

Risk Reduction with Effective Critical Path Method (CPM) Schedules

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The purpose of the CPM schedule (*A scheduling technique whose order and duration of a sequence of task activities directly affect the completion date of a project*) is to assist in the cost effective management of the project, anticipate problem areas, and allow the project team to mitigate the impact of unforeseen conditions. What a tool! Without this tool, the project management team is simply reacting to a crisis of the moment and their hurried reaction may exacerbate an already difficult project by doing *harm* in the response to the disaster of the moment.

If this is a correct understanding of the purpose and intent of CPM schedules, then why is the art and practice of scheduling often blamed when problems do arise and they were not foreseen? Let's look in on the start of the OMEGA project as the "new" scheduler, Bart, meets Old Bill, the Project Manager, to find some clues:

Bill: "Well Bart, I am glad to have you here, even if we really needed you *last* month *before* we got started. First order of business for you is to get the baseline schedule "Primavered" and submitted ASAP."

Bart: "Thanks Boss, I am anxious to start. Can you give me a few pieces of background on the bid assumptions and the subcontractors we will be using?"

Bill: "Feel free to make any schedule assumptions you want. We have twenty-six months from last month to finish this job or we pick-up major liquidated damages."

Bart: "Well actually, for the schedule to work with the planned means and methods I will need to know your execution plan and the assumptions that were made in preparing our bid schedule for the work, for example, how many days are planned for site clearing, foundation excavation, concrete pours with winter weather on us and then open winter steel

erection, and bad weather days etc., for this area. I also need to know the local labor availability to determine manpower restraints for the subcontractors etc, given that the new Nuclear Plant over in Delta is sucking labor from the entire Mid-Atlantic region at high pay rates."

Bill: "The bid schedule was a one liner with a completion milestone."

Bart: "How did we go about sequencing the site work, due to the power line restrictions and the other site crane access constraints?"

Bill: "Bart, I have been building things for over forty years and I never worried about all this computer generated restraint/constraint stuff and anyway, I just finished a similar job out in Montana in twenty-nine months! I just tell the subs to Get It Done. ASAP."

Bart: "OK Boss, I guess I better get started gathering information and work on some real scheduling!"

Assumptions, Assumptions, Assumptions. Some explicit, some implicit; and now it is up to newcomer Bart to determine and quantify them in order to begin a realistic project schedule development.

Bart has a real challenge ahead of him and he must rapidly assimilate all of the organizations project knowledge while catching-up with an ongoing project. Luckily for Bart, he recently attended an advanced CPM scheduling seminar and on his way back to his office he recalls the following key fundamental points about construction project CPM schedule development identified in the seminar.

The initial CPM should provide a logical deliberate model of the intended means and methods of the project and include sound reasoned input from the major sub-contractors for the work. Modeling (scheduling) the work at the initial project CPM level can only be expected to include the obvious first order relationships between work elements, sub-contractors and work elements supplied by others. Second order relationships between material/supply vendors and the contractors, and third order relationships between project work and the work elements to be provided by “others”¹ should be included as subsequent, more detailed and up-dated CPM schedules prepared during the project.

The CPM schedule becomes a model/map of the interactions of a very diverse group of work entities and the model of the planned and actual interactions of the entities over the course of the project. In many construction undertakings, it is the failure to understand the interactions (interrelationships) which doom the ability to schedule, control, and influence/predict the pace and sequence of the work. More often than not, perfecting (optimizing) the work of one of the participants leaves the others at a greater disadvantage in completing their work.^{2,3}

All CPM constraints are not created equal. Physical restrictions (constraints) of the worksite must be taken as givens and thoughtfully used to model the work. If, for example, the work must be installed from the south boundary to the north boundary, then that primary direction of work flow must override the more convenient (profitable) flow that a few participants desire to work from- east to west. Physical site restrictions are primary constraints and cannot be ignored except at peril to the overall project execution.

The initial CPM schedule is the best and most likely plan for the work execution at the time the plan is developed, and it must be expected that the plan will become more detailed and mature with each monthly schedule status and emerging work challenge. In a very interesting and noteworthy paper, Donella Meadows likened complex systems modeling work at MIT with dancing, in her paper, *Dancing with Systems*. What an interesting way of thinking about CPM models for the construction work on a capital project - each participant to the work must respond to the beat of the project and interact with the other “dancers” to compliment each others movements to progress the overall work elements and coordinate their interactive movements to gracefully complete the dance(the work).

Unfortunately, the natural tendency of all models or systems is disorder⁴ and the main purpose of project management is to impose and maintain order in the overall project execution of the

¹ “others” as indicated on the design drawings for the project; who are they anyway?

² Systems Thinking – perfecting the parts can inadvertently damage the whole in unexpected and subtle ways.

³ Each sub-contractors incentives are unique and determined by individual contracts, not the overall goal of completion of the main work.

⁴ The Second Law of Thermodynamics

work. The primary tool for imposing order at the construction site is the CPM schedule and the schedule is in reality just the forward looking model for the overall construction work plan. To reduce the risk of project cost overruns or delays, effective use of the CPM tools in forward looking non-reactionary ways to model and forecast the planned work is necessary. The CPM schedule therefore becomes the primary tool to bring order and rhythm to the construction site dance of project completion.

We must remember that a CPM schedule is a dynamic tool. The schedule is only reliable at the time it was developed. It models the optimal approach (critical path) to a set of circumstances (activities and relationships) as quantified by the scheduler. Nevertheless, one can't predict what others will do to affect the model. Inevitably there will be external circumstances not under the control of the project team that will make it go awry. These external circumstances will challenge the optimal approach. Understanding that the CPM schedule is a proactive tool to accommodate issues as they arise allows the project team to produce a flexible construction model to evaluate and quantify the best path toward a successful project.

Bart can meet the challenge for the OMEGA project if he can effectively implement these concepts with the active assistance of the entire project team. If he does, the schedule will not be responsible for project failures or challenges if they occur on OMEGA.