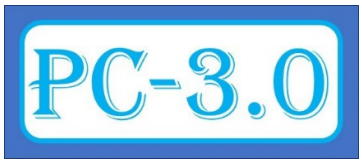
WPM for Lean & Distributed Projects

Introduction

This article looks at the challenge of predicting the likely completion date in distributed projects and other construction projects using ***lean*** management approaches. Traditional approaches to scheduling using the critical path method (CPM) are fundamentally incompatible with these types of projects.

These two types of project differ, lean is a management choice, whereas distributed projects are a physical fact. Both types are defined as Class 3 projects in ***Scheduling Challenges in Agile & Distributed Projects***[1]. Class 3[2] projects typically have some degree of overarching constraint – there is a required overall sequence of working, with a degree of flexibility in the way the detailed work is performed to achieve the overall objectives. The degree of flexibility varies from project to project, but because there is an innate capability for management to re-sequence some of the work relatively easily. This means the scheduling assumption built into CPM that there is one best way of doing the work, that can be defined at the start, fails.

Various techniques can be used to plan future work in both lean and distributed projects, but the focus on continuous improvement and need for flexibility to overcome issues means most of these techniques are not good for predicting project completion[3].



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] Download ***Scheduling Challenges in Agile & Distributed Projects*** from:
https://mosaicprojects.com.au/PDF_Papers/P208_Scheduling_Challenges_in_Agile_+_Distributed_Projects.pdf

[2] Project classes used in these papers are:
- **Class 1**: Physically constrained – there is only one viable work sequence
- **Class 2**: Practically constrained – management decisions create the one best work sequence
- **Class 3**: Overarching constraints – there is a required overall sequence of working, with a degree of flexibility in the way the detailed work is performed to achieve the overall objectives
- **Class 4**: Arbitrary constraints – there is no required sequence of working (as in Class 1 or 2), but management has decided to impose a detailed sequence of work as a matter of choice.

[3] Techniques for controlling this type of project are discussed in ***Calculating Completion***:
https://mosaicprojects.com.au/PDF_Papers/P217_Calculating_Completion.pdf

The concept of ***Work Performance Management*** **(WPM)**[4] closes this gap. WPM uses the amount of work completed to date, compared to the amount remaining, to calculate the likely completion date with a high degree of reliability.

Lean Construction Management

Lean construction is a project delivery process that uses Lean methods to maximize stakeholder value and reduce waste by emphasizing collaboration between everyone involved in a project. The core objective is to plan the project to deliver a continuous flow of work for most of the resources, most of the time (continuous flow process or CFP). Key in these CFPs is that work gets done in small chunks. Each chunk is involved in one production task (or operation) at a time and, once processed, the chunk is made available for the next production tasks. The 'chunk' may be a space (eg, a room) or an artefact.

Control is achieved by ***pull planning,*** a collaborative scheduling approach that starts with team members and asks them to identify project milestones. When this is done, work backward and add the details and requirements to the scheduling. Everyone involved in the project is encouraged to speak up and offer suggestions about how processes can be improved as part of a continuous process.

Continuous improvement means, always thinking of ways to make the process better, which is the responsibility of everyone from the owner down to subcontractors. This can mean adapting the CFP mapping a dozen or more times. As in agile projects, the team decide what to do next, updating the plan at relatively short intervals with a view to optimizing productivity and delivering the project is the shortest overall time. Lean construction seems to work, but it is the antithesis of CPM scheduling.

Lean advocates suggest their approach can be applied to any type of construction or engineering project. While not wishing to enter into this debate, the simple fact is traditional CPM and lean are mutually exclusive. Construction projects using the traditional CPM approach to management and control have a predetermined schedule that can be used to predict completion, projects applying lean need a similar predictive tool, and as demonstrated below, WPM is a viable option.

Distributed Projects

Distributed projects are ones where the physical distribution of the elements to be constructed means significant amounts of the work can be done in any sequence and changing the sequence when needed is relatively easy.

[4] For ***a general description of WPM*** see: https://mosaicprojects.com.au/PMKI-SCH-041.php#Overview

Some examples include:

- Infrastructure upgrades (eg, replacing asbestos telecom pits)
- Computer hardware upgrade / replacement across 100s of desktops
- Some housing projects, particularly subdivision works
- Constructing windfarms[5] (on-shore or off-shore)
- Normal road maintenance work in a city

The characteristics of distributed projects are:

- The work sequence is relatively easy to change
- Management focus should be on optimizing resource workflows
- Control is based on key resource productivity
- Access to the next 'task' for each resource crew is based on conditions precedent (constraints), not mandated logic.

For example, to remove 200 asbestos cement telecom pits in a suburb, and replace them with plastic pits you need:

- Somewhere to dispose of the old pits (asbestos hazard)
- The new pits to install (procurement)
- Trained people and the right equipment

But the actual replacement work can be done in almost any sequence.

Efficient workflows still need appropriate planning and preparation at each location ensuring:

- Everything is ready to start at the next location
- Relocation / travel distances are optimized
- Work at a location is done in the correct sequence

Constraints may affect each task and the overall project

- Some constraints affect the whole project
    - Planning approvals
    - Design and approvals
    - Safe work procedure approvals

[5] See the discussion on ***managing Windfarm construction in Scheduling Challenges in Horizontally Distributed Projects*** (starting page 8): https://mosaicprojects.com.au/PDF_Papers/P208_Scheduling_Challenges_in_Distributed_Projects.pdf

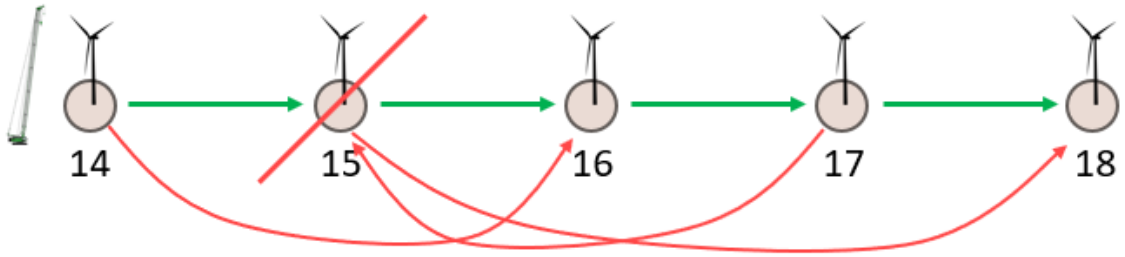
  - Resource and supply contracts / agreements / deliveries
- Some affect the ability to complete a task
  - Access to the specific work area
  - Supply of components
  - Internal sequence of working

The degree of flexibility open to management for the re-scheduling of work varies from project to project and is influenced by the management approach and capabilities.

CPM Limitations in Distributed Projects

The core concept underlaying CPM is there is one best way to undertake the work of the project and this can be accurately modelled in the CPM schedule. Therefore, the model can be used to assess the consequences of any deviation from the plan and predict the revised project completion date.

This theory fails as soon as the sequence of work becomes relatively easy to vary. **For example**, the main crane working on tower erection is currently planned to erect the towers in the sequence 14, 15, 16, 17, and 18. The crane has just finished Tower 14 and is derigging ready to relocate to Tower 15 when a major defect is identified in a component for Tower 15 preventing the tower being completed. Defect rectification is expected to take 4 days.



In a CPM schedule, the delay of 4 days to Tower 15 would flow through and show as a 4-Day delay to the completion of the project. But, in a distributed project while there will be some delays, the sequence of work could be revised to 14, 16, 17, 15, 18, and any delays will be caused by inefficiencies and extended travel distances. The ability to change the sequence and its consequences will depend on the specific circumstances of the project, at the time of the delay. This flexibility invalidates the CPM paradigm[6]:

- The short-term resequencing needs management agility
- Calculating the effect on overall progress and the project completion needs a different approach.

Applying WPM to Lean and Distributed Projects

Calculating Completion

Most of the tools and techniques used to manage lean and distributed projects are good at defining the work (done, in-progress, or not started) and can indicate if the work is ahead or behind a nominated

[6] The legal and contractual implications of this type of challenge in distributed projects is analyzed in ***Assessing Delays in Agile & Distributed Projects***: https://mosaicprojects.com.au/PDF_Papers/P215_Assessing_Delays_In_Agile_+_Distributed_Projects.pdf

planned rate of production, but in the absence of a valid CPM schedule there is no direct calculation of the time the work is currently ahead or behind schedule, or what this is likely to mean for the completion of the project.

Where Earned Value Management (EVM) is used the Earned Schedule (ES) extension to EVM will provide a reliable and repeatable calculation of the current status and consequently the projected completion date. The problem is implementing EVM is a significant challenge for most organizations, and very few projects are managed using EVM and ES[7].

Work Performance Management (WPM) has been designed to solve this challenge. It uses the same concept as Earned Schedule, but is a simple, practical tool that uses project metrics that are already being used for other purposes. The function of WPM is to assess progress and calculate a predicted completion date in a consistent, repeatable, and defensible way by comparing the amount of work achieved at a point in time with the amount of work planned to have been achieved. Based on this data WPM calculates the project status and the expected completion date assuming the rate of progress remains constant.

All the project needs to know to implement WPM is how much work it has to do, when the work needs to be done by, and how much has actually been accomplished. Provided the 'work' is measured in a consistent way, the WPM calculations will be consistent and reliable. Options for measuring the work include planned cost (PV and EV), planned hours of effort, a physical count of the work produced, or any other easily available metric.

Applying WPM to a Distributed Project


Scheduling the planned work should be as realistic as possible, but in many situations a straightforward pragmatic approach will suffice.

This sample project is the replacement of 200 asbestos-cement telecommunication pits with modern 'plastic' pits to remove the asbestos hazard. Work involved:

- Prerequisites:
  - Somewhere to dispose of the old pits (asbestos cement is a hazardous material)
  - New pits to install (procurement)
  - Trained people
  - Notice to home owners before work in their street
- Repetitive element

[7] For ***more on EVM and ES*** see: https://mosaicprojects.com.au/PMKI-SCH-040.php#Overview

- Remove old fibro cement pits (asbestos hazard)
  Note: the underground conduits (ducts) are not being replaced
- Replace with new 'plastic pits'
- Tidy up the area

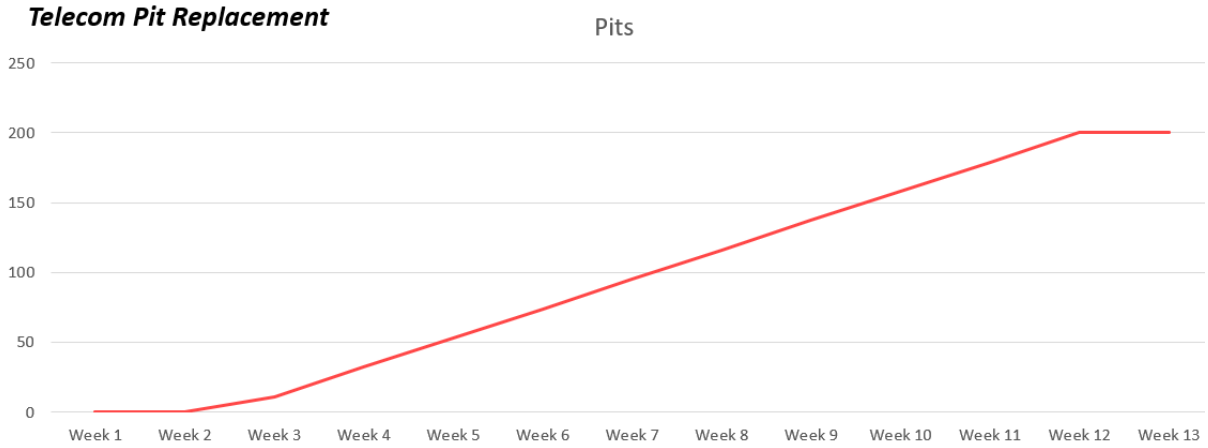
- Finalize the project.

The repetitive work of replacing the pits can be done in almost any sequence.

Consider the schedule needed for this project, given a contract period of 13 weeks (3 months) to replace the 200 pits:

- Allow 2 weeks for initial procurement and training
- Allow 1 week for initial on-the-job learning – 11 pits only
- Allow 1 week at the end for project finalization
- Therefore 9 weeks are left to install 189 pits = 21 per week.

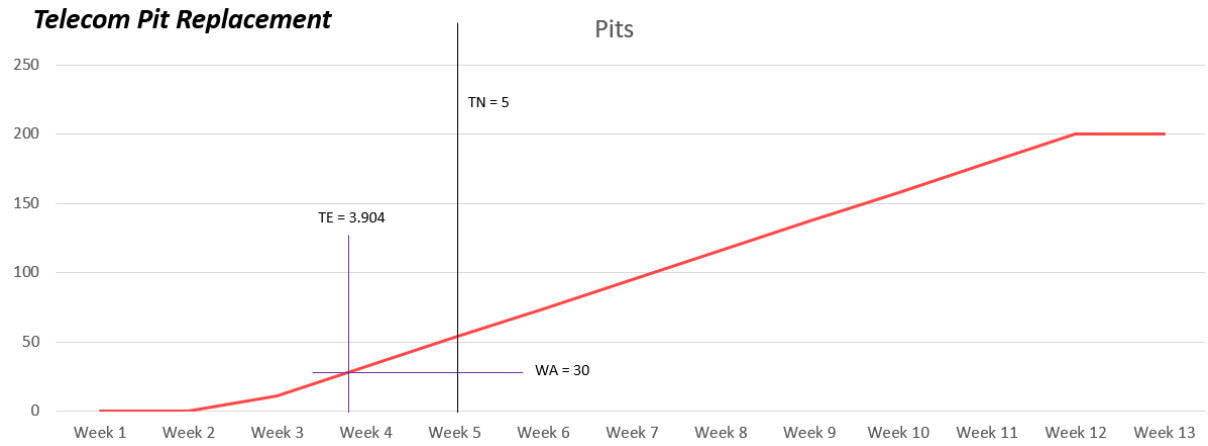
This produces the following cumulative graph:



Then to assess progress at a point in time all that is needed is a count of the pits completed.

The measured progress at the end of Week 5 shows:

- Time Now = 5 **TN = 5**
- The actual progress is measured as 30 pits complete **WA = 30**
- The planned progress at Week 5 was 53 pits complete **WP = 53**



Time Earned (TE) is calculated on the assumption that the work within a week is a 'straight line' from the start of the week to the end. The time 30 pits were planned to be complete occurs at some point in week 3:

- 11 pits were planned to be complete at the start of week 3 (end of week 2) **TE = 3.???**
- The remaining 19 pits were completed during week 3, and the planned production rate is 21 pits per week. Therefore, the fraction of week 3 needed to achieve 30 pits is: 19/21 = **0.905**
- Therefore: **TE = 3.905**

We now have the data needed to calculate the work performance measures:

Work Performed Variance (WPV)
WPV = 3.905 - 5 = -1.095 Progress is currently 1.095 weeks behind schedule (just over 1 week late)

Work Performed Index (WPI)
WPI = 3.905/5.0 = 0.781 Less work is being done than planned.

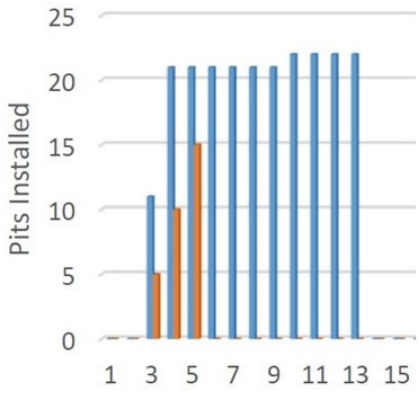
Based on the WPI, the predicted project completion (Expected Completion or EC) is calculated as:

EC = PC/WPI 13/0.781 = 16.645 weeks

The project is expected to complete 16.645 - 13 = 3.645 weeks (or 3 weeks 3 days) late based on a 5-day week. This prediction assumes no management action is taken to improve performance.

These calculations are embedded in the WPM Excel spreadsheet to make assessing progress quick and easy:

WPM Update Report



Work per Time Unit

A free sample version of the ***Easy WPM Workbook*** containing this data can be downloaded from: https://mosaicprojects.com.au/shop-easy-WPM_WS.php

Conclusions

WPM is designed to fill an identified gap in the management of lean and distributed projects. It is designed to be a simple robust performance measurement system that will provide an accurate assessment of how far ahead or behind plan the work currently is, and based on this information, the likely project completion date assuming work will continue at the current rate.

The two requirements to implement WPM are:

- A consistent metric to measure the work planned and accomplished, and
- A simple but robust assessment of when the work was planned to be done

The metric used can be a core deliverable (eg, 2000 computers replaced in an organization), or a representation of work such as the $ value of the work extracted from the project budget. Peripheral and support activities can usually be ignored when establishing the WPM metric, they rarely impact the project delivery independently; failures in the support areas typically manifest in delays to the primary delivery metric.

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

Other papers in this series:

1. **WPM Overview**: https://mosaicprojects.com.au/Mag_Articles/AA037_-_Overview_of_WPM.pdf
2. **How WPM Works**: https://mosaicprojects.com.au/Mag_Articles/AA038_-_How_WPM_Works.pdf
3. **WPM solves CPM optimism**: https://mosaicprojects.com.au/Mag_Articles/AA039_-_WPM_solves_CPM_optimism.pdf
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