

Construction Project Scheduling: Keys to Success

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This Practice Note provides guidance to the owner of a construction project on how to draft a scheduling specification mandating that the contractor prepare a comprehensive schedule that supports proper planning of the work. It also provides guidance to ensure that the schedule is accurately updated as work progresses to enable the parties to identify potential issues that may delay the work and impact the cost of construction.

Construction contracts usually specify that time is of the essence in performing the contract work (as defined in the contract). The scheduling of work is often of paramount importance to an owner for reasons including:

- The need to complete a project within a certain time frame or by a specific date.
- Limitations on the availability of required labor, materials or equipment.
- The need to perform certain weather-sensitive construction operations.
- Cost impacts associated with idle labor and equipment.

Schedule delays and disputes over time extensions or impact costs are a major source of claims on a construction project, often because the contractor did not prepare a comprehensive or accurate baseline schedule or did not properly update the schedule as work progressed. The owner's failure to detail the required information in the project's scheduling specification or to timely review schedule updates can also contribute to scheduling failures.

This Note provides guidance for an owner on:

- Preparing a detailed, comprehensive scheduling specification.
- Examples of key activities to be detailed in the schedule.
- Practical solutions to ensure that the baseline schedule and all updates are reviewed and understood.

This Note also provides basic definitions of commonly used scheduling terms (see *Box, A Primer on Scheduling Terminology* (<http://us.practicallaw.com/0-574-8625#a1008726>)).

PURPOSES OF PROJECT SCHEDULING

Scheduling requirements on a construction project help ensure that all activities required by the contract documents to be performed by the contractor to complete the work are:

- Properly planned.
- Adequately staffed.
- Appropriately coordinated.
- Executed in an orderly and expeditious manner.

Schedules also contribute to the owner's decision-making regarding the evaluation of:

- The contractor's monthly progress payment applications (see *Practice Note, Payment Provisions in Construction Contracts: Drafting Strategies: Payment Application Process* (<http://us.practicallaw.com/1-568-1506#a694718>)).
- Proposed changes to the contract, including whether the contract time should be extended.

Depending on the nature and scope of the project, a construction schedule can be as simple as a list of activities that are organized in a logical, time-scaled sequence. However, on large construction projects such simple schedules are likely not adequate to meet their intended purpose.



There is, however, a perceived risk involved in an owner requiring the contractor to submit schedules which the owner then reviews and accepts. An owner-approved or accepted schedule takes on a certain legal significance and can later be used by a contractor as the basis of a claim.

The downside of not requiring a schedule is that the contractor's project plan is not communicated to the owner. In that instance, the owner is unable to:

- Effectively measure the progress of the work.
- Confirm that the work is being properly coordinated to avoid delay.
- Verify the timing for performing its own responsibilities required to complete the work.

The owner and contractor should endeavor to agree on a schedule that meets the intent of the contract documents and outlines a logical path for completing the work. In the absence of a clearly articulated scheduling specification in the contract documents, proper project scheduling may be dispensed with by the contractor as a cost-saving measure.

Most experienced owners recognize that the risk of not requiring comprehensive project schedules far outweighs the risk of requiring, reviewing and accepting a contractor's project schedules and incurring the potential increased costs carried in the project's budget.

During the design phase the owner and its engineer should devote the time necessary to draft a scheduling specification that is commensurate with the amount of detail, involvement and control the owner wants exercised on the project. It should be aligned with the complexity of the project and modified on a project-by-project basis. A balance must be struck to prevent the requirements from becoming so burdensome that the schedule becomes unmanageable and disconnected from the contractor's actual project management.

The time and effort spent on developing an appropriate scheduling specification during the design phase is usually rewarded by the planning and coordination benefits provided throughout the life of the project.

ELEMENTS OFTEN MISSING FROM STANDARD CONTRACTS

Standard industry form contracts often provide the contractor with minimal direction regarding scheduling requirements. Contracts often contain general language, such as "Prior to the start of any work, the contractor shall submit its proposed construction schedule for the engineer's review." This all but invites the contractor to provide an inadequate project schedule.

For example, experience shows that if a generic scheduling specification is used, a ten- or 12-line bar chart may be submitted for a \$20 million project. While this type of submittal may technically meet the contractual requirements, it provides little or no detailed information concerning how the project is planned to be constructed. It also makes analyzing project change orders, schedule risks or delay impacts difficult for both parties.

The owner should consider including the elements discussed in this Note in its scheduling specification to strike a balance between the appropriate amount of detail and requirements that may lead to scheduling challenges.

A DETAILED SCHEDULING SPECIFICATION

Most standard industry form contracts are silent on the key aspects of project scheduling. Critical elements that are not addressed clearly, if at all, include:

- Specific timing for submitting schedules and updates.
- Level of detail required in the schedules.
- Content of the information required in the schedules.
- Format of the schedules, including specific software requirements.

Without mandating the scheduling detail, adequate project schedules likely will not be developed nor the multiple benefits of creating them achieved. When planning the project, the owner must determine the information and level of detail required to meet its objectives for project controls.

SCHEDULE SUBMITTALS TIED TO THE NOTICE OF AWARD

Project scheduling is often started too late. In fact, it is not uncommon for a baseline schedule to first be submitted or approved many months after construction has already started, which defeats the purpose and benefits of creating a baseline schedule.

Many traditional scheduling specifications tie the initial schedule submittal to the notice to proceed with language, such as "The project schedule shall be submitted within 30 calendar days after the notice to proceed." There is typically as much as 30 calendar days, or more, between the notice of award and the notice to proceed. While this time is typically used for startup activities, such as buying out suppliers, executing subcontracts and obtaining permits, it should also be used for planning the execution of the work and the initial development of the project schedule.

An earlier start to scheduling may potentially be achieved by tying the submittal of the initial schedule to the notice of award rather than to the notice to proceed. For example, a specification requirement can be written as "Submittal of the project schedule shall be made within 30 calendar days after notice of award," which may help to start the planning and scheduling process earlier.

A PRELIMINARY CONSTRUCTION SCHEDULE

On anything other than a small-scale construction project, a requirement that the project schedule be submitted within 30 calendar days after notice of award or even notice to proceed is probably not enough time to prepare a well thought out, thoroughly coordinated schedule.

The development of a detailed construction plan often requires input from subcontractors, some of which may not yet be selected or are just getting involved at the earliest stages of the project. As a result, the contractor may be forced to put a schedule together simply to comply with the submission requirement even though that schedule:

- May not represent the way the contractor or its subcontractors eventually decide to proceed.
- Is not likely to be followed during the construction of the project.

The owner can manage this challenge by requiring a startup or preliminary schedule covering activities during the first 90 days, followed by a detailed construction schedule. For example, language can be incorporated into the scheduling specification, such as:

A preliminary project schedule shall be submitted within 30 calendar days after notice of award which details the work the contractor intends to accomplish during the first 90 calendar days after the notice to proceed is issued and includes summary level activities through project completion. The Contractor shall then submit a detailed construction schedule within 60 calendar days after the notice to proceed that details all work required to complete the project scope within the entire construction period.

This detailed construction schedule should ideally include and be fully integrated with the work identified in the preliminary schedule. Once the owner accepts the detailed construction schedule, it becomes the baseline schedule for the project.

This specification gives the contractor an opportunity to promptly develop a detailed and logical short-term schedule and a fully detailed baseline schedule in a reasonable time frame following the notice to proceed.

MONTHLY SCHEDULE UPDATES

The scheduling specification should also require regular schedule updates with an accompanying schedule narrative. While the updates are typically provided on a monthly basis, they can be required more frequently depending on the duration and complexity of the project.

The monthly schedule update documents and monitors the progress of the construction work and should reflect:

- Actual start and finish dates for all completed activities.
- Actual start and anticipated finish dates for all in-progress activities.
- Anticipated start and finish dates for all future activities.

A provision should also be included that allows the owner's scheduler or the engineer to request a revised schedule submittal within a set time frame if the schedule requires revision, in whole or in part, for a specific reason, such as inaccurate as-built schedule dates or percentage complete estimates.

Each construction schedule update should also contain a narrative describing the work accomplished during the reporting period, with specific attention to the project's critical path. Included in the report should be:

- Current or anticipated delays or problems.
- All planned corrective measures to mitigate any delays.

- A list of all modifications to the schedule in the current update that reflect a departure from earlier schedules, at a minimum including:
 - changes in activity durations;
 - addition or deletion of activities;
 - changes to logic ties, resources or constraints; and
 - notations of the reasons for each departure.

It is often helpful to include summary tables or charts depicting executive level highlights, such as:

- Contractual milestones.
- Currently scheduled dates for contractual milestones.
- Previously scheduled contractual milestone dates.

All modifications to the schedule should require approval by the owner's scheduler or the engineer.

AN AS-BUILT SCHEDULE SUBMITTAL

As the project nears its end, contractors commonly focus on tasks necessary for final completion, such as commissioning systems and punchlists. As a result, regular monthly schedule updates can be forgotten, leaving the project record unclear regarding actual activity completion dates.

One way to ensure these updates are not forgotten, is to include an as-built schedule as part of the documents required for final payment and release of retainage (see *Practice Note, Payment Provisions in Construction Contracts: Drafting Strategies: Final Payment* (<http://us.practicallaw.com/1-568-1506#a475219>)). This as-built schedule should contain a list of all activities performed on the project with their recorded start and completion dates and provides a record of the timing of all project work.

FINANCIAL INCENTIVES IN THE CONTRACT DOCUMENTS

Construction contracts typically do not include a pay item for developing and submitting a project schedule. However, many do include a mobilization payment to the contractor to recognize that it is critical to maintain adequate cash flow at the start of a project.

Therefore, the mobilization payment, or some portion of it, can be made contingent on receipt and approval of the contractor's schedule. If the mobilization payment is to be paid in more than one installment, the payments can be structured as follows:

- First payment is contingent on submittal of the baseline schedule.
- Second payment occurs on acceptance or approval of the baseline schedule.
- Third payment occurs on submittal and approval of the first monthly schedule update.

Alternatively, scheduling can be included as a specific pay item on the schedule of values. However, the specification should state that the contractor is entitled to bill this line item only after submittal and approval of the baseline schedule and each monthly schedule update. This provides the contractor with a financial incentive to submit project schedules and clearly acknowledges that proper project scheduling is a cost item for a contractor. However, this arrangement could present challenges if project completion is delayed and additional schedule updates are required, but contract funding for that line item has been exhausted (see *Practice Note, Payment Provisions in Construction Contracts: Drafting Strategies: Schedule of Values* (<http://us.practicallaw.com/1-568-1506#a64389>)).

PRE-CONSTRUCTION SCHEDULING CONFERENCE

Scheduling is too often not performed on a project because:

- The importance to the owner of the schedule requirements is not clearly communicated to the contractor.
- The contractor does not fully understand the detailed requirements of the scheduling specification.

Requiring a pre-construction scheduling conference within a few days after contract award can help overcome these issues. In addition to other key planning items, the meeting should:

- Be attended by the owner and contractor and their respective project managers and schedulers.
- Emphasize the importance of project scheduling.
- Include a detailed discussion of the scheduling specification requirements.
- Address any other project-specific requirements that are related to or could impact scheduling.

SCHEDULING SOFTWARE REQUIREMENTS

The scheduling specification should also specify the scheduling software requirements. If the owner and its scheduling consultant use specific software, the specification should require the contractor to use the same system.

Due to compatibility issues, different software can create consistency problems when the information is exchanged electronically between team members. This can lead to confusion and impact the team members' ability to:

- Accurately define progress.
- Understand delays.
- Identify scheduling risks.

Other requirements of the scheduling specification can include:

- Requiring the software to be capable of being cost and resource loaded (see *Resource Loading* (<http://us.practicallaw.com/0-574-8625#a541686>)).
- Identifying specific formats for the data transfer of schedule files, layouts and reports.
- Providing a scheduling template that is consistent with the owner's internal systems, including pre-defined calendars and a work breakdown structure (WBS).

A WORK BREAKDOWN STRUCTURE

The owner may require the contractor to provide "specialty" schedules that extract specific types of activities from the overall project schedule, including, for example:

- Information related to submittals.
- Work in specific areas.
- Activities performed by certain trades.

In this circumstance, a detailed scheduling specification may require the contractor to use WBS coding that associates each schedule activity with multiple categories, such as:

- Submittal review and approval.
- Procurement and fabrication.
- Delivery.
- Construction and installation.
- Change order.
- Area of work or trade responsibility.

If these requirements are made known to the contractor's scheduler before the project begins, the detailed coding structure is easily incorporated into the schedule, relieving any burden associated with providing specified additional reports.

KEY ACTIVITIES AND CONSIDERATIONS FOR THE SCHEDULE SPECIFICATION

The scope and reliability of a project schedule can be better determined by defining and incorporating certain key activities. The specification should identify the owner's requirements, which can be modified if necessary after consulting the contractor. Several comprehensive activities can be incorporated into the scheduling specification.

SUBMITTAL AND RESUBMITTAL REVIEW TIMES

The specification should define the amount of time the engineer is given to review both the contractor's submittals and any required resubmittals. This helps provide proper planning for the contractor, the owner and the design professional reviewing the submission. A clause can be inserted in the contract documents to the effect that, "The engineer shall have [NUMBER] calendar days from receipt of a contractor's submittal in which to review and respond to the submittal."

Different time frames can be stipulated for different submittals, such as:

- Short durations for simple submittals and catalogue cuts.
- Longer durations for more complex submittals.
- Even longer durations for submittals requiring review by an independent party, such as a state highway department or railroad.

However, the owner should be mindful of the potential risk if the owner or its engineer fails to return the submittal within the stipulated time frame. An owner can expect the contractor to point to any deficiency as support for any delay or impact claim from the contractor.

The contract documents should also address the time frame to review resubmittals by either:

- Providing the engineer with the same amount of time allowed to review the initial submittal.
- Specifying a reduced amount of time as determined by the owner and the engineer.

This clarifies whether:

- The owner and engineer only have a single time frame in which to review the submittal and all resubmittals.
- The "clock starts all over again" with each resubmittal.

Without direction in a specification, schedules sometimes contain a single activity labeled "submittal and procurement" for each item or material installed. The parties should instead require at least these four separate activities for each item or material provided:

- Submittal.
- Submittal review.
- Resubmittal and resubmittal review.
- Procurement and delivery.

The specification should also contain a master list of all required submittals prepared by the engineer to assist the contractor. However, the contractor should also be required, after reviewing the engineer's schedule, to:

- Prepare and submit its own schedule listing all submittals required by the contract documents.
- Include the date it anticipates furnishing each submittal to the owner and engineer for review.

The contractor's submittal schedule should be one of the initial submittals on the project, along with the schedule of values and project schedule. A separate submittal schedule:

- Helps to ensure that the contractor is aware of and plans for all submittals.
- Allows the owner and design professionals to plan their staffing and workload in response to the contractor's planned timing.
- Can be used to counter a contractor's claim that the owner or engineer delayed reviewing submittals if the contractor "dumps" all of its submittals on the owner at the same time rather than staggering them as contractually planned.

PROCUREMENT AND DELIVERY

The scheduling specification can be written to mandate that fabrication, delivery and installation times for all major contractor-furnished materials and equipment are separate activities on the construction schedule. Long-lead items requiring significant fabrication time should be identified and separately tracked in the procurement section of the schedule. The engineer should consider identifying in the contract documents which items of equipment fall under this requirement.

Another option is to require the contractor to provide a schedule report showing the anticipated order and delivery dates for each major piece of equipment. Once again, the contract documents should specify which equipment is included to prevent any disagreement over this defined term. This ensures that critical procurement activities are identified, coordinated and completed as necessary in order to support the project. It also identifies areas of potential risk associated with vendor deliveries.

If a specialty schedule, such as a procurement schedule, is determined by the owner to be necessary or desirable, the scheduling specification should include a provision requiring specific coding within the WBS coding structure for procurement activities. This allows the contractor to produce a separate procurement schedule without any additional work (see *A Work Breakdown Structure* (<http://us.practicallaw.com/0-574-8625#a930735>)).

OWNER-FURNISHED ITEMS

Owner-furnished items must be coordinated with the contractor's work. This can be accomplished by requiring the contract documents to identify "not-earlier-than" delivery dates for owner-furnished items and to require these dates be included in the contractor's schedule. The dates should be based on delivery dates set by the manufacturer or supplier, plus an appropriate contingency time factor. This contract requirement can be worded as:

Deliveries of owner-furnished equipment or materials shall be shown on the schedule with the dates set forth in the contract documents or provided by the owner or its designated representatives.

Alternatively, the contract documents can define schedule windows for owner-furnished items by stipulating that owner-furnished items must be delivered no earlier than a certain date and no later than a specified date. This alternative approach gives the contractor some reasonable assurance of when the owner-furnished items are to be on site to enable it to plan accordingly. The language above can also be included in the scheduling specification.

The owner should contemporaneously provide the contractor with the status of these items as schedule updates are prepared and submitted. However, the contractor should not be permitted to modify activities in the schedule associated with owner-furnished items without the owner's approval.

OPERATING CONSTRAINTS

A careful review of project requirements by the owner and its operating staff must take place during the design phase so all necessary constraints are identified and noted in the bidding documents. Examples of constraints during the project construction that an owner may impose to meet its needs may include:

- The contractor shall have no more than two influent pumps off line at any time.
- No more than one battery of clarifiers can be taken out of service at a time.

- Power shutdowns and cut overs must take place between midnight and 5:00 a.m..
- The work in a specific area needs to be completed before work in another area begins.

It should not be assumed that at the time of bidding a contractor can successfully guess the constraints to which it must adhere during the course of construction. Therefore, all constraints and construction sequences must be incorporated in the specification for them to be enforceable without a change order. The specification should also mandate that the construction schedule reflect any constraints.

INTERIM MILESTONE DATES

Another method of establishing construction sequences is by setting interim milestone dates in the contract documents defining the timing for performing certain work, such as:

- The contractor must complete all work of the contract required to complete a watertight exterior envelope and a temporary climate-controlled environment by a specific date.
- Work on the digesters shall not commence until on or after a specific date.

This language assists the contractor in planning, coordinating and sequencing the work. Milestone requirements are especially useful for projects:

- Involving the renovation of existing facilities that must remain operational during construction.
- With multiple prime contractors.
- That interface with other concurrent projects.

Where specified constraints or sequences are embedded in the contract documents, the scheduling specification must require that all these items be reflected in the schedule exactly as they are called out in the contract documents. The owner must also carefully review the baseline schedule and all schedule updates to confirm that these mandated items are correctly reflected in the project schedule before accepting or approving any schedule or update.

Some contractors may take the position that the owner waived any requirements not shown on the schedule at the time the owner accepted the baseline schedule. To protect itself from this argument, the owner should include the following language in the scheduling specification:

To the extent a contract requirement is not incorporated into any schedule submittal, acceptance of the schedule submittal does not relieve the contractor of its responsibility to adhere to the contract requirements.

If the contractor requests relief from a requirement and the owner agrees, the acceptance letter should specifically identify that concession. The owner should promptly follow up with a written change order memorializing the changed contract requirement.

SUBSTANTIAL COMPLETION

Before bidding, the owner should carefully define in the contract documents what is necessary to achieve substantial completion of the contract work. For example, the owner should decide whether start-up and testing activities must occur for the project to achieve substantial completion or if these activities can take place after the work is declared to be substantially complete.

This determination can only be made by the owner and engineer during the project's design phase. Clearly defining these requirements helps avoid disputes regarding the imposition of liquidated damages, completion and project close-out. During review of the contractor's baseline schedule, the owner should verify that all activities scheduled to occur after the substantial completion milestone do not impede the owner's beneficial occupancy or use of the project.

MAXIMUM DURATION REQUIREMENTS

A detailed scheduling specification can also set the maximum duration of any activity on the schedule (although exceptions often are made for submittal, fabrication and delivery activities). This influences the level of detail of the construction schedule without interfering with the contractor's means and methods of performing the work.

While more detailed scheduling requirements often result in better planning and coordination, an owner should be careful not to make the specification overly burdensome. To do so may lead to a schedule that is provided simply to meet a submittal requirement rather than actually being a useful project management tool.

For example, the scheduling specification on one project mandated that no activity be longer than five working days in duration. Unfortunately, with few exceptions, the contractor's schedule reflected almost all activities with five day durations.

RESOURCE LOADING

Currently many projects contain a specification requirement that all on-site construction activities on the schedule be resource loaded with costs, manpower (labor by craft or trade) and equipment. This enables the owner's schedule consultant to compare the planned resource loading with the planned schedule duration to check if each is logical, reasonable and mutually supportable. This also allows the owner to review the reasonableness of the contractor's plan for constructing the project and forms a baseline against which to measure actual performance and allocation of resources during construction.

Some owners have started using a "pay off the schedule" specification in which every schedule activity is cost loaded with the appropriate portion of the total project's schedule of payment values. This emphasizes the necessity for proper planning and execution and gives the contractor a financial incentive to properly and timely update its schedules.

At the end of every month, the contractor's payment application consists of:

- A list of all schedule activities completed or in progress.
- The percentage of work accomplished.
- A calculation of the value of the work performed, consisting of the percentage completed times the cost loaded value of the schedule activity, less applicable retainage.

This approach may appear to greatly enhance the quality of the contractor's scheduling. However, it also makes the monthly progress payment process more complicated. It also requires all owner personnel responsible for reviewing monthly payment applications to be schedule-oriented and knowledgeable about both the progress of the project and the status of the schedule.

CHANGE ORDER IMPACTS

Some owners have started requiring that each change proposal or time extension request be accompanied by a time impact analysis or fragmentary network (referred to as a fragnet) to demonstrate the effect of specific delays on the overall project schedule. If this specification is created and actually adhered to, arguments over the potential impact of a change should be easier to resolve.

PROJECT REALITIES AND EFFECTIVE SOLUTIONS

While a detailed scheduling specification sets the groundwork for a comprehensive construction schedule, attention to the schedule must continue throughout the project duration. Both the contractor and the owner must show commitment to respecting and documenting the schedule through project completion. What follows are some suggestions for implementing the scheduling specification to achieve the desired benefits.

PRACTICAL NEED FOR DEDICATED SCHEDULERS

A contractor's failure to properly schedule a project is frequently the result of its failure to employ the services of a qualified construction scheduler. Contractors sometimes assign schedule responsibilities to a project staff engineer who has many other responsibilities, which can include:

- Coordinating submittals.
- Submitting requests for information (RFIs).
- Generating and submitting change proposals.

As a result, scheduling may not be the project engineer's primary charge and may not even be seen as a high priority for that individual.

However, a contractor who includes in its bid the cost of a dedicated scheduler when one is not required by contract may have a difficult time competing in a tight bidding climate. To level the playing field for all bidders, owners should include a scheduling specification that requires the project to have a dedicated scheduler. This emphasizes the criticality of project scheduling and ensures that the opportunity and climate for proper scheduling exists.

Some other possible considerations when drafting the specification for the dedicated scheduler include:

- Requiring the contractor to submit a resume for the proposed scheduler for review and acceptance by the owner, that includes:
 - a description that meets minimum scheduling experience requirements; and
 - references from past projects who will attest to the scheduler's skills.
- Requiring the contractor's dedicated scheduler to:
 - be on site at set intervals or full time depending on the project's size and complexity; and
 - attend all meetings concerning project progress.
- Enabling the owner to direct the contractor to:
 - remove an incompetent scheduler; and
 - install a qualified replacement within a defined time frame.

Inadequate scheduling can also stem from the owner's lack of review of or input into the project schedule. To address this, the owner should have its own qualified scheduler to review the schedule for:

- Accuracy.
- Contract compliance.
- Risk management.
- Project planning.

The owner has a shared responsibility for an accurate schedule that does not conclude when the scheduling specification is issued. An owner may publish a specification that includes some of the recommendations outlined in this Note, but may not have the time or expertise to review the submitted schedules to ensure contract compliance. Depending on the project requirements and the importance of timing for project delivery, the owner may choose to retain its own scheduling consultant to review and monitor the contractor's schedule submissions.

THOROUGH REVIEW OF BASELINE AND UPDATED SCHEDULES

Owners, engineers and project managers must understand the liability associated with reviewing and accepting a contractor's schedules. Schedule review plays just as important a role in the successful timely completion of a construction project as the review of technical submittals is to the long-term life of a facility.

Schedule review also has a similar amount of associated legal risk. Therefore, a thorough, detailed review of the contractor's baseline schedule and all schedule updates is necessary to ensure the schedules comply with the specification requirements. Key flags for potential trouble include:

- Unrealistically shortened activity durations.
- Artificially increased activity durations.
- Unreasonable logic ties (see *Box, A Primer on Scheduling Terminology* (<http://us.practicallaw.com/0-574-8625#a1008726>)).
- Inappropriate review times.
- Sequestering of float.

- Open-ended activities.
- Failure to include critical activities or known constraints identified in the contract documents (see *Operating Constraints* (<http://us.practicallaw.com/0-574-8625#a58760>)).

Schedule update reviews should also include comparing the start and finish dates with:

- Daily field reports.
- Inspection records.
- Monthly progress reports, including photographs.
- Weekly project meeting minutes.
- Contractor weekly bar charts or three week look-ahead schedules, or both.

ELECTRONIC SUBMITTALS

It is advisable for the scheduling specification to include language requiring the contractor to electronically transmit all scheduling submittals in the native scheduling format, in addition to the paper copies and written narratives that are typically required. With the electronic data, the owner's scheduler can run computer comparisons and identify any changed data. A review of the electronic schedules can assist in identifying areas affected by changed durations or logic, which signal potential delay.

ACCURACY OF AS-BUILT ACTIVITIES

The owner's scheduler should routinely check every schedule update to confirm that no changes were made to previously-completed activities. To make this review easier, the scheduling specification may require the contractor to submit a separate report with each schedule update specifically identifying every change made since the last monthly update, including changes in:

- Logic.
- Durations.
- Actual start and finish dates.
- Activity additions and deletions.

This requirement can be buttressed with language confirming the owner is not responsible for the impact of any change made to the schedule that is not specifically identified in the monthly schedule change report.

It is also possible to electronically check for changes in schedule updates by employing forensic scheduling software that identifies all changes from the last update. The owner or its scheduler can use either the schedule analysis program built into the scheduling software or third-party software that compares and analyzes the two schedules. With this information in hand, the owner or its scheduler can quickly determine whether any changes were made to previously-completed activities or those activities not worked on during the update period.

After the schedule update, including the contractor's narrative, has been thoroughly reviewed, the owner's scheduler can review the changes made and:

- Verify the necessity for the changes.
- Open a dialogue with the contractor about the reasoning for the changes with a focus on minimizing schedule delay risk.

CONTEMPORANEOUS SCHEDULE REVISIONS

As a contractor's planned means and methods are often re-thought or changed during the course of construction, the schedule may be changed to mirror the current conditions and the revised plans of execution. This occurs often and does not necessarily represent a concern if there is no critical path impact to the project schedule. Some of the more common changes made to electronic schedule updates that should be reviewed by the owner's scheduler include:

- **Deleted or added activities.** Deleting or adding activities to an approved baseline schedule should only be done to reflect changes in the scope of work or as warranted by changes in means and methods.
- **Changing original durations.** Original durations submitted with the baseline schedule should not change unless justified by the contractor and reviewed by the owner for reasonableness.
- **Changes in relationships.** Adding or deleting logic relationships is another way to increase or decrease the time to complete the project and these changes must be reviewed for reasonableness by the owner's scheduler.
- **Use of constraints.** Adding constraints can interrupt the calculation of the schedule by overriding the calculation of the critical path method forward and backward pass algorithm. If added to the schedule updates, constraints should be justified by the contractor and reviewed for reasonableness and necessity.
- **Retained logic versus progress override.** The progress override feature accelerates a schedule by ignoring logic ties or relationships within the schedule model when activities are commenced out of sequence. This can result in a schedule reflecting an earlier completion date than may be realistically possible. Therefore, it may be prudent for the scheduling specification to require that retained logic be used (see *Box, A Primer on Scheduling Terminology* (<http://us.practicallaw.com/0-574-8625#a1008726>)).

CONTRACTOR'S PROJECT MANAGEMENT TEAM

When the contractor's project management team is involved with planning the project but not developing the project schedule, there is often a disconnect between the schedule and management's plan for execution of the work. This increases the likelihood that the schedule will not be an effective planning tool but is only used to meet a contract requirement or to assert or defend against claims.

A detailed specification should require the contractor to identify the specific member of its project management team who is responsible for providing input and signing off on project schedules. This helps to ensure that the schedule accurately reflects the planned means and methods and actual events in the field and is used in the manner for which it was intended.

A PRIMER ON SCHEDULING TERMINOLOGY

While an owner can draft a specification mandating certain schedule and reporting activities, the information is only useful if the owner understands the information being reported. Even where the owner employs a scheduler, an understanding of a few basic terms is necessary for an owner to even speak knowledgeably with its own consultant. These terms include:

- **Critical path.** When discussing the schedule, project participants often speak in terms of the project's critical path. This is the longest continuous chain of activities used to establish the minimum overall duration for performing the project. Depending on the nature of the project, one or more critical paths can be used to monitor the project's duration. A delay in completing any activity on the critical path will extend final completion of the project accordingly.
- **Sequence.** The order in which activities occur with respect to one another by establishing the priority and dependencies between activities. This allows project participants to visualize the work flow.
- **Constraint.** Any external factor that impacts the scheduling of an activity. The restriction can include:
 - a limitation on the start (no-earlier-than), finish (no later-than) or duration of (not longer than) an activity;
 - a resource, such as labor, cost or equipment; or
 - a physical event that must be completed as a condition to performing an activity.
- **Milestone.** A event or activity used to establish a particular point in time for reference or measurement. Achieving a contractual milestone is generally capable of being objectively confirmed by having completed a checklist of requirements for that milestone.

- **Logic.** A description of the relationship between activities and events based on the interdependency of their start and finish dates. Except for the first and last activity, each activity:

- follows another activity, referred to as a predecessor; and
- is followed by another activity, its successor.

The logic of each activity is determined by the need to meet competing constraints on that activity as defined by such things as:

- contract requirements;
- physical capabilities of the trades the performing work;
- safety concerns; and
- resource allocations.
- **Retained logic.** One of two types of logic used to address activities that occur out of sequence. Scheduling software reschedules the remaining duration of the out-of-sequence activity according to the current logic and following its predecessors.
- **Progress override.** The other type of scheduling software logic used to address activities that occur out of sequence. The activity is treated as though it has no predecessor constraints by scheduling its remaining duration to start immediately.
- **Preferential logic.** A contractor's approach to sequencing work over and above those sequences indicated in or required by contract documents. Also used when the work flow in a contractor's critical path schedule uses logic ties, constraints and other mechanisms that are contrary to what would be expected for that type of effort. The term normally has a negative connotation.

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