

Defining the Critical Path

One of the more perplexing issues facing the scheduling profession is defining precisely what is the ‘critical path’ within a CPM¹ schedule. There are many different descriptions in regular use some are²:

- Longest sequence of activities in a project plan which must be completed on time for the project to complete on due date. An activity on the critical path cannot be started until its predecessor activity is complete; if it is delayed for a day, the entire project will be delayed for a day unless the activity following the delayed activity is completed a day earlier.
- The series of tasks that must finish on time for the entire project to finish on schedule. Each task on the critical path is a critical task.
- Generally, but not always, the sequence of activities that determines the duration of the project. It is the longest path through the project [*PMBOK® Guide* 4th Edition]
- In a network diagram, the longest path from start to finish or the path without any slack, and thus the path corresponding to the shortest time in which the project can be completed.
- In a project network diagram, the path with the longest duration. The critical path may change from time to time as activities are completed ahead of or behind schedule. See critical path method.
- The line of project activities having the least float, especially when float is close to, or below zero.
- Generally, but not always, the sequence of schedule activities that determines the duration of the project. Generally, it is the longest path through the project. However a critical path can end.... In the middle of the project schedule. [*The Practice Standard for Scheduling* – PMI]
- The route through the network that has only critical activities.
- The series of consecutive activities that represent the longest path through the project.
- The series of interdependent activities of a project connected end-to-end, which determines the shortest total length of the project. The critical path of a project may change from time to time as activities are completed ahead of or behind schedule.
- The series of activities that define the total project duration.
- The path (sequence) of activities which represent the longest total time required to complete the project. A delay in any activity in the critical path causes a delay in the completion of the project. There may be more than one critical path depending on durations and work flow logic.
- A sequence of activities through a project network from start to finish, the sum of whose durations determines the overall project duration. [*APM BoK* 5th Edition]
- The sequence of activities that must be completed on schedule for the entire project to be completed on schedule. It is the longest duration path through the work plan. If an activity on the critical path is delayed by one day, the entire project will be delayed by one day (unless another activity on the critical path can be accelerated by one day).

Many of these descriptions are discussions rather than a definition and several are circular or contradictory.

Why the Critical Path needs definition

Having an unambiguous definition of the Critical path is important because many contracts will only provide an extension of time for excusable delays if the delay impacts a ‘critical activity’ or causes an activity to

¹ CPM = Critical Path Method

² Many definitions sourced from: http://www.maxwideman.com/pmglossary/PMG_C13.htm



become critical. At a more basic level, understanding what is important from the viewpoint of criticality is central to the whole philosophy behind the ‘critical path method’ of scheduling.

The definition of ‘critical activity’ is generally agreed as being those activities that make up the ‘critical path’. However, as can be seen from the above, what is not generally agreed is the definition of what constitutes the ‘critical path’.

Creating a precise and unambiguous definition of the ‘critical path’ is important. However, this is far from simple primarily due to advances in scheduling practice that allow the inclusion of date based constraints at any point in a schedule.

Critical Path -v- Critical work!

A number of authors including Murray Woolf³ have criticised the concept of ‘critical path’ preferring to focus on critical work. The concept of ‘critical’ can be extended to include:

- Near-critical path activities with low total float (say, less than 5 days) that may become the controlling path of activities if the low total float is used-up.
- Hyper-critical with negative float. This means, the activity is already delaying a constrained date.
- Activities in-progress or due to start because of their affect on resource utilisation, efficiency and costs.
- High-cost, long duration lead time, or other very important activities

The effect of resource utilisation also has a profound effect on the concept of the ‘critical path’; this is discussed in our paper ‘*Resource optimisation - a new paradigm for project scheduling*’⁴.

In summary, not all critical activities are on the critical path and not all of the activities on the critical path need to be considered critically ‘important’ activities. Common sense is needed to interpret the schedule information sensibly!

A New Definition of the Critical Path

Most planners and schedulers seem to have agreed the following basic points:

- The use of the term ‘critical’ in project scheduling has a precise meaning that is different from the general dictionary meaning. In scheduling, ‘critical activities’ make up the ‘critical path’. Other activities may be critically important in the normal dictionary meaning of the term, but they are not ‘critical activities’.
- Float is not a key determinant of ‘criticality’ and the ‘critical path’⁵. If the natural time required to complete a schedule is less than the contract period, and a date constraint is applied to the final milestone it is quite possible to see a ‘critical path’ with positive float. Conversely, if the natural time required to complete a schedule is more than the contract period, and a date constraint is applied to the final milestone it is quite possible to see a ‘critical path’ with negative float.
- The ‘critical path’ is the path that defines the end point of the schedule. Delays on the ‘critical path’ will delay project completion; accelerating work on the ‘critical path’ will advance project completion (at least until another path becomes critical).

³ See **Faster Construction Projects with CPM**: <http://www.mosaicprojects.com.au/Books.html#murray>

⁴ See: **Resource optimisation - a new paradigm for project scheduling**: http://www.mosaicprojects.com.au/Resources_Papers_152.html

⁵ For more on the calculation of Float see: http://www.mosaicprojects.com.au/PDF/Schedule_Float.pdf



Based on these foundations, the CIOB⁶ has developed the following description:

Critical Path = *the longest sequence of activities from commencement to completion of a key date, section, or completion of the works as a whole. In relation to each, it is that sequence of activities, which will take the longest to complete or, put another way, the sequence of activities, which will determine the earliest possible finish date. Hence, it is timely commencement and completion of those activities on that path, which will secure completion of the key date, section, or the works as a whole on time.*

The above description can be reduced to the following definition:

Critical Path:

The sequence of activities that determine the earliest possible completion date for the project or a phase of the project.

This new definition does not preclude the possibility of several ‘completions’ within the one project to account for interim handovers. It allows for the possibility of the critical path starting at the beginning of the schedule or at some interim point where an external dependency allows the ‘critical’ work to start. Additionally, the sequence of activities may be determined logically (through links or dependencies) or through the sequential movement of resources. The definition is both concise and unambiguous.

This definition has been adopted by the committee developing the *ISO 21500 Guide to Project Management*, hopefully it, or a similar unambiguous definition will survive through to the publication of the standard.

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http://www.mosaicprojects.com.au/PM-Knowledge_Index.html

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visit Mosaic's scheduling home page at:
<http://www.mosaicprojects.com.au/Planning.html>

⁶ Chartered Institute of Building: *Guide to Good Practice in the Management of Time in Complex Projects* (Wiley).
See: http://www.mosaicprojects.com.au/Books.html#CIOB_Guide