

Re-Baselining Baseline Schedules

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Abstract - The vast majority of contractors use an overall summary schedule (also known as a baseline) as a tool to organize and plan their approach to the work and, if the specifications require, get paid. But construction is dynamic and the work plan inevitably changes to adapt to actual progress. As the work progresses, contractors typically manage the work using a series of detailed look-ahead schedules that are generally compatible with baseline schedule. They don't develop their initial baseline schedule with the intent of substantiating delay claims. As Callahan and Hohns have pointed out, most contractors use a schedule "...as a guide, not a ruler." But identifying cause for delay is an issue today. As a consequence, the authors are convinced that the development of the baseline schedule has become too mechanical, too detailed and too cumbersome to work effectively. The payback for the effort involved in developing and maintaining a schedule as currently practiced is questionable. This paper presents the authors' opinion regarding the issues and options for re-evaluating the purpose and development of the baseline schedule. For instance, who should be involved initially? What is the appropriate level of effort to expend developing a baseline? What is the correct level of detail to be contained in a baseline? What does it mean to have "scope completeness and sequence reasonableness"? The objective is to get back to the original intent of developing a schedule as a *prospective* management tool that recognizes the dynamic nature of construction and can also be used for *retrospective* analyses.

Introduction

"...It's vital to know the difference between good planning and too much planning." [6] Not enough planning allows the process of construction to get unruly and take on a life of its own. Too much planning stifles the ability to adapt to changing conditions. Good planning allows a project manager to have a game plan and impose order on the chaotic process of constructing a multi-story hospital. Too much planning locks a project manager into a predetermined course of action, creates a security blanket for the owner that lets it assume things are under control, and eventually shortchanges the project manager's ability to be flexible and capitalize on opportunities.

The message of this paper is that it is important to plan, but only to a point. As several great military strategists have advised; you can plan only so far into the battle; you have to save lots of room for your adversary's contribution.

Not that the construction process is necessarily a battle, but it does share some characteristics with the process of waging a battle. At the start, it is important to marshal one's forces. The jobsite must be organized, materials and equipment purchased for the lowest possible price from a cadre of suppliers and installation agreements with a variety of specialty subcontractors negotiated. And guess what, any of the folks can let you down. Things go wrong. As work gets completed and progress unfolds, a contractor must roll with the changes and work with them instead of resisting them. The peg may have started out round but its square now and hammering harder isn't going to make it fit. [6]

A good baseline schedule is the spine or the detailed outline of one's intentions for the work. The prime contractor tries to capture his expectations, intentions and assumptions regarding the construction of the project in a summary fashion in one document. Essentially, the contractor is saying "The scope of work is best organized into these activities, which I intend to perform in this particular sequence, which will result in these key events occurring in this amount of time with these levels of resources." The baseline is intended to help keep the project on task; it is not the task itself. It is a tool to make his job easier.

However, most owners, designers, construction attorneys and claims consultants view a schedule differently from the contractor. On most major construction projects today, a contractor is required by contract to prepare a detailed CPM schedule using computer software. As Callahan and Hohns point out [1]:

The vast majority of contractors do this primarily as a tool to organize and manage the work (and get paid), not to measure the length of a delay. Most contractors don't maintain their schedule with the textbook regularity and detail, but instead use shortcuts, seeking from the schedule only the information needed to plan the next few weeks or evaluate past progress in certain key or troublesome areas. These contractors use the schedule as a guide, not a ruler. Yet when a delay has occurred, the court expects the contractor to present a critical path method schedule measuring the contemporaneous method.

For the authors, who have over 90 years of combined scheduling experience, the typical situation is that twelve (12) months into a twenty-four (24) month contract the baseline schedule ceases to reflect the contractor's approach to the work any longer. But there are several change requests pending that may affect their approach to completing the work and the owner is negotiating the time and money involved. Also, the contractor is behind in some areas and is being pushed for a recovery schedule. The project manager doesn't want to develop a revised schedule (to-go baseline) until all the outstanding issues are settled, and his/her experience

suggests that some issues will linger until the end. The project manager's thinking is along the lines of "why should I hurry up to complete X only to wait for you to decide how you will finish Y?" He/she resorts to managing by look-ahead schedules that have little relation to the current baseline. The CPM schedule has become highly unreliable and workflow and productivity is likely to be highly variable. The schedule update required by the contract has become submittal paperwork, to be attached to the monthly pay request, with little or no relationship to the actual plan for completing the work.

Re-Baselining Baselines

It is generally understood that the contractor is responsible for scheduling, sequencing and prosecuting the work to comply with the requirements of the contract documents. The owner, often through a consultant, will review the contractor's initial schedule "for conformance with the Contract Times and sequences of Work indicated in or required by the Contract Documents." [3] This review may or may not extend to evaluating feasibility, scope completeness, sequence reasonableness and general conformance to industry scheduling concepts. Some contracts require that the Critical Path Network (CPM) schedule (network analysis system) be developed, submitted and accepted before starting the work. Once accepted or approved, the baseline CPM schedule is, by specifications, to be used for organizing and directing the work, reporting progress, requesting payment for work performed and substantiating the effects of delay [see 7]. It is typically updated monthly (to show progress against the plan) and revised periodically (to adjust future logic). It is usually prepared using computer software such as Primavera™, MS Project™ or another software.

For the last 30 years or so, the construction industry has basically been banging its collective head against the wall requesting that a contractor give the owner a complete and detailed schedule within the first thirty (30) days of the contract and realizing that it is near impossible to attain. But equally frustrating is the situation in which the contract has been under construction for six months and there is yet to be an agreement between the owner and contractor regarding an acceptable baseline schedule. The authors are tired of being a party to this frustration continuum and propose that there is a middle ground that can be deemed a complete, tactical and strategic approach to the work in sufficient detail to satisfy both parties' objectives of submitting and accepting a schedule within the first thirty (30) to forty-five (45) days of the contract.

Obviously in an endeavor as complicated as designing and constructing a major facility, it is important to have a plan and establish ground rules about the form and process of construction before you get started. For instance, is it important

to construct from the lowest elevation first? If this is a mid-rise building, are we going to build the primary structure from the bottom up then finish top-down? How will the exterior skin be installed; left to right, in two directions at once? And so forth.

Armed with a good plan, the project participants can focus on what matters most. But, what are the characteristics of a good plan? How detailed should the plan be? Who should be involved in developing the plan? When should the plan be revised? What sort of effort should be expected in developing and maintaining the plan? Who should be responsible for it? What are the legal implications of the plan? If the plan is submitted for approval is it a commitment? Do today's scheduling specifications help or hinder the process?

The construction industry seems to have developed into a culture of expecting one should be able to "have it all" (meaning; within budget, on time, with quality and technical performance met or exceeded) or else someone is to blame and they should pay. Perhaps this is an outgrowth of society in general and our expectations as consumers. Certainly the authors have no argument with the movement for increased quality in the constructed product. And we do not sanction incompetence. We do believe, however, that the act of constructing a facility is not an exact science and therefore, that, good planning also includes contingency for the unanticipated events. The ability to control outcomes is a function of the nature of the industry and stakeholder relationships. What is important is to set up a situation which allows the highest probability of success. When it comes to discussing the schedule, efficiency should be tempered with effectiveness, and therefore, allow for some flexibility. While the owner and its designer are not necessarily a contractor's adversaries, in some ways they are like the opposing forces in a battle in which one may make some moves that are unanticipated by the other that he must react to without losing ground.

There is an old construction saying that is usually couched as advice to the field labor and goes something like: "get busy...do something...do anything, even if it's the wrong thing...we'll ask for forgiveness later." The practical reality is that the ticking clock is our friend if it gets us moving with urgency and passion. In a sense this is a good thing if it can be harnessed appropriately, which means that we accommodate the inherent ambiguity associated with future events. But this appears to be at odds with the current state of construction contracts which are more concerned with timely notice requirements, detailed reporting submittals, upfront change order quantification and specific procedural remedies for expected problems that essentially obligate the contractor to be the mitigating agent or backstop for most design deficiencies and owner hiccups that result in delay. The situation is

exacerbated by a contract administration philosophy that selects a contractor based on the lowest bid and shortest duration possible. Then “pushes” for as much upfront information as possible including the development of a detailed contract schedule (literally with *thousands* of activities with durations of not more than 20 working days) in the first thirty (30) to forty-five (45) days based on a set of assumptions that are not realistic. Then “pushes” for early dates and strict specification adherence using computerized software (often cost and resource-loaded). Then “pushes” the contractor for upfront pricing on change orders and expects the contractor to make them fit within the completion date. And then “pushes” the contractor to revise the schedule every time the software indicates that the project is falling two (2) weeks behind. Isn’t it time to re-think the purpose, development and administration of the baseline schedule?

Pragmatically, there still must be a baseline to substantiate the effects of delay to a contract. Contractors should be able to demonstrate how an action or inaction of an owner affects their approach to the work. A contractor needs to manage what is within its control and has an affirmative duty to mitigate the effects of delay by taking reasonable actions in a timely fashion. Float time should be reasonable and explicitly identified and understood.

The authors believe that both the practical construction realities of planning and the legal requirements of scheduling can be met by rethinking the way we develop the first complete contract schedule, sometimes referred to as the *Revision 0 (Rev. 0)* schedule or the first *record* or *baseline* schedule. It is proposed that this be done by getting the “right” people involved at the “right” time and in the “right” way. It can be accomplished by fully utilizing milestones and target times, and hierarchical scheduling; avoiding overly detailed schedules. [See Milestone definition in 2] The planning and scheduling focus could be readjusted to “chains” and “chunks” of activities, key transition points and the use of schedule contingency in the form of capacity buffers. [See Buffer definition in 2] This could be achieved using a multi-step process.

Proposal for Developing a Baseline Schedule

In the realm of CPM scheduling, there are basically two areas of concern to the authors: (a) the creation of the initial baseline, and (b) the maintenance of the schedule as the project unfolds. The authors propose that the process of developing a baseline schedule should more or less follow the design process itself meaning that it should have a program/study phase that leads to a schematic/preliminary design phase that leads to a design development (sixty percent (60%) design complete) phase that leads to a working drawings phase. For the development of a baseline

schedule, we suggest the following phases (each being a necessary prerequisite step for the following phase):

1. Study Phase - A study and interview phase used to identify major items of work in the scope of the contract as they impact the schedule and to develop a strategic game plan in an initial set of milestones that pin key events and/or transition points in time.
2. Outline Phase - A phase that brings the key players together immediately after the Notice to Proceed is issued to further develop the list of milestones into a milestone-level schedule (aka Outline Schedule) that includes only sufficient summary activities and logic to reasonably portray the tactical sequencing of the work in conformance with the contract times and required work sequences. It should have a consistent level of detail throughout and the authors suggest that, if acceptable to both parties, it serve as the *as-planned* schedule. It should be submitted with the first pay application (approximately thirty (30) days after NTP).
3. Baseline Phase (Rev. 0 Submittal) - The phase that develops the details of the Outline Schedule into a traditional Baseline Schedule, including computer plots, schedule reports, narrative, and demonstrates conformance to all aspects of the contract documents and contractor's management of the site. The authors suggest a modification to the traditional industry convention in that the level of detail will *not* be consistent throughout and will include capacity buffers (specifically applied schedule contingency) as well as explicitly portray float. For buildings, the next stage of construction i.e., site and foundations is more detailed than superstructure and enclosure, which in turn is more detailed than rough-in work and finishes, and so forth. The initial Rev. 0 should be submitted with the third pay request (about ninety (90) days after NTP).

For schedule maintenance as the contract unfolds there are the following phases:

4. Updates/Revision Phase - The phase of managing the work. Updates only add progress to the schedule. Revisions modify activities, logic and restraints for the work remaining. Revisions, once accepted, become new to-go baselines. Revisions usually occur because of contractor initiated re-planning, changes in the work, schedule recovery and/or delay.
5. Short-Term Schedules - Three (3) to six (6) week rolling look-aheads used to manage the work on a crew level that fits within the current baseline or record schedule (depicting weekly and/or daily activity).

This paper is meant to discuss the process of developing the first baseline and as such will not discuss updates, revisions and short-term schedules.

Study and Milestone

The authors personally believe that there has been a failure of scheduling professionals industry-wide that is evidenced by their willingness to dive into a plethora of detail in an initial schedule without having achieved consensus of some of the key players at some bird's eye level. We believe this is why there is often a disconnect between the schedule and the real key players. Ideally, the authors suggest that this initial phase of the schedule development be directed by a contractor executive with sufficient knowledge and experience to be viewed as a *project planner* and with the authority to sign-off on the final Outline Schedule deliverable.

Additionally, we believe that one of the fundamental problems with the current state of baseline schedules is that they are prepared by young, construction-inexperienced computer software professionals that can satisfy the requirements of the contract documents without really understanding what it takes tactically to construct the project. It may be an oversimplification, but for the most part, today's schedulers convert superintendent bar charts into CPM diagrams that meet specifications for payment purposes. Maybe we have convenient memories, but in the 1970's, the initial, as-planned schedules were developed by the most senior people on the jobsite, not the most junior!

The first thing the project planner should do, once the contractor has been awarded the contract (owner's intent to award to the contractor) and before the Notice to Proceed is issued, is study the Contract Documents in detail (contract, drawings, technical specifications and division 0 specifications) seeking to fully understand in broad terms key scope items, contract requirements and constraints that will affect scheduling. This includes the pre-bid and award correspondence and meeting minutes. For instance, are there any mandatory sequencing requirements? Are there some specific quirks or nuances about the submittals that you have to be aware of? Obviously, a thorough knowledge of the scheduling specification is required. The idea here is to develop a thorough understanding of what will affect scheduling that is *not* shown on the plans and specifications as well as what is shown.

Besides studying, the project planner should visit the site and conduct a limited set of interviews. The authors suggest interviewing the estimator, the project manager and/or key superintendents, the owner's representative, the designer, the tenant/occupant (if applicable) and three (3) to five (5) key

subcontractors and first tier suppliers, if any (structural, mechanical, electrical, plumbing, security, etc.). The interview with the estimator is very important because it is likely that the pricing that underlies the bid is premised on conversations with subcontractors and suppliers and contains implied work sequences and time periods performing the work. It is important to understand the expectations, intentions and assumptions of the key stakeholders regarding the project such as: the type and amount of construction equipment on site; anticipated production rates; early access by MEP subcontractors; and so forth.

There are two specific goals to this Study Phase. The first is to develop a list of twenty (20) or so key questions that must be answered to develop the Outline Schedule. Each contract will have its own totally different set of questions depending on the specific circumstances and players involved. These questions include permitting issues, weather concerns, permanent utility hook-ups, key bid assumptions, site logistical problems, black-out times, and so forth. The asking of questions facilitates the learning process before putting activities and logic on paper. The questioning process doesn't stop once it's begun.

The second goal of this Study Phase is to develop a list of Milestones for the contract. The question is often asked, "How many Milestone dates should be established at this point?" At the risk of being overly prescriptive, the authors believe that a loose rule of thumb is forty (40) to sixty (60) for an expected 600 to 1000 activity schedule (which should adequately schedule a \$25 million building project over an eighteen (18) to twenty-four (24) month duration.)

Armed with key questions and a list of milestones, the project planner is ready to facilitate a meeting with the planning team to develop the Outline Schedule.

The Outline Schedule

The authors suggest that the project planner facilitate an Outline Schedule development meeting with a selected planning team within a week of receiving the Notice to Proceed (NTP). The goal is to develop and submit the Outline Schedule within the first month of the contract.

The planning team consists of, possibly, a facilitator/consultant, the project planner, the project manager, superintendent, the scheduler, and key subcontractors (if deemed appropriate). The goal of the meeting is to develop, in one session (8 hours or less), a master, summary level Outline Schedule that utilizes the project planner's Milestones and addresses each of his/her twenty (20) questions. The Milestones should pin the starts and completions of chains, chunks and sequences of key activities and events and "... include all activities and logic necessary to

reasonably portray sequencing and dating for the Milestones in conformance with Contract Times and Work sequences.” [2]

An important part of the meeting is comprised of adding detail to the Outline Schedule by breaking down the time between Milestones into summary activities/logic denoting chunks of work that confirm or require adjusting the chunk durations depicted between the Milestones. The authors suggests (as a rule of thumb) that there be no more than five (5) to seven (7) major transition stages in a typical twenty-four (24) month building project schedule (although the type of project, nature of relationships and logic may dictate more or less). Use the backward pass to determine “bottlenecks” and key transition points. Remember that this Milestone and chunk duration Outline Schedule is the foundation for the baseline schedule and, in broad terms, is complete in scope and reasonable in its sequencing. Further, it should document logic, timing and Total Float criteria for the Progress Schedules. [2]

The authors believe that once the Outline Schedule is submitted to and accepted by the owner, it becomes the as-planned schedule until the baseline supercedes it. It is important to have documentation for the summary activities and logic used to set/confirm the chunk durations (time between Milestones).

It is also important to make float times explicit and include appropriate time contingency at key merge and transition points by using capacity buffers on milestones (essentially giving a milestone some duration). (Note that this differs from the traditional use of the term *milestone* as a zero duration event). The authors suggest using a capacity buffer approach that is a variation of the traditional cost contingency system used during design (10%-15% for schematic design; 5%-10% for design development and 3%-5% for construction documents):

- 2% of overall contract time can be distributed among first third milestones (2% of 730 days is 15 days, to start of superstructure).
- 3% of overall contract time for middle third milestones (3% of 730 is 22 days, framing, enclosure and rough-in work).
- 5% of overall contract time for final third milestones (5% of 730 is 36 days, building finishes and commissioning).

This is meant as a guideline only and depends on the type of construction and the nature of the variability associated with the Milestones [for more discussion see 5].

There is no resource loading or cost loading of the activities in the Outline Schedule. However, it is important to realize the Outline Schedule must reflect the

real dependencies of tasks and/or resources. We have all seen schedules that have two activities tied together with logic that is convenient because one occurs after the other but has no real dependency. Subjective logic can seriously distort the critical path and undermine the value of the schedule as a management and delay analysis tool.

The authors suggest that the Outline Schedule be developed utilizing some appropriate scheduling software (although most any software will work because of the overall simplicity of the Outline Schedule). Further, that it be submitted to the owner for review and acceptance with the first payment application (or within the first 30 days after the NTP).

The Baseline Schedule

The development of the Baseline Schedule is now made easier because of the preceding prerequisite two phases. Once the owner accepts the Outline Schedule, the project scheduler then can facilitate a Baseline Schedule development meeting (some refer to this step as “full-wall” planning session) among the key project stakeholders. Key project stakeholders include all previous interviewees and key subcontractors and material suppliers. The goal of this session is to add the requisite detail to the Outline Schedule to allow it to function in its traditional role as a management and delay analysis tool (which necessarily includes the requisite schedule documentation). Feasibility should be tested against proposed crewing, realistic production rates, site logistics, proposed equipment usage, and material availability. A typical “full-wall” planning session is one to two 6-hour day(s).

The authors do not suggest that the entire schedule be detailed in this first session, but rather add the fixed logic for the first third of the construction or group of stages of the work that makes sense. For instance, consider that a typical mid-rise construction project could be divided into thirds (first third – excavation, foundations and primary framing; second third – secondary framing, building close-in and MEP rough-ins; and final third – finishes and commissioning). This initial session would develop the fixed logic for the first third of the project or perhaps to the start of structural steel erection. Then the group would develop prototype “fragnets” to be used as *demonstration logic* beyond the first third of the construction (beyond the milestones that can be reasonably supported by fixed logic such as that event denoting “coming out of the ground” and the start of building framing). Understand that a delay has more effect on fixed logic, near term milestones and chunk durations than farther out.

The idea is that the project scheduler would convene a set of scheduling meetings at regular intervals (in advance of the completion of the third of the

contract under progress) with the expressed purpose of adding fixed logic to the Baseline Schedule for the next third of the construction [see 5].

For contractor management purposes, the project scheduler would insert additional activity detail from the fixed phase schedules into 4 to 6-week look-ahead schedules utilizing detailed bar charts for the field. The look-aheads are the subject of the weekly project meetings.

Between milestones, the authors believe that we should allow the specific details of the fragments to change if milestones and chunk durations remain unaffected. Only change the current Baseline Schedule when positive knowledge exists that Milestones or activity chains should not or cannot be executed when scheduled or when the overall chain duration between milestones fixed in the Outline Schedule must be changed.

Recognize that float is an expiring resource available to all parties while milestone capacity buffer (duration associated with a milestone) is for the exclusive use of the party performing the work, (that is, buffer is for the contractor's exclusive use in planning and managing productivity variability). This means that the contractor can use the buffer to resolve its delays, but the owner can't. However, the authors believe that it is important to understand that under this proposed approach, either party is allowed to engage the other to re-plan the future *past the fixed logic* to mitigate the effects of its delays. Of course, the implication is that the owner has no objections to the Outline Schedule as developed and has bought into the Baseline Schedule.

The initial Baseline Schedule should be submitted with the third payment application (or about ninety (90) days into the contract) and should be reviewed and accepted before the fourth payment application is submitted.

Concluding Remarks

The authors' proposal for re-baselining the development of Baseline Schedules derives from a desire to have a schedule that can serve two masters: contractor project management and delay analysis. The well-designed schedule provides a clear road map for the project, reflects the collaborative support of all involved, makes it possible to precisely monitor progress by comparison with the baseline and facilitates efficient completion and recovery from delays [4].

In the authors' opinion the time has come to re-establish the benefit and development of a properly prepared baseline schedule. The need for the baseline schedule to represent how the contractor plans to meet the contract requirements is still valid, however, its use in determining time entitlement has caused the industry

much consternation. Without a credible baseline schedule, it is left up to individuals with special interests to determine how to explain the effects of delays after the fact. Also, the need to plan a project schedule with the benefit and participation of senior construction personnel, in outline form, from front-to-back-to-front again, prior to developing the detailed logic must be emphasized.

The approach to developing a Baseline Schedule described in this paper is a guideline that takes into consideration:

- the main objective and use of the baseline schedule;
- the need for a reasonable level of effort in its preparation (but not too much);
- the need for a flexible and adaptable plan;
- the fact that it's initial development should not be left to those smart, yet inexperienced in the methods of construction; and
- it's possible use for demonstrating and substantiating the effects of delays.

We believe that this is a prime example of a little bit extra effort at the beginning of the contract paying significant dividends throughout the life of the project. The authors are not prescribing that the contractor spend more time than necessary to develop the outlines schedule or baseline schedule, just that they spend enough time with the right individuals to develop the baseline schedule properly. We are also suggesting that owners, designers, attorneys and consultants adjust their thinking and contract administration preferences to include an understanding of the changing nature of construction. The authors are suggesting that overly ambitious and tedious scheduling specifications are not necessarily the answer. This approach outlined in this paper has been used by the authors with much success.

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