Identify the Critical Path Using a Gantt Chart

Introduction

The critical path is the sequence of discrete tasks/activities and milestones that has the longest duration through the project with the least amount of float. The critical path defines the shortest possible amount of time required to complete the project.

This job aid addresses how to identify the critical path using a Gantt chart. A Gantt chart displays a program or project schedule in bar chart form. In MS Project, Gantt chart views also include a table portion that provides text-based information about corresponding project tasks.

1. To learn more about using a Gantt chart to view schedule information, see the How to Read a Schedule job aid.

Things to Know Before You Begin

While Gantt charts are common tools used in project scheduling, there are no standard layouts or symbols for these tools. This job aid includes representative formats and symbols similar to those used in EVM 202 and other DAU courses. In addition, the Gantt charts used in this job aid were created using MS Project.

Note: Your organization may use different software tools, layouts, and/or symbols to create network schedules and Gantt charts.

1. To learn more about how to use MS Project to view schedule information, see the Using MS Project job aid or consult the Help functionality within MS Project.

Critical Tasks and the Critical Path

A Gantt chart displays a project's activities and milestones against time. This job aid uses the following sample project to explain how to identify the critical path on a Gantt chart. This Gantt chart was created using MS Project.

Chronological display of project tasks over time
Identify the Critical Path Using a Gantt Chart

MS Project determines critical tasks by applying a filter on tasks with a float value of 0 days or less. In this project, the critical tasks are depicted by a red bar in the graph. This is a common convention, but analysts should verify how the scheduling software they use displays information.

These critical tasks are not automatically on the critical path because they may or may not be in the sequence of tasks (path) through the schedule network which has the longest total duration and least amount of float through the contract. Tasks on the critical path typically have a float value of 0 days. Tasks on the critical path cannot be delayed without delaying the finish time of the entire project.

In the sample project, the Project Summary task shows that the total project duration is 27 days. The project starts on January 1 and finishes on January 27.

Identify the Critical Path
To determine the critical path, start with the first task in the project and work through the network, following these steps:

1. Eliminate tasks that are never on the critical path.
   a. Summary Tasks—summary tasks are not on the critical path. A summary task is an aggregation of the tasks below it. In the previous example, the Project Summary task comprises Tasks A through H below it. Summary tasks don’t have predecessors or successors.
      
      Note: In MS Project you can hide all summary tasks from the Gantt chart.
   b. Complete Tasks—complete tasks are not on the critical path. If a task has an actual finish date, it is complete and therefore not on the critical path.

2. Identify the first task on the critical path.
   a. If a task has an actual finish date of NA, it is not complete and may be on the critical path. The incomplete task with the earliest start date in the network is usually the first task on the critical path.
   b. If there two or more incomplete tasks with the same earliest start date, the task that has the latest finish date is the first task on the critical path. This is the first task on the critical path because it has the longest duration of the two or more incomplete tasks.
3. Determine the next task on the critical path by evaluating the successors for the first task on the critical path.
   a. Identify the successor task with the latest finish date and least amount of float (usually 0 days).
   b. Check the relationship logic between tasks to make sure the logic makes sense. For example, if two or more successor tasks share the same least float value (e.g., two successor tasks have a float value of 0), follow the network logic for all those tasks to determine which task is first in the path logic and which falls next in the path logic.

4. Map out the remaining tasks on the critical path.
   a. Repeat steps 3a and 3b for each task on the critical path until you have mapped out the complete critical path to the end of the project.

Identify the Critical Path—Practice
Using the sample project, we will apply steps 1-4 to identify the critical path.

Step 1—Eliminate Tasks Never on the Critical Path

Step 1a—Summary Tasks
For this project, ID 0, the Project Summary task is technically the first task in the schedule. However, it is a summary task, which means it has no predecessors or successors and is an aggregation of all the project tasks below it. Therefore, it is not on the critical path.

Step 1b—Complete Tasks
None of the remaining tasks in the sample project has an actual finish date, which means all tasks are incomplete. So, we do not need to eliminate any additional tasks.
Step 2—Identify the First Task on the Critical Path
The next task in the project is ID 1, Task A. As determined in steps 1a and 1b, it is not a summary task since it has successors, and it is not complete because its actual finish date is NA.

Chronologically, Task A is the first incomplete task in the network, with a start date of 1/1/2007 (step 2a). All of the other incomplete tasks start later (step 2b), therefore Task A is the first task on the critical path. Note that Task A also has a float value of 0 days and is represented by a red bar in the Gantt chart.

*The tasks on the critical path thus far are: Task A*

Step 3—Determine the Next Task on the Critical Path
Since task A is on the critical path, move to step 3 and evaluate task A’s successor tasks.

 كالِيِّ، MS Project identifies successors and predecessors by task ID, not by task name.

Step 3a—Identify the Successor Task with the Latest Finish Date and Least Amount of Float
Task A has three successor tasks: ID 2 (Task B), ID 4 (Task D) and ID 6 (Task F). Evaluate each of those successor tasks. Once again, none of them are summary tasks or completed tasks.
Of the three successor tasks, Task F has the latest finish date (1/21/2007), but task D has the least float (0 days). To determine which of these is on the critical path, check the relationship logic between tasks (step 3b).

Step 3b—Check the Relationship Logic Between Tasks
Task A has a finish-to-start relationship with Task D, and Task D has a finish-to-start relationship with Task F. This sets up a path A – D – F where Task F cannot start until task D is finished and Task D cannot start until task A has finished. It is not necessary to further specify a finish-to-start relationship between Tasks A and F since that is already implicit in the relationships between Tasks A and D and Tasks D and F.

However, as you can see from Task A’s successors, there is a relationship specified between Task A and Task F. This redundant relationship can be removed, so you do not need to evaluate Task F as a successor to Task A. You only need to evaluate Task D and Task B as successors to Task A.

**Note:** It is important to remove redundant logic because it makes determining the critical path more difficult.

Of those two successors, Task D has the latest finish date and least amount of float. The conclusion is that Task D is on the critical path, and this is also indicated by its representation by a red bar on the Gantt chart.

*The tasks on the critical path thus far are: A – D*

Step 4—Map Out the Remaining Tasks on the Critical Path
Since Task D is on the critical path, repeat step 3 for it. Evaluate its successor tasks to determine which is on the critical path. Task D has two successor tasks, ID 6 (Task F) and ID 7 (Task G).

**Note:** Even though Task F was removed due to redundant logic when evaluating Task A’s successors, you still need to evaluate it now in its role as a successor to Task D.

Neither Task F nor Task G is a summary task or a completed task, so that doesn’t eliminate them from being on the critical path.
Of the two tasks, Task G has a later finish date (1/25/2007) than Task F (1/21/2007) and also less float (0 days vs. 6 days). It is on the critical path, which is also indicated by its representation by a red bar on the Gantt chart.

*The tasks on the critical path thus far are:* A – D – G

Since it is on the critical path, repeat step 3 for Task G. Evaluate its successor tasks to determine which is on the critical path. Task G only has one successor, ID 8 (Task H). Task H is not a summary task because it has a predecessor, and it is not complete.

Task H has 0 days of float. Notice it is also the last task in the network, and has no successor tasks. Therefore, Task H is the last task on the critical path.

*The critical path is:* A – D – G – H.

Step 4 is complete and the critical path has been determined.

**Critical Path Duration**

The critical path determined in steps 1–4 is the path with the longest total duration through the project. The Project Summary task shows a total project duration of 27 days. Adding the durations of the tasks on the critical path results in a total duration of 27 days.

\[
\text{Critical Path Duration} = \text{Task A} + \text{Task D} + \text{Task G} + \text{Task H}
\]

\[
= 5 \text{ days} + 10 \text{ days} + 10 \text{ days} + 2 \text{ days}
\]

\[
= 27 \text{ days}
\]

So, A – D – G – H is the path with the longest duration through the project. In addition, all the tasks on this path have 0 days of float, while the remaining tasks not on this path have more than 0 days of float.