



Construction Scheduling Games – Revisited & Updated¹

Amanda Jo Amadon, PMP²

Emily Federico, PSP³

Stephen Pitaniello, P.E., CFCC⁴

James G. Zack, Jr., CCM, CFCC, FAACE, FRICS, PMP⁵

ABSTRACT: The intended purpose of construction scheduling is to assist with proper planning and coordination of a project. All too frequently, construction schedules are used primarily to help build or defend against claims. Much of the process of building claims through the use of schedules involves schedule gamesmanship. This paper briefly identifies 19 common schedule games played on construction projects. The paper also offers 53 suggested defenses to help prevent and detect schedule gamesmanship. Some suggested defenses involve changes to contract document language and thus, need to be implemented during the design phase. Other suggested defenses are pragmatic in nature and can be implemented on a daily basis by a knowledgeable project management team even in the absence of specification language. Additionally, in this new edition of the paper, there is a checklist of 57 items that should be examined when reviewing a schedule to determine whether schedule gamesmanship is being employed.

¹ The opinions and information provided herein are provided with the understanding that the opinions and information are general in nature, do not relate to any specific project or matter and do not necessarily reflect the official policy or position of Navigant Consulting, Inc. Because each project and matter is unique and professionals may differ in their opinions, the information presented herein should not be construed as being relevant or true for any individual project or matter. Navigant Consulting, Inc. makes no representations or warranties, expressed or implied, and is not responsible for the reader's use of, or reliance upon, this paper, nor any decisions made based on this paper.

² Director, Navigant Consulting, Inc., Coral Gables, FL

³ Associate Director, Navigant Consulting, Inc., Fairfield, CT

⁴ Managing Director, Navigant Consulting, Inc., New York, NY/Fairfield, CT.

⁵ Executive Director, Navigant Construction Forum, Navigant Consulting, Inc., Boulder, CO.



INTRODUCTION TO “REVISITED & UPDATED” PAPER

The original article, “Scheduling Games People Play and Some Suggested Remedies”⁶ began as a four page memorandum in 1990 when the Director of Construction Management for the firm one of the authors then worked for asked that a “Tech Transfer Topic” be drafted and circulated to the firm’s construction management staff alerting them to some of the problems with construction schedules. The article grew through several iterations from this four page memorandum to a twenty five page paper entitled “Construction Scheduling Games and Ways to Win.”⁷ It has been reprinted numerous times since with a few more games or defenses being added each time. However, the last time the paper was reissued was at the 1995 CMAA Annual Meeting.⁸ It is time to resurrect the paper and update it to today’s 21st century environment and, equally as important, to today’s construction scheduling software!

INTRODUCTION TO THE 1995 PAPER

The intended purpose of scheduling on a construction project is to help ensure that the work of the project is adequately planned, tracked and managed. A construction schedule can be as simple as a list of activities, organized in a logical sequence, and time scaled. The concept of construction scheduling is to see that all activities necessary to complete the work, in accordance with the requirements of the contract documents, are properly planned, coordinated and managed.

Unfortunately, it sometimes appears that the more frequent use of a construction schedule is to help build claims. Some construction contractors, not all, perform scheduling only because (1) it is a requirement of the contract documents; (2) it is required in order to receive their monthly payment; and/or (3) it will help enhance their chances of recovering

⁶ AACE International Transactions, 1991.

⁷ *The Construction Specifier*, Volume 47, Number 9, September 1994.

⁸ CMAA Annual Meeting Transactions, October, 1995.



more from the owner in time extensions and claims. Scheduling to some contractors, therefore, is not used as a project management tool for planning, coordination and control of the work.⁹

Of course, there is a risk involved with owners requiring contractors to submit schedules and then proceeding to review and accept them. Approved or accepted schedules tend to take on a legal status of sorts. The risk, of course, is that the owner accepts a schedule and agrees to something that is later used as documentation of claims against him/her. Some owners contend that this is the construction industry's version of self incrimination. Conversely, the owner's lack of approval of a contract required schedule may also increase the owner's risk. However, the downside risk of *not* requiring construction schedules is that the project plan is *not* communicated, and the owner is left with no way to measure progress, check on coordination, or verify the timing of its own responsibilities required to complete the work. The owner and contractor should strive to agree on a schedule that meets the intent of the contract documents and outlines a logical path to the completion of the work. In these days of tougher competition and declining profits, and given the absence of a clear scheduling requirement in the contract documents, some contractors may be tempted to dispense with proper project scheduling as a way of saving costs. However, most experienced project managers recognize that the risk of *not* requiring schedules far outweighs the risk of requiring, reviewing and accepting contractor schedules.

COMMON SCHEDULE GAMES & SUGGESTED DEFENSES

Project managers involved in the review of schedules submitted by construction contractors need to be positioned to detect technical schedule issues in order to minimize the opportunities that often promote schedule games. If the owner can guard itself against schedule gamesmanship it effectively reduces the risks inherent in incorrect, inaccurate and/or self-serving construction schedules. There are a number of games played with

⁹ Zack, James G., Jr., "Are You Prepared for Construction Claims", *The Construction Specifier*, Volume 37, Number 7, July, 1984.



respect to construction scheduling. The more common schedule games and a number of suggested defenses against each are offered in this paper. Some of the concepts are pragmatic suggestions and can be implemented on a routine basis by the project management team working in cooperation with the owner and the contractor. Other suggestions are recommended changes to contract documents¹⁰ and specification language and can only be implemented during the design phase of the project, prior to bid opening.

Game: Failure to Provide a Construction Schedule – Some construction contractors try to avoid giving the owner any project schedule at all. This happens most often when there is no scheduling specification in the contract or when the contract documents do not provide specific requirements and only require the contractor to "Submit a plan for constructing the work." In situations like this, the perception is that without a construction schedule, the owner will be unable to demonstrate the contractor's failure to properly plan, coordinate and prosecute the work. An ancillary theory seems to be that the absence of a project schedule on a job leaves the contractor, or its construction claims consultant, free to develop a schedule delay claim at the end of the job to help demonstrate whatever recovery is being sought.

Defense: Detailed Scheduling Specification – Lack of a detailed schedule may also arise from minimal or no scheduling requirements in the contract documents. It is axiomatic that contractors rarely volunteer to do more than what is clearly required in the contract. Therefore, owners and design professionals should spend the time necessary, during the design phase, to draft a detailed scheduling specification that is commensurate with the amount of involvement and control the owner wants to see exercised on the project. The scheduling specification should be aligned with the complexity of the project and designed on a project-by-project basis. The amount of time and effort spent on this task during the design phase will be more than repaid by the planning and coordination it

¹⁰ Navigant Consulting, Inc. is a consulting firm and does not offer legal advice. An owner considering any of the suggested defenses listed herein is strongly advised to seek input from knowledgeable legal counsel on the specific language to incorporate into the contract in order to address the various games identified in this paper.



provides throughout the life of the project. Owners should also be mindful of the specified requirements as too often the specifications become so burdensome that the scheduling efforts become a project within a project. This can result in a schedule that is disconnected from the contractor's actual management of the project.

Defense: Mobilization Payment Contingent upon Submittal and Approval of the Baseline Schedule – The lack of construction schedules may well arise from the fact that there is typically little or no financial incentive in the contract documents concerning a schedule submittal. That is, there is rarely a pay item in a contract for developing and submitting a project schedule. Many construction contracts, however, now provide mobilization payment to the contractor in recognition of the fact that cash flow at the outset of a project is critical. This is also provided in an effort to avoid "front end loading" the project payment schedule. Therefore, one way to entice the contractor to provide the baseline schedule is to make the mobilization payment (or some portion of the mobilization payment) contingent upon receipt and approval of the contractor's schedule. If there is to be more than a single mobilization payment, that is, if the mobilization payment is to be paid in more than one installment, the first payment could be contingent upon submittal of the baseline schedule, the second payment contingent upon acceptance or approval of the baseline schedule and the third payment based upon submittal and approval of the first monthly update.

Defense: Scheduling Start at Notice of Award – Failure to submit schedules may also be caused by the fact that scheduling is often started too late. Typically, there is a fair amount of time between the date of bid opening and the notice to proceed with the work of the contract – often as much as thirty to ninety days, or more. This time can and should be used for planning the project, but all too frequently is used for other purposes, such as buying out suppliers and materialmen and arranging subcontractors. The notice to proceed is frequently issued before scheduling begins and often the contractor argues, at that point, that it is "too busy building the job" to perform scheduling. It is not uncommon in this situation that a baseline schedule is submitted and approved many months after the construction has started, defeating the purpose and benefits of having a baseline schedule.



One way to get scheduling started earlier, and to avoid this argument, is to tie schedule submittals to the notice of award rather than the notice to proceed. For example, a requirement that the "Submittal of the preliminary project schedule shall be made within fourteen days after notice of award" will aid in starting the planning and scheduling process earlier.

Defense: Include a Milestone for the Baseline Schedule Submittal and Approval – Another financial incentive that may be employed in a contract is the addition of a contract mandated milestone, with associated liquidated damages, that sets forth the submission and approval of the baseline schedule. This milestone can be tied to the notice to proceed such that the notice to proceed will *not* be issued until a defined period of time (i.e., 30 days) after the baseline schedule is approved. A late approval of a baseline schedule would result in a day for day delay to the notice to proceed and potentially the contract completion date for which liquidated damages could be assessed. If this approach is considered, it is imperative that the schedule specifications and conditions outline the review and approval process and clearly define it in the contract documents to avoid a dispute between the parties relative to a protracted review, revision and approval process. While this approach provides an incentive for both parties to agree on a baseline schedule, many times the owner may not be in a position to “delay” the notice to proceed or commencement of physical work due to business reasons for completing a project on a date certain.

Defense: Pre-Construction Scheduling Conference – All too often scheduling is not performed on a project because the contractor does not comprehend that scheduling is truly important to the owner and the design professional and/or does not understand the detailed requirements of the scheduling specification. Requiring that a pre-construction scheduling conference be held within a few days after award of the contract can help overcome this problem. The importance of project scheduling can be discussed and emphasized at this meeting. Further, a detailed discussion of the scheduling specification requirements as well as any other project specific requirements that are related to



scheduling or need to be taken into account when preparing a schedule can be held with the contractor's project manager and scheduler.

Defense: Preliminary or 90 Day Schedule – One of the difficulties often encountered by contractors is a specification requirement that the "Project schedule shall be submitted within thirty (30) days after notice to proceed." On anything other than a small, non-complex construction project, this is probably *not* enough time to prepare a well thought out, thoroughly coordinated project schedule. Additionally, the development of a detailed plan may require input from subcontractors, some of which may not be involved at the earliest stages of the project. When faced with such a situation, a contractor will frequently "throw something together" to comply with the requirement. The schedule submitted does not represent the way the contractor or its subcontractors, intend to proceed, nor does the contractor make much of an attempt to follow the schedule during the construction of the project. One way to avoid this situation is to require that "A preliminary project schedule shall be submitted, within 30 days after notice of award,¹¹ which details the work the contractor intends to accomplish during the first 90 days after issuance of the notice to proceed." This gives the contractor an opportunity to develop a detailed and logical short term schedule promptly and a full detailed baseline schedule some 30 to 45 days after the approval of the preliminary schedule.

Defense: No Work Started until Schedule Submitted – Most contractors want to start work on the project immediately after the notice to proceed. In part, this is due to the eagerness of the contractor to start the work as well as the contractor's need for cash flow on the project. (Remember, the contractor has carried all costs from the time it began reviewing the bidding documents until after notice to proceed without any reimbursement at all from the owner.) Thus, contractors often focus on getting work going rather than planning and scheduling the work. The former produces cash flow while the latter produces cash outflow. Owners, who may have spent years, planning and designing the

¹¹ "Notice of award" is, in the public works sector, a formal notice from the owner that the contractor has been selected for award of the project and must now produce bonds, insurance documents, and other administrative items prior to the formal award by the awarding authority.



project, are equally eager to start work in the field. However, experience has demonstrated time and again that it is almost always better to delay the start of the construction work until a proper plan can be developed and agreed upon in order to minimize risks of schedule delays and cost overruns. Thus, a requirement that "No construction work will be permitted and no progress payments will be made until the [preliminary] project schedule is submitted and approved" will entice a contractor to prepare and submit a proper schedule in a timely manner. An alternative to this approach is to mandate two separate notices to proceed, with the second notice to proceed being contingent upon the submission and approval of a baseline schedule. This forces a focus on planning and scheduling at the beginning of the project rather than rescheduling work after construction has commenced due to lack of initial planning.

Game: Inadequate Scheduling – When the entire scheduling specification reads something to the effect, "Prior to start of any work, the contractor shall submit its proposed construction schedule for the engineer's review" the contractor is almost invited to provide an inadequate project schedule. Experience shows that when given such a scheduling specification, some contractors may submit a ten or twelve line bar chart for a \$20 million project. While such submittal meets the requirements of the specification set forth above, it provides little detailed information concerning how the project will be constructed, the interrelationship of activities, etc. Further, such a schedule makes the analysis of change orders, delay impacts, or schedule risks on the project very difficult for both parties. The object of this game is to confuse time related issues by denying the owner the opportunity to perform a detailed schedule analysis in order to ascertain the true cause, effect, and responsibility for delays.

Defense: Detailed Scheduling Specification – Inadequate scheduling is frequently caused by the lack of a scheduling specification that details what the owner expects in, and from, a project schedule. Therefore, a detailed scheduling specification will go a long way toward overcoming problems concerning inadequate scheduling. In planning for the project, owners need to determine what information and at what level of detail is needed in the project schedules to meet its objectives for project controls.



Defense: Minimum Number of Activities – One symptom of inadequate scheduling is a lack of activities in the project schedule. For example, a \$25 million project that includes only 40 activities in the schedule is greatly oversimplified and may lack sufficient detail to be useful. A detailed scheduling specification can specify the minimum (and maximum) number of activities required in the construction schedule. This will assist in influencing the level of detail in the schedule, thereby allowing for an increased understanding of the contractor’s plan, the interrelationship of key owner and third party activities and potential risks to project completion.

Defense: Maximum Duration Requirement – In the alternative, the detailed scheduling specification can state the maximum duration of any activity on the schedule (other than submittal, fabrication and delivery activities). This will help influence the level of detail of the construction schedule without interfering with the contractor’s means and methods. Although more detailed project scheduling requirements often result in better planning and coordination than less detailed requirements, an owner should be careful not to make the specification overly burdensome as this may lead to a schedule that is simply provided to meet a submittal requirement rather than a contractor’s project management tool.

Defense: Dedicated Scheduler – Frequently, contractors fail to properly schedule a project because they do not employ the services of a qualified construction scheduler. Rather, contractors assign the responsibility for scheduling the project to the newest (i.e., least expensive) project engineer on staff. This project engineer may have several other responsibilities including coordinating submittals, submitting requests for information, posting plan clarifications, preparing lift and shoring drawings, etc. Thus, scheduling is not the project engineer’s primary job and it may not even be a very high priority job for this person. Further, a contractor who bid a dedicated scheduler when one is not required may have a difficult time competing in a tight bidding climate. To level the playing field for all bidders, emphasize the criticality of project scheduling, and see that the opportunity and climate for proper scheduling exists, the scheduling specification may require that the project have a dedicated scheduler. Depending on the size of the project, the specification



may also require that the dedicated scheduler be on site full time. If this is done, the specification may also set forth minimum scheduling experience requirements; require references from past projects that can attest to actual scheduling experience and, contain a clause that allows the owner to remove the scheduler from the site if he/she proves incompetent and require the contractor to replace the removed scheduler within a defined time period. The specification, in lieu of requiring a full time presence on site, can require that the scheduler visit the project site to confirm progress and attend all meetings concerning project progress, alleged delays or time impacts.

Defense: Contractor's Project Management Involvement – The lack of input from the contractor's project management team often results in scheduling inadequacies. When the contractor's project management team is involved with the planning of the project but is not involved in the development of the detailed and contract required schedule, there is often a disconnect between the schedule and the project management's plan for the execution of the work. Consequently, the schedule may not be an effective planning tool and the likelihood that the schedule will only be used as a tool to assert or defend against claims increases. A detailed specification should require that a member of contractor's project management team provide input and sign-off on the project schedules. The specification should state that the contractor identify a specific individual(s) that will be responsible for this task. This will help to ensure that the schedule accurately reflects the planned means and methods and actual events in the field, and is used as a planning tool rather than a means of asserting and defending against claims.

Defense: Owner's Scheduler/Scheduling Consultant – Inadequate scheduling can also stem from the owner's lack of review of or input into the project schedule. In order to address this, the owner should have a qualified scheduling individual(s) who will review the schedule for accuracy and contract compliance and for risk management and project planning. Often, an owner will publish a scheduling specification that may include some of the defenses suggested in this paper but does not have the time or expertise to adequately review the schedules that are submitted in accordance with the contract terms.



The owner has a shared responsibility for an accurate schedule that does not conclude with the issuance of the schedule specifications.

Defense: Scheduling System Requirements -- Another cause of inadequate scheduling is the contractor's failure to provide the appropriate scheduling software for the project. Detailed scheduling generally calls for sophisticated scheduling software. Failure to utilize appropriate scheduling software will almost always lead to inadequate scheduling. A detailed scheduling specification should specify the software requirements for scheduling on the project and can also specify that these be identified in writing at the pre-construction scheduling conference. If the owner and/or its own scheduling consultant(s) utilize specific scheduling software, the specification should require that the contractor use the same. Because of compatibility issues, the use of different software by the owner and the contractor can result in issues when the information is exchanged electronically between the various team members. This can lead to confusion and impact each team members' ability to accurately define progress, understand delays and identify risks. Further, the specification can require that the computer system necessary to support project scheduling be located at the project site.

Game: Submittal Review Time – If the contract documents specify that "The engineer will review contractor submittals within a reasonable period of time so as not to delay progress on the work" or language similar to this, some contractors may include very short durations for submittal review times in the project schedule (i.e., three days). This approach is based upon the impreciseness of the term "reasonable period of time". If the project schedule is accepted as submitted, the submittal review time included in the schedule determines the definition of what is a "reasonable period of time". It is arguable then that any review of a contractor submittal that takes more time than indicated in the project schedule is "unreasonable" by definition, thus setting the stage for delay and impact claims.

Defense: Minimum Owner/Engineer Review Time – If owners want to avoid being trapped by three day submittal review times being defined in the baseline schedule, a



clause can be inserted in the contract documents to the effect that "Unless specified elsewhere in these specifications, the engineer shall have thirty (30) calendar days from receipt of a contractor's submittal, in which to review and respond to the submittal." A different timeframe can be utilized if owners are uncomfortable with the 30 calendar day suggestion above, as can work days versus calendar days. And, different timeframes can be stipulated to different submittals – shorter times for simple submittals and catalogue cuts, longer for more complex submittals and even longer for those submittals that have to be reviewed by an independent party (i.e., State highway department, railroad, etc.). This type of specification requirement helps provide for proper planning by both the contractor and the owner, but there is a risk in that if the owner fails to return the submittal within the stipulated timeframe, this opens the door to potential delay and impact claims.

Defense: Resubmittals – The Same Review Time – To provide some additional protection, a clause can be added to the contract documents to the effect that resubmittals of contractor's submittals shall have the same review time as the initial submittal. This clarifies entirely the issue of whether the owner and engineer have a single timeframe in which to review the submittal and all resubmittals, or whether the "clock starts all over again" with each resubmittal.

Game: Failure to Show Submittal Review – The alternative to the above game is to show no submittal review times at all in the project schedule. Under this scenario, the construction activity associated with the submittal is shown as starting on the same day or the next day after the submittal activity is complete. The result can be that some contractors will raise the specter of a delay or impact claim any time the start of any onsite activity is delayed beyond the planned or scheduled start date, while the engineer reviews a submittal. Furthermore, the exclusion of schedule activities associated with review times in the schedule does not allow the contractor or the owner to identify or manage areas of risk in the submittal preparation and review process.

Defense: Submittal Reviews Incorporated Into the Schedule – A contract requirement that requires all submittals and submittal reviews be reflected as schedule activities will help



avoid many of the games played concerning submittals, submittal reviews, and their time impacts. In many instances, schedules are produced that contain one activity labeled as “submittal and procurement” when they should be individually identified as four separate activities; submittal, submittal review, procurement and delivery. If this is done, it is recommended that a master list of all required submittals be provided by the designer to assist the contractor in complying with such a requirement. This action will save the owner and the contractor a great deal of time.

Defense: Submittal Schedule – In addition to the above suggested defense, a contract requirement can be added that requires the contractor to prepare and submit a schedule of submittals listing all anticipated submittals required by the contract documents and when each submittal will be provided for review. This is now required in the Engineering Joint Contract Documents Committee (EJCDC) General Conditions, for example.¹² This will help ensure that the contractor is aware of and plans for all submittals; allows the owner and design professionals to plan their staffing and workload appropriately; and, helps avoid some of the schedule games played concerning submittal activities within a project schedule. The submittal schedule should be part of the initial submittals on the project (i.e., with the schedule of values, project schedule, etc.). The early submission of the submittal schedule will provide for better coordination between the contractor and design professionals, allowing the design professionals to plan their work accordingly in order to ensure that they meet the contractor’s requirements. Furthermore, this will assist with the identification of potential areas of risk and afford the team members the opportunity to address these potential risks during the early stages of the project before impacts or delays occur. This is ***not*** an onerous requirement as some would claim, which is explained in the following defense.

Defense: Define Work Breakdown Structure (WBS) Coding Structure – The owner may want the contractor to provide “specialty” schedules that extract specific types of activities from the overall project schedule. These specialty schedules may include information

¹² EJCDC General Conditions 1910-8, 1990 edition.



related to submittals, work in specific areas, or activities performed by specific trades. If such specialty schedules are going to be required by the owner, then the detailed scheduling specification can require that the WBS coding identify schedule activities by certain categories (i.e., submittal, submittal review and approval, procurement and fabrication, delivery, construction and installation, change order, area of work, trade, responsibility, etc.). If this is specified in the contract documents such that the contractor's scheduler knows this from the outset, then the coding structure can easily be provided and specialty schedules are not onerous burdens.

Game: Delivery Dates for Owner Furnished Equipment or Materials – It is not uncommon in the construction industry for owners to procure and furnish long lead items necessary for the project to the contractor. These items may include both equipment and materials. This is frequently seen as having a potential for both time and cost savings on a project that requires long lead items, uses existing master supplier agreements, or can achieve program wide cost savings when multiple projects use the same commodities. For obvious planning and coordination purposes, dates for delivery of owner furnished items *must* be shown on the project schedule. If the owner furnished equipment or material delivery dates are shown on the schedule, and the schedule is accepted by the owner after review, then this forms a sort of warranty (or implicit agreement between the owner and the contractor) that the owner furnished items will be delivered no later than the date shown on the schedule. Some contractors, in consequence of this, will show delivery of owner furnished items in an unrealistic manner – generally, earlier than is achievable. This is done either out of a lack of knowledge of the planned delivery dates or as a schedule game. If the owner is unable to meet the previously scheduled and "agreed to" delivery dates, this failure sets the stage for delay and impact claims.

Defense: Not Earlier Than Delivery Dates for Owner Furnished Items – To help avoid a situation that some contractors create by establishing very early delivery dates for all owner furnished items (either in an effort to enhance the chances of establishing a delay due to late delivery of owner furnished items or because of its lack of knowledge of the delivery dates anticipated by the owner) the contract documents can stipulate the earliest



possible delivery dates for all owner furnished items. These dates should be based upon delivery dates established by the manufacturer or supplier, plus an appropriate contingency time factor. If this is done, the specifications need to require inclusion of these earliest possible dates in the contractor's schedule for planning and coordination purposes. Such a contract requirement could 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."

Defense: Schedule Windows for Delivery of Owner Furnished Items – A variation of the above remedy is for the owner to establish schedule windows, in the contract documents, for providing owner furnished items. That is, the owner can stipulate in the contract documents that owner furnished items will be delivered no earlier than a certain date, and no later than a specified late date. In this manner, the contractor is given some reasonable assurance of when the owner furnished items will be on site, while at the same time the owner mitigates or lessens the risk of a schedule game concerning the items provided to the contractor by the owner. This sort of contract clause provides for much better planning and coordination on the part of the contractor. Thus, both the owner and the contractor gain. Again, this sort of action needs to be buttressed with a contract requirement that the schedule windows be incorporated into the contractor's baseline schedule. Language similar to that shown in the previous defense should be sufficient. In either this or the preceding defense, activities in the schedule associated with owner furnished items should not be modified without the owner's approval. Therefore, the owner should provide the contractor with the status of these items as schedule updates are prepared.

Game: Failure to Show Procurement Activities – Under this scheduling game the schedule simply shows installation of equipment, without showing required predecessors including submittal preparation, submittal review, fabrication, or delivery times. Under this scenario, if the installation takes place later than planned on the accepted baseline schedule, some contractors may allege that the owner caused the delays and request a time extension and associated time related damages, when in reality the procurement was



not truly delayed. (Depending upon the terms of the contract documents, supplier or vendor delays may be alleged if the contract documents provide for a time extension for such delays.)

Defense: Incorporation of Fabrication, Delivery and Installation Activities – To avoid some of the problems concerning procurement activities, the scheduling specification can be written to specifically require that fabrication, delivery, and installation times for all major contractor furnished equipment be included as separate activities on the construction schedule. To prevent a dispute with the contractor over such a requirement, the designer should consider specifying in the contract documents which items of equipment are considered major under the terms of such a requirement. Again, the primary purpose of this suggestion is to see that adequate planning and coordination is provided. A secondary benefit of this requirement would be to help avoid some schedule games concerning fabrication and delivery times.

Defense: Separate Equipment Procurement Schedule – Another means of assisting with proper planning and scheduling of contractor furnished equipment, is to insert a contract requirement that the contractor shall provide a schedule printout showing the anticipated order and delivery dates for each major piece of equipment on the project. If such a requirement is utilized, the contract documents should specify which pieces of equipment are considered to be major in order to prevent any argument over this defined term. This will help with the coordination of the work, identify areas of potential risk associated with vendor deliveries, and help avoid some schedule games associated with anticipated equipment delivery dates.

Defense: Define WBS Coding Structure – Some contractors will profess to see no need for a separate procurement schedule and will assert the position that this is just another onerous paperwork requirement that has nothing to do with building the project. This ignores the true purpose of such a requirement, which is to make certain that critical procurement activities are identified, coordinated, and completed as necessary in order to support the project. As noted earlier, if a specialty schedule, such as a procurement



schedule, is determined necessary (or desirable) by the owner, then the scheduling specification should include a provision requiring specific coding within the WBS coding structure for procurement activities. This will allow the contractor to produce a procurement schedule without any additional work.

Game: Failure to Include Contract Schedule Constraints – Many owners go to great lengths during the design phase of a project to plan for and include certain schedule constraints in the contract documents. These constraints may be identified as activities that have to be completed before other activities can start; phases that the work is required to be completed in; or construction sequences that must be adhered to so as not to disrupt ongoing owner operations. This is, perhaps, more true in renovation type projects than new facility projects. Notwithstanding the clear requirements of the contract documents, some construction contractors may *not* include these constraints and restraints in their initial schedule submittal to the owner. This occurs because contractors overlook such constraints, do not understand the constraints, or simply ignore the contract requirements. If the owner, after review of the schedule submittal, accepts the contractor's schedule without the constraints and later attempts to enforce the requirements of the contract, some contractors will argue that the owner "waived the contract requirements" by acceptance of the schedule, and thus now owes an equitable adjustment in order to re-establish these constraints.

Defense: Schedule, Logic and Operating Constraints, and Sequences Listed in Specifications –

Examples of constraints during the construction of the project that an owner may impose to meet their 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 AM", or "The work in Area 1 needs to be completed before work in Area 2 starts", etc. A review of the project by owners and their operating staffs must take place during the design phase of the project, such that all identifiable and necessary constraints are noted in the bidding documents. If the owner and engineer cannot identify these



constraints themselves, it is unreasonable to assume that a contractor can successfully guess, at the time of bidding, what constraints they will need to adhere to during the course of construction. Therefore, all such constraints and sequences must be incorporated into the specifications in order to make them enforceable. The specifications should also make it mandatory that the construction schedule reflect all such constraints.

Defense: Interim Milestone Dates – Another method of establishing construction sequences, especially useful when working on projects involving renovation of existing facilities while the facilities remain fully operational, is to establish interim milestone dates in the contract documents. For example, the contract documents may establish that "The headworks portion of the project must be operational no later than July 1, 2016," or "Work on the digesters shall not commence until on, or after, September 1, 2014". Such requirements may also be useful on projects with multiple prime contractors or projects that interface with other concurrent projects. This will assist the contractor in planning, coordinating, and sequencing their work and should help alleviate delay and impact claims arising because the owner imposes requirements during the performance of the work that were not known to the contractor at the time of bidding.

Defense: Specified Constraints and Sequences Correctly Reflected in Schedule – If there are specified constraints or sequences embedded in the contract documents, the schedule specification needs to be clear that all such items shall be reflected in the schedule as they are called out in the contract documents. If the owner has included specific operating constraints, logic sequences, delivery windows, review times, and/or interim milestone dates in the contract documents then the owner needs to carefully review the baseline schedule and all schedule updates to determine that these mandated items are correctly reflected in the project schedule. Some contractors may take the position that the owner waived requirements that were *not* shown on the schedule at the time the owner accepted the baseline schedule. In order for the owner to protect itself from the contractor taking this position, it should consider including language in the acceptance letter for the baseline schedule that states something to the following effect, "To the extent a contract requirement is not incorporated into the schedule, it does not relieve the contractor of their



responsibility to adhere to the contract requirements.” In the event that the contractor requests, and the owner accepts relief from a requirement, the acceptance letter should specifically identify the contract requirement where relief is accepted. This should be followed up with the execution of a contract change order that formally memorializes the change to the contract.

Game: Phony Early Completion Schedules – Many early completion schedules are *not* real in the sense that the contractor did not *bid* an accelerated rate of progress in order to complete the job early.¹³ An early completion schedule may be developed by a contractor when they bid the project for the full time of performance and then discover, after bid opening and award, that the job can be accomplished in less time. In the alternative, some contractors may bid the full time of performance, but later submit an accelerated schedule in order to increase their opportunity to raise claims for delay. (This type of construction schedule has been referred to frequently as a phony early completion schedule and can be considered as a form of contingency bidding.)¹⁴ Artificially decreasing activity durations is the most common method of accomplishing this tactic. This scheduling game provides some contractors the opportunity to file claims for delayed early completion even if the job completes on time or early, by arguing that "But for the actions of the owner, I would have finished even earlier!"^{15 16 17}

Defense: Pre-Bid Project Scheduling – One way to avoid phony early completion schedules or contractors claiming that they bid the project on an accelerated schedule or

¹³ Galloway, P.D. and Nielsen, K.R., "Evaluating the Contractor's Right to Finish Early", Annual Seminar and Symposium, Project Management Institute, 412 – 418, 1990.

¹⁴ Zack, James G., Jr., "Early Completion Schedules: The Newest form of Contingency Bidding", *Strategem*, Volume 2, Number 2, 1985.

¹⁵ Zack, James G., Jr., "Check Your Scheduling Practices", *Civil Engineering*, Volume 56, Number 9, September 1986.

¹⁶ Wickwire, I., Driscoll, T.J., Hurlbut, S.B. And Groff, M.J., Construction Scheduling: Preparation, Liability and Claims (3rd Edition), Aspen Publishers, New York, NY, 2010.

¹⁷ Wickwire, J. and Smith, R., "The Use of Critical Path Techniques in Contract Claims", *Public Contract Law Journal*, 7(1), 1-45, 1974.



early completion basis, is for the owner to determine what the *realistic* period of performance for the work of the contract should be before the project is let for bid. The best means of determining this timeframe is to have some pre-bid project scheduling performed by a construction scheduler, at the time the project's plans and specifications are undergoing the QA/QC process (i.e., once the plans and specifications are considered essentially complete). This will also help prevent a situation where the time to perform the work is either too long or too short -- either one of which may lead to scheduling games and contingency type bidding on the part of some contractors.

Defense: "Joint Ownership of Float" Clause – Float within the project schedule is generally owned by the project unless otherwise specified in the contract documents.¹⁸ This means that the float can be used by either party (i.e., used on a "first come first serve basis"). However, a specification which is silent in this regard can lead to confusion between the parties with respect to the issue of "who owns the float". To avoid confusion and possible gamesmanship in the assertion of claims for delays to activities that had float, it is recommended that a "Joint Ownership of Float" clause be inserted in the scheduling specification. Language such as "The contractor's construction schedule shall begin with the date of issuance of notice to proceed and conclude with the date of final completion of the project. Float, or slack time, within the construction schedule is *not* for the exclusive use or benefit of either the owner or the contractor, but is a jointly owned, expiring project resource available to both parties as needed to meet contract milestones and the contract completion date." Under this specification language, a contractor can still show the early completion of the work by identifying the difference between the planned completion and the contract completion dates as "project float". In fact, the scheduling specification generally should include such a requirement. This sort of specification language, therefore, does not interfere with the contractor's right to finish early but simply serves to protect owners from delayed early completion claims. Under the scenario where the project owns the float, the owner should be aware of and look for instances when the

¹⁸ Wickwire, J. and Driscoll, T.J., "Current Issues and Developments Related to the Use of CPM in Contract Claims", Proceedings, Fifth Annual Construction Litigation Superconference, Conference Management Corporation, San Francisco, CA, 1990.



contractor may manipulate the schedule to reduce float along paths where the owner has the most risks and increase the float along the paths where the contractor may have the most risk.

Defense: Limited Form of "No Damages for Delay" Clause – It is commonly accepted that broad form "No Damages for Delay" clauses are construed in the strictest manner possible out of a sense of equity.¹⁹ There are, however, a number of States where "No Damages for Delay" clauses are unenforceable by statute. As of the 2006 – 2007 timeframe, some 15 States had prohibited, in whole or in part, including Arizona,²⁰ California,²¹ Colorado,²² Kentucky,²³ Massachusetts,²⁴ Minnesota,²⁵ Missouri,²⁶ Nevada,²⁷ North Carolina,²⁸ Ohio,²⁹ Oregon,³⁰ Rhode Island,³¹ Texas,³² Virginia,³³ and Washington.³⁴ Therefore, owners who decide to employ this approach need to seek the advice of competent legal counsel to determine whether such a clause is enforceable in the owner's jurisdiction. However, specifically crafted and sharply limited "No Damages for

¹⁹ Gibbs, K. and Hunt, G., California Construction Law (16th Edition), Aspen Publishers, New York, NY, 2000. See also, Brown, E.C., California Infrastructure Projects: A Legal Handbook for Successful Contracting & Dispute Resolution, ALM Media Properties, San Francisco, CA, 2010.

²⁰ Ariz. Rev. Stat. §41-2617.

²¹ Cal. Pub. Cont. Code §7102.

²² Colo. Rev. Stat. Ann. 24-91-103.5(1)(a).

²³ 371 Ky. Rev. St., 45 A-245, §371-160. It is interesting to note that this statute is applicable to some private contracts in addition to public works contracts entered into after June 26, 2007.

²⁴ Mass. Gen. Laws Ann., Chapter 30, §390.

²⁵ Minn. Stat. Ann. §15.411(2).

²⁶ Mo. Ann. Stat. §34.058.

²⁷ Nev. Rev. Stat. Ann. §§108.2453(e), 624.622(2)(c).

²⁸ N.C. Gen. Stat. Ann. §143-134.3.

²⁹ Ohio Rev. Code Ann. §4113.62(C)(2).

³⁰ OR. Rev. Stat. §279CV.315(1).

³¹ R.I. Gen. Laws §37-2-42(a),(d).

³² Tex. Gov't. Code Ann. §2260.003(a)(3), (c)(5).

³³ Va. Code Ann. §2.2-4335(A).

³⁴ Wash. Rev. Code Ann. §4-24.360.



Delay" clauses are generally still enforceable in many States. Therefore, it is suggested that contract documents include language such as the following to help enforce the "Joint Ownership of Float" concept and decrease the owner's exposure to unrealistic delayed early completion claims, such as "Pursuant to the contract's float sharing requirements, no time extensions will be granted nor delay damages paid until a delay occurs which impacts the project's critical path, consumes all available float or contingency time available, and extends the work beyond the contract completion date."

Another limited form of "No Damage for Delay" clause generally considered reasonable and enforceable is one which modifies the standard "Differing Site Conditions" or "Changed Conditions" clause to the extent that if the contractor encounters uncharted or undocumented utilities that do *not* belong to the project owner or is delayed by third party interference. In this scenario, the contractor is entitled to recoup the direct costs associated with the problem and an excusable, non-compensable time extension, but is *not* entitled to receive extended overhead or delay damages. This is a specifically crafted risk sharing/risk assignment clause whereby the owner and the contractor are each being assigned some of the risk for unknown utilities belonging to a third party or other interferences caused by third parties.

Defense: "Reduction of Contract Duration" Clause – One way of defending against early completion schedules that are truly phony (that is, not actually bid on an early completion basis) is by inserting a clause in the contract documents which allows the owner to *reduce* the time of performance of the work under the contract to match the time of completion shown on a contractor's baseline early completion schedule, at no cost to the owner. This effectively restores the status quo between the contractor and the owner. That is, neither side can assess damages against the other at a different point in time. This is an effective means of dealing with the problem of unrealistic early completion schedules but needs to be used judiciously *and in conjunction* with an effective pre-bid scheduling effort which helps to establish a realistic time of completion.



Defense: "Owner Credit for Field Overhead Associated with Early Completion" Clause – Another mechanism to defend against phony early completion schedules is to insert a clause that allows the owner to obtain a credit (through the issuance of a deductive change order) from the contractor based upon the field office overhead costs saved for every day of early completion shown on the approved baseline schedule. If utilized, the clause should state that the owner is entitled to this credit *unless* the contractor can document, through submittal and review of its bid takeoff, that the contractor actually bid the contract on an early completion basis. (In such a case, the owner has already received its credit through a lower bid cost.) This is a controversial contract clause and a high risk proposition, and as such, should be crafted and reviewed carefully, and used with a great deal of caution. It is perceived that such a clause is a defense against truly phony early completion schedules. Some argue that it may actually increase bid costs because contractors will not bid or schedule early completion that they might otherwise actually be able to achieve through higher productivity rates and that would mutually benefit both the owner and the contractor.

Defense: Escrow of Bid Documents – Although a somewhat controversial topic in the construction industry, it is perceived that escrow of bid documents will go far to help reduce schedule games and claims, especially those concerning alleged early completion. (Escrow of bid documents is a contract requirement that the low bidder turn in certified copies of all bid takeoff information utilized in preparing its bid within a specific period of time [i.e., twenty four hours] after bid opening. These documents remain in the possession of a third party for use in analyzing claims, change orders, impacts, etc., for the duration of the project.) Having access to the contractor's bid takeoff allows the owner to review claims associated with the manner in which the project was bid, such as those that assert that the job was bid on an early completion basis; that the project was bid on an accelerated basis; that the project was bid on the basis of four electrical crews for six months; that the project was premised at the time of bidding on a certain productivity rate; etc.^{35 36}

³⁵ Sutliff, C.D., and Zack, J.G., "Contract Provisions that Ensure Complete Cost Disclosure", *Cost Engineering*, Volume 28, Number 10, October, 1987.



Defense: Banked Float Requirement – Another mechanism designed to deal with delayed early completion claims is the concept of banked float. Float within a construction schedule can be created by either the owner or the contractor during the performance of the work. For example, early return of a critical path shop drawing does equally as much to create float as increased labor productivity on critical activities. Under the concept of banked float, the scheduling specification recognizes this situation and sets up an arrangement where the float created by each party is credited to that party on a monthly basis. The banked float approach can still be used along with the joint ownership of float language as only float specifically agreed to as being created by one of the parties is banked, all other float remains jointly owned. But, the language creating the banked float system requires that the owner and the contractor agree, at the end of every month, what float was actually created during the update period, and by whom. (Failure to reach agreement on float creation and delays monthly negates this approach all together. This means that the owner and the contractor must be prepared every month for the duration of the project to negotiate float creation and delays.) Delays caused by each party then come out of the banked float accounts until such time as a delay exceeds the float in the account. This basically gives rise to concurrent delay situations. As such, neither party is charged with delay damages until their delay exceeds the float they have created.

Game: Preferential Logic – In this sort of situation, some construction contractors will not sequence activities in the most logical manner, but rather, in a manner as to create the maximum possible opportunity for owner interference. Contractors employing this tactic may try to put themselves in a position to claim delay or interruption whenever the owner requests a different sequence of activities.

Game: Sequestering of Float – Sequestering of float is a scheduling technique whereby a project schedule is constructed that has little or no float visible within the schedule. A schedule constructed in this manner will have multiple critical paths throughout the

³⁶ Avoiding and Resolving Disputes in Underground Construction: Successful Practices and Guidelines, Underground Technology Research Council, American Society of Civil Engineers, New York, NY, 1987.



network or a single critical path with numerous other paths through the network containing, say, ten or less days of float. The idea behind this type of scheduling is that no matter what the project owner does during the performance of the work, it will likely bring about an impact to the end date of the project. Methods of sequestering float on a project schedule include:

Preferential Sequencing: A variation of this game is that some contractors take activities that could be performed concurrently and establish them in the project schedule as sequential (that is, with finish-start relationships) simply to consume float within the schedule network.

Artificial Activity Durations: Some contractors attempt to sequester project float by artificially extending or inflating activity durations in the schedule's network (i.e., a thirty day activity is placed in the schedule as a forty day activity). This is done by some contractors simply to consume float within the network, and again, artificially impact or influence the critical path of the schedule. This is easily accomplished through the use of scheduling software packages that allows resource leveling.

Defense: Thorough Review of Baseline and Schedule Updates – From a practical point of view, owners, design professionals, and project managers need to comprehend the liability associated with the review and acceptance of contractors' construction schedules. Schedule review is every bit as important to the successful completion of a construction project, as the review of technical submittals is important to the long term life of a facility. Schedule review also has a similar amount of legal risk associated with it. Therefore, a thorough, detailed review of the contractor's baseline schedule as well as all schedule updates is one mechanism to detect and prevent schedule games. It is critical to carefully review of the schedule submittals for compliance with specification requirements, preferential logic, unrealistically shortened activity durations, artificially increased activity durations, construction logic, review times, sequestering of float, failure to include critical activities or known constraints identified in the contract documents, etc. Schedule update



reviews should also include a comparison of the start and finish dates with field records of inspection staff, job photos, weekly meeting minutes, monthly progress reports, contractor weekly bar charts or three week look ahead schedules, etc. A schedule review checklist is provided in a later section of this paper.

Defense: Subcontractor Participation Requirement – Experience indicates that those contractors who are playing schedule games against owners generally do *not* involve their subcontractors in the formation of the baseline schedule or any schedule updates. This is because many of the scheduling games identified cut as much against subcontractors as against the owner. Accordingly, a contract requirement that major subcontractors participate in, and sign off on, the baseline schedule and all schedule updates will help prevent some schedule games since there is rarely an advantage to the subcontractors to participate in such games. If this clause is utilized, the contract documents should stipulate which subcontractors are considered major under the terms of the specification. Such a requirement enhances project coordination and communication, provides for better project planning and serves to ward off schedule gamesmanship.

Defense: "Non-Sequestering of Float" Clause – In order to combat float sequestering games an owner may consider including a "Non-Sequestering of Float" clause in the scheduling specification. Language such as the following can be utilized, "Pursuant to the float sharing requirements of the contract documents the use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity durations are prohibited and the use of float time disclosed or implied by the use of alternate float suppression techniques shall be shared to the proportionate benefit of the owner and the contractor." Such a contract clause should go on to state that sequestering of float shall be cause for rejection of the contractor's schedule submittal. This clause may be difficult to enforce since logic relationships and activity durations go to the means and methods of the contractor. An owner has to be cautious in dictating or directing the manner in which the contractor executes the work. Furthermore, a contractor who sequesters float should be aware that this adversely impacts its ability to properly and effectively manage the work and exposes itself to risks of delays.



Defense: Resource Loading of Schedule Activities – One way to determine whether games are being played with schedule activities is to have a specification requirement that *all* on site construction activities shown on the schedule shall be resource loaded with costs, manpower (i.e., labor by craft or trade), and equipment. If this is done, then a schedule reviewer can compare the resource loading with the duration to see if each is logical, reasonable, and mutually supportable. This also allows the owner to review the reasonableness of the contractor's plan for the construction of the project as well as forming a baseline against which to measure actual contractor performance during the construction of the project. Such resource loading of schedule activities can also be used as a part of delay and impact claim analysis in the event such claims later arise.

Game: Failure to Include Start Up/Testing Activities – In facilities facility type projects, some contractors fail to include any time for start up and testing of the facility at the end of the project. The schedule submitted to the owner for review and concurrence will be almost entirely consumed with construction activities leaving little, if any, time for start up and testing activities. Then, when it takes longer to start up and test the facility, some contractors may attempt to assert delay and impact claims on the basis that they and the owner had previously agreed, by acceptance of the baseline schedule, that this activity would take a significantly shorter period of time than it actually did. Claims of superior knowledge on the part of the owner sometimes arise in this type of situation. As with the submittal and procurement activities discussed earlier, the contractor's schedule should include as many separate activities as required to accurately define, plan and execute the scope of start-up and testing work.

Defense: Estimate Time for Start-Up and Testing Activity – Sometimes the failure to include sufficient time in the start-up and testing activities is a scheduling game. However, more often than not, contractors are unfamiliar with starting up and testing various types of facilities. Their expertise lies in constructing facilities, not starting them. Thus, to a great extent, this type of scheduling is not a game but a lack of knowledge and experience with this type of work effort. Most owners, on the other hand, are experienced



with the operation of the facilities under construction. Therefore, owners *are* in a superior position (relatively speaking) to estimate the amount of time needed to successfully start-up and test a facility. The specifications should identify, at a minimum that the contractor should expect to spend “no less than ‘x’ calendar days starting up and testing the facility”. Preferably, the specification should detail (to the extent possible) the activities for start-up and testing and the corresponding estimated durations. In addition, the specification should also provide information on the time required for the preparation and review of procedures, permits, etc. The inclusion of this information in the specifications puts the contractor on notice at the time of bidding, allows the contractor to properly factor in this amount of time within their schedule, and also helps defeat this type of game. Estimates during the planning phases should be conservative and the parties responsible for the start-up and testing activities should be involved in the identification of the durations and preparation of the schedules.

Game: No Schedule Updates – Another game played by some contractors, especially when the scheduling specification requires a schedule update only when a “major change occurs”, is to *not* provide schedule updates to the owner, or provide them infrequently, (e.g., once every six months or yearly). This game rests on the lack of a precise definition of the term “major change”. The hope of those contractors playing this game is to force the owner to calculate change order impacts or delays on the basis of the baseline schedule. This schedule game also impacts the contractor and the owner’s ability to identify impacts or risks to the project as early as possible and proactively address them.

Defense: Construction Scheduling – Pay Item on the Schedule of Values – One method that may help convince some contractors to perform appropriate construction scheduling, including schedule updates, is to include scheduling as a specific pay item on the schedule of values. The specification should state that the contractor is entitled to bill for this pay item only after submittal and approval of the baseline schedule and each monthly schedule update. This type of specification provides the contractor with a financial incentive to submit schedules and clearly acknowledges that proper project scheduling is a costly item for a construction contractor. The fact that it also has to be approved prior to



payment helps to avoid the typical “schedule submissions for payment only” situation where the submitted schedule is being used for payment only and not as a project management tool.

Defense: “Pay Off the Schedule” Specification – In order to emphasize the necessity for proper planning and execution as well as to give contractors a financial reason for properly and timely updating their schedules, some major construction owners have gone to a “Pay Off the Schedule” specification wherein every schedule activity is cost loaded and the schedule of payment values is a listing of all schedule activities. At the end of every month, the contractor's payment application is a listing of all schedule activities completed or in progress, the percentage of work accomplished, and a calculation of the value of the work performed (i.e., the percentage completed times the cost loaded value of the schedule activity, less applicable retainage). It is perceived that this approach greatly enhances the quality of the contractor's scheduling and helps defeat many schedule games. However, it does make the monthly progress payment process somewhat more complicated and requires that all owner personnel dealing with monthly payment applications be schedule oriented and knowledgeable of both the progress of the project and the status of the schedule.

Another version of this that is utilized by the U.S. Federal government is the concept of using the Earned Value Management System (“EVMS”) that links the schedule to the applications for payment. EVMS has long been employed in the private sector in the petrochemical business but was first employed by the Federal government in the 1960’s in the production of missiles and aircraft. It has increasingly been used in construction projects especially on Federal government contracts.³⁷ The use of the schedule as a tool for progress payments can be difficult for the parties to implement because the Schedule of Values and the project schedule are *not* mirror images of each other. Furthermore, this may adversely affect the contractor’s use of the schedule as a tool for planning and

³⁷ Fleming, Q.W. and Koppelman, J.M, Earned Value Project Management (3rd Edition), Project Management Institute, Newton Square, PA, 2005.



coordinating work and may result in other scheduling games (i.e., showing inaccurate progress).

Defense: Liquidated Damages Associated with Schedule Submittals – One means of demonstrating the criticality of project scheduling to contractors and helping assure proper and timely submittal of schedule updates is to have a contract clause that provides for the imposition of liquidated damages (that is, "\$X/day" of damages) for every day the schedule submittal is late. It is beyond the scope of this paper to discuss the formula for establishing and calculating the amount of such liquidated damages. Suffice it to say that it is possible to establish a reasonable value of the damages to be incurred by the owner in the event that the contractor fails to submit schedule updates in a timely manner. The approach would be based upon the amount of scheduling work the owner would have to have performed, at their own expense, if the contractor fails to conform to the requirements of the scheduling specification.

Defense: Withholding of Payment for Failure to Update Schedule – A contract clause can be created that states the submittal of the schedule update is a "condition precedent" to monthly progress payments being processed by the owner. (Note that the term "condition precedent" may be required in order to make such a clause enforceable.) This is one way to defeat the game of not submitting schedule updates. It is, however, a harsh clause in that if a contractor does a great deal of acceptable work during the month but fails to submit a schedule update, all compensation for the work in place would be denied. However, if the owner is utilizing a "Pay Off the Schedule" specification, as discussed previously, then this type of clause is entirely logical and defensible due to the fact that the updated monthly schedule submittal *is* the monthly payment application. Failure to submit the updated schedule has the same effect as *not* submitting a payment application on any other construction project. That is, no payment application, no payment for the month!

Game: Inaccurate Schedule Updates or Inaccurate As-Built Information – A game often played by contractors is to provide schedule updates that utilize inaccurate start and finish



dates. Typically, an activity on the schedule will be shown to have started earlier than it actually did and/or completed later than it actually did, depending upon which benefits the individual playing the game. The concept here is to absorb schedule float slowly by using inaccurate dates, generally to the detriment of the owner. It should be noted that there are times when these inaccuracies are not a contractor's attempt to play schedule games, but rather, result from a lack of attention to detail (or knowledge of activities) in the schedule update. Regardless, both of which defeat the purpose of schedule updating to monitor progress and identify risks.

Game: Inaccurate Schedule Updates – Scheduling Away Project Delay – Another common game played by contractors is the practice of “scheduling away project delay.” This occurs when the contractor is behind schedule at the point in time the schedule update is submitted, yet the project completion date has not slipped. With this, the contractor often reduces durations or changes logic in those activities planned to start after the data date of the schedule update. If the as-built progress up to the data date is behind schedule, as compared to the baseline schedule, the contractor may change durations and/or logic of future activities to offset the exact amount of delay thereby producing an update that shows that the project is “on schedule” when in reality it is behind schedule.

Game: Changing Project History – A rare game, but one still occasionally played by some contractors, is to consume schedule float by going back and changing or adjusting start and finish dates on activities already completed a month or more previous to the present schedule update, and running out the schedule update utilizing the changed information. Based upon this revised project history the current monthly update is then calculated and submitted for review and concurrence. This has the effect of influencing or impacting the schedule update, again, usually to the detriment of the owner.

Game: Changing Project Calendars – Another form of scheduling games stems from a spinoff effect of a modification to the scheduling software packages currently on the market, which has the ability to change the project calendar for the schedule every time the schedule is updated. This software enhancement was made to allow for daily or



hourly scheduling of separate trades. The impact, however, is to allow a slow absorption of float by the contractor by changing project calendars. The impact is that float is slowly consumed even though the project work is proceeding basically as planned.

Defense: Spot Check Project History/Schedule Change Report – One way to defend against the game of changing project history in order to sequester float or enhance the chances of raising delay claims, is for the owner’s scheduler to routinely spot check the project schedule every month. It is suggested that the scheduler check the schedule reports every month to see that no changes in previously completed activities have been made. A variation of this is to insert a requirement in the scheduling specification that the contractor has to submit a separate report with each schedule update that specifically identifies *every change* made to the schedule since the last monthly update, including logic changes, durations, actual starts/finishes, activity additions/deletions, etc. This makes it easier for the owner’s scheduler to review schedule updates. This requirement can be buttressed with language to the effect that the owner is not responsible for any changes made to the schedule that were not specifically identified in the schedule change report provided with the monthly update. Further, it is possible to electronically check schedule updates for changes by employing forensic scheduling software (either the schedule analysis program built into the scheduling software or a third party software that provides comparison and analysis of two schedule updates). The analysis software will identify and printout all changes from the last update. With this information in hand, the project scheduler can then quickly check to determine whether any changes made were made to previously completed activities or activities not worked on during the update period. With a thorough review of the schedule update, coupled with the contractor’s schedule update narrative, the owner’s scheduler will be able to review the changes made (i.e., logic, duration, calendars, constraints, new activities, deleted activities, etc.) and be in a position to verify the necessity for the changes and/or open a dialog with the contractor as to the necessity or reasoning for the changes with a focus on minimizing schedule delay risk and avoiding schedule gamesmanship. A schedule review checklist is provided later in this paper. The following are some of the more common changes made to electronic schedule updates by contractors to “schedule away project delay” or misrepresent delays:



Deleted or Added Activities: Deleting or adding activities to an approved baseline schedule is generally considered a poor scheduling practice unless changes in the scope of work or to means and methods warrant such changes.

Changing Original Durations: Original durations, as submitted with the baseline or re-baseline schedule, should *not* change unless approved by the owner. Decreases in original durations are used as a way to “schedule away” a contractor’s own delay.

Changes in Relationships: Deleting or adding relationships is also another way to increase or decrease the time to complete the project. This too can be used to either incorporate delays into the schedule or to “schedule away delays.”

Use of Leads or Lags: A variation of changing logic relationships is the use of leads or lags. However, leads/lags are sometimes used as means to “schedule away delay”.

Use of Constraints: Constraints can interrupt the calculation of the schedule, overriding the calculation of the Critical Path Method (“CPM”) forward and backward pass algorithm.

Retained Logic vs. Progress Override: Progress Override accelerates a schedule by ignoring logic ties or relationships within the schedule model.

Defense: Joint Updating Requirement – A contract requirement can be inserted that requires the owner, the architect/engineer, the contractor, and all major subcontractors shall participate in a joint schedule update meeting every month. If this requirement is included in the scheduling specification, the contract documents should specify which subcontractors are considered major to avoid arguments over who should attend the meeting (e.g., “Any subcontractor with a subcontract equal to or in excess of five percent of



the contract value..."). This joint discussion will help enhance communications between the parties involved in the project and help avoid surprises when schedule updates are provided. This should also help reduce the incidence of schedule games since all parties are involved in the schedule update process, thus establishing a check and balance system for the project. A construction owner does not want to interfere with the prime contractor/subcontractor relationship, nor does the owner want to be set up by schedule gamesmanship. The subcontractor participation requirement allows the owner to use the subcontractors as tripwires to detect schedule games, without raising the specter of owner interference. An added benefit is that it provides a forum for the parties to discuss issues impacting the project schedule and address them as a team to manage risks and mitigate delays.

Defense: Addition of Activities for Resubmittals – When it comes to providing schedule updates and identifying the status of various activities, contractors sometimes include the time for the resubmission of information in the “owner/engineer review and response” activities. This may inaccurately give the appearance that the owner/engineer has exceeded the review time allowed by the baseline schedule, when in fact the additional time is associated with a re-submittal processes. In defense of this, the specification should indicate that new activities be added if re-submittals are necessary. By clearly identifying the activities that the contractor is responsible for versus those that the owner/engineer is responsible, risks are better managed and impacts (or potential impacts) are better understood.

Defense: Electronic Submittal of Schedule Submittals – One way to detect and defeat these types of schedule games is to write the scheduling specification to provide for electronic transmittal of all scheduling submittals in addition to the hard copy print outs and written narratives. The owner's scheduler will be able to detect these types of schedule games by running computer comparisons of changed data. For example, no activities should have been changed prior to last month's data date. If any changes such as this were made, this indicates false data input or at least identifies an area that requires further explanation from the contractor. Additionally, a review of the electronic schedules



can assist in identifying areas where the contractor may be “scheduling away project delay” by changing durations or logic.

Defense: Recorder of the Schedule Requirement – The Recorder of the Schedule specification is a variation of the Electronic Schedule Submittal defense. Under this approach, the contractor will create his own baseline construction schedule and provide it to the owner and architect/engineer, as is customary. Upon approval of the baseline schedule, the owner's scheduler enters the document in their computer. The schedule in the owner's computer is the “record schedule” for the project, pursuant to the requirements of the scheduling specification. Each month, the contractor submits only a list of changes to the previously approved schedule for insertion by the owner's scheduler. The owner's scheduler makes the changes called for by the contractor and submits the resulting schedule update to the contractor for its review and concurrence. The objective of this form of scheduling is to ensure that no schedule games are played on monthly updates (i.e., changing project history, sequestering of float by use of inaccurate activity start/complete dates, changing project schedule calendars, etc.). Further, this form of scheduling ensures that the owner always has access to the most current schedule update. Experience has shown that some contractors prefer this scheduling technique as it decreases their scheduling costs. On the other hand, there is a corresponding increase in the owner's scheduling costs. Owners who practice this form of schedule management need to be cautious that they do *not* take over the contractor's schedule, depriving the contractor of the right to schedule the work in the manner it chooses. Further, owners must understand that they need to be totally responsive to the scheduling needs of the contractor as the owner is acting as the contractor's schedule recorder.³⁸

Defense: Weekly Progress Reports – One of the greatest difficulties faced by owners dealing with contractor's schedule updates is the issue of exact start and completion dates of schedule activities. Most contractors create, for their own internal use, weekly or bi-weekly construction schedules that are provided to their own trade foremen and

³⁸ Zack, James G., Jr., “Claimsmanship: A Current Perspective”, *Journal of Construction Engineering and Management*, Volume 119, Number 3, September, 1993.



superintendents. These documents generally contain the most accurate schedule update information for the contractor. Language in the scheduling specification that requires the contractor to provide a copy of these weekly or bi-weekly schedules to the owner will provide the owner current and accurate schedule update information. Further, if the owner accepts the contractor's submittals in whatever form the contractor gives to its own people, such a requirement imposes no additional work on the contractor. In addition to the submission of the weekly or bi-weekly schedules the owner may require the contractor to submit its daily reports along with those of its subcontractors. These will also serve as contemporaneous records to determine when an activity started, when it was completed, how many days it took and how much manpower, material and equipment was required to perform the activity.

Game: Failure to Incorporate Change Orders Into Schedule Updates – In this type of game, some contractors will either fail to include change order work in the schedule, or include the changed work in such a manner as to impact the schedule to the maximum extent possible. In either scenario, some contractors attempt to set up a situation wherein they can show maximum possible impact at a later point in time.

Defense: Time Impact Analysis Requirement – Some owners have started requiring scheduling specification in the contract documents a "Payment for Change Orders" clause, or a "Delay and Time Extension" clause, that requires each change proposal or time extension request be accompanied by a time impact analysis. A time impact analysis is generally defined as an estimating procedure that utilizes fragmentary networks (fragnets) to demonstrate the effect of specific delays on the overall project schedule.³⁹ If such a specification is created and adhered to, then arguments over the potential impact of a change ought to be easier to resolve.

³⁹ Driscoll, T.J., "Time Impact Analysis: A Key for Successfully Proof of Delay", Proceedings, Fifth Annual Construction Litigation Superconference, Conference Management Corporation, San Francisco, CA, 1990.



Defense: Fee for Change Order Schedule Analyses – One way to get most contractors to submit this information is to offer a financial incentive. The "Payment for Change Orders" clause or the scheduling specification the owner may specify a set value for each change order schedule analysis or time impact analysis performed and submitted with a change order proposal. For example, a flat fee payment on each change order proposal will allow one half manday per schedule analysis of a change order. If the schedule analysis is performed and submitted, the contractor will receive this flat fee (even if the schedule analysis only took 10 minutes). There is a greater likelihood that this work will be done if the owner is willing to pay for it; and the overall cost to the owner is not very high. The value of such contemporaneous schedule documentation from the contractor is inestimable.

Game: After the Job "But For" Schedules – A typical scenario on a project today is for the contractor to submit, sometime after the project is completed, as-planned and as-built schedules, and to merge the two together to create a "but for" schedule. That is, "but for the actions of the owner, I would have completed by a certain date. Therefore, the owner owes all delay costs for the period of time between the "but for" schedule completion date and the actual completion date of the project." Typically, such scheduling is performed by a claims consultant after completion of the project and is based on the contractor's project records. Also typically, the as built schedule used to modify the initial baseline schedule does not resemble the contractor's schedule updates (how the project was actually constructed). Thus, the owner has to fight to prove that the claims schedule submitted by the contractor is erroneous in many respects. This often times requires a good deal of schedule analysis, at great expense to the owner.⁴⁰

Defense: As Built CPM Submittal "Condition Precedent" to Retainage Release – The single most effective defense against this common problem is to insert a provision in the contract documents that the contractor must submit an as-built construction schedule

⁴⁰ Loulakis, M.C. and Cregger, W.L., "Legal Trends: Flawed CPM Schedule May Be Costly to Contractor", *Civil Engineering*, Volume 63, Number 11, 1993.



(certified by the contractor's project manager and project scheduler as representing the way the project was actually constructed) as a condition precedent to requesting retainage release. This will help form a record of how the project was actually built, put together and submitted contemporaneously at the end of the project by the contractor. In the event a claims schedule is submitted later, this certified as built schedule can be used to help keep the record straight. It must be understood that such a schedule submittal will have neither logic, nor any critical path. It will consist only of a list of all activities performed on the project with their recorded start and completion dates. However, this information can later be used to analyze a forensic schedule created by a contractor in order to demonstrate owner caused delay.

Game: Substantial Completion Activity – It is a commonly accepted rule of construction law that contract imposed liquidated damages stop at the time the project is determined to be substantially complete because the owner has the benefit of the bargain contracted for at that point and can occupy and utilize the project for its intended use. One of the most common arguments in the construction industry, therefore, revolves around questions such as, "When was the project substantially completed?" or "What is substantial completion date for this project?" Contractors generally want, of course, to argue the earliest time possible and as a result, some contractors may include an activity or milestone called "Substantial Completion" in the schedule. They hope to get the owner to accept this as a schedule activity and then argue anything scheduled or performed beyond this activity is *not* subject to liquidated damages.

Defense: Define Substantial Completion – This is an acceptable practice, *provided that* the owner carefully defines the term "Substantial Completion" in the contract documents prior to bidding. For example, the owner must consider whether start up and testing need to occur prior to the time the project is considered substantially complete, or if this activity can take place after the job is declared substantially complete. This type of definition can only be done by the owner and the design professional during the design phase of the project and will help avoid problems concerning schedule games, imposition of liquidated damages, completion and close out of the project, etc. The owner, during the review of the



contractor's baseline schedule, will have to ensure that all activities scheduled after the substantial completion milestone are in fact activities that will not impede the beneficial occupancy or use of the project.

SCHEDULE REVIEW CHECKLIST

Defense: Schedule Review Checklist – The following are a number of electronic checks project managers and schedulers need to perform to ensure that schedule gamesmanship is *not* taking place when construction schedules (baseline schedules, schedule updates, and schedule revisions) are being submitted.⁴¹

Software Settings

- **Retained Logic vs. Progress Override vs. Actual Dates** – Progress Override accelerates a schedule by ignoring logic ties or relationships. If the schedule does not reflect how the work is actually being performed in the field then Progress Override may be the better choice. Otherwise, the choice of Retained Logic is more suitable. Be aware that Progress Override may accelerate the schedule unrealistically.
- **Continuous Activities** – Schedules typically are prepared assuming activities are performed continuously. If the default schedule setting is changed, it should be reviewed and approved in the schedule narrative. While this is no longer a default setting – the scheduler can introduce “Suspend Dates” to an activity.
- **Total Float Calculation** – The finish date is the Primavera Project Management default because it better reflects the relationship between the completion of the

⁴¹ The authors want to express their gratitude to Donald McNatty, Vice President, D.R. McNatty & Associates, Inc. for providing this checklist and granting permission for its use in this paper. Mr. McNatty is not only a former construction contractor but one of the nation's most skilled users of Primavera software.



project and float. Changes in this setting can cause variations in float calculations on the same schedule.

- **Lag Calculation** - In Primavera Project Management, the user has the option to choose the calendar to use for scheduling relationship lag. The options are the predecessor activity calendar, successor activity calendar, 24 hour calendar or the project default calendar.
- **Activity Percent Complete Calculation** – The default setting in Primavera Project Management is “Duration % Complete” which is based on original duration. Other options include “Units % Percentage Complete” and “Physical % Percentage Complete” which is based on the user’s judgment.

Dates

- **Start Date** – This is the start date of the project schedule. It may be the same as the notice to proceed, or the notice to proceed plus one day, or some earlier date the contractor feels should be reflected in the schedule. Regardless of its basis, the schedule Start Date should not change.
- **Data Date** – Date *from which* unfinished work is scheduled. Future activities start at the beginning of the subsequent workday closest to this date. Anything else should raise questions.
- **Schedule Status Through** – This is the end of the work day prior to the Data Date. All “actual” work is recorded through this date. Anything else should raise questions.
- **Must Finish By Date (MFB)** – Usually reflects the contract completion date or milestone dates set in the contract. Other activities using this type of date should



be justified. (Note: MFB is midnight of that day in P6 and therefore means “must finish before”).

- **Calculated Finish Date (EF)** – This is the latest calculated early finish date in the schedule and is the calculated completion date of the project. If this date exceeds the MFB, negative float results. Should this happen, this is indicative of project delay and should be examined carefully.
- **Total Calendar Day Duration** – Total calendar days (*not* work days) from start to finish in the schedule. Always compare this to the Time of Completion clause in the contract.
- **Calendar Days Remaining** – Number of calendar days remaining from the beginning of the Data Date to the end of the finish date. Compare this to the Time of Completion clause less the number of calendar days expended to date.
- **Percentage Calendar Days Expended** – Percentage of calendar days expended to the Data Date. Compare this percentage to the estimated percentage of work completed to see if there is a correlation.
- **Calendar Days Remaining to MFB Date** – Percentage of calendar days remaining from the Data Date to the Project Completion Date. Compare this percentage to the estimated percentage of work completed to see if there is a correlation.
- **MFB/EF Variance** – Difference in calendar days between the MFB and the scheduled completion date. A negative value indicates that the project will *not* complete on time.
- **New Actual Starts** – Number of activities there were statused with actual start dates for this update. This does not include previous updates.



- **Changed Actual Starts** – Number of previous actual start dates that were changed in this update. This is generally considered a poor scheduling practice, could be revising schedule history, and definitely needs to be included for review and approval in the schedule update narrative.
- **New Actual Finishes** – Number of activities statused with actual finish dates for this update. This does *not* include previous updates.
- **Changed Actual Finishes** – Number of previous actual finish dates that were changed in this schedule update. This is generally considered a poor scheduling practice, could be revising schedule history, and definitely needs to be included for review and approval in the schedule update narrative.
- **Actual Start Dates** ⇔ **Data Date** – The Data Date begins at the start of the Data Date workday and is used as the starting point for remaining activities. All actual starts and finishes should be “as of” the end of the work day prior to the Data Date. Actual dates on or beyond the Data Date are considered to be poor scheduling practice by the scheduler of how the schedule calculates.
- **Actual Finish Dates** ⇔ **Data Date** – Same as above.

Activities

- **Number of Activities** – Total number of activities in the schedule. Once the baseline schedule has been submitted, any activities added to or deleted from the schedule should be submitted for review and approval in the update narrative.
- **Net Increase (Decrease)** – Increase or decrease in the number of activities in the schedule. This number should be constant unless there is a change in the scope of work, approach to constructing the project or impacts that need to be incorporated into the schedule.



- **Number of Relationships** – This number should also remain unchanged after submittal of the baseline schedule. Any changes should be submitted for review and approval in the update narrative.
- **Net Increase (Decrease)** – Net increase or decrease in the number of relationships.
- **Relationship/Activity Ratio** – This is the ratio of relationships to activities. It is always expected to be more than 1.0 as every activity has at least one relationship. A ratio of 1.2 to 1.5 is considered to be an average ratio. A higher ratio than 1.5 may indicate an unnecessarily logically constrained schedule.
- **Started** – Activities started during the update period. This is an indicator of continued progress of the work. Fewer activities started during the update period when compared to the last update period may indicate delay or impact.
- **Completed** – Activities completed during the update period. This is an indicator of continued progress of the work. Fewer activities completed during the update period when compared to the last update period may indicate delay or impact.
- **In Progress** – Activities in progress during the update. An increase in the number of activities may indicate more work is being accomplished. A decrease in the number of activities may indicate the project is delayed and/or impacted. This number usually increases until the end of the work draws near.
- **Not Started** – This number should be declining as the project progresses. If new activities are constantly added, this number may not decline and should be reviewed for possible problems in the schedule. If the number remains relatively constant for two or more update periods this is an indication of project delay and should be reviewed.



- **Percentage of Activities Completed** – This number should be increasing as the project progresses. If the number is declining it could be an indication of stalled progress or a shut down period.
- **Activities Deleted** – Total number of activities deleted. Deleting activities after a baseline schedule is submitted is generally considered to be a poor scheduling practice. If the scope of work or the work plan has been changed significantly enough to warrant this level of revision, a new baseline schedule (re-baselining) should be considered.
- **Activities Added** – There are many valid reasons for adding new activities to a schedule update. All of them should be submitted for review and approval in the monthly schedule update narrative.
- **Original Durations Changed** – Original durations submitted with the baseline or re-baselined schedule should *not* change unless approved. Changing original durations could be construed to be revising history and is generally considered to be a poor scheduling practice. However, changes to original durations (especially if the durations are longer) may be an indication of poor or lost productivity or project delay.
- **Activity Descriptions Edited** – Descriptions submitted in the baseline schedule should never be changed unless approved. It is difficult to compare a progressed schedule to a baseline schedule when activity titles have been changed or activities are added or deleted.
- **Number of Deleted Relationships** – Same as above. Any changes should be submitted for review and approval in the schedule update narrative.
- **Number of Added Relationships** – Same as above. Any changes should be submitted for review and approval in the schedule update narrative.



- **Activities with Lags** – Lags represent “hidden activities.” Lags, both negative and positive, are often justified in a construction schedule, but should be submitted for review and approval in the baseline schedule and subsequent update narratives. Generally, lag values in excess of 15 work days (will occur within one or two monthly updates) should be defined as schedule activities for better visibility, justification and statusing.
- **Activities with Negative Lag** – Negative lag is often prohibited by scheduling specifications. At the very least, negative lag should be identified and justified in the schedule narrative.
- **Relationship Lags Changed** – Any changes in previously submitted values should be submitted for review and approval in the update narrative.
- **Activities with No Predecessors** – Good schedule practice indicates only one activity with no predecessor (the start of the schedule). Missing relationships can produce unrealistic schedule dates and/or float values.
- **Activities with No Successors** – Good schedule practice indicates only one activity with no successor (the finish of the schedule). Missing relationships can produce unrealistic schedule dates and/or float values.
- **Activities Working Out of Sequence** – Out of sequence progress is common in construction schedules. It indicates that the project is *not* being constructed in the sequence indicated in the baseline schedule or previous schedule updates. Most scheduling specifications require that out of sequence progress be resolved with each schedule update. Note that the use of Progress Override in calculating the schedule results in schedule logic being ignored and will reduce the impact of out of sequence work (and possibly accelerate the schedule unrealistically).



- **Constraints Added** – Constraints can interrupt the calculation of the schedule, overriding the calculation of the CPM forward and backward pass algorithm. All constraints and changes to constraints should be identified in the schedule narrative for review and approval.
- **Constraints Deleted** – Same as above. Any changes should be submitted for review and approval in the update narrative.
- **Existing Constraints Changed** – Same as above. Any changes should be submitted for review and approval in the update narrative.
- **Activities that Should Have Started** – When activities do *not* start as planned, it may indicate that progress is *not* keeping up with the schedule. This may be an indicator of project delay or impact (such as loss of productivity) and should be examined carefully.
- **Activities that Should Have Finished** – When activities do *not* finish as planned, it may indicate that progress is *not* keeping up with the schedule. This may be an indicator of project delay or impact (such as loss of productivity) and should be examined carefully.
- **Number of Activities Percent Complete Reduced** – On an in-progress activity, the percent complete should be *increasing* from one update to another. If the percent complete is *decreasing* it indicates negative progress for the update period.

Critical Path

- **Lowest Total Float** – Indicates the Lowest Total Float in the project. The ideal is zero float. A positive value indicates that the project will complete early, negative that the project will complete late.



- **Activities on the Critical Path** – Number of activities that are critical on each update. If this number *increases* from update to update this is an indicator that near critical activities are becoming critical and the project is slipping. Such an increase may also be an indicator of project impact or delay.

Constraints

- **Number of Constraints** – The number of constraints in the schedule. Most scheduling specifications require that only contract milestones be used as constraints. All constraints should be submitted for review and approval.
- **Number of As Late as Possible Constraints** – An As Late as Possible Float Constraint forces an activity to *appear to be* more critical than it is and could be an indication of poor scheduling practice or schedule gamesmanship.
- **Number of Mandatory Constraints** – Mandatory constraints force an activity to start or finish on a specific date, and only that date. The reality of construction projects is that an activity may be able to occur earlier, or even later, and that the date is *not* actually “mandatory”. Mandatory constraints are often misused in CPM schedules.

Calendars

- **Calendars** – The number of calendars in a schedule will *increase* the complexity of the schedule. A high number of calendars may be an indication of an overly complex schedule and/or schedule gamesmanship.
- **Calendars without Holidays** – One of the primary purposes of a calendar, other than defining working days, is to also define holidays or other non-work periods so that activities are not erroneously scheduled on non-work days. No holidays in a



schedule could add ten or more work days to an annual calendar and may not be realistic.

- **Untitled Calendars** – Untitled calendars are an indication of poor scheduling practice.
- **Number of Calendars on Critical Path** – Multiple calendars on the critical path can result in the interruption of float values on the critical or longest path, and should be reviewed as to purpose and justification.
- **Number of Calendar Changes** – Generally, calendar assignments should *not* be changing from update to update. Changes should be submitted for review, justification and approval in the update narrative.

As noted earlier, these are all checks that a schedule reviewer should make when reviewing any schedule update. Schedule analysis software (either included in the scheduling package itself or procured from a third party) makes such reviews much easier. The schedule reviewer ought to create a spreadsheet with all of these items on the vertical axis and the baseline and each schedule update at the top on the horizontal axis. This will create a pictorial view of each update and the reviewer can watch for changes in each item listed above to determine what needs a more thorough review and/or justification from the contractor.

CONCLUSION

The intended purpose of construction scheduling is to see that proper, prudent planning and coordination of all activities needed to complete the work has been done prior to the start of construction and then is accurately updated throughout the course of the construction through completion. As discussed, an all too frequent use of construction schedules is to help develop construction claims and/or avoid liquidated damages by masking the delay events for which the contractor is responsible. Many scheduling games



are played throughout the construction industry. There are means to defend against such games which, if applied properly, can help restore construction scheduling to its intended purpose.