

Critical Chain Project Management — Estimating and Scheduling

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Perhaps the most arduous task that afflicts project managers involves keeping today's aggressive project schedules on track. Because resources are continually restricted more and more and the highly skilled, high-priced resources are often required for multiple projects, resource constraints become one of the highest risks to the project schedule. To help ensure that project schedules are met, project managers have learned to concentrate on a project's critical path. They have also learned that the resources used along the critical path—the *critical chain* of resources—especially those resources shared among projects, must be proactively managed.

This is where Critical Chain Project Management (CCPM) can aid the project manager—by planning and managing a project's schedule through a unique optimization process that joins the task-dependent critical path with the critical chain—the resource-dependent tasks that impact the project completion date. The critical chain explicitly defines a *resource-leveled set of tasks*. If the quantity of resources is unlimited, the critical path and the critical chain are identical.

Unfortunately, the resource-leveling activity that identifies the critical chain often extends the project's end date. To meet the original, predefined end date, the new schedule must be optimized. Critical chain optimization, just like critical path optimization, looks at individual tasks to determine which time estimates can be shortened. Critical chain optimization, however, also focuses on a project's resources, keeping them levelly loaded through flexible start times and quickly switching among tasks.

Critical chain optimizing recognizes that the *entire* safety margin originally built into every project schedule might not be required and that all tasks, in theory, could be completed ahead of schedule. Keep in mind, though, that as long as the safety margins exist in individual tasks, the ability to shorten the overall project length is minimalized. Yet, if the safety margins are all removed and even one critical task exceeds its estimated length, the completion date for the entire project is jeopardized.

Scheduling Buffers

CCPM methodology places safety margins—*buffers*—in the project schedule while pushing individual tasks to completion in the shortest time possible. The project manager applies and monitors four specific buffers that allow for contingencies where resource risks have the greatest impact on a project:



The *project buffer* protects the project from missing its scheduled end date due to variations along the critical chain. It places a portion of the safety margin time that was removed from each task estimate into a buffer task, thus moving the times of uncertainty from individual tasks to a pooled buffer task. The project buffer is inserted between the final scheduled task and the scheduled project end date. The critical chain starts at the beginning of the project and ends at the start of the project buffer, not at the end of the project. Time is added to or subtracted from the project buffer as the actual time required to complete each task changes.

The *feeding buffer* minimizes the risk that late completion of a non-critical chain task will affect the critical chain. The project manager inserts an amount of time at those points in the schedule where inputs from non-critical chain tasks merge with critical chain tasks. The result is very similar to a relay race where the speed of the race, in general, is able to be maintained by the overlap in runners at the hand-off point.

The *resource buffer* is an alert that is sent to critical resources to ensure that they have time to complete their current tasks and begin to prepare for the critical chain task so that work can begin on the latter task as soon as the former task is completed. This buffer can be implemented easily and provides immediate benefit with little or no cost.

The *capacity buffer* places on-call resources that are available to avoid schedule delays due to unforeseen issues into the budget. Because this buffer adds additional cost to the budget, it is, unfortunately, seldom applied—such an expense goes against most organization's cost control principles. Obviously, the capacity buffer makes more sense in a multi-project environment, where the cost can be distributed over multiple project efforts.

The project manager focuses on managing these buffers during the monitoring and control phases. Frequently updating the time-to-complete for individual tasks while closely monitoring the consumption and replenishment of the buffers allows the project manager to track actual project progress against the original schedule. The project manager can effectively analyze current progress, implement corrective actions, and maintain focus on the most critical aspects of the project.

CCPM Process

At a high level, the CCPM process for developing and controlling a project schedule is composed of the following steps:

1. Reduce individual task estimates dramatically. This is done either by slashing the estimate by 50 percent or by applying a three-point estimating process to each task.
2. Resource level the project to remove resource contentions. At this point, the critical path is transformed into the critical chain.
3. Aggregate a portion of the reduced task estimates into a project buffer, and insert this buffer at the end of the project.



4. Insert feeding buffers at points where non-critical chain paths intersect the critical chain. The subordination of non-critical chain paths allows continued focus on the critical chain.
5. Insert resource buffers where appropriate to reduce the probability that a critical resource is unavailable when scheduled.
6. Insert capacity buffers where appropriate.
7. Limit or eliminate multitasking.
8. Schedule tasks with no predecessors to start as late as possible.
9. Encourage tasks to be completed as quickly as possible. Emphasize the importance of start times and aggressive task completion rather than due dates.
10. Manage buffers to support preventive and corrective actions.

Multi-project Environment

Even though CCPM concepts are often applied in a single-project environment, they take on additional significance in a multi-project environment. The most loaded resource shared across projects, also called the *drum* resource, affects the overall completion date or schedule of the individual projects because each project is forced to progress at the pace of the drum resource.

Consequently, the critical chain and the paths that merge with it may result from resource dependencies outside the scope of a single project. Providing visibility to resource conflicts that exist outside the individual project is necessary to get a true picture of the overall project management environment within any organization.

Conclusion

If your organization is highly networked, has a large number of projects requiring a few critical resources or a drum resource, and primarily operates by using time as the dominant leg of the triple constraint, then CCPM can be a meaningful addition to your project management toolkit. But every organization, regardless of size and project management inclinations, should consider gradually incorporating into its current project management methodology the individual CCPM principles that are applicable.

CCPM may be the most important new approach to project scheduling in the last thirty years. It is a method that can be applied to meet the ever-increasingly aggressive schedule requirements that every project manager is facing while, at the same time, helping organizations to maintain quality and productivity. It has been proven to be an effective method to protect your projects from the inevitable slippages that occur in every project.



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