WPM Solves CPM Optimism

CPM is wildly optimistic[1]! We all know (or should know) that when a project is running late, the predicted completion date calculated by the 'critical path method' (CPM) at an update tends to be optimistic, and this bias remains true for predictions calculated using either time analysis or resource levelling. There are two reasons for this:

1. The assumption in CPM is that all future work will occur exactly as planned regardless of performance to date, consequently the planned durations of future activities do not change
2. The burning of float has no effect of the calculated completion date until after the float is 100% consumed and the activity become critical.

However, as discussed in ***Why Critical Path Scheduling is Wildly Optimistic!***, having an optimistic schedule for the purpose of motivating resources to perform to the plan is not all bad[2] – the updated CPM schedule shows the minimum level of performance needed to stop the situation deteriorating.

The problem is senior managers need a reliable prediction of when the project can realistically be expected to finish and CPM cannot provide this. A more realistic / pessimistic view can be obtained by using the performance to date as the best indicator of future performance and using this data to project the likely project completion date. This is the approach used in Earned Value Management (EVM), Earned Schedule (ES), and Earned Duration (ED). Over the last 20+ years, EVM has been shown to be a reliable predictor of project completion costs, and ES an equally reliable predictor of the project completion date, but running an EVM/ES system[3] involves adding additional processes to your controls system.

The simpler approach proposed in this post is to apply the principles of Work Performance Management (WPM) to a CPM schedule, using 'activity days' as the metric. WPM uses a similar calculation to ES to predict the project completion date, but does not need a full EVM implementation to create the data[4].

WPM is the core component of Project Controls 3.0 (PC-3.0). While WPM can be used on its own as an effective project controls tool, it overall effectiveness is enhanced through the implementation of the PC-3.0 paradigm. PC-3.0 shifts the focus of project management and controls towards delivering success, rather than measuring what has happened. For more on PC-3.0 see: https://mosaicprojects.com.au/PC-3-00-Overview.php#PC-3-Overview

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1 For more on this issue see ***Why Critical Path Scheduling is Wildly Optimistic!*** https://mosaicprojects.com.au/PDF_Papers/P117_Why_Critical_Path_Scheduling_is_Wildly_Optimistic.pdf

2 For more on ***using the schedule for motivation*** see: https://mosaicprojects.com.au/PMKI-TPI-015.php#Process1

3 For more on ***Earned Value Management (EVM) and Earned Schedule (ES)*** see: https://mosaicprojects.com.au/PMKI-SCH-040.php#Overview

4 For more on ***Work Performance Management (WPM)*** see: https://mosaicprojects.com.au/PMKI-SCH-041.php#Overview

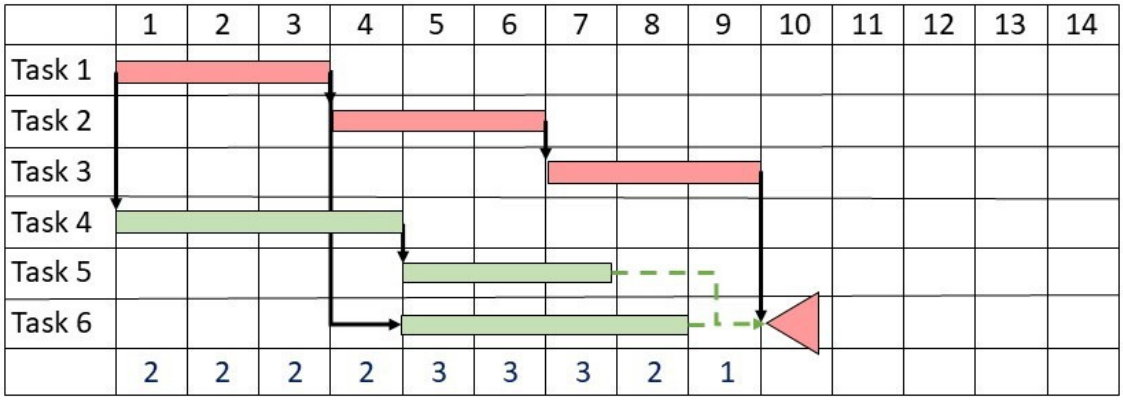
In this example, the metric used for the WPM calculations is the 'activity days' shown on the project bar chart. An activity with a duration of 3 days, has a value of '3 activity days' – one on each day it is scheduled to work[5].

For this example, a simple network is created and a comparison of the CPM analysis and the WPM projection is made at each update.

Setting the Baseline

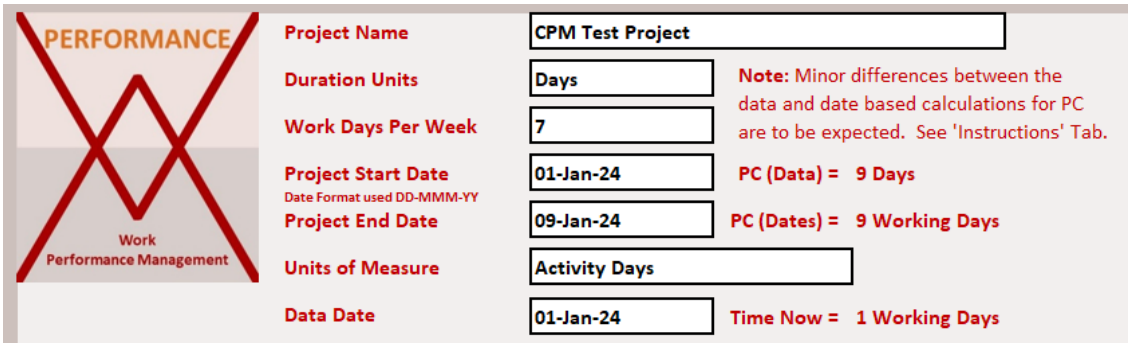
CPM Analysis

The baseline network has six activities (3 critical) with an overall schedule duration of 9 working days. In total, there are 20 'activity days' in the scheduled, and work planned per working day is totalled at the bottom of the bar chart.



WPM Analysis

This schedule data is entered into the WPM tool.
Note: WPM is based on a calendar so the baseline must be set from a date:



The day-by-day totals are then copied from the schedule into the Work Planned (WP) tab:

[5] **Notes:**
- Any duration unit could be used, weeks, hours, etc. All that is required is consistency.
- In this example, the bar chart is generated from a CPM schedule, however, WPM can be used with equal effect to assess the expected completion date for manually drawn bar charts.

PERFORMANCE

Work Performance Management

Work Planned: **CPM Test Project**

Establish your Baseline for Worked Planned at the start of the project (this should not change). The values entered are per Days Between 1 and 14 line items can be entered to establish the plan. Descriptions of the work can be included in the first column. **Variations** to the planned baseline can be added in the 'Variation' section below.

The work units for this project are: Activity Days

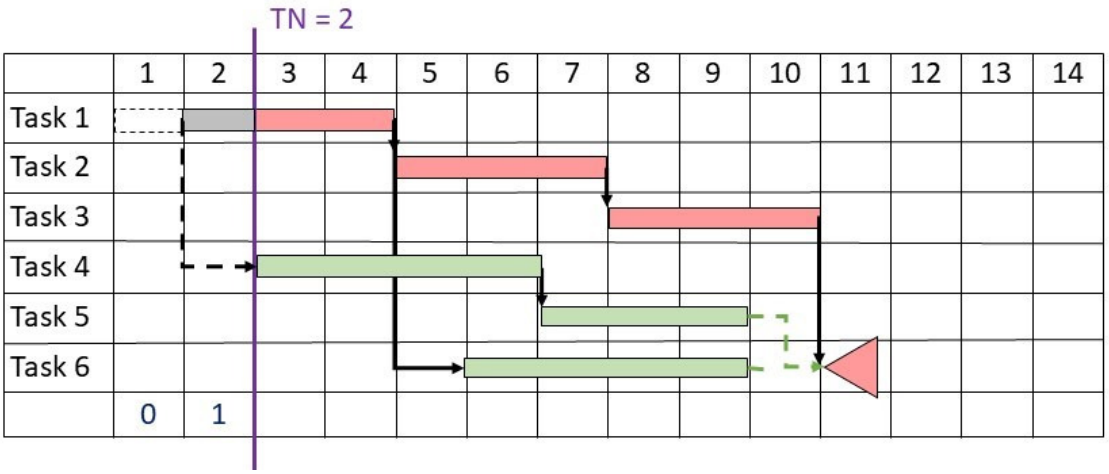
Planned Completion (PC) = 9

Days No.		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Include in PC Count		1	1	1	1	1	1	1	1	1	
Activity Days Cumulative		2	4	6	8	11	14	17	19	20	
Total Activity Days per Days		2	2	2	2	3	3	3	2	1	0
Baseline Work Planned:	Total Allocated										
From schedule	20	2	2	2	2	3	3	3	2	1	
	0										

Update 1, Time Now = 2

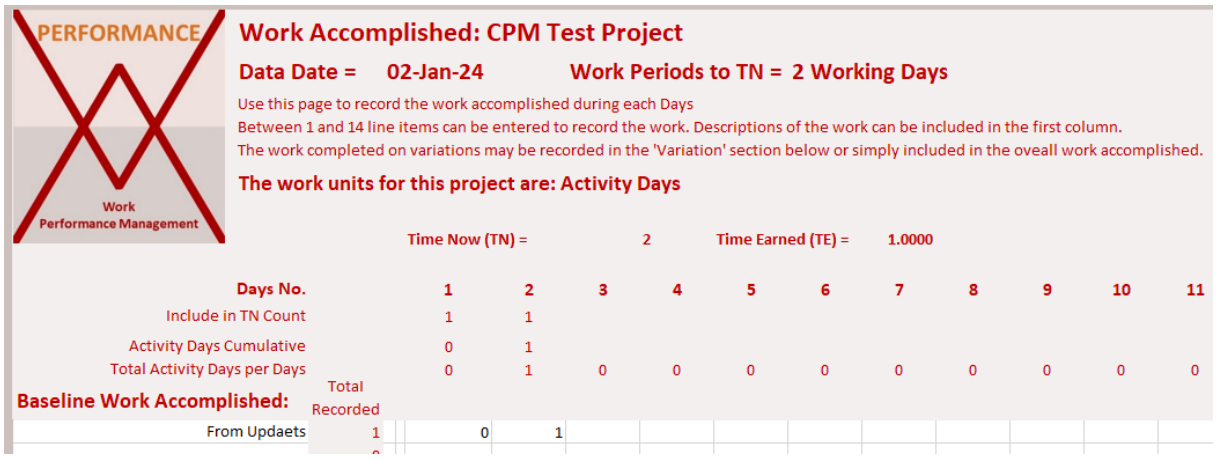
CPM Analysis

As with most projects this one starts slow and is short of resources. The project manager concentrates on the critical activity. The day lost at the start is reflected in a one-day delay to the predicted completion date, the 2 days delay to the non-critical activity has no effect on the predicted completion date:

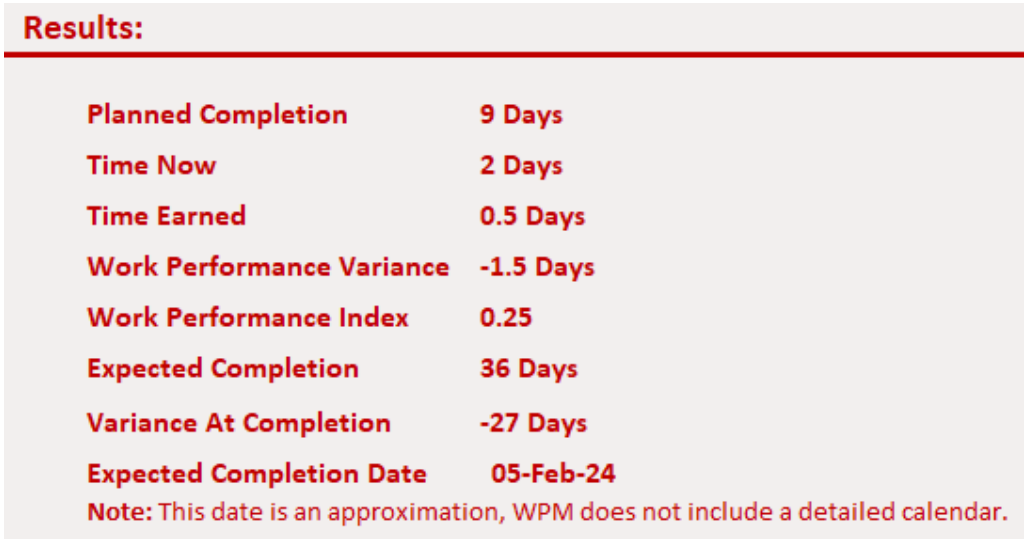


WPM Analysis

The data date of 2nd January is entered on the Master sheet, and the total days achieved for each working day is entered in the Work Accomplished (WA) tab. This is recorded as:



Based on this level of performance the predicted completion date for the project is automatically calculated as:



Only 25% of the schedule work has been accomplished (4 days work planned, 1 achieved). The variance at completion (VAC) and the expected completion (EC) date are calculated based on an assumption the project will continue to only achieve 25% of the planned work into the future.

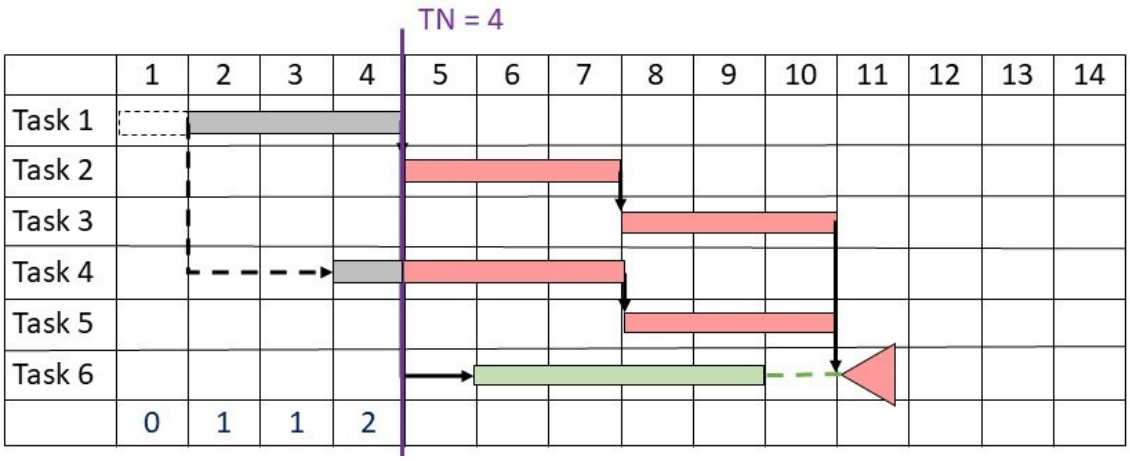
Commentary

These projections are overly pessimistic. Experience from EVM tells us there is a need for 2 or 3 updates before the data settles down. However, we do know the project is more than 1 day behind and something needs to be done to increase the rate of work achieved each day. One hopes management take note on the slow start and resource the project properly.

Update 2, Time Now = 4

CPM Analysis

The resources assigned to the project remain less than planned, with only sufficient people to prevent delays to the critical activities (including Task 4 once it became critical). Consequently, there is no change in the projected completion date:



WPM Analysis

The data date of 4th January is entered on the Master sheet, and the total days achieved for the next two working days are entered in the Work Accomplished (WA) tab. The predicted completion date for the project is then automatically calculated as:

Results:

Planned Completion	9 Days
Time Now	4 Days
Time Earned	2 Days
Work Performance Variance	-2 Days
Work Performance Index	0.5
Expected Completion	18 Days
Variance At Completion	-9 Days
Expected Completion Date	18-Jan-24

Note: This date is an approximation, WPM does not include a detailed calendar.

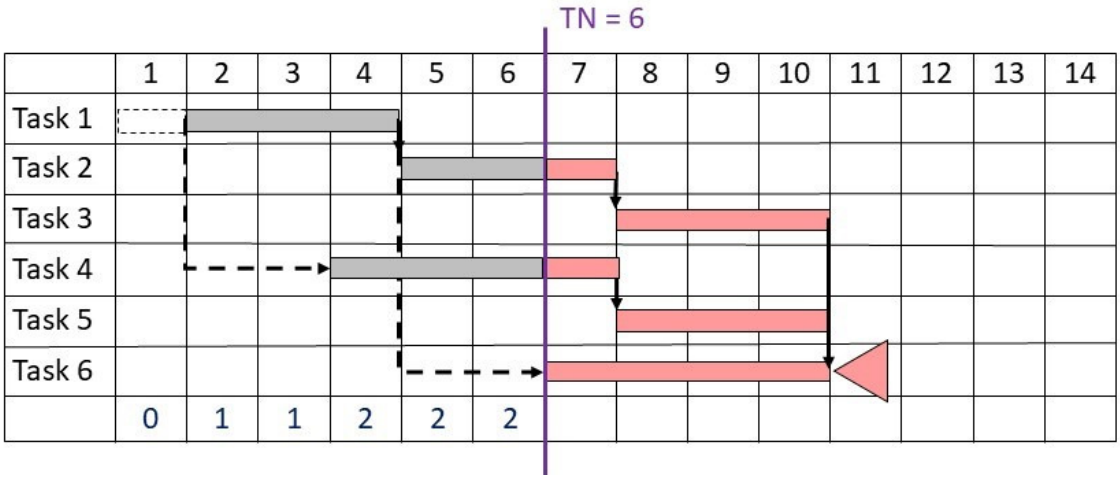
Commentary

Overall, as shown by the work performance index (WPI) the amount of work achieved has increased from 25% to 50%, this improvement is shown in the expected completion and VAC data. However, WPM still shows a major increase in productivity is needed to achieve on-time completion. The current work performance variance (WPV) is double the variance shown by the CPM analysis and is trending in a negative direction.

Update 3, Time Now = 6

CPM Analysis

The project manager has enough resource to hold the line by focusing on the critical activities, but the remaining noncritical activity has continued to be delayed to the point where it has now also become critical but the project end date has not shifted:



WPM Analysis

The WPM spreadsheet is updated and the predicted completion date for the project is automatically calculated as:

Results:

Planned Completion	9 Days
Time Now	6 Days
Time Earned	4 Days
Work Performance Variance	-2 Days
Work Performance Index	0.6666667
Expected Completion	13.5 Days
Variance At Completion	-4.5 Days
Expected Completion Date	13-Jan-24

Note: This date is an approximation, WPM does not include a detailed calendar.

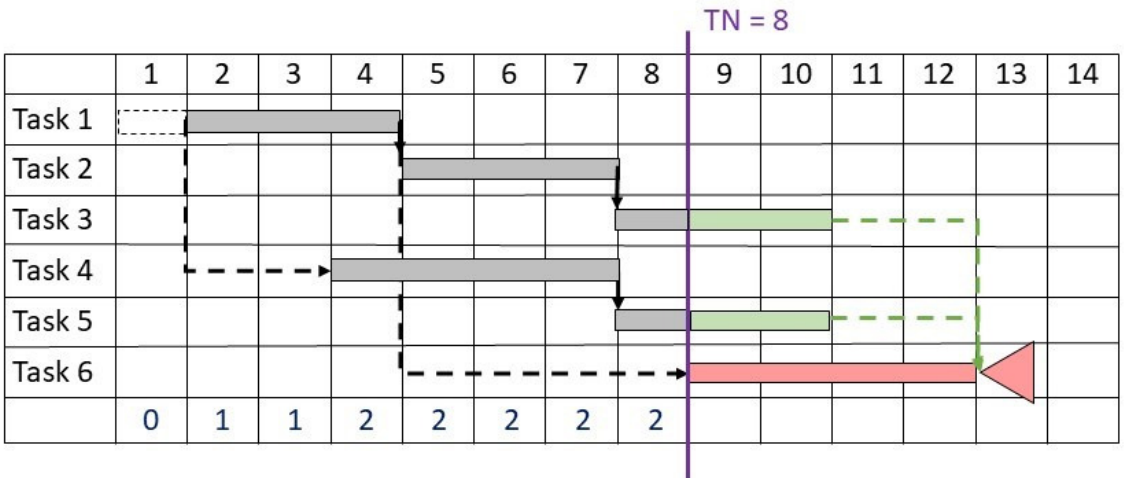
Commentary

The trend in the at completion data is improving (the very poor performance at the first update is becoming less significant), but the expected completion date is still significantly later than that shown by the CPM analysis.

Update 8, Time Now = 8

CPM Analysis

The project cannot obtain more resources and the project completion slips two days in the next two days.



WPM Analysis

The WPM spreadsheet is updated and the predicted completion date for the project is automatically calculated as:

Results:

Planned Completion	9 Days
Time Now	8 Days
Time Earned	5.3333 Days
Work Performance Variance	-2.6667 Days
Work Performance Index	0.6666667
Expected Completion	13.5 Days
Variance At Completion	-4.5 Days
Expected Completion Date	13-Jan-24

Note: This date is an approximation, WPM does not include a detailed calendar.

Commentary

The WPM predicted completion date remains the 13th January whereas the CPM date as shifted back to the 12th – CPM is still more optimistic.

From a WPM perspective, there are a number of options to complete the project from here but based on the production rate achieve to date, the end date should not slip any further. There are 8 'activity days' work to complete and at the established production rate of 2 'activity days' per day, and 4 days remaining 2 x 4 = 8. However, the slow down at the end of the project may extend this time by a day or so.

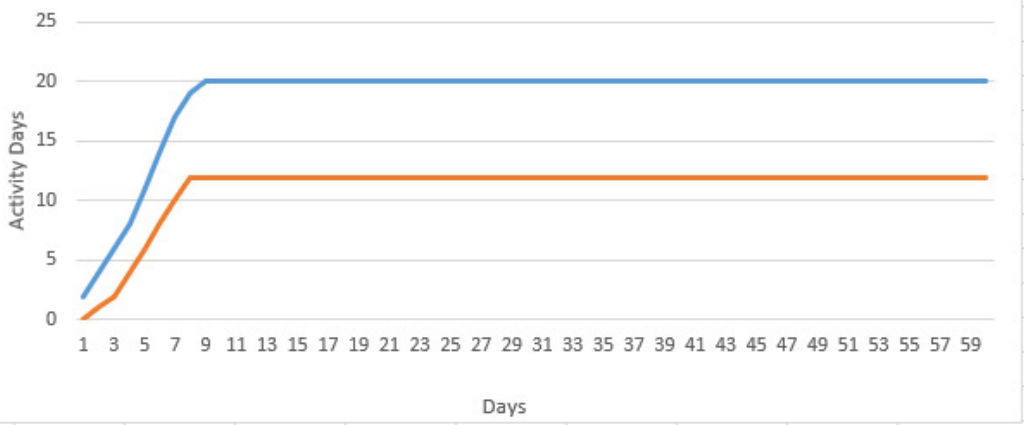
The WPM report as at Day 8 (8th January) shows:

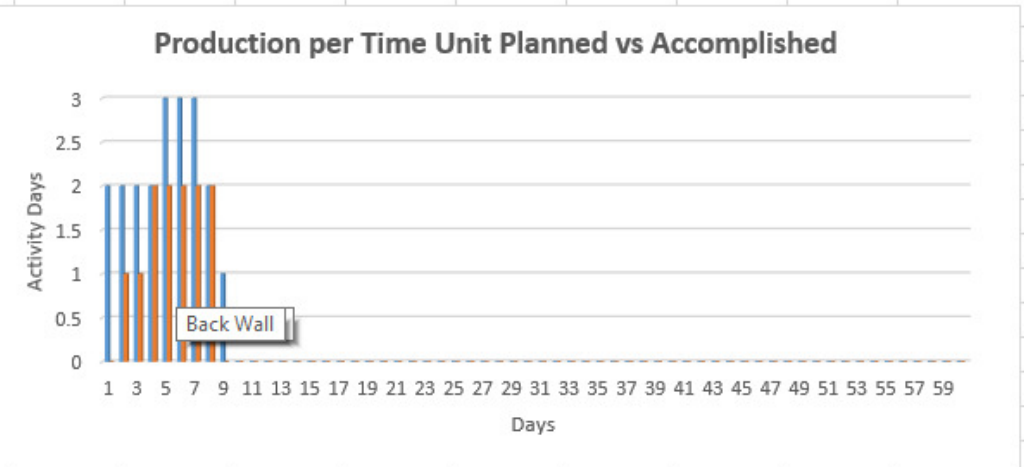
CPM Test Project

Time Now = 08-Jan-24

Planned Completion	9 Days
Time Now	8 Days
Time Earned	5.3333 Days
Work Performance Variance	-2.6667 Days
Work Performance Index	0.6667
Expected Completion	13.5 Days
Variance At Completion	-4.5 Days
Expected Completion Date	**13-Jan-24**

Note: This date is an approximation, WPM does not include a detailed calendar.





Summary

Overall, this project has been managed effectively with the available resources, but it is only at day 8, the 89% completion point that CPM predicts a likely completion date that may be achieved (and may not), before this point, the CPM completion was showing an optimistic completion date of day 10.

The more pessimistic predictions from WPM highlight the disastrous start and the steady overall improvement in the situation. Once the project 'stabilises' (EVM data suggests this occurs around the 20% stage on major projects), the predicted completion from WPM is relatively consistent.

The CPM calculations may be different if resource levelling was used but the same optimistic bias outlined at the beginning of this article remains. If resource levelling is used, the resource dates should be used to set the WPM baseline.

Alternatively for a richer view of the data, a second spreadsheet based on the CPM time analysis 'late dates' can be set up and its predictions compared to those from the early date spreadsheet used in this example.

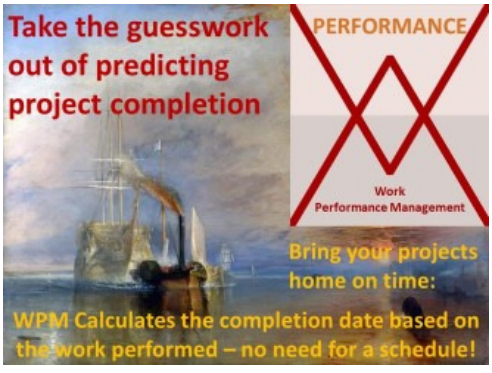
Conclusions

WPM is designed to give early warning of productivity problems; it is not an alternative to CPM on projects where CPM can be effectively used.

The effort to set up and run WPM is relatively low all that is needed is a tabulation of days planned and the day's work achieved at each update for the system to work.

The value of WPM is stripping away the optimism bias inherent in CPM scheduling (particularly early in the project). This provides management with a clear indication of where the project is likely to finish if work continues at the current levels of productivity. These predictions are not a statement of fact, change the productivity and you change the outcome!

Management is unlikely to take action if they cannot see a problem. WPM highlights productivity issues far sooner than CPM. Consequently, WPM is seen as a valuable addition to projects running CPM schedules as their primary control tool. The CPM schedule focuses is on ensuring the 'right work' being done, the WPM calculation tells you if enough work being done – both sets of information are needed for effective management.



Try WPM on your projects:

The ***Easy WPM Workbook***, is a practical spreadsheet that performs the calculations needed to implement Work Performance Management (WPM) to accurately calculate the status and projected completion of your projects.

Download the free sample files, or buy the ***WPM Workbook*** and instructions for use for **$20** (plus GST for Australian purchasers only), from:
https://mosaicprojects.com.au/shop-easy-WPM_WS.php

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