as to preserve the enforceability of the remaining provisions of the specification.

SCHEDULE UPDATE SUBMITTAL

Components of and Deliverables of an Update Submittal

At a minimum, the schedule status update submittal consists of a schedule narrative and a copy of the schedule's native electronic database in a form consistent for archiving and transference to other project participants such as the owner. Additional schedule submittal components may also include printed CPM reports and graphics, data tables to substantiate the claimed progress, early/actual/late progress and budget curves (S-curves), and related progress and resource graphics, as required by the contract.

For cost and liability issues, some schedulers believe that the owner should consider minimizing the required contract scheduling submittals. Reducing unnecessary submittal requirements helps to reduce overall preparation costs which may lead to lower project cost. Liability is assumed with additional submittal requirements due to the fact that the owner is responsible for reviewing the contents of all submittals. The experienced reviewer can produce any additional reports that are needed for the review from the electronic schedule database. Other schedulers insist on printed reports being submitted along with the electronic schedule database.

Typically the schedule update submittal consists of the following components:

• A written narrative describing changes made to the schedule and the overall impacts to the project.

• A complete electronic copy of the schedule update database.

• Printed reports, as required by scheduling specification.

• Graphics, as required by scheduling specification.

• Any other contractually specified documents or inclusions such as a time impact analysis (TIA) or recovery schedule.

Schedule Narrative

The schedule update narrative adds and supports understanding of the schedule update. The narrative describes changes made to the schedule, current issues, problems, and related schedule notifications to the owner. It is a universally important document as the narrative is understandable by all project shareholders, not just the scheduler. A good narrative both informs the owner and reserves the rights of the contractor.

A narrative may include the following items, as appropriate:

• Identification of significant schedule progress during the reporting period.

- Progress against contractual milestones this period.

- A list of significant activities started or completed during the reporting period.

- Explanation of any lack of progress on critical path activities planned to be performed during the previous reporting period.

- The status of major project material and equipment procurement.

- Identification of constraints to progress (delays) encountered during the reporting period.

- Identification of proposed schedule change orders submitted during the last reporting period.

- Explanation of any significant schedule variances from the baseline (target) schedule plan.

- A list of all changes made to the logic or planned durations this update period.

- Explanation of any schedule changes, including changes to the logic sequence or to activity durations and the impacts to the overall project.

- Project risk analyses.

- Project schedule concerns and issues.

- Recovery plans (if required by the contract/specification.)

Because a narrative supports and adds to the understanding of the submitted schedule, reviewing an incomplete schedule submittal is inefficient and possibly misleading. The reviewer may be confused or overlook important issues that a narrative would have quickly clarified. For this reason, a partial schedule submittal usually does not constitute a contractual submittal.

If the project is on schedule, then the narrative should state this fact. Some court cases have hinged on the issue of whether or not the participants understood that a problem existed at a certain point in time. The fact that the narrative written at the time of a delay did not contain even a mention of an obvious delay condition was later used to question the validity of an analysis created after the project was completed.

The contractor should not wait for the narrative submittal to inform the owner of possible delays to the project. Notice of potential delays should be transmitted separately and as soon as practical after observing a delay issue that impacts the owner and as mandated by the terms of the contract. The narrative should contain confirmation (and perhaps elaboration) of any previously transmitted delay notice.

Printed Reports

Printed schedules can pose serious problems for the reviewer. While the preparer is always responsible for the accuracy of all submittals, printed schedule reports may contain inconsistent or contradictory information from that presented in the electronic version of the schedule for the same status date. Printed material is incapable of being re-formatted to match reports from earlier submittals and is much harder and error-prone to review than using electronic versions with the proper comparison software. In addition, a single printed report is usually incapable of printing all activity, relationship, cost, resource, log, code, workday calendars, and administrative settings that may be contained in the electronic version of the CPM schedule.

Even after the CPM has been calculated, it is very easy for non-technical people to inadvertently change

calculated results or otherwise manually modify project schedule documents before they are printed. With many software packages, an accidental click on an activity bar can drag it sideways and instantly change the reported dates and float for that activity. Often misrepresentations of the schedule can be unintentionally made. The mistaken application of groupings, filters, sorts, or other inappropriate reporting criteria may confuse, hide, or fail to display important data in the printed report. The fact that these reporting settings have been changed is typically not readily observable in the printed report.

On the other hand, printed reports cannot change over time. A signed schedule report at least ensures that the signer had seen the copy of the schedule represented. As stated earlier, the scheduling community is divided on the importance and use of submitted reports.

The best way that the reviewer can be sure that the information in the reports exactly matches the information in the electronic version of the schedule is to load the schedule electronically and print their own reports. In the case of a mismatch between the printed report and the electronic version, it is a disputed issue if the information derived from the electronic copy of the schedule database takes precedence over a submitted printed report or if the reverse is true.

If printed reports or graphics are to be submitted by the contractor, then it is important that the title information, format, filters, groupings, and sorts be agreed upon before the first report submittal and not be changed without consent from the owner.

Schedule Input Data File

It is common to use CPM scheduling software to maintain project status and forecast project completion. Contract specifications normally require the submission of an electronic import (or input) file in a format and medium that can be used by the owner using their own copy of the CPM scheduling software and computer to re-create the same scheduling database for their own use. This submitted data file is quite different from a graphics file (such as a "PDF" file), as it contains all of the information contained in the schedule, not just a single view of the current status.

Schedule Update Process

Once a baseline schedule submittal is established and accepted, then a schedule update should be made on the next periodic schedule update cycle date. Schedule update submittals should show the status of the entire project scheduled as of a single date specified (for example, "on the 20th of each month") or on a particular, reoccurring date as determined by contractual frequency requirements. Many projects time the schedule update status to coincide with the payment application time period in order to provide documented backup of the project status.

Schedule updates should be adjusted to show a status date also known as the "data date." The status of all activities in the schedule should be noted as based on this single status date. Once the activity status is entered, the CPM calculations are performed consistent with the status date. No unfinished work should be found in the schedule to occur prior to the status date, and no completed work should be found in the schedule to occur later than or on the status date.

Most CPM scheduling software contains internal settings that determine the specific manner in which the CPM calculations are produced. An example of this would be whether float is calculated using the calculated start dates or the finish dates. None of the software calculation rules affecting how the CPM was calculated should be changed from those used in the previous approved schedule update (or baseline schedule if appropriate) unless the CPM rule change and reason for that change is documented in the schedule narrative and not prohibited by specification. If the owner does not approve of the CPM rule change, then this rule should be returned to the previously approved setting.

After the CPM calculations have been performed and saved, no changes should be made to the

schedule update without repeating the CPM calculation process. Failure to observe this rule may result in schedule settings that are inconsistent with the CPM calculations.

If the owner is in disagreement with the assessment of activity status in a schedule update, then the exact issues in question should be stated clearly in writing in a prompt manner. The stated status in a schedule is the sole reflection of the contractor's assessment. The owner may accept a schedule update with status assessments that they disagree with but these specific disagreements should be documented.

It is in both party's best interest to resolve and agree to all dates and status so as to reduce ambiguity and potential future conflicts. If the contractor agrees to change their status in response to a request by the owner, then a separate corrected schedule should be re-submitted by the contractor. It is not good practice to just agree to the change(s) without submitting a revised electronic document that reflects the change(s).

Schedule Status

Schedule status should be noted and documented as soon as possible after the activity has started and finished. This allows for the most accurate assessments and also provides the scheduler with the best opportunity to verify the accuracy of these dates and progress.

The schedule status should be observed, documented, and entered into the scheduling software as it is physically observed. Larger projects may wish to use a progress tracking system for progress calculations. It is not an acceptable practice to have the scheduling software automatically enter actual date status as it was planned (e.g. via an automatic update.)

Actual start dates should reflect substantial and effective start of the work and not just the start of some minor, inconsequential preparatory work. For example, activities may have a proper actual start date while not showing any evidence of actual work in place, if actual work is being accomplished elsewhere that contributes and is included in the work plan for that activity. This sort of work is often reflected in shop preparation and prefabrication in off-site or remote areas. This is one of the reasons why it is very difficult to reject actual date assessments made by the contractor. Such off-site critical work should be described in the narrative and the owner should be kept informed of its existence and progress. Significant off-site work should be identified as separate activities from on-site work wherever practicable.

Activities that are in-progress should be statused by estimating the remaining duration of an activity, not by estimating a percent complete. Remaining duration should be based upon the time necessary to complete the work logically holding-up the substantial start of the successor activity and allowing that activity to continue to substantial completion without interruption.

There are several reasons for not using percent complete as a status assessment. In some cases, percent complete is an assessment of relative earned value and not an estimate of the remaining time durations. Due to progress payment considerations, the activity percentage earned value may reflect non-linear assessments such as major equipment procurement receipt and delivery, which is usually accounted at the start of the installation activity process and not distributed evenly across the entire activity duration. Finally, it generally far more accurate to estimate remaining duration than it is to determine the portion of total work accomplished.

Actual finish dates should reflect substantial completion of the activity that allows the defined successor work to start without delay. This means that there may be unfinished work remaining for an activity with a proper actual finish date, but that this remaining work should in no way interfere with, or hinder the subsequent work in any manner (even to include shared resources.)

Should that completion assessment vary widely from the absolute completion of the activity (and especially if the activity has a float value very close to the critical value), then the narrative should include

an explanation for such a completion assessment. Activities that remain short of absolute completion for a sustained period of time should be incorporated into a project-wide punchlist that is made available to both parties. Schedules should include an activity reflecting punchlist work partly for this reason.

Schedule status may also contain the as-built logic changes depicting the actual causes for timing and work flow used during the last update period. In CPM schedules, the status of actual and planned logic is an important aspect of the entire status process.

Schedule specifications may require the contractor to modify activities durations and logic of the schedule update to show planned work for planned activities to match the current plan. Some other specifications may forbid changing the schedule without a formal review. If the contractor is not allowed to document the status of changed activities without a formal review, then this review process should be accomplished on short notice with quick resolution or the owner might be held responsible for delaying and disrupting the status update process. All significant changes to activities and logic should be documented in the schedule narrative to explain the reasons for the changes. As-built logic is just as important to document as are as-built dates.

Some reviewers try to separate the documentation of status (the addition of actual start and finish dates and percent complete for existing activities) from schedule modifications (the addition, deletion, or modification of activities or logic) when reviewing the schedule. This is difficult if not impossible to do. Activity status without proper durations and logic is just a bar chart and not a CPM schedule. Schedule status that does not reflect the logic planned and actually used does not create a meaningful representation of future planned work, nor does it properly indicate the project's critical path.

It is acceptable and advisable for the contractor to unilaterally insert new activities with actual dates into the schedule update depicting delays that occurred during the last update period, providing that logic ties are not also included. Without logic ties, such insertions cannot affect the CPM calculations and the additions represent an excellent form of communication between the contractor and owner. Such insertions should be addressed in the narrative. If the owner objects to prejudicial wording of the activity, they may do so in their review without needing to resort to schedule rejection.

Others feel that before an activity may be inserted in the schedule update, it must first be submitted and approved as a time impact analysis component. The main problem with this approach is that this requirement greatly delays the introduction of this information into the schedule and deprives the owner of timely notice of these scheduling issues. Tolerance for the unilateral insertion of delay activities into the CPM schedule is not currently a widely held practice amongst the scheduling community.

Activity Suspension

There are several acceptable techniques used to show work suspensions in a schedule. If the suspension of work was caused by actions or inactions of parties not under the contractor's control then further issues should be considered. The following suggestions are examples and do not constitute the entirety of the actions needed.

Activities that have started but were not actively worked on during the update period can sometimes be split or converted into two activities with connecting logic to indicate this period of inactivity, provided the specifications do not prohibit it. If this is done, then original durations and budgeted resources and costs should also be properly allocated between the two activities to total the original quantities.

It is also permissible to not split the suspended activity provided that a statement of inactivity during the last reporting period is placed in the narrative. If the activity is not split into multiple activities, then some scheduling software allows the scheduler to designate a suspend date and later a resume date for the activity. This is not always the best option as most scheduling software only allows for one such suspend/resume cycle to be listed per activity.

Another "activity suspension" technique used in lieu of the above is the creation of a new activity workday calendar that shows the period(s) of inactivity as non-work (holiday) periods and assign this calendar to the described activity. Once done, some scheduling software will then be able to indicate this period of inactivity in the bar chart view by "necking" the bar during the inactive periods.

SCHEDULE UPDATE REVIEW PROCESS

Reviewer's Role and Responsibilities

The reviewer is usually either the owner's representative or a member of the owner's staff. As a staff specialist, the reviewer should be working toward the best interests of the owner as well as the successful completion of the project. The reviewer needs to be fair and objective in the overall review process.

Review Process Overview

A schedule update review is performed by observing the changes made to the schedule since the last accepted schedule update (or the baseline schedule if no previous updates have been submitted and accepted) and evaluating the appropriateness and impacts of the changes. For the purposes of discussion, a "change" here includes status updates as well as activity, logic, resource, coding, or other alteration to the schedule. Reviewable changes do not include formatting issues such as activity groupings, filters, or sorts used for presentation and schedule organization. These computer formats only affect presentation of the schedule and are not meaningful to effective review.

The schedule update should be evaluated using the following criteria:

• Requirements included in the contract specifications.

• Physical dimensioning and instructions found in the contract plans.

• Resource availability.

• Professional scheduling practices and guidelines generally accepted for use by professional scheduling practitioners.

Because it is so important that the owner be made aware of all changes in the schedule, it is recommended that some sort of automated "assist" be used in the course of identifying these changes. This automated process of identifying changes may be provided by developing internal schedule export routines based in spreadsheets or databases, or by utilizing commercial software designed for this purpose. Some professional CPM schedule software systems contain add-on or built-in routines designed for identifying these changes. The interpretation of the significance and acceptability of schedule changes remains the responsibility of the reviewer, but these automated processes can make the change identification process more efficient.

If a schedule update includes a change that is not performed in the manner expected by the reviewer and that change is in accordance with the evaluation criteria listed above, then the reviewer should accept the change. This guidance does not prevent the reviewer from commenting on that change in the formal review report.

Other than schedule status changes, the reviewer should not require additional changes to the schedule submittal that are not directly supported by the contract specifications or other contract documents. Although the reviewer may recommend additions or changes as enhancements or improved professional practices, the failure to comply with these types of requests should not be a cause for schedule rejection if the recommendation is not required by the contract documents.

Generally it is not an accepted practice to reject a change made that existed in earlier accepted schedule updates. The proper time to object to a change is in the first schedule update that contains this questionable change, not in later reviews of schedule updates with this change already incorporated. This reversal of acceptance disrupts the entire schedule review process and draws into question the acceptability of all earlier schedules that contained the questionable change. Just as the contractor is responsible for providing a complete and accurate schedule submittal, so is the owner responsible for the timely and complete review and acceptance of any schedule update change.

Acceptance versus Approval

The accuracy and viability of the submitted schedule update is the responsibility of the contractor. The schedule should be the contractor's assessment of current project status and their plan for future progress. The owner does not take responsibility for the contractor's actions by either accepting or approving the schedule update submittal. The owner merely indicates whether or not they accept the submitted schedule update as meeting the scheduling specifications and standard scheduling practices. In the context of schedule update submittals, the term "approval" means the same thing as "acceptance" and does not constitute any shift in the responsibility of scheduled work from the contractor to the owner.

Schedule Update Review Items

Activity IDs are the "tags" that uniquely identify each activity regardless of other changes. Once deleted from a schedule, that same activity ID should never be re-used for another activity in that schedule unless it is a direct reinstatement of the original activity without modifications.

All changed items in the schedule should be considered and not just changes on the critical path. Changes made in one review period may not manifest themselves as a critical change until a later date. At a minimum, the schedule update review should include any changes in the following items:

- Scheduling software system checks:

  - Project start, status, and other imposed project dates. In one popular scheduling program widely used, there are a total of 23 different settings that should be checked, five of them having to do with project dates. Check to verify that the project start date and calendar start dates have not changed, as this will modify the work day numbers. This also interferes with automated schedule checking software. Changing the required completion date will change the project float. Changing the schedule time units from days to hours may also confuse automated schedule checking software.

  - Other software rules governing automated responses to inputs. Some scheduling systems allow the user the option of "locking" the percent complete as the ratio between original duration and remaining duration. In this case, there is no point in reviewing both percent completes and remaining durations. If this setting has been changed to allow independent behavior, then the review should consider both.

  - Project calendars. Every CPM calculation is translated into dates using the workday and holiday activity calendars. Changing a calendar setting can expand or contract the apparent project duration. Some contractors interpret the requirement to document actual work to mean that they should also modify the work day calendars to reflect unplanned non-work days such as rain-days. This is done by changing the affected work day in the calendar from a work day to a non-work day, or "holiday". Changes to the calendar in the past (before the current status date) should not affect forecast dates. This procedure of documenting approved non-work days (sometimes called "weather days") also provides a method of adjusting the internal work day count in the schedule to align with the actual project work day count.

- ==Work breakdown structure== (WBS):

  - Deleted/added/modified WBS levels in the structure.

- ==Activity data:==

  - Deleted/added/modified activities.

  - Changes to internal activity settings such as:

    - Activity type.

    - Activity calendar.

    - Activity description.

    - Original duration.

  - Date analysis:

    - New dates added.

    - Changed actual dates that had been reported earlier.

    - New actual dates for a time period earlier than the start of this reporting period.

    - Invalid actual dates in the future.

    - Missing actual dates.

    - Suspended/resume dates.

    - Progress with suspended activities.

  - Progress analysis:
    - Progress but no actual start date.

    - Actual start with no progress.

    - Completion without an actual finish date.

    - Active activities with no progress.

    - Newly completed activities.

    - In-progress activities.

    - Unstarted but able to start activities.

    - Total float change greater than the reporting period.

  - ==Milestone analysis.==

  - Activity codes & activity ID codes:

- Change of activity code definitions.

    - Deleted/added/modified activity codes.

  - Activity constraints:

    - Deleted/added/modified constraints.

    - Out-of-date expected finishes before the status date.

- Relationships:

  - Deleted/added/modified relationships.

  - Newly "orphaned" activities without successor relationships.

  - Invalid added relationships.

  - Modified relationship lags.

  - Interruptible activities.

  - Activities without a predecessor relationship.

  - Active activities without a successor relationship.

  - Activities that started out-of-sequence.

- Activity logs, memos, or notebooks. Activity logs are sometimes considered a notification of project conditions from the contractor to the owner and should be reviewed for changes at every update. This is an excellent place to include delay and disruption information to maintain a contemporaneous record of project events. Using the activity logs for this purpose has the added advantage of making it clear to all just what schedule work was affected by the impact.

- Overall review items:

  - Critical path versus longest path.

  - Compare progress on the critical path from previous schedule update.

  - Activities starting later than necessary.

  - Activities starting earlier than logically allowed.

In addition to the above review items, if resources or costs are included in the schedule the following items should also be evaluated:

- Activity resources:

  - Change in resource definitions.

  - Deleted/added/modified activity resources.

  - Changes to internal relationship settings such as:

    - Driving resource.

- • Primary resource.

- • Resource lags.

- • Resource types.

- • Activity costs or values:

  - • Change in cost definitions.

  - • Budgeted costs.

  - • Earned value.

  - • Actual costs.

Actual Date Revisions

Sometimes a situation arises when previously reported actual dates or other schedule status is revised in the new schedule update submittal. An actual date reported in an earlier schedule update may have been deleted (causing the activity to once again be active in this update.) Perhaps an activity was reported as active in a previous schedule update but now the actual dates supplied in this update indicate that it was really finished long ago. Perhaps an actual date reported earlier has been modified to reflect a new, different actual date in this schedule update.

It is important that previously reported actual information remain constant in subsequent schedule submittals. From a project documentation perspective, it is not good practice to change or delete historical activity information (including logic relationships) in subsequent schedules submittals that were previously reported in earlier schedule submittals. The reviewer should request that the deleted or changed historical schedule information be re-inserted in the current schedule before the schedule submittal can be accepted. If such a request is refused by the contractor, then the reviewer should ask for a written statement as to why the change to the previously reported dates is necessary and what the impact was to the critical path in the older schedules by making this change in this schedule update.

More commonly observed than activity or logic deletions is the changing of previously reported actual start and finish dates. New information can become available to the contractor that reveals the previously reported information was inaccurate and therefore the newer, more accurate information should be reported. Dates and status should be corrected when the contractor is made aware that an error was previously made in the schedule assessment. The status changes should be made in the next schedule update submitted and the schedule narrative that accompanies the schedule update should identify these corrections and explain the circumstances for the previous reporting error.

A key aspect of a useful schedule update check is to make sure that all such changes to previously recorded historical information are identified and recorded in the schedule narrative. The reviewer should check previous schedule submittals to see if these changes affect earlier assessments such as longest path and critical path delay assessments. Any previously accepted time impact analysis showing a different result from the changed actual dates should be resubmitted for re-evaluation. Consideration should be given for the necessity for rejecting previous schedule approvals and requiring resubmittals or as a minimum document these changes with revised schedule narratives.

If the contractor is requesting the recognition that a change in the status of a previously submitted schedule has resulted in a change in controlling or delaying calculated results, then the contractor should resubmit the changed schedule update with a narrative explaining the changes and the reason that improved or more accurate information became known.

At a minimum, the reviewer should confirm that a change in previously reported actual dates was intentionally performed and not done in error. It is easy to accidentally modify such information while preparing a schedule update. One of the objectives of a schedule review is to reduce uncertainly. If an actual date is changed, then two potential options exist: the change was intentional or it was done accidentally. If the narrative does not report that a date change was intentionally made, then the owner should require the contractor to confirm the intention of the change no later than the next schedule update.

Rules for Acceptance of Constraints

Constraints are forced-date overrides to computed CPM dates that may be assigned to an individual activity in a CPM schedule. This definition and discussion of constraints only considers the use of directly overriding of dates and does not involve logical, resource, or other types of constraining issues.

Constraints may change or modify the CPM calculations. As constraints hide the pure-logical relationships between activities, their use is discouraged. A bar chart schedule may be thought of as a fully-constrained CPM schedule. Some schedulers incorrectly use constraints to make activities fall in time-periods as if they were preparing a bar chart schedule. Constraints should be used to reflect contractual requirements and not used just to make the early start date of an activity equal to the planned start.

Adding non-contractual constraints reduces activity float that may later become "critical" due to the actions of the owner when no real project delay is manifested. Allowing a non-contractual constraint to be added to the schedule may signal the owner's willingness to allow this same constraint to be considered even in the event of a future delay. If the reviewer feels that the non-contractual constraint may be left in the schedule, then it is advisable to include a comment in the review report that such addition must be removed prior to performing any delay analysis. If the contractor wishes to show a scheduling intent, then they should state this in the narrative and not through the use of constraints.

If the scheduling software provides a separate data entry point for planned dates that does not interfere or override the early and late calculated dates, then it is an acceptable practice to enter planned date information, provided the dates fall within the range of calculated early and late dates. The "three-week look-ahead" (or equivalent) schedule is a more appropriate place for the contractor to indicate planned start dates.

ADDITIONAL TOPICS

Old scheduling issues may lie dormant for years, only to be re-introduced as new understanding of the principles and limitations of a particular schedule become better understood. This certainly is the case with using an automatically resource leveled schedule as a schedule update submittal.

Resource Leveled Schedules as a Submittal

Resource leveling is accomplished after the CPM calculation is made and is used as a forecasting tool by the contractor to better plan requirements. A resource leveled schedule results in activity changes that are either manually adjusted, automatically adjusted through software routines, or a combination of both. Note: in this section of the RP, we refer to "resource leveling" as delaying or constraining the scheduled start of activities for resource considerations without the use of logic. Modifying the scheduled start of activities using logic is not considered in this context. Most project scheduling specifications do not discuss the application of resource leveling after completing critical path method calculations. This recommended practice neither advocates nor opposes the use of resource leveled schedules.

Some contractors take the position that it is reasonable to use resource leveling in schedule updates. They argue that as resources requirements must be considered in all practical schedule forecasts, then resource leveling is the natural facilitator of this concept. These same contractors contend that since resource leveling is being considered in the schedule update process, it should also be applied in the performance of time impact analyses.

Some owners object to the use of forward resource leveling in schedule updates, as this may delay some activities later than they would ordinarily be shown using just CPM calculations. This has the effect of "reserving" activity float for the exclusive use of the contractor. In addition, when used in time impact analyses to determine the effects of delays, forward resource leveling has a strong tendency to produce vastly larger impacts to project completion than just CPM calculations alone.

Ordinarily, the first action that a reviewer performs after loading the schedule is to recalculate the schedule using the status "as of" status date (which is usually already set in the schedule software parameters.) This is done to ensure that no latent information contradicting the CPM calculations exists before reviewing.

The exception to this rule is when the reviewer is analyzing resource-leveled schedules. In this case, the CPM calculations should not be made on the original schedule. Unwittingly re-calculating the CPM and then reviewing a resource leveled schedule might result in the acceptance of a schedule that might otherwise have been rejected. Many reviewers create a copy of the resource leveled schedule, perform the CPM calculation on the copy and compare the two schedules.

Scheduling software generally does not indicate if resource leveling has been used which makes that determination a problem for the reviewer. If it has been used, then the contractor should state so in the narrative.

There is no easy, definitive method of checking to see if the submitted schedule has been resource leveled. Reviewing the leveling set-up portion of the software and noting the lack of assigned resources to be leveled and/or prioritization selections is a reasonable sign that no leveling has been performed. The only true test for both manual and automatic resource leveling is performed by making a copy of the schedule, performing a CPM calculation against this copy, and then making a date-by-date comparison against the original update schedule. This activity-by-activity comparison is a time-consuming process and very seldom performed.

A resource leveled schedule is not the "CPM schedule" in the strictest legal sense. A resource leveled schedule is a CPM schedule that has been further adjusted to override and invalidate the CPM early and late date calculations. If the specification requires a CPM schedule submittal, then a resource leveled schedule does not meet that requirement unless the owner allows this modification to the CPM schedule. If the owner wishes to accept resource leveled schedules, then it is the responsibility of the contractor to explain exactly what changes were made in addition to the ones made during the actual CPM calculation process.

Engineering calculations should not contain more "precision" than the level of accuracy of the input data. Anything reported in a more detailed manner than known from the inputs may be mathematically correct but misleading. This same principle also holds true for automatic resource-leveling of CPM schedules. Resource availability is not typically dynamically known nor modeled to exactly match the current environment. Resource limits are seldom backed by adequate study and description (and in fact are often exceeded on construction sites.) The algorithms used to determine activity scheduling using resource constraints scientifically cannot be proven to be the most optimal.

If the owner does not wish to accept the resource leveled schedule as meeting the requirement for submitting a CPM schedule, a possible alternative (other than rejecting the submittal outright) is for the reviewer to recalculate the CPM using the exact CPM calculation settings in effect for that schedule and reviewing this re-calculated schedule as the submittal and stating so clearly in their written review. The contractor should object to this procedure in writing if they do not wish to accept this adjusted schedule

as their submittal; understanding that the objection nullifies the reviewer's acceptance.

<u>As-Built Schedules as a Submittal</u>

The contractor is responsible for the accuracy of the dates, status and CPM network logic shown in the as-built schedule. The contractor should review and compare all actual dates to the project documentation dates as a part of the process of submitting a certified as-built schedule. The final, contractually submitted as-built schedule is generally considered the "certified as-built schedule" and should report actual schedule performance as accurately as possible.

All parties have the right to depend upon this as-built information as correct and not subject to later revision. The owner may elect to accept later revisions to an as-built schedule, but only when a reasonable explanation is provided by the contractor. In cases of disputes, the last as-built schedule submitted by the contractor that was accepted by the owner is the first schedule that should be considered for use to analyze delays, should a final accepted as-built schedule submittal not exist. This makes a thorough review of the periodic as-built schedule submittal very important to both parties.

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