How to Reduce Project Lead Times Through Improved Scheduling

Probabilistic Scheduling & Buffer Management

Conventional Project Scheduling often results in plans that cannot be executed and too many surprises. In many cases, "the plan" is a bidding exercise that has little effect on project behavior and thus, is a poor indicator of what actually occurs during a project. This paper explores the reasons why and offers a solution to project planning.

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5/21/2009

What are Probabilistic Scheduling and Buffer Management?

Probabilistic scheduling uses knowledge of the variation in project tasks and the project environment (project risks) to make quantitative prediction of a range of project outcomes. Instead of providing a fixed date to answer a question such as "When is first oil?" probabilistic scheduling provides a range of answers of the type, "There is a 50% chance of achieving first oil by date x or sooner, and a 90% chance of achieving it by date y or sooner." More general application of probabilistic planning also considers the range of project costs and returns. This evaluation focused on the range of outcomes for key project dates, such as first oil. Quantifying the range and probability of outcomes can aid project planning and decision-making.

Probabilistic scheduling provides a method to quantify the risk management process. Quantifying the impact of potential risks improves decision-making affecting the control of those risks, and potentially on the overall financial viability of the project. It specifically aids the upfront recognition of critical issues and proactive management of those issues.

Buffer management is a method to control work more effectively. When applied across multiple projects, it aids project and resource-level decision making to accelerate the completion of all of the projects sharing resource pools. Buffer management achieves better resource utilization through enabling resources to focus on project tasks in priority order, completing them all sooner as compared to switching back and forth between multiple tasks on multiple projects. It improves project team focus by rapidly identifying the project tasks requiring action to ensure project completion on or before a committed project completion date. Buffer management enables committing to high probability fixed dates while using the variation information provided by probabilistic scheduling.

Buffer management uses the probabilistic schedule analysis to place time buffers at the end of chains of project tasks leading to a desired project outcome date (e.g. first oil). It then uses project task status information and decision rules to control the project. When used with multiple projects, buffer management provides the project resources with information as to which task they should focus on next. It also provides the project team with information on which tasks need focused attention, and when they must take action to ensure project delivery to the committed milestone.

Approach

The overall approach begins with a probabilistic scheduling/buffer management strategy and schedule, agreed to between the project team and Pinnacle Strategies coaches. We then develop the roles statement and the basic process adopted for the pilot.

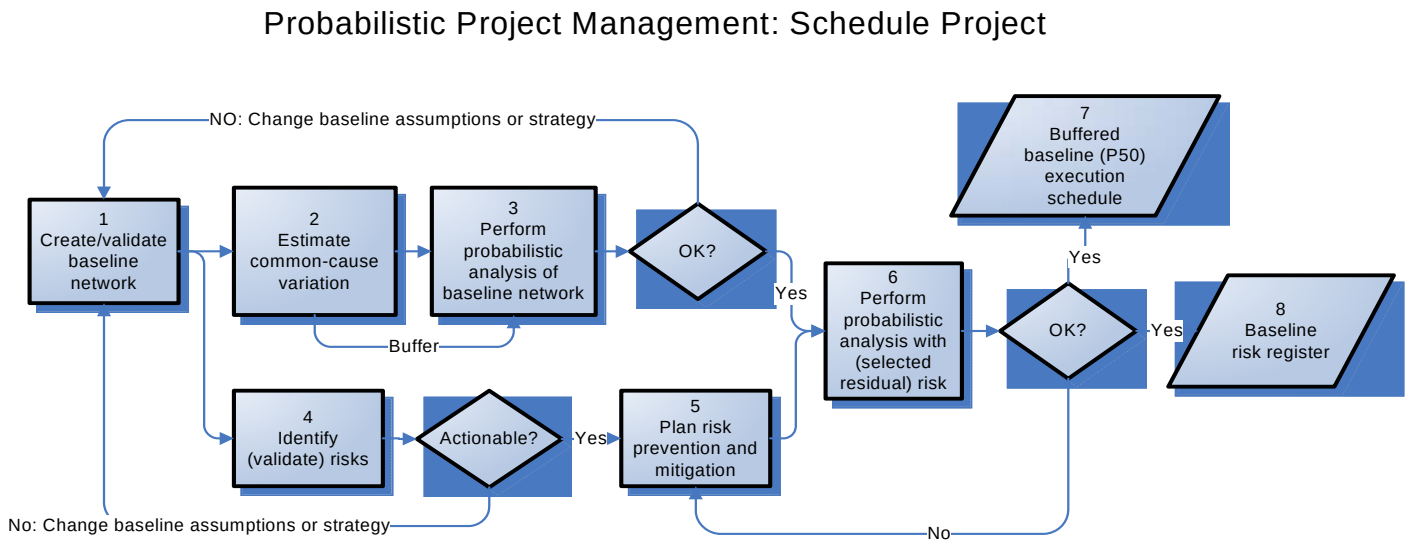

Figure 1: Probabilistic planning deploys knowledge of variation in project tasks to optimize the plan.

Figure 1 addresses two causes of variation (Deming, p. 310), common causes and special causes. Common cause variation is the variation inherent in the system, while special cause variation has some definite cause; e.g. an identified project risk. Common cause variation is why performing the same task on five different projects will show variation in the time to complete the task. You seek to manage Special Cause variation by your risk management process. Deming (p. 309) notes that the reason for the distinction is that, "the type of action required to reduce special causes of variation is totally different from the action required to reduce variation and faults from the system itself". This project introduces buffer management as the tool to more

effectively manage common-cause variation, and to identify when action is required to control special-cause variation beyond those items identified in the risk management process.

Step 7 of figure 1 identifies a buffered project schedule. For this pilot, a single project time buffer was added at the end of the critical path leading to first oil. The buffer size (duration) is the difference between the 90% probable and 50% probable date predicted for first oil. Inserting this buffer into the deterministic schedule enables using the deterministic schedule to control the project, using a buffer management process.

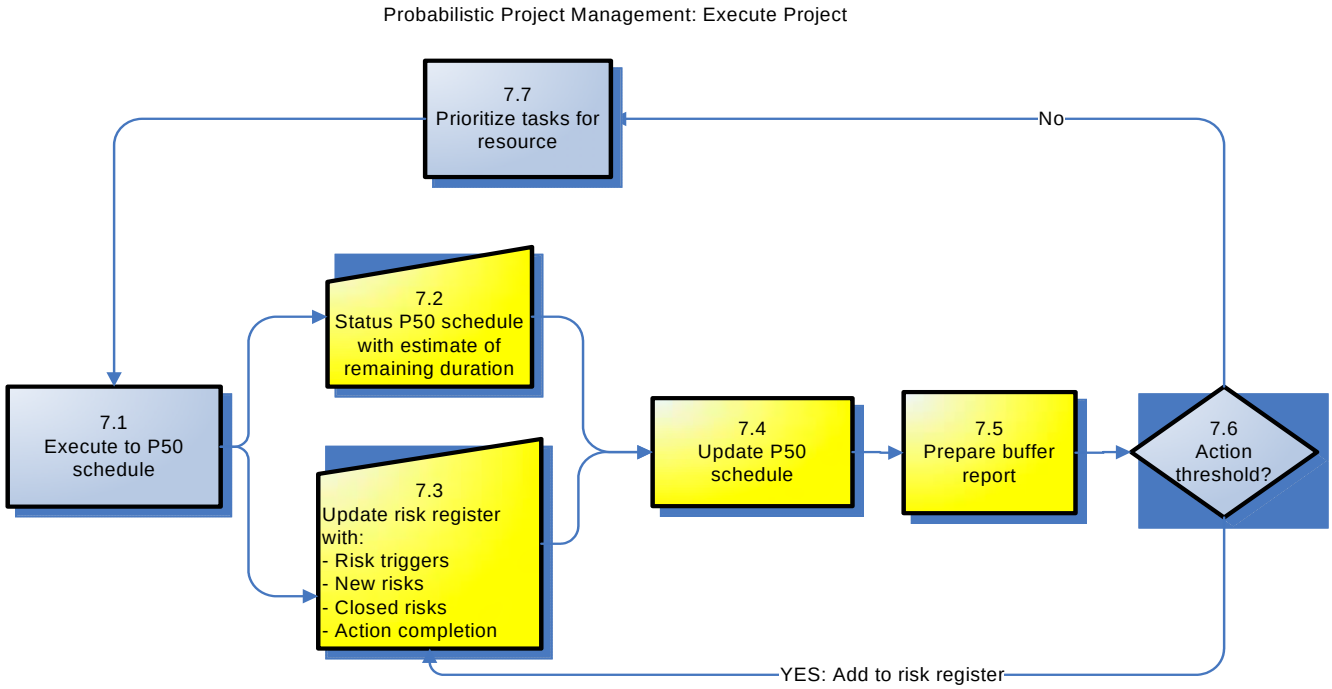

Figure 2: Buffer management execution ensures that the project team focuses on the right tasks to complete the project on or ahead of schedule.

Figure 2 illustrates how the probabilistic analysis and buffer management is used during project execution. The project team updates progress on the schedule on a frequent basis to achieve the benefits in terms of task priority and action signals for the project team. We recommend weekly (at a minimum) updates. The execution process uses a buffer status chart (called a fever chart) during execution to determine when to take action on the project (e.g. accelerate selected tasks). It does not require re-running the probabilistic analysis each week. Updates to the project logic (e.g. new tasks), or changes to the risk register (e.g. new risks, or risks no longer applicable) may initiate a need to re-run the probabilistic analysis.

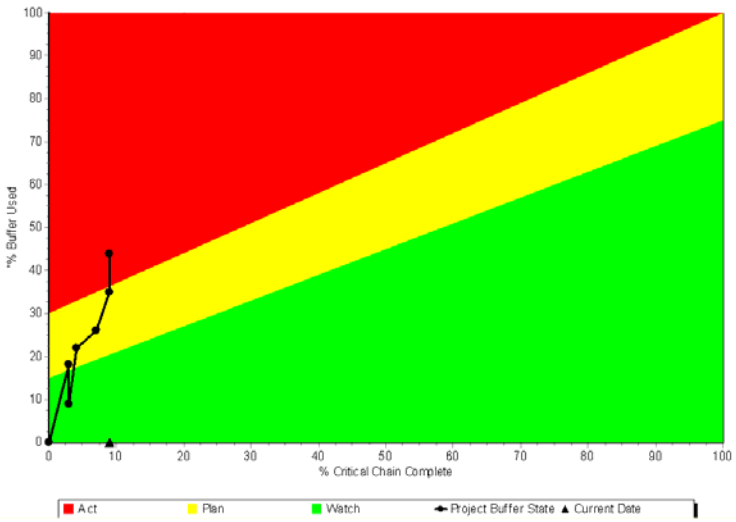

Figure 3: The buffer management fever chart defines when to take action to recover time on the project.

Figure 3 illustrates a buffer management fever chart. The vertical axis indicates the percentage of buffer consumed, based on inputting the weekly status into the schedule program (MS Project or Primavera). The horizontal axis illustrates the project progress, in terms of the percentage of the critical path baseline time accomplished. The three regions represent action criteria:

- Green, no action.
- Yellow, plan buffer recovery.
- Red, execute buffer recovery.

Note that a project that completes within 100% of buffer consumed successfully meets the committed date for the milestone controlled by the buffer; e.g. fist oil.

Lessons Learned in Implementation

1. Creation of the probabilistic schedule provides an effective quality check of the deterministic schedule. This alternative way of viewing and analyzing the schedule led to many improvements in the deterministic schedule task definition and logic.
2. The probabilistic analysis process identified unexpected impacts of constraints and lags in the deterministic schedule. Standard scheduling best practices should seek to minimize these constraints and ensure that they are visible. The baseline schedule should seek to eliminate constraints.
3. The primary buffer used to manage the project is a project time buffer placed at the end of the critical path; in this case in front of the First Oil milestone. Buffers should be placed in front of reportable milestones requiring a higher probability than 50%. These milestone buffers should be external to the critical path of the project. Modeling of weather and loop current impacts can be lumped together, and included in the risk quantification analysis. They should not be included in the critical path. This way, they will not push out the baseline task dates.
4. Risk definition in the risk register must be improved to be understandable by all project participants, with due consideration that personnel assignments often change during the life of a project. It must include a specific format for stating risks, input columns for the probabilistic information, and a column to supply the basis for the quantitative risk estimates. We found a number of instances where no one currently working on the project understood what the risk statement in the register meant.
5. Traceability from the risk register to modeling in the probabilistic schedule is necessary to relate the variation in the output date to the manageable risk cause.
6. Project work package leaders (WPLs) working on multiple projects using a plethora of tracking mechanisms (schedules and action lists) will have a hard time focusing on what needs to be done in what order. Each functional organization has their own work scheduling system for both project tasks and action items. These systems do not tie directly to the project systems. Thus, extensive manual effort would be required to synchronize these tools across all projects.
7. Some WPLs determine the end of tasks by the availability of personnel to schedule a review meeting; i.e. they work to schedule a meeting with a reviewer, and the date of that reviewer's availability determines the completion date for the task. This approach wastes project time (delays project completion), as they cannot complete sooner than those dates. This approach will significantly reduce the potential gains of probabilistic scheduling/buffer management.
8. Projects do not effectively use a single Work Breakdown Structure (WBS) to integrate project work. The schedule does not relate to a WBS. This complicates understanding how to link risks to and actions to schedule activities, as activity numbers change with schedule modifications. In addition, it complicates the integration of the functional systems for schedule and action tracking relative to the project system.

Probabilistic Scheduling and Buffer Management Benefits

The probabilistic scheduling process has the following benefits:

Shorter Project Lead Times

There are fewer surprises. Having done a proper job of evaluating project risk and task durations, you're prepared to deal with the "murphys" that always occur during project execution. Since you've already prepared, you can respond much quicker, without wasting time.

Second, a good project plan moves these potential risk events off the critical path (if possible!). By moving risk events off the path that determines project delivery, eliminating disruption to your deliveries. That doesn't happen without planning.

Third, the tasks themselves are stripped of the safety that most project plans have, with all task safety aggregated at the end of the critical chain. Saftey aggregation allows you to manage the safety as a project level item, rather than letting it be dispersed to every resource in your project. That means that you need less, and the overall project duration is shorter with greater certainty of completion on time.

Scheduling process improvement

- Improve the credibility of the project plan
  - Give a greater understanding of the work to be accomplished through:
    - Consistent task estimates across groups
    - Reliable task relationship linkages
    - Greater assurance of risk and team focus
- Improved control during execution through:
  - Earlier identification of problem areas
  - More proactive project management

You can expect additional benefits from probabilistic scheduling and buffer management:

- Increased availability of engineering resources to effectively deliver on more projects
- Improved visibility of project risks and their impact on schedules
- Greater flexibility to respond to risks, thus
- Improving on-time completion of projects.

These will be caused by better planning and deployment of the resources to project tasks, reducing waste and inefficiency in task performance. If we can help the resources focus on one project task at a time, and pass on their result to the next task in the project, we can reduce delays and rework.

Benefits from Behavior Change

The primary benefits (more projects and better reliability) to the system will come from enabling resources to focus on one task at a time, complete it, and hand it on to the next task in sequence. The shortening of actual task duration by focusing on one task at a time is evident, but the improvement in efficiency and reduction of stress and chaos resulting from this improved focus may not be so evident. Human performance research indicates gains upwards of 40% are achievable through eliminating task switching on intellectually challenging tasks.

You can realize significantly more benefit by implementing probabilistic scheduling and buffer management across multiple projects. Many WPLs and resources supporting this project are also assigned to other projects not deploying probabilistic scheduling/buffer management. Since they do not receive comparable priority information from the various sources competing for their attention, applying buffer management on a single project does not help in make the priority call on "Which task to work on next?" The natural result of this is to devote shared time to multiple projects' tasks, thus delaying the work on all of the tasks, and possibly delaying the projects.

Next Steps

For more information on Probabilistic Scheduling:

1. Visit http://pinnacle-strategies.com to browse a variety of articles and resources, including critical chain project management
2. Subscribe to Mark Woeppel's blog, at http://pinnacle-strategies.com/blog and join the discussion

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