ARTICLE

Re-Calculating the Route

Sat Navs and the Critical Path in Construction Projects

"What is on the critical path[1]*?"* is one of the most regularly asked questions of a project planner. It is often assumed that an absolutely definitive answer can be provided by simply using a critical path method (CPM)[2] planning software tool.

However, when an answer to a question starts with *'the computer says…'* one should review the basis and assumptions upon which the plan was made and also apply the good old test of common sense through the lens of experience.

Have we started on the right path?

When lawyers are asked about the potential result of a hypothetical legal case, they will often caveat their answer by saying *"it depends..."*, usually on the precise facts of the case, and it really is no different in the case of critical path method planning.

For the sake of brevity, in this article, I will be assuming that we have started on the right path in that the schedule in question has already been developed with due care and diligence[3] and does not exhibit the basic traits of poor planning.

The main route — the critical path

Car satellite navigation systems (Sat Navs) provide a good analogy for representing the process of project planning. Before you start on your journey, you will make a set of decisions regarding your travel preferences (the preferences being akin to the construction execution strategy adopted). You will select whether to use toll roads or motorways. You input your destination and then the Sat Nav might then give you some further routing options, such as the shortest route in distance, fastest route and those with the fewest risks (potential roadworks or congestion). At that point you make a choice of routes, press the 'calculate route' button and that effectively becomes your 'critical path' (maybe the yellow brick road?) but commonly shown as a string of red (or red-ringed)[4] activity bars on the Gantt chart[5] within the CPM software.

1 Society of Construction Law Delay & Disruption Protocol, 2nd Edition February 2017, Appendix A, Definitions & Glossary at page 62; *"Critical Path: the longest sequence of activities through a project network from start to finish, the sum of whose durations determines the overall project duration. There may be more than one critical path depending on workflow logic."*

2 SCL Protocol (ibid) at page 62: CPM – *"The methodology or management technique that, through the use of calculation rules (usually automatically carried out by programming software), determines the critical path and calculate float."*

3 CIOB Planning Protocol 2021 (CIOB PP21) (02) Feb 2021 & the CIOB Guide to Good Practice in the Management of Time in Major Projects 2nd Edition, 2018.

4 The red colour on the activity bar is normally the default display. The display settings in the software can be altered by the scheduler.

5 Collins's dictionary: a chart showing, in horizontal lines, activity planned to take place during specified periods, which are indicated in vertical bands, named after the originator, Henry Gantt. Also, often known as a bar chart.

However, if one went back into the 'preferences' in the car Sat Nav and said 'avoid motorways' and hit the re-calculate button, the route options might change and your choice of path likewise. It will be the same in the critical path method schedule.

In addition to those activities that are defined by the basic laws of physics, a properly constructed critical path method construction programme is actually built upon many levels and layers of choice.

For planning purposes, the project will be broken down to an appropriate level and number of chunks (i.e. activity tasks). Those activity tasks will be linked together by the scheduler using the appropriate construction logic, hopefully as agreed in association with the project execution team.

Some of the logic links may be created through the assessment of 'hard construction logic' (i.e. foundations before walls, walls before roof). However, much of the logic inputted into the plan will be decided by the project team through preference dependent upon the execution strategy to be adopted, for example, the choice regarding resource flow or sequence, resource availability, logistics, procurement & design methods, area/zone sequencing and so on.

In addition, the duration estimated for each task will be dependent upon the resources and method adopted, such as the number of people or type of machinery being used for the activity. These parameters can be altered (increased or decreased) depending upon various factors. These may include how much time is available to undertake the works or how safe it would be to have two (or more) work operations being undertaken in the same space at the same time.

In certain situations, it may make sense to do something in an unusual way that costs more money to achieve a quicker result.

It is only when all the planning meetings, execution strategy decisions, method statements, basis and assumptions listings that underpin the plan have been documented and packaged up holistically with the schedule that the communication of a robust critical path really becomes a viable proposition. As in a school mathematics examination, credit should be taken for showing your workings.

The side roads — activities with float

Although project focus is usually applied to the zero float critical path, one should also never lose sight of those activities within your CPM network that might present an amount of total float.[6] Some of these activities may be 'near critical' or they could have a higher risk profile (risk sensitivity).

Near critical activities

There is no absolute definition of which activities in a CPM schedule should be considered as being near critical (i.e. how much total float is considered as being near critical). The definition of near criticality is a decision that must be taken by the execution team. The assessment will depend on several factors, such as the duration of the project, the number of activities in the project and the duration of the activities (hourly, daily, weekly). However, the basic principle is that the team should remember to be constantly vigilant to activities which lie in the defined 'near critical' zone.

Risk sensitive activities

If one conducted a qualitative and quantitative risk simulation[7] on a deterministic CPM programme, the activities that exhibit a wide range of optimistic, most likely and pessimistic potential durations (as compared to the single deterministic duration originally placed into the CPM schedule) might statistically land on the risk simulated critical path more often than those activities on the CPM schedule's deterministic critical path.[8]

Higher risk activities could easily lose all their float in one quick hit if they are subject to probabilistic and/or conditional branching risks.[9] An example being the procurement of specialist equipment. Say a factory acceptance test[10] of a unique state of the art piece of

6 The period by which a task can be delayed or extended without delaying the completion of the project.
7 Using risk simulation software e.g. performing 'Monte Carlo' or Latin Hypercube' simulations.
8 Activities with high-risk sensitivity will often be visible at the top of the risk simulation 'Tornado Chart'. A Tornado chart is one of the common outputs produced by a risk simulation software package.
9 Probabilistic and conditional branching is a method for analysing expected values when more than one possible path for a project exists. Branching occurs when there is one or more successors to an activity, which can occur based on certain conditions or probabilities.
10 Factory Acceptance Test ("FAT"). A range of tests applied to certain complex pieces of equipment at the manufacturing facility (factory) to ensure that the performance of the equipment is satisfactory before shipping and delivery to the site.

equipment was assessed to have a 30% chance of failing. If the failure required re-work and re-testing before releasing the equipment for shipping to the site then potentially several days, weeks or even months of contingency/float could be eaten up very quickly. This may push an item that had a significant amount of float onto the critical path immediately upon such a failure.

Are we there yet?

Asking where a critical path runs might elicit a single answer, but the answer will likely have been based upon several inputs resulting from decisions made between various options and requirements. It is like attempting to solve a mathematical equation which has multiple variables.

To adequately describe a critical path, it is also important to know and understand the basis and assumptions which led to the choice of route in the first place. Therefore, next time you ask a planner *"what is on the critical path?"*, and the planner hesitates for a moment or says, *"it depends"*, it is probably because it actually might be complicated!

One thing I hope you never hear from your project planner is the equivalent of the Sat Nav instruction *"re-calculating route… make a 'U-turn when possible"*. That would probably not be good news.

Bon voyage!

Stephen Podesta is a planner and delay analyst who advises both domestic and international clients and contractors on construction time-related matters.

To discuss any of the issues raised in this article, please contact Stephen on the details below.

STEPHEN PODESTA
+44(0)20 7632 5184
stephen.podesta@fticonsulting.com