

Making CPM More Transparent

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ABSTRACT

This paper presents several new ideas that users of CPM software should demand of their software suppliers to increase transparency. These ideas are offered without claiming legal copyright as a gift to the professional scheduling community in hopes that some or all will be adopted by existing and new software developers to improve their product. The Author of this paper is a well-known CPM software developer who has invented dozens of new CPM concepts.

INTRODUCTION

Some people have said that the newer features of modern CPM schedules confuse more than help and allow for bad schedules.[1] Some even believe that these features are the cause of bad schedules. They advocate the return to simple ADM without constraints and multiple calendars. Moving 'backward in time' ignores the realities of today's modern scheduling world.

Another approach offered is better training. A cursory review suggests that this is a partial solution offered by those who are already better trained. Sadly, companies often expect scheduler training to be earned before hire and do not see the need for funding further training. The reality is that every year, thousands of new people are introduced to CPM scheduling without training and we need to consider this fact in our equation.

A third solution is to improve the CPM tools that we use. By this, I don't mean making the software easier to use. That, in itself, has not led directly to better scheduling. [1] We need better measurement and more transparency with the CPM software that we currently use. [2] Longest Path Value [3] and Enhanced PDM [4] are two such new concepts that are designed to improve the measurement of criticality. The problem is that new algorithms tend to turn CPM scheduling software into 'black boxes' where the User does not understand the process being employed.

Instead of better measurements, a more useful approach would be to better explain the processes currently being used so that the casual observer can understand the underlying factors. Reports and graphs should educate, not mislead the reviewers.

This paper is inspired and is an extension to the paper presented by Mark Sanders called, "Transparent CPM." [5] In his paper, Mark stated that with added flexibility in CPM software comes the need for added transparency. Mark's excellent paper proposed new logic matrix layouts and a PERT-like view of logical relationships used.

OVERVIEW

This paper presents 24 new ideas that users of CPM software should demand of their software suppliers to increase transparency. I offer these ideas without claiming legal copyright as a gift to the professional scheduling community in hopes that some or all will be adopted by existing and new software developers to improve their product. Perhaps a trademark could be awarded just like that proposed for RDCPM™ [6] to software companies who's CPM software meets all of the standards listed here.

Not all of the ideas presented here are completely new and unused. Some have been implemented by some software manufactures in an incomplete, or less than perfect fashion. When reviewing the various issues below that need qualifying indicators, also keep in mind that each indicator symbol for a particular issue should be unique and not confused with the others. A single "*" to indicate that 'something odd is happening here' is insufficient help to a confused Scheduler.

NEEDED FEATURES

Printable Holiday Lists. While all professional CPM software will produce some sort of a calendar report, none simply list out all holidays for reference. The graphic display of actual calendars with both workdays and holidays is interesting, but of little use on most large projects. A typical project produces tens of pages producing such a report.

What is needed is a short, concise list of holidays that can be used by a Scheduler to confirm that the correct holidays were used in the calculation of the CPM. In addition, shorthand statements such as, "every January 1st" is also not helpful because even this is ambiguous. If January 1st falls on a Sunday, is the following Monday observed as well? We Schedulers need to be able to quickly and easily audit the calendars for correctness.

Workday/Calendar Day Conversion Utility. If you have ever tried to 'back-track' schedule logic to understand an odd float issue, then you will appreciate being able to reference the work day number used by the program to compute the date. We need the scheduling software to provide a built-in facility to use the calendars in use to quickly and neatly look-up a calendar day and tell you the

corresponding workday number and vice-a-versa. SureTrak [7] has this feature available through its Visual Basic interface but this is not made available to the standard Scheduler.

Workday Numbers. Whenever a date is shown, we should also have the option of displaying the calculated CPM workday number. This is an essential tool for Forensic Analysts and a useful tool for all Schedulers. P3 shows the workday number whenever you select the 'pick-a-date' calendar option. P3e/c hides all references to workday numbers.

In addition, we need a workday report option. P3 has this option but P3e/c does not. Schedule users should be able to work in work days just as easily as they do in calendar days.

Color-code Calendar Dates to Calendar Used. When viewing the schedule listing on the screen, why not color code the calendar dates to the calendar used? In this way, Calendar 2 dates might all be shown in blue and Calendar 3 days in red. This would make identifying calendars a lot easier than just listing it in a report column. The colors and calendar numbers would be user-configurable.

Relationship Reports. Primavera's products cannot produce a simple list of relationships without exporting them first to a spreadsheet. We don't need a list of all activities and the accompanying predecessors and successor relationships. We need a list of all relationships.

With such a simple list, we should be able to sort and select by such parameters such as relationship and lag. Talented Schedulers have been doing this imperfectly for years using spreadsheets, it is time for the software companies to include this simple feature into their own software and add full functionality.

Newer software that allow for relationship links to activities outside of the current schedule are even more problematic. In such cases, the relationship report should not only contain the Activity ID, but the project name as well. We should also see an indicator that denotes whether this 'external' relationship was considered during the CPM calculation. Depending upon internal setting, the Scheduler may elect to ignore such relationships when calculating the CPM.

Orphaned Activities Report. We need to be able to list those activities without a successor relationship. Activities that lack successors usually have incorrect float values calculated. Activities no longer connected to the network should be easily identifiable and obvious.

Late Start Report. Activities that logically could have been started but have not should be given special attention. Good scheduling practice requires aggressive performance of work that could start but still has float. If you wait on starting all

activities until they run out of float, resource considerations may make the resulting schedule unworkable. Modern schedules do not provide this type of information to the Scheduler.

Constraint Used Flag on Reports. By this, I stress the word, “used” as opposed to just indicated. Currently, Primavera’s software products show an asterisk (“*”) to the right of any dates that might be affected by a user-imposed constraint. This asterisk is shown even if the calculated date was not affected by the constraint.

If the constraint was Start-no-earlier-than 13JAN05 and the CPM calculated the early start of that activity to be 21JAN05, this asterisk would still be shown on all reports to the right of the early start date. While we are at it, how about adding a reporting option to select unused constraints or used constraints for inclusion/exclusion?

Longest Path Flag. The concept of CPM Longest Path has existed since the start of CPM calculations. Primavera, Inc. has included a function in their software to identify the Longest Path for selection on reports. Without running a report (or setting a filter to exclude all other activities,) one cannot identify which activities are on the longest path and which ones are not. This flag should be available for display on all reports. In addition, it would be helpful to sort and select based upon Longest Path. Ron Winter Consulting produces an add-on software that performs this function. [3]

External Relationships Used Indicator. May CPM software programs now allow the Schedule to designate logical relationships to and from the current schedule to other, external schedules. In cases such as these, the external relationships may be used to affect the CPM calculations or may be ignored. As this can make a large, ‘untraceable’ change in the resulting dates, this CPM setting should be clear to those who review the schedule.

Interruptible Duration In-Effect Indicator. Activity durations may be designated either continuous or interruptible. When two mutually exclusive relationships tug and pull on an activity, does the schedule keep the stated duration constant or does it stretch the activity out so that both requirements can be met?

Interruptible activities can show incorrect total float and may even appear on the Longest Path when no such criticality actually exists. As a side point, it would also be nice to exclude interruptible activities on the Longest Path if they are not really part of the controlling work.

Expected Finish Date Used Indicator. Expected Finish is a ‘reverse scheduling tool.’ With it, you set the early finish date for an activity and the CPM software computes the duration. The use and existence of this imposed

constraint is not indicated on reports. While we are at it, we should be able to report when an expected finish date is earlier than the data date or is otherwise unused.

Resource Leveling Used Indicator. To my knowledge, it is impossible to review any CPM schedule and be sure that Resource Leveling had been used to create the current dates. No indicator exists to signal this action has occurred. All that can be done is to observe that the early start of certain activities appear to be different than what could be expected from a 'pure' CPM calculation.

One cannot even be sure of the parameters that were used to produce the resource smoothing or leveling. The parameters may be those currently in the resource leveling set-up or they may have been changed since the leveling occurred. The parameters may be the same ones and then certain activities were later manually adjusted to create different dates.

The only way to be reasonably sure that resource leveling was used and that the current leveling settings were employed is to make a copy of the schedule, re-run the CPM calculations, re-run the existing leveling procedure, and then compare the resultant dates of every activity from one schedule to the other. Even then, it must be pointed-out that different settings can produce the same results.

External Resources Considered during Leveling Indicator. One of the values of multi-project scheduling is the ability to consider the global effect that a limited resource has on all projects under consideration. Equipment, specialized crafts, even cost may be 'shared' with several projects. When resource leveling involves multi-project resources, a 'transportability' issues arises. In this case, the only way a reviewing authority can produce the same results is to also have access to all of the other projects using that same shared resource.

CPM Calculated Indicator. It would be a simple matter to have an internal flag that was reset every time the CPM was calculated. This flag would then be set anytime any edit or modification to the CPM rules were made. The flag would not be set for inconsequential changes such as layout, sort, or filter changes.

Currently, after the CPM is calculated, durations, logic, and even dates may be changed before saving or producing reports. An automatic flag warning the reviewer that something in the schedule has been modified on every report is the least that we can do for schedule transparency.

CPM Calculation Mode Printed in Header of Every Report. Every report and graphic should indicate what rules went into creating the dates being displayed. A knowledgeable Schedule would counter that there are too many settings to display all of them in the space allowable. I say that you could code them for quick review (and easy printing.) A settings line could look like the following,

CPM Settings = ERACCS(0)PLECEC

Where the code would be deciphered by looking at each ordered letter as follows,

Key:

1. E = Use external relationships, I = Only Internal relationships
2. R = Retained Logic, P = Progress Override, A = Actual Dates
3. A = Calculate start-to-start lags from Actual, E = Use Early start
4. C = Use Continuous Activities, I = Interruptible Activities
5. C = Show open ends as critical, N = non-critical
6. S = Calculate total float using Start Dates, F = Finish Dates, W = Worst
7. (0) = Activities with less than 0 total float shown as critical (note: any number may be used besides '0'), (L) = Longest Path is used for criticality.
8. P = Predecessor activity calendar used for lag calculations, S = Successor activity's calendar, 2 = 24 hour calendar, D = Project Default calendar
9. L = Link Percent Complete to Remaining Duration, U = Unlink
10. E = Use Expected Finish date, I = Ignore Expected Finish constraint
11. C = CPM calculations used, L = Schedule has been Resource Leveled
12. E = External resources considered, N = Not considered.
13. C = CPM calculated, N = Changes made to schedule since calculation

Out-of-Sequence Progress Indication. If an activity is actively reporting progress before all of the required predecessor work is complete, then we say that the activity is proceeding out-of-sequence. Out-of-sequence progress is a significant contributor to schedule confusion. This activity abnormality should be signaled and available for selection in reports.

Do Not List or Display Ignored Relationships. In the process of computing a CPM with out-of-sequence progress using the Progress Override mode, the software ignores all predecessor relationships to out-of-sequence activities in its calculations. It does, however display the ignored relationship on the graphic screen and list it in reports as if it were used. This has caused a wide-spread confusion amongst Schedulers as to the nature of this calculation mode. Any relationship not used in the CPM calculation should automatically not be listed in reports and graphics.

Flag to Identify Controlling Relationship. Primavera does this on all of their products. Microsoft Project does not. There should also be graphic options to only include controlling relationships. How about graphic option to color controlling relationships red and the others as black in the Barchart View as well as in the PERT view?

In-Progress Lag Report and Value. Remaining Relationship Lag should be displayed just as activity remaining duration is shown and editable. The CPM

feature of Remaining Duration was added so that Schedulers could monitor and change this calculated duration result.

Lags are to relationships what durations are to activities. Remaining Lag is always calculated during the CPM calculation. Why should remaining lag calculations be discarded by the software instead of saved and displayed? Why should we be unable to indicate that actual remaining lag is only 2 days instead of the calculated 4 days? Part of the reason CPM Schedules are so hard to understand is that fact that not all of the data used is displayed.

Complete CPM Algorithm Used Explained in the Manual. Many people are surprised to find out that the various software companies compute the CPM differently. To this author's knowledge, no CPM software company explains how they compute the CPM when multiple calendars and actual status are involved. Until the method is completely explained, CPM scheduling software will always be a 'black box'

Displaying Early and Late Computed Dates for Completed Activities. Part of the CPM algorithm not understood by most Schedulers is that all activities (even completed ones) are used by the software to calculate the CPM. The early start/finish and late start/finish dates are even computed for completed activities. Once done, the scheduling software either blanks out the date fields or places the actual start and finish dates in its place. These dates are needed for some higher-level CPM calculations that would be of use to Schedulers and are not available due to deliberate post-CPM intervention by the software.

Hidden Activity Indicator. A large source of confusion for Beginner Schedulers is hidden activities. This occurs when a filter has been used to only display a portion of the total set of activities. While this feature is very useful, when the schedule is saved with the filter set the displayed subset is saved as the default view. When another Scheduler next opens the schedule, it appears that activities are missing when they are just hidden. The program should make it very plain to the Scheduler when a filter is being used and that not all activities are being displayed.

Automatic Audit Trail of Changes. You cannot sell an accounting program without a built-in audit trail, but no CPM scheduling software package has this feature. The ability to list every change made in a scheduling session has many uses. This feature is not the same as an 'un-do' feature. Many operations performed cannot be un-done.

In addition, selective undo based upon audit trail selection is quite useful. If I deleted an activity and then added another, I don't want to delete the added activity just to un-delete the other. A change report such as produced by Claim Digger and Schedule Analyzer [8] will not produce the same results as a pure

audit trail. It does not list who performed the changes and it does not work in cases such as resource leveling.

CONCLUSION

The schedule software industry is in a race to create and market software with more features designed to make producing schedules and graphics easier with more flexibility. This focus on 'chrome' has been at the expense of transparency. We need a systems approach to the design criteria to better monitor and control the consequences of the existing features. In addition, the entire industry needs to mature to the point where its internal processes are adequately documented and verified by objective professional agencies.

As an example of my assertion, this is what the Primavera Help File has to say about the Actual Dates CPM calculation mode:

When you choose Actual Dates, backward and forward passes are scheduled using actual dates. Note: The Actual Dates option can cause negative total float if the schedule has actuals before the Data Date.

The manual further suggests that the calculation of Actual Dates produces results that are in between that of Retained Logic and Progress Override.
[9]

No where is there an explanation of the actual algorithm used. No example is provided to show its intended use. This is the sum total of information that is provided for a feature that Primavera invented and thousands of schedules use to calculate CPM dates and total floats. This 'take-it-or-leave-it,' black box approach is unacceptable in a professional arena.

In summary, I have presented recommendations for the following transparency issues,

1. Printable Holiday Lists.
2. Workday/Calendar Day Conversion Utility.
3. Workday Numbers.
4. Color-code Calendar Dates to Calendar Used.
5. Relationship Reports.
6. Orphaned Activities Report.
7. Late Start Report.
8. Constraint Used Flag on Reports.
9. Longest Path Flag.
10. External Relationships Used Indicator
11. Interruptible Duration In-Effect Indicator.
12. Expected Finish Date Used Indicator.

13. Resource Leveling Used Indicator.
14. External Resources Considered during Leveling Indicator.
15. CPM Calculated Indicator.
16. CPM Calculation Mode Printed in Header of Every Report.
17. Out-of-Sequence Progress Indication.
18. Do Not List or Display Ignored Relationships.
19. Flag to Identify Controlling Relationship.
20. In-Progress Lag Report and Value.
21. Complete CPM Algorithm Used Explained in the
22. Displaying Early and Late Computed Dates for Completed Activities.
23. Hidden Activity Indicator.
24. Automatic Audit Trail of Changes.

The suggestions presented here are just the beginning of what can be done to address the confusion and complexity of the current scheduling paradigm. New features must be added only after the processes have been documented and all needed monitoring facilities are in place.

References:

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[7] SureTrak, Primavera Systems, Inc., Three Bala Plaza West, Bala Cynwyd, Pennsylvania

[8] Software tools available for schedule analysis include "Claim Digger," originally developed by HST Software, Inc. in 1991 and (acquired by Primavera Systems Inc., in 2003) and "Schedule Analyzer," "Schedule Analyzer Forensic," and "Logic League" developed by Ron Winter Consulting, LLC. 2003

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