
 The cornerstone of confidence™		October 2004
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SEMINARS PinnacleOne Institute	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <h2>Construction Scheduling 101</h2> </div>	 Jennifer Frank, P.E. Jennifer Frank is a Scheduling and Construction Claims Analyst in PinnacleOne's Middletown, CT office. She has over 25 years experience in construction management working on a wide variety of projects including offices, schools, hospitals, prisons, pharmaceutical and water treatment plants. As a scheduler for a large construction management firm, Ms. Frank had primary responsibility for the development, updating, and analysis of CPM schedules for the design and construction phases of building projects throughout the Northeast United States with construction values up to \$80 million. In this
SERVICES Program & Project Management Dispute Avoidance & Resolution	<p>Construction scheduling has come a long way in the last 25 years. Unfortunately, despite the widespread use of computerized scheduling on construction projects today, there still exists a large disparity in the level of understanding of those involved in construction in the proper use of this powerful tool. Some even say there is a crisis in the construction industry because they believe scheduling software is being misused to assert delay claims and there is, in their view, a predominance of poor quality schedules. Whether this is true or not, everyone who is involved in design or construction - owner, architect, engineer, contractor, subcontractor, or attorney - could use the refresher course "Construction Scheduling 101."</p> <p style="text-align: center;">Critical Path Method Scheduling - It's a <u>Good</u> Thing, Use It!</p> <p style="text-align: center;"><i>"Good Fortune is What Happens When Opportunity Meets Planning."</i></p> <p style="text-align: center;">- Thomas Alva Edison</p> <p>On any project there are always too many things to do and not enough hours in the day. Who needs another task - preparing a detailed schedule? Whether you are in the earliest phases of the design process, still hiring the design team, or trying to plan a complex site acquisition and permit process, or getting ready to buy out your project and begin construction, you need to have a plan and know your timeline. The scheduling process forces you to think about all the tasks that need to get done on a project and how long each task might take, and it provides you a logical way to organize these tasks.</p>	
<p>PinnacleOne is a national construction consulting firm that provides sound advice, strategic solutions and peace of mind to its clients. Its diverse, highly trained professionals guide its clients through every step of the design, construction and contract closeout process to help them achieve their goals, and at the same time, avoid and manage risk. PinnacleOne's unimpeachable objectivity, along with a proven approach to planning and attention to detail, has earned the company a reputation as one of</p>		

the finest consultants in the construction industry.

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In the process of developing the project schedule, the project team has to think about what needs to be done to design, bid, and construct the project. How long will it take to do the design? What about third party reviews? How much time is needed to obtain permits? When will the end user need the project? How will the completion of the bid documents impact the construction process? What is a reasonable duration for construction? What cash flow will be needed to pay for the design and construction of the project? The scheduling process provides the project team a framework for answering these questions.

The scheduling process also forces the contractor to envision how they are going to build the project. What preparations are needed before the work can start in an area? Does someone need to be relocated? Are there utilities to disconnect? Will the roof go on before the exterior masonry is finished? The scheduling process provides the contractor a more thorough and structured planning process while they are reviewing the plans and figuring out the sequence for building the project. Most importantly, it gets the "plan" that is in someone's head down on paper, where the rest of the team can understand, review, and critique it.

The Evolution of Construction Scheduling

In the "old days" before the advent of personal computers and specialized scheduling software, we simply drew bars on a time-scale on what was called a Gantt chart or bar chart. These charts gave us a rough idea of when things would start and finish; however, they lacked a key piece of information - they did not tell us how the various aspects of the work on the project related to each other and in particular if there was any flexibility in when these things could be done without delaying the completion of the project. With bar charts, you could not tell what work *really* mattered and what you had to watch. When the project got underway, it was also difficult to tell using the bar chart whether the project was on time. When things changed, revising the bar chart could be a lot of work.

We now have much better tools to schedule our projects - personal computers and relatively inexpensive, easy to use scheduling software. As a result, we can now schedule our projects using critical path method (CPM) scheduling. Anyone who has ever worked with me on a project will tell you that I am *passionate* about CPM scheduling. I have found this scheduling technique to be

capacity, she led teams of contractors, owners, and designers in the interactive development of schedules using the "card trick" process.

Since joining PinnacleOne, Ms. Frank applies this experience and her skills in CPM scheduling to analyze delay claims and she is an instructor of the PinnacleOne Institute where she conducts seminars on CPM scheduling-related topics. Ms. Frank is a registered professional engineer in Connecticut and New York.

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a powerful tool which provides a wealth of information to those who make the effort to prepare and use it properly.

CPM Scheduling and the Critical Path

The goal of CPM scheduling is to accurately forecast the work activities to be done in a complicated construction project, indicating their duration and the time frame and sequence in which they will be done. This modeling of the planned construction process is developed into a "network" of activities which reflects the plan for the job at a given point in time. The basic CPM scheduling process involves three key components - developing a list of tasks or activities, assigning durations to each activity, and then connecting the activities to each other in a logical order, using specific types of relationships. The software does all the hard work of calculating when each item of work can be performed given its relationships with the other work activities in the project's schedule network.

The CPM schedule calculation process determines the series of activities that takes longer to finish than any other series of activities. This set of activities is the "critical path" of the schedule and it establishes the minimum duration for the project. Activities on the critical path must be completed on time or the overall project end date will move later. In a building construction schedule, the critical work activities generally include the major building components and the materials which take the longest to get, like steel, stone, and windows. The critical work will also usually include the last or most difficult area of the building to finish; which is why you may find "balance HVAC" on your project's critical path. The project team should always carefully review the activities on the critical path and their relationships to other activities.

The CPM scheduling software also calculates the amount of time that you can postpone working on non-critical work activities without impacting the project end date. This time is known as "float" or "slack time." Float values change over time depending on the progress of other work on the project. Keep an eye on the "near critical" activities in the schedule, activities whose float is within one to three weeks of the critical path. Slippage in these activities will result in them becoming critical, sometimes taking even longer than the original critical path. It is not unusual for the critical path to shift several times throughout the life of a project.

The scheduling software programs now available are capable of handling a large number of activities connected with multiple relationships that more realistically "model" the true nature of the design and construction process. These programs can do much more than just identify the project's critical path and calculate the start and end dates for the project work activities. In addition to these critical functions, the scheduling software also allows activities to be grouped and sorted as you choose, allowing you to look at just the shop drawings, the steel erection or just the site work if that is what you want to do. The software allows you to design the output in a myriad of different ways depending on how you want to use the schedule.

Changing the Schedule

No CPM schedule is perfect. It is important for everyone who uses and reviews CPM schedules to understand that the scheduling process, like engineering, combines both technical skills with a tremendous amount of judgment.

Durations are approximate and there is often more than one way to build a given project. Even the best schedulers are human, so there will usually be mistakes in any schedule. Necessary work activities may have been left out or there may be relationships missing between dependent activities. The beauty of the CPM scheduling software is that it allows you to easily rearrange your activities and otherwise improve the schedule as the project progresses or job conditions change.

As we all know, the design and construction processes are both dynamic and ever changing. It is important to allow the schedule to be adjusted and revised on an as-needed basis, so it relates to how the work is actually being done. For example, in the event that a certain material is delayed or an area put on hold for re-design, the activities can be rearranged in the schedule to give the project team an accurate picture of the impact of these changes. The important thing about these schedule revisions is that they be discussed and documented. When definitive information is not available, use what is known at the time and adjust it as you know more. Failure to keep a schedule "current" is one of the main reasons the schedule stops being used.

What about the changes that occur on all projects? I say "put them in your schedule." It serves the interests of all parties involved in a project with

changes, delays or other job problems that these project events be accurately documented. The schedule is a good place to do that documentation and the best time to do it is when the events are happening. When did the carpenter strike start and finish? When did the south half of the third floor get put on hold? And when was the revised design received? And what is the delivery date for the added materials? The scheduling software allows you to use the schedule to memorialize these dates.

Yes, it takes time and money to develop and maintain a detailed CPM schedule. The benefit of these efforts is an accurate planning and forecasting tool which will give your project team a dynamic picture of how the work is progressing and which areas require attention at any given time. This helps everyone make better decisions during construction and substantially decreases the likelihood of having to work out costly schedule-related claims when the project is complete.

Why am I so passionate about CPM scheduling? As a scheduler for a large national construction manager, I have seen the good fortune that comes with going through the process of developing a well-thought out CPM schedule and properly updating this schedule during construction. Now that I am a schedule analyst for a construction claims consulting firm, I have seen too many times what can happen on projects that do not have one.

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