Core Scheduling Papers: #3

Dynamic Scheduling

Diagrammatic representations of activities or events plotted against a time axis has been around since the mid eighteenth-century[1]. For the first 200 years, static bar charts were the norm; dynamic schedules were only developed in the late 1950s. Unfortunately, despite the many advantages offered by a well-constructed dynamic schedule, by the mid-1990s most schedules had reverted to static displays[2].

A schedule consists of series activities to create the project's deliverables, dependencies between the activities (either inferred or as part of the model) and perhaps some hard dates. The way the schedule is created determines if the schedule is rigid or dynamic. If you enter the activities as 'fixed bars' in a Gantt Chart view (the default way of working in Microsoft Project and a number of other tools) fixed dates are created and you will end up with a rigid schedule; a Bar Chart or a Gantt Chart[3]. Skilled schedulers know the core value of a CPM schedule lays in its ability to dynamically model data.

Dynamic CPM Schedules[4]

A properly developed CPM schedule is a 'dynamic schedule'. However, a schedule is only dynamic if it can be easily kept up-to-date when you are busy during project execution – this is not just a fashionable term, it is critical to effective project management. So, whilst by definition a CPM schedule is a dynamic model, this can only be achieved if the schedule meets the following requirements:

---

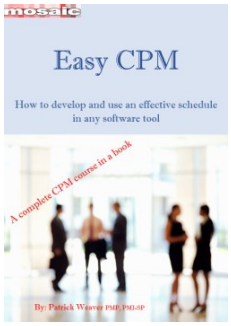
1 For more on the ***History of Scheduling*** see: *A Brief History of Scheduling*: https://mosaicprojects.com.au/PDF_Papers/P042_History_of_Scheduling.pdf

2 Weaver. P. (1995) ***Barcharts and Networks – a world of difference***. AIPM National Conference, Adelaide.

3 These terms are essentially the same. The name 'Gantt Chart' is technically incorrect but widely used, see: https://mosaicprojects.com.au/PDF_Papers/P173_misuse-terms-gantt-PERT.pdf.

4 From more on ***creating a CPM schedule*** see: *Scheduling Good Practice*: https://mosaicprojects.com.au/PMKI-SCH-010.php

---



This series of 'core scheduling papers' are designed to complement Mosaic's ***Easy CPM*** course-in-a-book.

To preview and buy the book, see: https://mosaicprojects.com.au/shop-Easy_e-Books.php

- All the relationships between the tasks that may impact the flow of the work are built into the model[5]. These relationships are called 'dependencies':
    - Every Activity and Milestone should be connected from its start to at least one predecessor and can trace its logical predecessors to the Start Milestone and from its finish to at least one successor and can trace its logical successors to the Finish Milestone
    - There are no 'dangles' or 'open ends'
- The number of hard dates (constrained dates) in your schedule are minimised and represent 'real' constraints such as contracted completion dates.

Creating a logically interconnected CPM schedule takes more time and effort that creating a simple static Bar Chart (or Gantt Chart). Therefore, the legitimate question to ask is; why is this important, and what is the payback?

Potential Gains from Dynamic Schedules

Projects are dynamic, many changes occur in every project. If the schedule is to remain useful (ie, realistic), every time a change happens, you need to change your schedule to reflect the new reality. This is usually managed as part of a planned status/update cycle once a week, or once a month depending on the size of the project[6].

Static Bar Charts require a significant effort to update – every change needs to be manually flowed through the whole schedule. For this reason, skilled schedulers[7] normally only use Bar Charts for short term 'Level 5' schedules[8] to plan and coordinate work in a small part of a project for the next one or two weeks. At the end of each period, the schedule is simply replaced with a new one.

Network logic within the overall project schedule tends to basically stay the same during the entire project, update the activities impacted by a change and the consequences flow realistically throughout the balance of the logic network; do the logic once well[9], and your schedule maintenance becomes relatively easy!

Eric Uyttewaal PMP, in his book *Dynamic Scheduling With Microsoft® Office Project 2003*, offers the following evaluation of maintaining a 'dynamic' -v- 'static' schedule:

> *Let's see if we can approximately quantify how much time you gain with applying the principle of dynamic scheduling and how much time you have to invest to make the model dynamic. Imagine a schedule with 100 tasks. It will take approximately 8*

---

5 For more on ***dependencies*** see: *Links, Lags & Ladders*: https://mosaicprojects.com.au/PDF-Gen/Links_Lags_Ladders.pdf

6 For more on ***updating***, see *'Managing for Success - The power of regular updates'*: https://mosaicprojects.com.au/PDF_Papers/P002_MFS_Full.pdf

7 For more on this see: ***The Roles and Attributes of a Scheduler*** at: https://mosaicprojects.com.au/PDF-Gen/Attributes_of_a_Scheduler.pdf

8 For more on this see: ***Schedule Levels*** at https://mosaicprojects.com.au/PDF-Gen/Schedule_Levels.pdf

9 ***Validating schedules for correctness*** is a largely automated process if you have the right tools, see: https://mosaicprojects.com.au/PMKI-SCH-020.php

hours of effort to discuss, identify and set all the dependencies and make the model dynamic.

How many changes occur? This is the hard question. We do know for sure that each task needs to be updated at least once, and about 30% of them twice. This already results in 130 changes to the schedule, if you enter them all individually. Other changes that typically happen in projects are:

- *Clients change their mind on requirements*
- *Deliverables are dropped; others are added*
- *Activities that were overlooked are inserted*
- *Activities that cannot be done are dropped*
- *Resources get sick or are reassigned*
- *Resources are interrupted with higher priorities*

Let's be conservative and say that these things cause 50 more changes, to a total of 180 changes for a 100-task schedule.

Entering 180 changes in a dynamic model would take you about 8 hours, since you only need to revise one (or two) fields for each change.

Entering 180 changes in a static model will require you to review the rest of the schedule every time. Therefore, you have to review and adjust on average 50 tasks in a static schedule with every change. If adjusting 50 tasks takes you about 2 hours for each change, the total time spent to keep the schedule alive will be 180 x 2 = 360 hours.

Working with a static schedule becomes a fulltime job and does not allow project managers to help their team members any longer. What you will see in practice therefore is that people who work with static schedules get smart and enter 5 changes at a time and only then review the rest of their schedule. In other words, they update their schedule only 180 / 5 = 36 times instead of 180 times.

Notice that the schedule is not up-to-date all the time any longer. Even in this case, they will spend at least 36 x 2 = 72 hours on their schedule.

The difference in effort spent on a static schedule versus a dynamic schedule is at least: 72 – (8 + 8) = 56 hours for a 100-task schedule, which is the gain you can expect from applying the principle of dynamic scheduling.

The expected gains calculated by Uyttewaal from applying the principle of dynamic scheduling to a 100 activity Microsoft Project schedule is 56 Hours. Whilst we do not fully concur with many of the items in his 'list of changes', the principle argued is very sound and if routine status/updating is being used the number of changes in a well-maintained schedule are likely to be greater (rather than fewer) as the actual progress on tasks is managed along with the changes.

Other key benefits of a dynamic schedule include:

- It is much easier it is to develop scenarios with a dynamic model as opposed to a static model.

- Every time the project slips during a 'status update', you will have to develop solutions to minimise the effect of the slippage; the dynamic model will be much more helpful than a static model.
- The schedule creation process forces the project team to work through the project and develop a logical roadmap for the efficient execution of the work. This thinking process can save a fortune once the actual work starts by anticipating and avoiding production issues.
- You create the schedule model (including dependencies) during the planning phase of the project when you have less time pressures than during the execution phase.

Creating a realistic and achievable schedule is a skilled art. Most project managers have neither the time (they should be managing the project) nor the inclination to become skilled schedulers. This should not be an issue if the 'performing organisation' responsible for the overall governance of the project develops an efficient PMO[10]. A skilled scheduler can easily support five or six medium sized projects and is best positioned in the PMO as a project support service[11]. On major projects the scheduler becomes an important part of the overall project management team.

To achieve the maximum benefit from 'dynamic scheduling' organisations will need to invest in training and potentially certification[12] to ensure that their schedulers and project managers apply the principle of dynamic scheduling properly and that people adjust their behaviours and habits to create 'good' schedules[13] and reap all of the potential rewards.

Maintaining Dynamic Schedules

Dynamic Scheduling is the process of absorbing the effect of real-time events, analysing the current status of schedule, and modifying the schedule to mitigate disruptions. In their paper *What is dynamic scheduling?*, the authors[14] outline a series of options for this based on manufacturing. The practical options from this paper for project scheduling are:

---

[10] For more on ***project governance and PMO's*** view a range of papers at:
- Project Governance papers: https://mosaicprojects.com.au/PMKI-ORG-005.php#Process3
- PMOs: https://mosaicprojects.com.au/PMKI-ORG-045.php

[11] The ***'value proposition'*** of an effective scheduler is outlined in : *The Roles and Attributes of Scheduler* at https://mosaicprojects.com.au/PDF-Gen/Attributes_of_a_Scheduler.pdf

[12] For more on training for schedulers see ***Easy CPM***: https://mosaicprojects.com.au/shop-easy-cpm.php

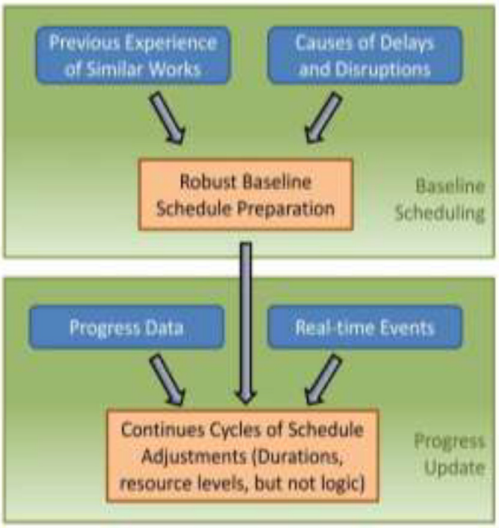
[13] From more on ***creating a 'good schedule'*** see: *Scheduling Good Practice*: https://mosaicprojects.com.au/PMKI-SCH-010.php

[14] *What is Dynamic Scheduling?* Amer Fahmya, Tarek M. Hassanb, Hesham Bassionic. PM World Journal, Vol. III, Issue V – May 2014 http://pmworldjournal.net

Robust pro-active scheduling: This scheduling approach is based on building predictive schedules with the main causes of disruption integrated into the schedule.

This concept is similar to the statusing and updating of a program, including adjusting future activities to accommodate identified 'real-time' events (risks).

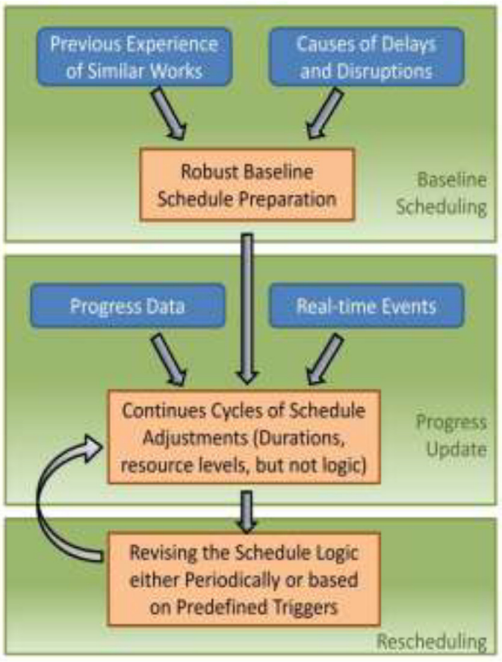
'Updating' has been part of CPM since the 1960s but is traditionally limited to near term adjustments.



Predictive-reactive scheduling: This is the most common Dynamic Scheduling approach used in manufacturing systems and includes updating the schedule logic.

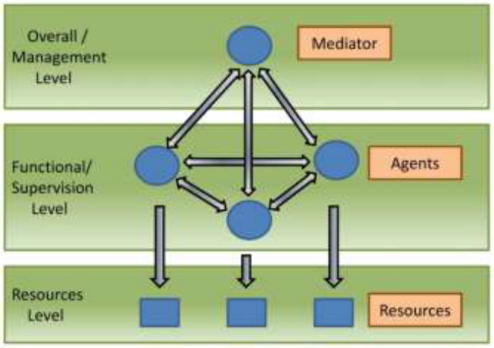
This approach is a standard CPM status/update with the addition of adjusting forward durations based on progress to date.

These are core elements of the 'schedule density' methodology as defined by the CIOB[15] in 2011.



[15] For more on ***schedule density*** see: https://mosaicprojects.com.au/WhitePapers/WP1016_Schedule_Density.pdf

The management framework for implementing dynamic scheduling / schedule density can either be through a central 'agent' (eg, a PMO or project scheduler) or distributed. The advantage of a distributed model is quicker local decisions coordinated though a central agency. This option can be particularly effective if schedule levels are used[16] within a carefully designed schedule structure.



The similarities between scheduling in a manufacturing environment, and in a project, environment, go back a very long way. Henry Gantt's work was focused on improving the efficiency of operations within factory machine shops[17].

The papers in this series:

A Guide to Scheduling Good Practice: https://mosaicprojects.com.au/PDF-Gen/Good_Scheduling_Practice.pdf

Attributes of a Scheduler: https://mosaicprojects.com.au/PDF-Gen/Attributes_of_a_Scheduler.pdf

Links, Lags & Ladders: https://mosaicprojects.com.au/PDF-Gen/Links_Lags_Ladders.pdf

Schedule Float: https://mosaicprojects.com.au/PDF-Gen/Schedule_Float.pdf

---

[16] For more on ***schedule levels*** see: https://mosaicprojects.com.au/PDF-Gen/Schedule_Levels.pdf

[17] For more on the work of ***Henry Gantt*** see: https://mosaicprojects.com.au/PMKI-ZSY-025.php

Schedule Levels: https://mosaicprojects.com.au/PDF-Gen/Schedule_Levels.pdf

Schedule Calculations: https://mosaicprojects.com.au/PDF-Gen/Schedule_Calculations.pdf

---

First Published 17th February 2008 – Augmented and Updated