

Delivering High-Quality Products With the CPM

By Captain Ivan P. Beckman

The goal of the U.S. Army Corps of Engineers is to deliver high-quality projects to its customers—on time and at cost. The Critical Path Method (CPM) of construction management is one technique used to achieve this goal. The CPM is a graphic tool for coordinating five aspects of construction—time, people, materials, equipment, and money.

While every construction contract would benefit from using the CPM, it is often neglected by both the government and the contractor and used only to process pay applications. However, the CPM is essential to fighting unnecessary time delays and cost overruns. As effort is put toward the critical path, certain elements may no longer remain critical and other key tasks may become critical. The CPM is essential in identifying the migration of critical elements. This article describes how everyone involved in a construction project benefits from using the CPM and gives examples of how it can be applied in the field.

Valuable Tool

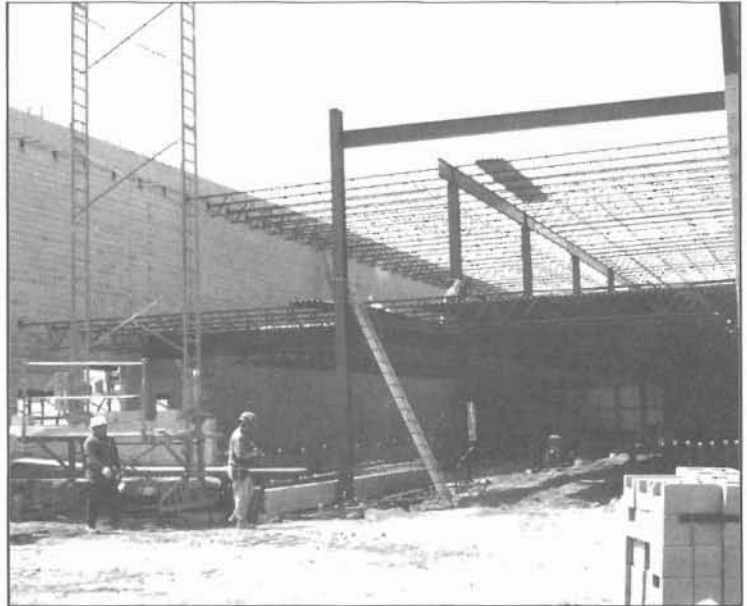
The Critical Path Method is a valuable tool for the government, the customer, and the contractor. By using this graphic management tool, it becomes obvious when unexpected events affect a project and require coordination.

Government

The government's representative must challenge every proposed change against the CPM and force the contractor to use his schedule. The CPM is a tool to supervise and manage construction and to prevent unnecessary delays in critical path activities. For example, the customer may request a minor change in an activity that will impact a critical activity. The government should use the CPM to show the customer how the change will delay the contract completion date and increase overhead costs. This information, which the customer may have overlooked, will help with decision making at all levels. The government should use the CPM as a negotiating tool by challenging time extensions for modifications and allowing them only if the contractor proves an impact on the critical path.

Customers

Customers should use the CPM as a requirements and date planning tool. By following the CPM, they will gain a greater understanding of a project's completion, which may



Using the CPM helps keep construction projects, such as this maintenance facility at Tinker Air Force Base, Oklahoma, on schedule.

be before or after the original estimate, and they will know when to move tenant units into and out of facilities. Customers can use the CPM to develop their own movement time line. They will also know when to provide equipment to the contractor that is government-provided/contractor-installed, based on the contractor's schedule.

Contractor

By correctly applying the CPM technique, contractors can greatly improve their job performance through resource leveling. Prime contractors can cross-level and focus their labor force and equipment on activities that have critical path importance. Subcontractors can see how their work fits into the project and can improve scheduling, planning, and ordering. Construction superintendents and project managers must be the primary keepers of the CPM.

Applying the CPM

Use of the CPM in field units saves time and money. It allows contractors as well as the government and customers to realize the relative importance of every construction activity based on the float time available and network logic. An activity that is delayed more than the allowable float time delays the entire construction project by the same amount of time. Delays that affect the critical path of a project are costly to contractors and the government. If a project is delayed, the contractor pays his extended overhead

How the Critical Path Method Works

The following examples show how the CPM can be used:

Project One

A contract modification was required to change the size of a chiller and provide additional cooling capacity in a new facility. The chiller had not yet been ordered. The contractor claimed an additional 28 days of delay for which he was due a time extension and extended overhead in the amount of \$56,000. The potential time extension would cause the user-need-by date to be missed by a month. The new facility's user had invested considerable time and planning in an anticipated turnover date and would experience planning difficulties and added cost to extend a lease and delay the movement. During negotiations, the government required the contractor to use the CPM to explain his time extension request. The contractor identified one key activity in the CPM—"Install Chiller"—that the change affected and which caused all other delays. A study of the CPM showed that "Install Chiller" had 43 days of float time. The activity's early-start date was more than 12 weeks away, while the contractor's proposal cited a 12-week period to order and receive the chiller. The government representative suggested that through the logic of the contractor's CPM, he was not due additional time for the

modification. The contractor, not able to argue against his own logic, conceded that the additional time extension was not required and dropped the requested time delay from the proposal. This saved the government considerable money and time.

Project Two

The project superintendent and quality control manager conducted construction planning on the project CPM, which was posted in the office trailer. The contractor updated activities with actual start and finish dates and color-coded activities to indicate completion status. The superintendent used the CPM to notify subcontractors of upcoming work requirements. Subcontractors used the CPM to schedule their work based on the completion of the preceding construction activities. The contractor used the CPM to closely watch critical path activities, which received priority effort. The contractor effectively cross-leveled resources (workers and equipment) for the benefit of the project. On this project, the contractor could boast that he was still on the original schedule despite 27 days of weather delay. This was mainly due to the contractor's understanding and application of the CPM technique on the job. It is important that project superintendents master their project schedules and the CPM technique early in the life of their projects.

along with liquidated damages. However, if a contractor is granted additional time as part of a modification, the government pays the price with money and time. The government must challenge each time extension against the CPM to determine if it is legitimate and then appropriately compensate the contractor.

Using the CPM also improves construction quality. Contractors can schedule construction activities during the best conditions within float-time windows. For example, it is not necessary to rush a concrete project during the winter if there is adequate float time for the activity to be done in the spring. Depending on preceding and subsequent activities, it may be possible to pour floor slabs after a weather-tight facility is built to control concrete curing conditions. Float time and network logic can and should be used to schedule activities under the best possible conditions.

The following suggestions may help project engineers apply the CPM in the field:

- **Scrutinize the preliminary CPM.** Contractors are required to provide the government with a preliminary CPM within 30 days after a notice to proceed, which covers the first 60 days of work. During that 60 days, contractors must produce a detailed initial CPM that covers the entire contract.
- **Scrutinize the initial CPM.** Ensure that construction superintendents and project managers explain their initial CPM in detail. Some contractors hire a subcontractor to write the CPM, and the subcontractor may turn it in for approval without the construction superintendent seeing it. Carefully review a contractor's submittal, and if the schedule doesn't seem logical, require a resubmission.

- **Emphasize construction superintendents' ownership of CPMs.** Superintendents must understand the logic of their CPMs and the importance of critical path activities. They must know which activities have float time and how much time is available per activity. Ensure that superintendents post their CPM in their construction trailer and keep it updated. Using the superintendents' CPM as a guide, frequently discuss the construction status with superintendents and project managers.
- **Scrutinize contractors' CPM updates.** Contractors are required to submit an updated CPM with every pay application along with a short narrative describing changes in the network since the last pay application. Reject the pay application if an update is not included. Ensure that contractors follow their own schedules.
- **Use the CPM in negotiations.** Contractors must use the CPM to justify all requests for time extensions due to weather delays and construction modifications. Contract time extensions should be granted only if critical path activities are delayed.

Key to Success

The Critical Path Method is the construction management tool of choice for project engineers in the field. When it is applied correctly, the government protects itself from excessive time delays and cost increases; contractors provide higher-quality projects on time and at cost; and customers gain a greater understanding of projects and increase their ability to plan. A mutual understanding of projects through the CPM provides the government, contractors, and customers the key to construction success.



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