

UNDERSTANDING THE TECHNIQUES TO UPDATE A SCHEDULE

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Abstract

Microsoft Project, Oracle Primavera P6 and Asta Powerproject are three commonly used software packages in the building and construction industry.

There are many techniques used to update a schedule and the selected technique is influenced by many factors including:

- The contract specification requirements
- The software package being used
- The users' knowledge and skill in the software package

This paper identifies and introduces three different principal techniques used in the building and construction industry to update a schedule.

The aim of this document is to outline:

1. Three techniques that are currently used to update a schedule,
2. The advantages and disadvantages of each technique, and
3. How Microsoft Project, Oracle Primavera P6 and Asta Powerproject support these three techniques.

Professional schedulers are usually familiar with Microsoft Project and/or Oracle Primavera P6, but many are unfamiliar with Asta Powerproject due to the lower market penetration of this software. This paper will give people who are unfamiliar with Asta Powerproject an insight into some the capabilities of this software.

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Introduction

There are many project planning and scheduling software packages used in the building and construction industries. The most widely used in Australia and most Western World countries are Microsoft Project and Oracle Primavera P6. Asta Powerproject is well represented in Europe and is gaining more market acceptance outside Europe.

A properly updated schedule is critical to the effective management of a project and to demonstrate delays and justify claims for time extension. Often schedules are not updated properly with the result that time extension claims requested as the result of delays may not be adequately demonstrated or justified.

There are three possible techniques that can be used to update a project schedule. AACE International does not identify or define official terms [1] for these techniques, so this paper will introduce and use the following terms:

- **Un-impacted.** With this technique only the percentage complete is assigned to activities to denote progress, and no activity dates (start or finish) are assigned or changed during the update process. This technique provides the status of each activity but does not generate a revised end date for the project.
- **Impacted with Actuals.** With this technique actual dates are assigned in the past to complete activities and to the completed portions of in-progress activities. Unstarted activities and incomplete portions of in-progress activities are scheduled into the future. New activities reflecting scope changes can be added as appropriate, and the project is scheduled to generate a revised end date. This technique conforms to AACE International recommended practices for statusing and updating a schedule. [2, 3]
- **Impacted Live.** With this technique, completed activities are manipulated so that they are scheduled when they actually occurred. The following software inbuilt fields are not used: **% Complete; Actual Duration; Actual Start; and Actual Finish.** In-progress activities are adjusted so they start when they actually started and will finish when they are planned to finish, while un-started activities are scheduled into the future with scope changes added as necessary.

The time interval selected to update the schedule is not addressed in this paper, but the selection of appropriate time intervals for the schedule updates is important. When the time interval is too long, then the impact of poor productivity or delays are not discovered early enough, and thus corrective action is taken too late to minimize any impact. The time interval should typically be at least 20 times over a project's lifetime with the time interval reduced in critical times, such as:

- When the start of a project has been delayed by failure to obtain approvals. It is often difficult to recover lost time from this day-for-day slippage.
- When there are significant changes of scope or method of execution. In this situation a new project schedule may be required.

- When there are multiple short concurrent delays that need to be recorded for analysis and apportionment of responsibility. These reduced update periods also call for use of the Half-Step technique to analyze delays.
- During the testing and handover phase of a project, where unexpected equipment or process failures can often result in multiple schedule revisions.

Aim

The aim of this document is to outline:

- The three techniques that are used to update a schedule,
- The advantages and disadvantages of each technique, and
- How Microsoft Project, Oracle Primavera P6 and Asta Powerproject support each of these techniques.

Terminology

Each software package and project management methodology uses different terms to identify the date that the schedule has been updated. Some examples are:

- **Data Date** – AACE® International Recommended Practice No. 10S-90, Oracle Primavera P6 and Phoenix and PMI *PMBOK® Guide* 6th Edition.
- **Status Date** - Microsoft Project and Earned Value Project Management by Quentin W. Fleming and Joel M. Koppelman.
- **Report Date** – Asta Powerproject and Tilos.
- **Time Now** – Australian Standard 4817 – Project performance using Earned Value and Earned Value Management APM Guidelines.

This paper will use the appropriate software term for the data date when discussing each software package and term data date when discussing scheduling principles.

There are many software functions that may be employed to update a schedule. Different software packages have different functions and sometimes some functions are similar but work in a different way. For example, out of sequence progress occurs when a successor activity starts before the driving predecessor has finished. There are software functions that decide how out of sequence progress is calculated. The P6 **When scheduling progressed activities use** function is similar to the Microsoft Project **Split in-progress tasks** function and Asta Powerproject **Move part completed links** and **Relink around complete tasks** functions, but they all work differently.

To avoid confusion over terms that may be either a software function or a project data element, the following formatting is used for clarity herein:

- All text that refers to a software function or software field is in bold print, therefore **Actual Start** would refer for the software field, while,
- Terms that refer to project data are not in bold print; therefore the term actual start would refer to an actual start date of an activity that could be entered into an **Actual Start** field.

The term “task” is used by both Microsoft Project and Asta Powerproject. The term “activity” is used by Primavera P6. The term “activity” will be used in this paper except when specifically referencing Microsoft Project or Asta Powerproject.

Some industries and methodologies use the term “programme” and some the term “schedule” for a Gantt chart. This paper will use the term “schedule.”

Software Versions

The screenshot Figures in this paper were used using:

- Figures 1 to 11 were produced using Microsoft Excel 2016,
- Figures 12 to 25 were produced using Microsoft Project Professional 2016,
- Figures 26 to 33 were produced using Oracle Primavera P6 PPM Version 17 and
- Figures 34 to 38 were produced using Asta Powerproject Version 14.

Introduction to the Three Techniques for Updating a Schedule

Un-Impacted

Before updating the schedule, the three activities shown in Figure 1 have no progress, and a simple schedule would look like this:

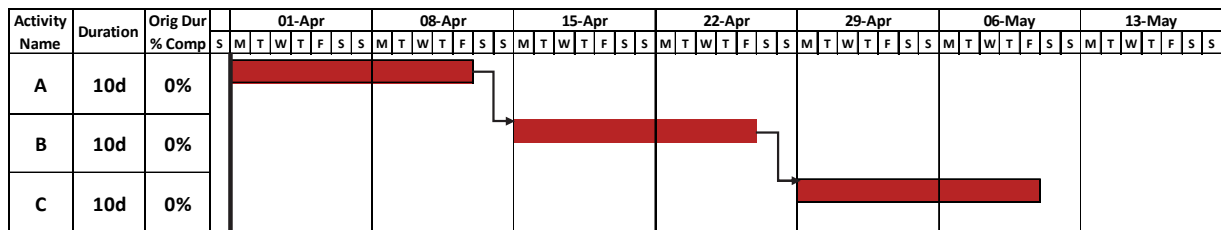


Figure 1 – Unprogressd without a baseline.

To update a schedule using the Un-Impacted technique:

- A baseline is not set or needed as the scheduled dates are not changed,
- The data date is identified and is displayed as a vertical line on the Gantt Chart,
- An activity percent complete is recorded for each activity to represent how much work has been completed,
- No dates are changed as a result of this update process.

After updating the schedule, the progress may be displayed against the original planned dates for each activity, as seen in Figure 2:

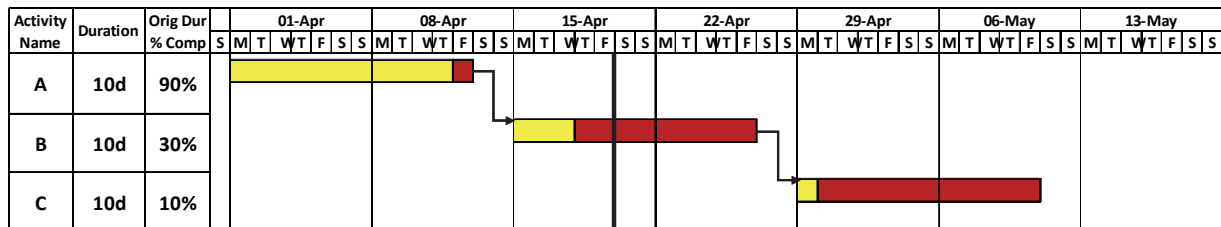


Figure 2 – Progressed un-impacted schedule.

Observing Figure 2, above, we find several problems:

- Activity A has incomplete work displayed in the past (to the left of the data date line), which is not logical,
- Activity B is behind schedule with some uncompleted work (red portion of the bar) displayed in the past, which is not logical, and
- Activity C displays completed work in the future, which is not logical and may also affect the scheduling of the uncompleted portion of the activity.

This schedule does not inform anyone when the uncompleted work will be performed because:

- There is incomplete work shown in the past and people may not travel back in time to complete the work in the past,
- Nor is it possible to have completed work in the future. Consequently, this situation makes the scheduling and projection of uncompleted work unreliable as it is affected by the completed work displayed in the future.

This schedule cannot be used to forecast of future work. Moreover, it cannot be used for delay analysis as it does not reflect when the work was completed or demonstrate the effect of delays.

Impacted with Actuals

Figure 3 shows a schedule updated using this second technique, wherein:

- A baseline is set and is normally displayed on the Gantt Chart as a second bar for each activity.
- The data date is set and displayed as a vertical line.
- Completed activities:
 - Are assigned an actual start date on the date the work actually commenced, and,
 - Are assigned an actual finish date on the date that the work actually finished.These actual dates can differ from the baseline scheduled dates.
- In-progress activities:
 - Are assigned an actual start date on the date the actual work commenced,
 - Some software calculates the actual duration while with other software it must be manually entered,
 - The remaining duration is assigned so the projected finish date is scheduled on the date the work is expected to finish. This could be determined by the productivity achieved to date, and
 - A percent complete is normally assigned to each activity. There are many methods of calculating and recording an activity progress percent complete. These include percent of duration, percent of labour hours, percent of cost or percent of physical work completed based on the Baseline or current schedule values. [4]

- Un-started and incomplete portions of in-progress activities may have their remaining durations adjusted by applying actual productivity rates achieved to date from similar completed work.
- Activities reflecting scope changes or delays may be added.
- Multiple splits (suspension and resumption of work) may be assigned in some scheduling software. Software that does not support multiple splits may have these modelled by the creation of multiple activities or by assigning a specific calendar to the activity to model the splits.

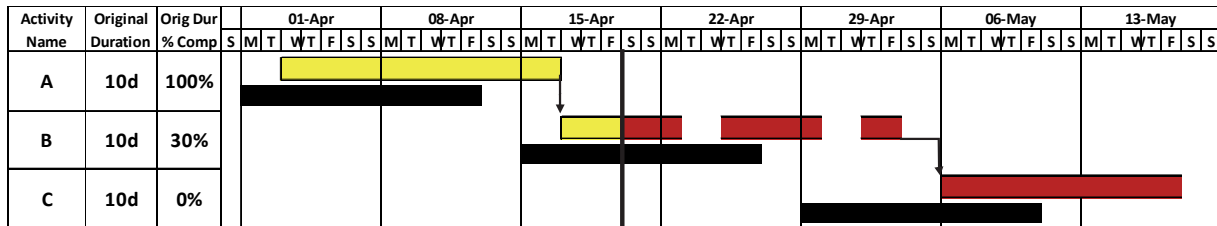


Figure 3 – Impacted with Actuals with splits.

In addition, scope changes may be represented by adding or deleting activities as seen in Figure 4.

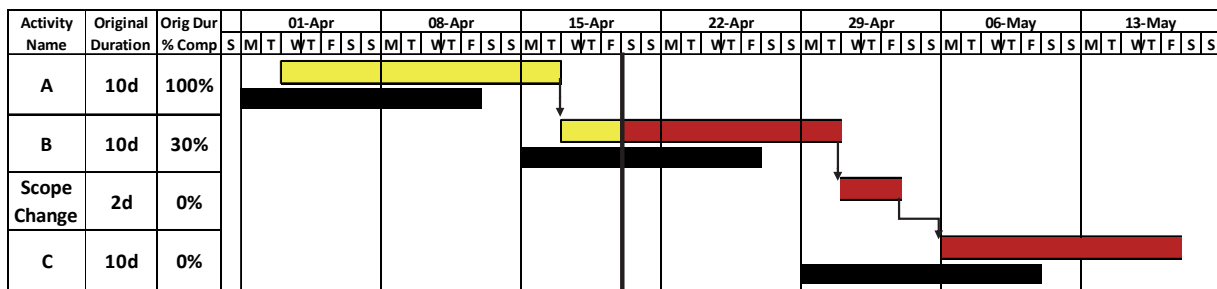


Figure 4 - Impacted with Actuals with a scope change activity.

This technique:

- Conforms to AACE International recommended practices for updating schedules,
- Results in software being used in the way most software is designed to be used,
- Records when activities actually started and actually finished, which is essential for historical records and claims assessment,
- Re-forecasts when incomplete or in-progress activities will take place, so it may be used to manage the project, and
- Demonstrates impacts to the schedule resulting from delays and changes in productivity.

Out of sequence progress occurs when a successor activity starts before the driving predecessor activity with a Finish to Start relationship has finished. Most software has options which determine how the remaining portion of a successor activity is calculated when it has commenced before its predecessor is complete.

In Figure 5, below, the schedule has been updated where the “out of sequence logic” has been acknowledged in the CPM calculations:

- The Primavera **Retained Logic** option or the Microsoft Project **Split In-progress** option or the Asta Powerproject **Move part completed links** has been used, and
- These options split the activities to allow the remaining portion of in-progress activities to acknowledge the predecessor Finish to Start relationship:

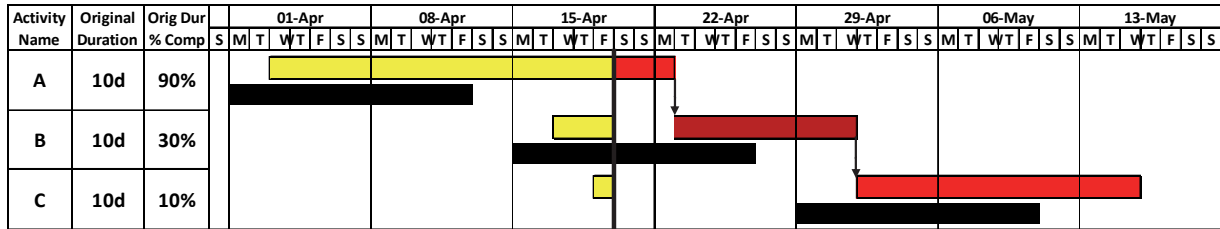


Figure 5 - Impacted with Actuals and out of sequence logic acknowledged.

Note that Figure 5 shows an interrupted period (gap) before work on the remaining portion of Activity B resumes, driven by the remaining duration of the predecessor Activity A.

In Figures 6, 7 & 8 below the schedule has been updated with “out of sequence logic” that is not acknowledged in the CPM calculations:

- In Figure 6, the Primavera **Progress Override** scheduling option has been used; the Microsoft Project **Split In-progress** option and the Asta Powerproject **Move part completed links** have not been used;
- The predecessor Finish to Start relationship is ignored and;
- The result is a less conservative schedule forecast, as the successor activities have not been split.

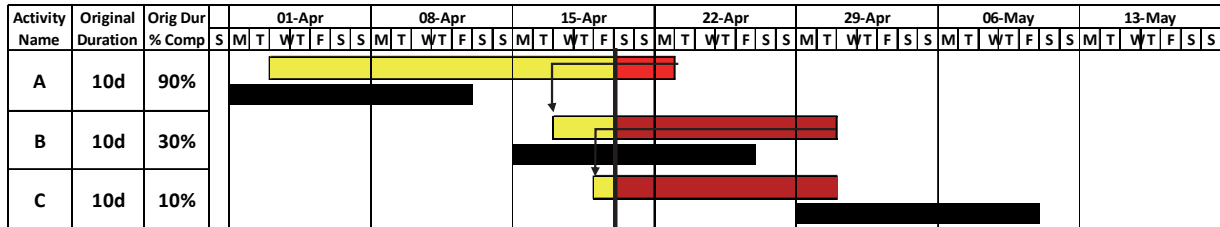


Figure 6 - Impacted with Actuals and out of sequence logic not being acknowledged.

Figure 6 shows Activities A, B & C with far greater concurrency than originally planned. This is a reason why many owners forbid the use of the Progress Override scheduling option.

- To overcome the issue of a shorter duration schedule which invariably results from the increased, unplanned concurrency, the remaining durations may be extended so that the end dates of in-progress activities calculate with the same end date as the schedule with the out of sequence option turned on, as shown in Figure 7:
 - The **Original Duration % Complete** for Activity B has reduced from 30% to 20% because the **Remaining Duration** has been extended to 9 days;
 - The **Original Duration % Complete** for Activity C is now zero because the **Remaining Duration** is now greater than the **Original Duration**.

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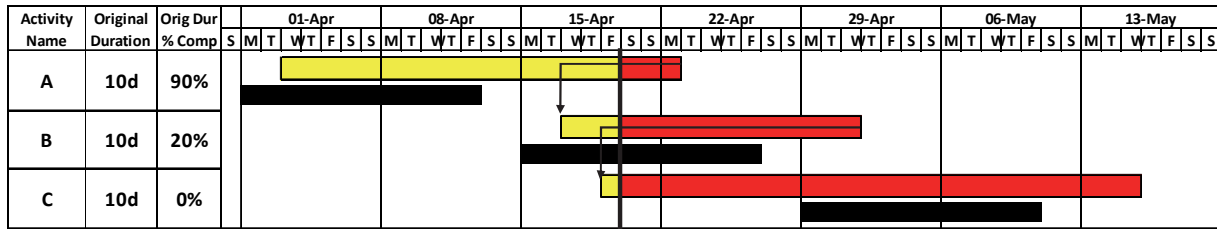


Figure 7 - Impacted with Actuals with out of sequence logic not being acknowledged and extended activity durations.

Figure 7 reveals that the extensions to remaining durations serve to override the calculations of percent duration complete for Activities B and C. This is problematic for progress reporting.

Depending on the software options and algorithms, such as selecting **Open Ends Not Critical**, the predecessor activities may no longer be critical and display **Total Float**, as shown in Figure 8, below:

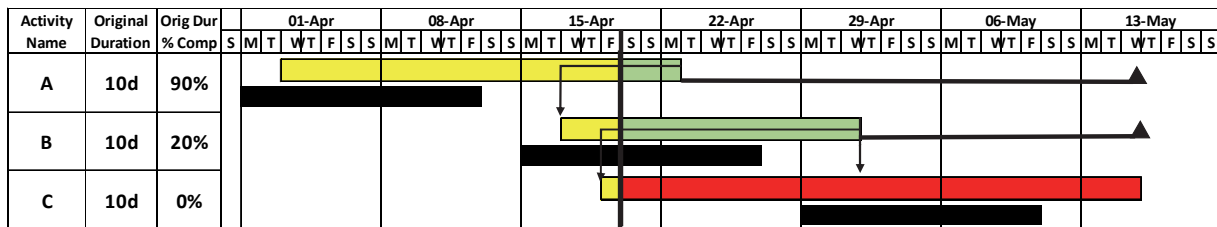


Figure 8 - Impacted with Actuals with out of sequence logic not being acknowledged and extended activity durations and Open Ends Not Critical.

The extended activity durations changes the reported percent duration complete, and selecting the Open Ends Not Critical setting results in only Activity C being reported critical in this sequence.

Impacted Live

To update a schedule using this technique no actual dates are entered into the software Actual Start and Actual Finish fields. Thus, at each update the schedule calculates a critical path including complete, in-progress and unstarted activities. This maintains a “Live As-Built” schedule which may be used for delay analysis for completed activities. The ability to maintain an As-Built critical path and to perform a Collapsed As-Built analysis is the driver for using this technique.

To update a project using this technique:

- A baseline is set.
- The software **Actual Start** dates, **Actual Finish** dates, **Actual Durations** and in some software **% Completes** are not entered into the inbuilt software fields.
- The data date may be represented by a curtain or vertical line graphically added to the Gantt Chart, or sometimes the software data date may be displayed, but only when the software does not use it for calculation purposes.
- Completed activities are updated by:

- The actual start dates are represented by the software **Start** dates and are calculated by the software from the project's start date, not from the current status date. The **Start** dates must be set by understanding what actually happened and then adjusting relationships and lag factors, or by adding delay activities.
- The actual finish dates are represented by the software **Finish** dates and must be calculated by modifying the **Original Duration** and/or the activity calendar.
- In-progress activities are updated by:
 - The software **Start** dates are scheduled by the software to equal the actual start. This is accomplished by understanding what happened in the project and then adjusting logic relationships or adding delay activities.
 - Planned finish dates are calculated by the software. **Finish** dates must be calculated by editing the **Original Duration** and/or the activity calendar. Therefore, the **Finish** date represents when the scheduler anticipates the activity will finish.

Note: The inbuilt software **Percent Complete** fields are usually not used because in most software applications, assigning them will prevent the scheduling calculation process from generating accurate start and finish dates. An alternative User Defined Field or a Text Field may be used to record the percent complete.

- Often the "As-Built Actual Start" and "As-Built Actual Finish" dates are recorded in other user defined fields as a permanent record. These are used to check the updated schedule in case the activity is accidentally moved during the process of updating the schedule.
- Un-started activities have their durations adjusted by taking the productivity achieved to date into account and modifying original durations accordingly.
- Multiple splits (suspension and resumption of work) may be assigned to represent non-contiguous work. Different software will handle these splits differently.
- Scope Changes and delays should be represented by adding activities so they may be removed to perform a Collapsed As-Built analysis. All changes should be recorded and explained in a notes field.

To create the schedule shown in Figure 9, below:

- The activities have had their durations and relationships edited to give the same result as the Impacted with Actuals technique, however,
- There are no **Actual Start** dates, **Actual Finish** dates, **Actual Durations** or **% Completes** entered into the software:

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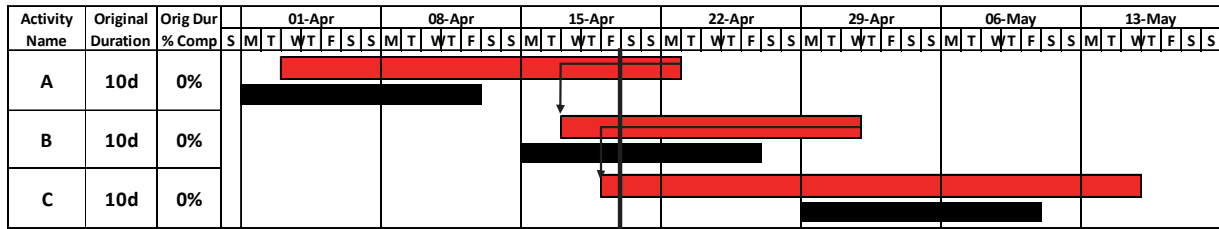


Figure 9 - Impacted Live

For software that allows splitting of activities, the result will be as shown in Figure 10, below:

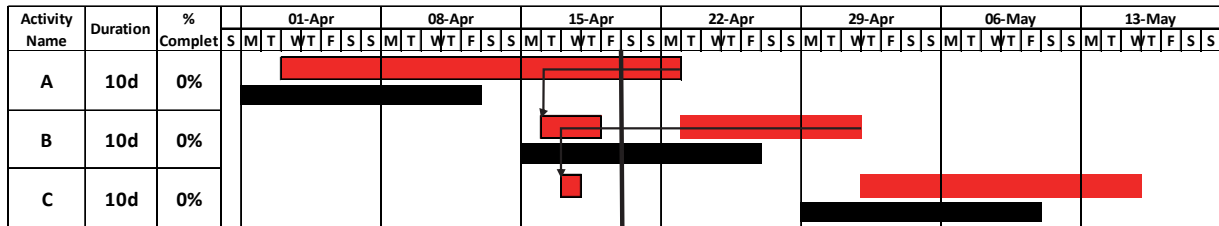


Figure 10 - Impacted Live with split activities.

- Software that does not allow the splitting of activities will require:
 - The activity calendar edited with additional non work time to represent the split, or
 - Activities must be added to demonstrate non-contiguous work, as per Figure 11, below,
- Activity B has been split into B-1 and B-2, and activity C into C-1 and C-2, and the logic has been revised accordingly.
- This results in the Baseline bars only being related to the first activity:

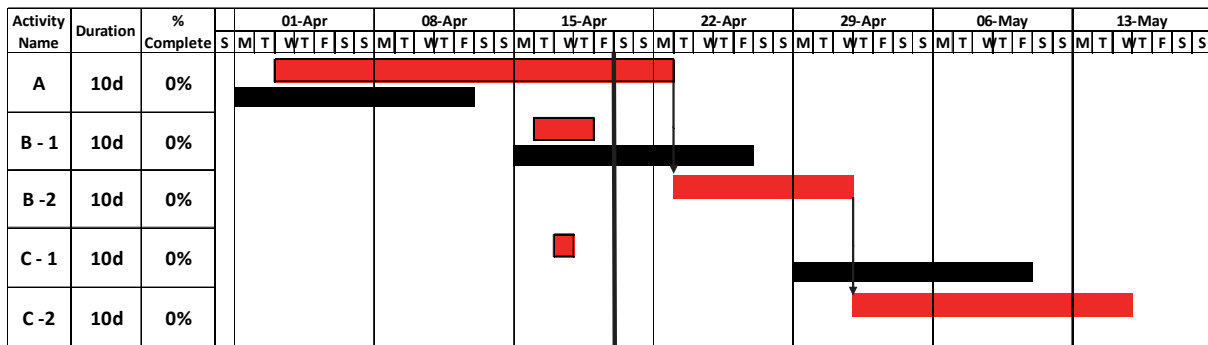


Figure 11 - Impacted Live with multiple activities representing split activities.

Although this technique does not use most software in the way they are designed to be used, it:

- Records when activities actually started and actually finished,
- Requires the scheduler to forecast when incomplete or in-progress activities will take place,
- Demonstrates delays and changes based on achieved productivity, and
- Has the advantage that it maintains the As-Built Critical Path.

Advantages and Disadvantages of Each Technique

Un-Impacted

This technique is commonly used by Microsoft Project users for the following types of projects:

- IT,
- Business change management,
- Domestic building,
- Small commercial building,
- Small factory and process plant upgrades, and
- Local council and in-house run government projects.

The author has observed that many users without formal training in scheduling software do not even set or display a data date. Thus ascertaining when a schedule has been updated may be difficult to identify by observing such a schedule.

Advantages

The advantages of this technique are:

- It is simple with Microsoft Project and little training is required to use this technique. P6 does not easily allow this technique and it is slightly more complex with Asta Powerproject.
- This technique allows the observation of the progress of activities against the plan.
- It clearly identifies which work is ahead of plan and which is behind plan.
- It hides slippage from the client/customer.

Disadvantages

The disadvantages of updating a schedule with this technique are:

- Incomplete work may be scheduled in the past and completed work may be scheduled in the future, further affecting other related incomplete work.
- Therefore it cannot effectively be used to manage work when the project is not running according to schedule.
- It does not generate a revised completion date based on the current status and performance to date.
- It may not be easily used for a time impact analysis or other evaluation of schedule changes because the actual dates and actual durations will be incorrect.

Impacted with Actuals

This technique is considered by the wider scheduling community as the correct technique to update a schedule. It is commonly used in all large projects and in most projects in the following categories:

- Large Commercial building
- Civil Construction

- Resources such as Mining, Oil and Gas
- Defence.

Advantages

The advantages of this technique are:

- It conforms to AACE International recommended practices.
- It uses the software in the way it is designed to be used.
- It is the process that may be used to manage a project because all uncompleted work is scheduled in the future.
- It generates a revised projected finish date for the project.
- It may be used for extension of time and delay analysis.
- This technique of updating a schedule supports Windows Analysis, Half Step, and other forensic techniques for analyzing project delays.

Disadvantages

The disadvantages of this technique are:

- The As-Built critical path for completed activities cannot easily be generated, and
- The total float and critical path are no longer calculated for completed work after an **Actual Finish date** is assigned to an activity. Thus the impact of delays to the critical path prior to the status date may not be clearly visible.

Impacted Live

Use

This technique is not a mainstream technique for updating a project schedule, but it is sometimes observed in two types of schedules:

- Some Project Control Managers prefer this technique, and it is used to update some projects by at least one major construction company in Australia, and
- Project Managers who do not understand how to update a project with Microsoft Project using the Impacted With Actuals technique. They often edit activities that are in progress or not started in order to force schedule activities where they are planned to take place. This technique is commonly used by self-taught project managers using Microsoft Project and the completed activities frequently do not have correct actual dates assigned.

Advantages

The advantages of this technique are:

- It may be used to manage a project during the construction/updating phase as all incomplete work is scheduled in the future.
- It generates a revised finish date for the project.
- The Critical Path is displayed for both completed and incomplete work.
- Changes to the As-Built Critical Path from the Baseline Critical Path are easily observed.

- This technique allows both client and contractor delays to be removed from the As-Built schedule, and the whole schedule will recalculate for delay and acceleration analysis. This is similar to using a Collapsed As-Built forensic schedule evaluation technique.

Disadvantages

The disadvantages of this technique are:

- This technique is not accepted in many contracts.
- It goes against the CPM calculation process that most software is designed to use, creating the following issues:
 - The software data date function is not used as designed; in many software packages it must be displayed by using other software functions.
 - Resources may not have the **Actual** and **Remaining Units** and **Costs** assigned, but these may be recorded and reported using other software fields.
 - The inbuilt software **Actual Start**, **Actual Finish**, **Actual Duration** and **% Complete** fields are not utilized, and other software fields must be used to record this data.
- Out of sequence progress functions may not be used.
- A higher level of user skill is required.

How Three Major Software Packages Handle Each Technique

Microsoft Project

Un-impacted – Microsoft Project

Microsoft Project makes this technique very simple so this is the most frequently used technique for untrained users to update a Microsoft Project schedule.

Microsoft Project does not force incomplete work into the future or completed work into the past in its default scheduling mode.

Figure 12 below displays an unprogressed project:

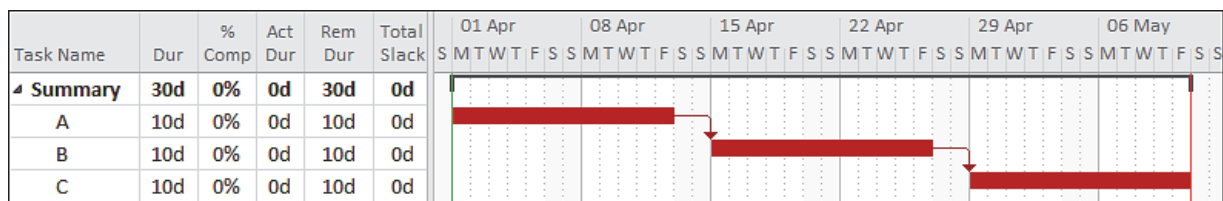


Figure 12 – Unprogressed Microsoft Project schedule.

Figure 13 below shows a schedule that has been updated by:

- Entering and displaying the **Status Date**,
- Entering the task **% Complete** and
- Displaying the **Progress Lines**.

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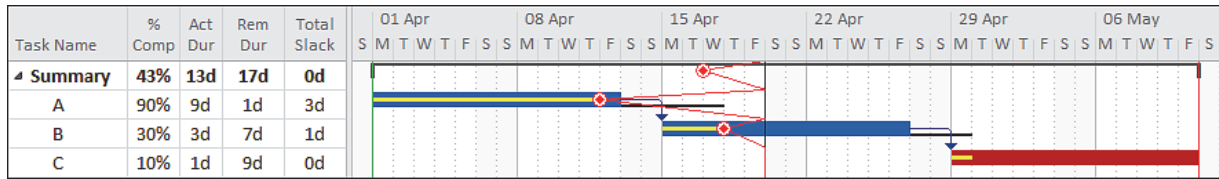


Figure 13 – Progressed Un-impacted Microsoft Project schedule.

In addition to the issues outlined earlier:

- **Total Float (Slack)** is calculated on a predecessor task when a predecessor and successor have reported progress. The value of the successor progress is taken into account to calculate the predecessor total float.
- The reported **% Complete** is the percent complete of the **Duration**; it does not reflect installed units, costs, or physical percent complete.
- The **Summary** task % Complete is calculated but it is not based on any work or costs. This is calculated from the sum of the **Detailed Tasks Actual Durations** divided by the sum **Detailed Tasks Durations** as shown below:

$$= 100 \times (9 + 3 + 1) / (10 + 10 + 10)$$

$$= 43.33\%$$

Impacted with Actuals – Microsoft Project

To obtain a correctly updated schedule, the following procedure must be followed:


- The Microsoft Project **Status Date** must be set and displayed,
- **Actual Dates** and **Actual Durations** must be in the past, and
- **Remaining Durations** must be in the future.

It is important to understand is that a change to the **% Complete** changes the **Actual Duration** and **Remain Duration**, resulting in either completed work in the future or incomplete work in the past. Thus the **% Complete** should never be manually changed.

The **Physical % Complete** may be displayed as a bar to record and display the percent of progress.

Figure 14 below has been updated correctly by using the following process:

- Turn off **Split in-progress tasks**; this ensures that when an **Actual Start** date is entered, the task does not split at the start,
- Display the **Baseline**, it is displayed as lower black bars in Figure 14 below,
- Do not enter a percent complete for any task as this will always result in an incorrectly updated schedule. This is because changing the **% Complete** field will change both the **Actual Duration** and **Remaining Duration** of the activity. Users must allow the software to calculate **% Complete** to obtain a correctly updated schedule,
- The **Physical % Complete** should be used to identify progress when it differs from the **% Complete**. This may be displayed as a bar on the Gantt chart,
- Completed activities:
 - Enter the **Actual Start** dates, as the dates the task actually started,

- Enter the **Actual Finish** dates for complete tasks, as the dates the task actually finished,
- In-progress activities:
 - Enter the **Actual Start** dates, as the dates the task actually started,
 - Adjust the **Durations** of in-progress tasks to generate the correct revised **Finish Date**,
 - Use **Mark on Track**  or manually adjust the **Actual Durations** to ensure that each in-progress task has been properly updated. That is with all actual durations in the past and remaining durations in the future.

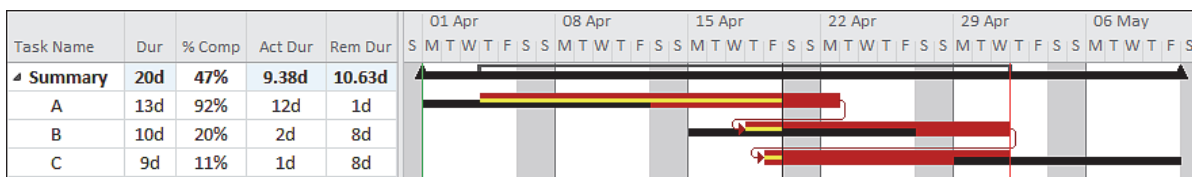


Figure 14 – Progressed Impacted with Actuals Microsoft Project schedule.

The user will end up with an illogical split at the start of a task when **Split in-progress** function is used (turned on) and **Calculate each project after each edit**, is also turned on, as per Figure 15 below:

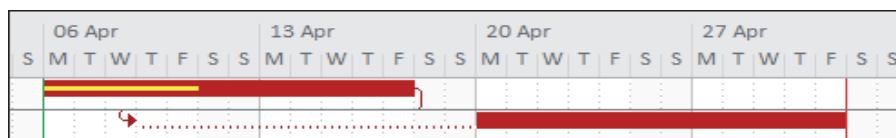


Figure 15 –Microsoft Project schedule with a split at the start of a task.

To correct this issue, the following process may be used when the Microsoft Project **Split in-progress tasks** function is required. This is the preferred option in the AACE International, Recommended Practice 90R-17, Stating the CPM Schedule. Figure 16 below has been updated by:

- Turning on **Split in-progress tasks**,
- Turning off **Calculate each project after each edit**, otherwise users will end up with splits at the start of a task which does not make any sense,
- Setting the **Baseline**, the lower black bars in Figure 16,
- Entering the **Actual Start** dates, as the dates the task actually started,
- Entering the **Actual Finish** dates for complete tasks, as the dates the task actually finished,
- Adjusting the **Actual Durations** of in-progress tasks so the **Actual Duration** represents the amount of completed work and should result in the **Actual Duration** finishing on or before the **Status Date**.
- Scheduling by pressing **F9**, which will result in the splitting of tasks stated out of sequence.
- Adjusting the **Remaining Durations**:

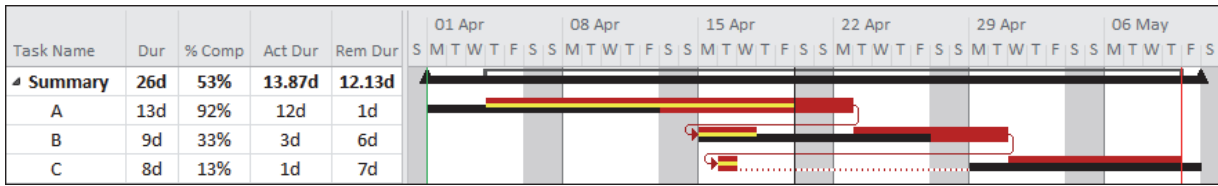


Figure 16 – Progressed Impacted with Actuals Microsoft Project schedule with Split in-progress.

Updating a Microsoft Project schedule with **Split in-progress tasks** turned on is difficult and time consuming.

There are various tools that may be used to assist with updating a project with Microsoft Project:

- **Update Project, Update work complete through:**
- **Update Project, Reschedule Uncompleted Work To Start After:**
- **Splitting tasks**
- **Status Date Calculation Options - When Updating a Schedule.**

These tools are discussed below:

Update Project

Microsoft Project has a function titled **Update Project, Update work complete through:** which is used to automatically update a project as if it had progressed according to plan. This function sets **Actual Start, Actual Duration, Actual Finish, % Complete** and **Renaming Durations** in proportion to a user-assigned date, which should be the data date that is represented by the **Status Date**. The result is displayed in Figure 17, below:

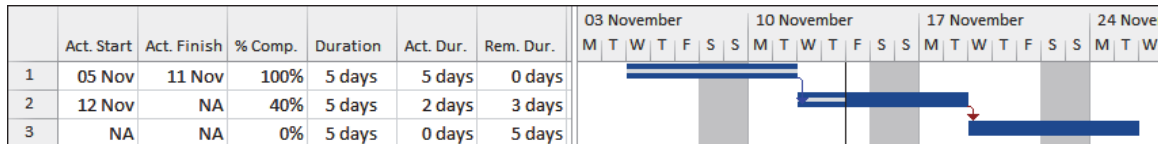


Figure 17 – Progressed Impacted with Actuals Microsoft Project schedule using **Update work complete through:**

Reschedule Uncompleted Work to Start After

There is a function available in the **Update Project** form titled **Reschedule uncompleted work to start after:** which does not set the **Status Date** and will:

- Split an in-progress task so the incomplete portion starts after the nominated date, and
- Move un-started tasks to start on the nominated date by assigning a constraint to the activity.

This is a very different method of calculation to other products like P6 and Asta Powerproject, which do not assign a constraint to maintain un-started tasks in the future and they both schedule incomplete portions of tasks after the data date. [5]

For this option to operate, the **Split in-progress tasks:** option must be set. Also it is best if the **Reschedule uncompleted work to start after:** date is set to equal the **Status Date**, otherwise the schedule will effectively end up with two data dates.

The following two Figures (18 & 19) show how the software assigns a **Start No Earlier** constraint to an un-started task to hold it out past which was the date used with the **Reschedule uncompleted work to start after:**

Before Applying:

	i	% Complete	Duration	Remaining Duration	02 December							09 December						
					S	M	T	W	T	F	S	S	M	T	W	T	F	S
1		0%	4d	4d	[Gantt bar from Dec 2 to Dec 6]													
2		50%	4d	2d	[Gantt bar from Dec 2 to Dec 6]													

Figure 18 –Microsoft Project schedule before applying **Reschedule uncompleted work to start after:**.

After assigning a **Reschedule uncompleted work to start after:** date of 06 Dec, note the constraint date assigned to Task 1 to prevent it moving back to the **Project Start Date:**

	i	% Complete	Duration	Remaining Duration	02 December							09 December						
					S	M	T	W	T	F	S	S	M	T	W	T	F	S
1		0%	4d	4d	[Gantt bar from Dec 2 to Dec 6]							[Gantt bar from Dec 6 to Dec 10]						
2					[Gantt bar from Dec 2 to Dec 6]							[Gantt bar from Dec 6 to Dec 10]						

This task has a 'Start No Earlier Than' constraint on 06 Dec.

Figure 19 – Microsoft Project schedule after applying **Reschedule uncompleted work to start after:**.

Splitting Tasks

A task may be manually split using the **Split Task** button  on the **Ribbon Toolbar, Task, Schedule** group.

The **Duration Type**, which is displayed in the first column of Figure 20 below is may be assigned using the **Task Information, Advanced** tab. This setting determines whether a split task displays the worked duration or the elapsed duration:

- **Fixed Units** and **Fixed Work** show the worked duration of 10 days, and
- **Fixed Duration** shows the duration of 15 days from the start to finish of a task.

Type	Duration	26 May							02 June							09 June							16 June		
		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W
Fixed Units	10 days	[Gantt bar from May 26 to June 5]							[Gantt bar from June 2 to June 11]							[Gantt bar from June 9 to June 18]									
Fixed Work	10 days	[Gantt bar from May 26 to June 5]							[Gantt bar from June 2 to June 11]							[Gantt bar from June 9 to June 18]									
Fixed Duration	15 days	[Gantt bar from May 26 to June 10]							[Gantt bar from June 2 to June 17]							[Gantt bar from June 9 to June 24]									

Figure 20 – Microsoft Project split task durations for diferent Task Types.

Status Date Calculation Options

The Microsoft Project **Status Date Calculation Options** also operates when a schedule is updated by revising the **% Complete** of activities. There are several software options that must understood

and set for this function to operate correctly. This is a difficult function to use as it only calculates when a **% Complete** is changed.

Figure 21 below shows a task with the **Status Date**, the dark vertical line, set to the next period data date:

Duration	% Complete	03 November							10 November							17 November							24 November						
		S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	
6 days	0%	[A solid blue bar representing 6 days of work, starting from the beginning of the 03 November period and ending at the end of the 10 November period.]																											

Figure 21 – Microsoft Project Status Date Calculation Options – Step 1.

When all the **Status Date Calculation Option** options are checked and the percent complete is changed from 0% to 40% the task is aligned to the new **Status Date**, and the bar is displayed as per Figure 22:

Duration	% Complete	03 November							10 November							17 November							24 November						
		S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	
6 days	40%	[A blue bar representing 40% of the task (2.4 days) is shown, starting from the beginning of the 10 November period and ending at the end of the 10 November period. A dark vertical line (Status Date) is positioned at the end of the 10 November period.]																											

Figure 22 – Microsoft Project Status Date Calculation Options – Step 2.

For a subsequent update, the **Status Date** has been moved to the following week. The task bars have not moved in respect to the Status Date and will not move when the project is recalculated:

Duration	% Complete	03 November							10 November							17 November							24 November						
		S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	
6 days	40%	[The blue bar from Figure 22 remains in the same position, but the dark vertical line (Status Date) has moved to the end of the 17 November period.]																											

Figure 23 – Microsoft Project Status Date Calculation Options – Step 3.

When the percent complete is changed to 60%, the task will split and the uncompleted portion of the task is now shown to be completed after the new **Status Date**:

Duration	% Complete	03 November							10 November							17 November							24 November						
		S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	
6 days	60%	[The blue bar is split into two segments. The first segment (2.4 days) is completed by the end of the 10 November period. The second segment (3.6 days) starts at the beginning of the 17 November period and ends at the end of the 17 November period. The dark vertical line (Status Date) remains at the end of the 17 November period.]																											

Figure 24 – Microsoft Project Status Date Calculation Options – Step 4.

Impacted Live – Microsoft Project

Microsoft Project makes this technique simple and has some advantages over other products:

- The **Status Date** may be used to show the data date. In the default scheduling mode Microsoft Project essentially ignores the **Status Date** for calculation of a task finish date.
- It allows multiple splits in the past and future to show when work was not contiguous, or will not be contiguous in the future.
- In Figure 25, below:
 - The **% Completes** are all zero and therefore there are no actual dates; the schedule is calculating all dates from the project **Start date**.

- **Physical % Complete** is used to show progress by editing the **% Complete** bar in the **Bars** form.
- **% Complete** (duration percent complete) does not change and is always zero.

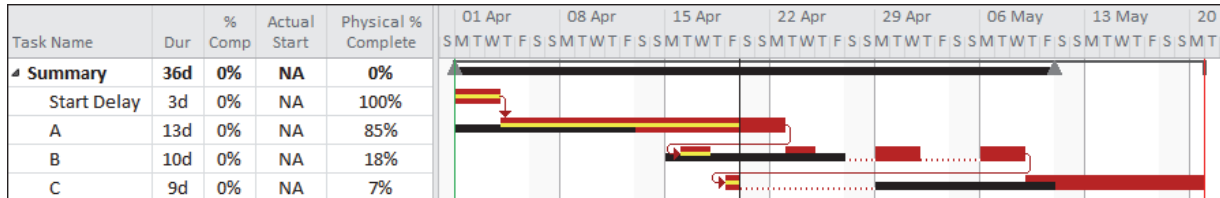


Figure 25 – Microsoft Project Impacted Live.

Advantages of Microsoft Project



Microsoft Project has a very high market penetration, and it's advantages are:

- Sharing project data is simple because many other companies use it,
- Many commands are similar to other Microsoft Office products,
- It is very simple to create small unresourced project schedules,
- It is a desktop application and does not incur the high cost of installing and maintaining a database and employing administrators.


Disadvantages of Microsoft Project

It is very difficult and time consuming to update a project using the Impacted with Actuals technique because:

- Microsoft Project ignores the **Status Date** in the default mode of operation and does not force incomplete work into the future in relation to the **Status Date**.
- No **View** supplied with a default installation of the Microsoft Project application displays the **Status Date**; and this has to be manually added to all views,
- The **Task Finish** date is not calculated from the **Status Date** plus the **Remaining Duration**, but calculated from the **Task Start Date + Duration**.
- It only allows one relationship between two tasks making it difficult to maintain a Closed CPM Network (no open ends).
- The **Actual Duration** is not calculated by the software. This has to be calculated manually by the scheduler, or the scheduler has to activate one of the software functions such as:

- **Mark on Track**  which calculates a task **Actual Duration** and **Remaining Duration** in relation to the **Status Date**, or
- **Update Project**  which updates a schedule as if it has gone exactly as planned.

Both the above functions direct the software to calculate the **Actual Duration** and **Remaining Duration** correctly in relation to the **Status Date**,

- The **% Complete** is linked to the **Actual Duration** and **Remaining Duration**, thus any change to the **% Complete** field will result in incomplete work displayed in the past or completed work displayed in the future.
- There are several functions in the software that, if used improperly, will result in an incorrectly updated schedule. These include:
 - The ability to enter a task **% Complete** and not result in the **Actual Duration** being in the past and **Remaining Duration** in the future. The **% Complete** field in Microsoft Project is the % duration complete.
 - The **25% Complete**, **50% Complete** and **75% Complete**  functions.
- The start and finish date and time of splits in tasks are not available through the user interface.
- A Baseline is a copy of some project data but is not a copy of a complete project.
- The management of multiple baselines is difficult as they may not be named.
- It is difficult to display more than one baseline bar.
- As users create more complex resourced schedules that must be updated with Actual Costs, Actual Units, Remaining Costs and Remaining Units MS Project becomes extremely difficult to use and other products become more attractive.

Very few Microsoft Project schedules are updated properly using the Impacted with Actuals technique due to the complexity of using the software. Usually people who attempt this method end up with incomplete work in the past, completed work in the future, and incorrectly reported Actual and Remaining Durations.

Oracle Primavera P6

Un-impacted – P6

This technique could be used with P6 but the author has never seen it utilized. One of the reasons why many companies move from Microsoft Project to P6 is so their schedulers will not update a schedule using the Un-impacted technique. Using P6 effectively forces schedulers to update a schedule using the Impacted with Actuals technique.

Should a scheduler wish to model the Unimpacted technique in P6 (perhaps to generate a display result that mirrors MS Project output), there are two methods that could be used to achieve this using P6:

- Using **Actual Start** and **Physical % Complete**, or
- Using **User Defined Fields**.

Using Actual Start and Physical % Complete

This method is demonstrated in Figure 26 below, which has:

- The **Default Percent Complete Type** is **Duration**,
- All the activities marked as started with an **Actual Start** equalling the **Start**,
- **Physical Percent** complete entered,
- The **Data Date** moved to the data date,

- The project has not been scheduled:

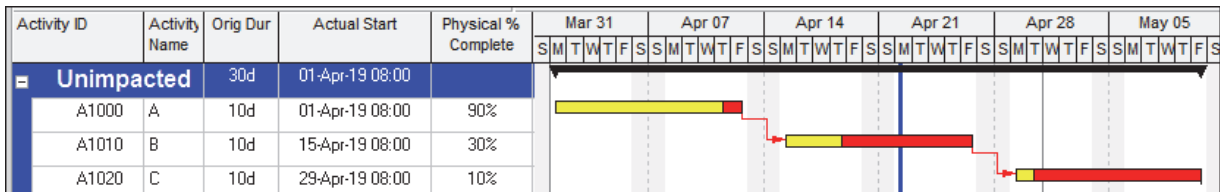


Figure 26 – P6 Un-impacted schedule using **Physical % Complete**.

- When a P6 baseline is set and the baseline bar is displayed then the **Progress Lines** can be displayed, but they will not be displayed without a Baseline Bar also being displayed, as shown in Figure 27:

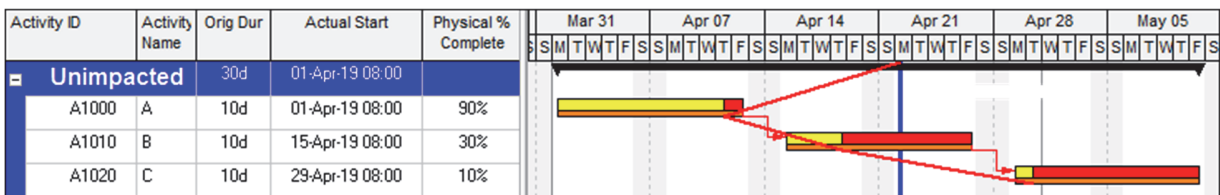


Figure 27 – P6 Un-impacted schedule with **Progress Lines**.

Using User Defined Fields

This method is demonstrated in Figure 28 below:

- It has three User Defined Fields, which are not used to calculate the schedule:
 - **Progress Start**, a UDF Start
 - **Progress Point**, a UDF Finish
 - **Progress % Complete**, UDF Text so summary values do not display as they would with a UDF Number,
- The **Progress % Complete** is entered to equal the % complete of the task,
- The **Progress Start UDF** is set to the **Activity Start** date, this may be achieved using a **Global Change**,
- The **Progress Point UDF** is set to a date that represents how much progress has been made,
- A **User Dates** bar is created to display the progress, and
- The **Data Date** is displayed using a **Curtain**:

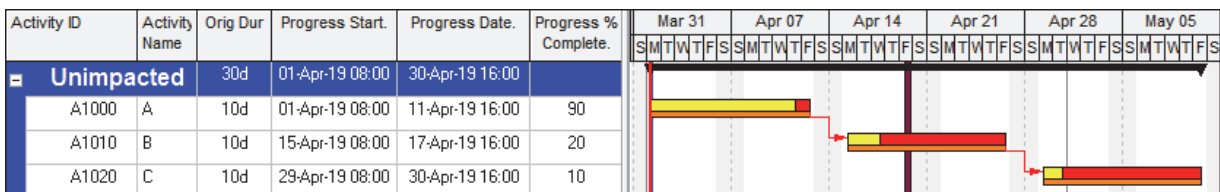


Figure 28 – P6 Un-impacted schedule using UDFs.

- One advantage of this technique over using the **Actual Start** and **Physical % Complete** is that the schedule may be scheduled at any time because the **Data Date** has been left the same as the **Project Start** date.
- The **Progress Point UDF** could be set with a **Global Change** from **Progress % Complete**. This is demonstrated in the Impacted Live section of this paper.

Impacted with Actuals – P6

This is how this software is designed to be used, and it is far easier to update a P6 schedule using this technique than it is to update a Microsoft Project schedule.

Figure 29 below shows a schedule that has been updated using the Suspend and Resume dates.

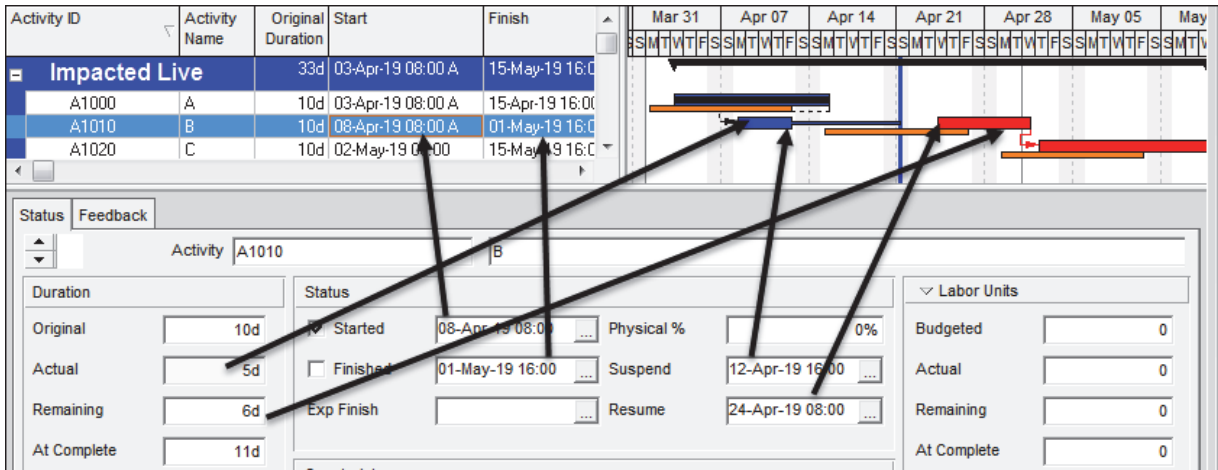


Figure 29 – P6 Impacted schedule displaying Suspend and Resume fields.

Figure 30 below shows a schedule update using the Retained Logic CPM calculation option:

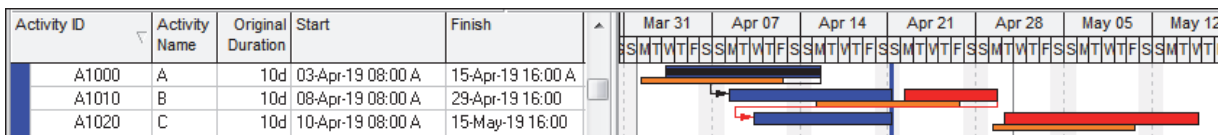


Figure 30 – P6 Un-impacted schedule using Retained Logic.

Figure 31 below shows a schedule update using the Progress Override setting for CPM calculations:

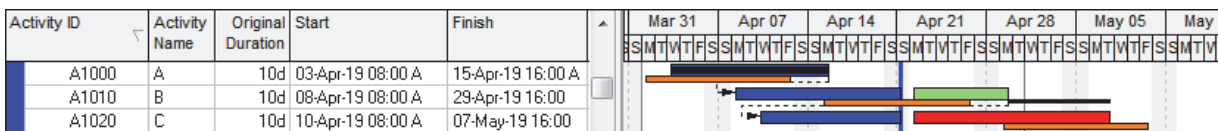


Figure 31 – P6 Un-impacted schedule using Progress Override.

Impacted Live – P6

As with other products, it is possible to use this technique with Primavera P6.

The data date may be displayed in one of two methods:

- After scheduling the P6 **Data Date** is moved to the required date but the CPM is not scheduled again, unless it is first moved back to the **Project Planned Start** date, or
- Display a **Curtain** to represent the data date.

A misleading summary % complete value will not be displayed in the bands when the percent complete is entered in a UDF text field, as per Figure 32 below.

Figure 32 below displays the P6 **Data Date** which was moved only after scheduling:

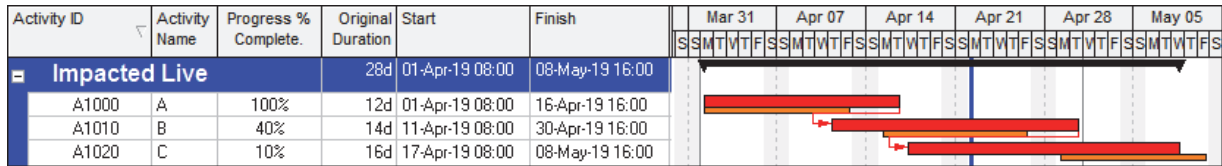


Figure 32 – P6 Impacted Live.

It is possible to display a percent complete bar following the process below using Global Changes:

- The percent complete must be entered into a UDF Integer and a UDF Number field. When the **Grand Totals** in **Group and Sort** is selected then this UDF Integer will have to be hidden as they will hold irrelevant summary values. It is not possible to Global Change from a UDF Text to a UDF Integer, so the percent complete should be entered into both of these two UDF fields.
- A UDF **Progress bar start date** and a **Progress bar start date** are used for displaying the progress bar.
- The **Progress bar start date** is set to equal to the **Start** by using the **Global Change** feature.
- The **Progress bar start date** is set to the **Start + (Finish – Start) x % Progress Complete** by **Global Change**.
- The progress bar is created using the **Progress Bar Start Date** and the **Progress Bar End Date**.
- Figure 33 below shows how the UDF Integer field **Progress % Complete Integer** displays an irrelevant summary **% Complete** of 150 which is greater than the maximum possible value of 100%. The UDF Integer field **Progress % Complete Text** displays a blank, which is preferable to a value over 100%.

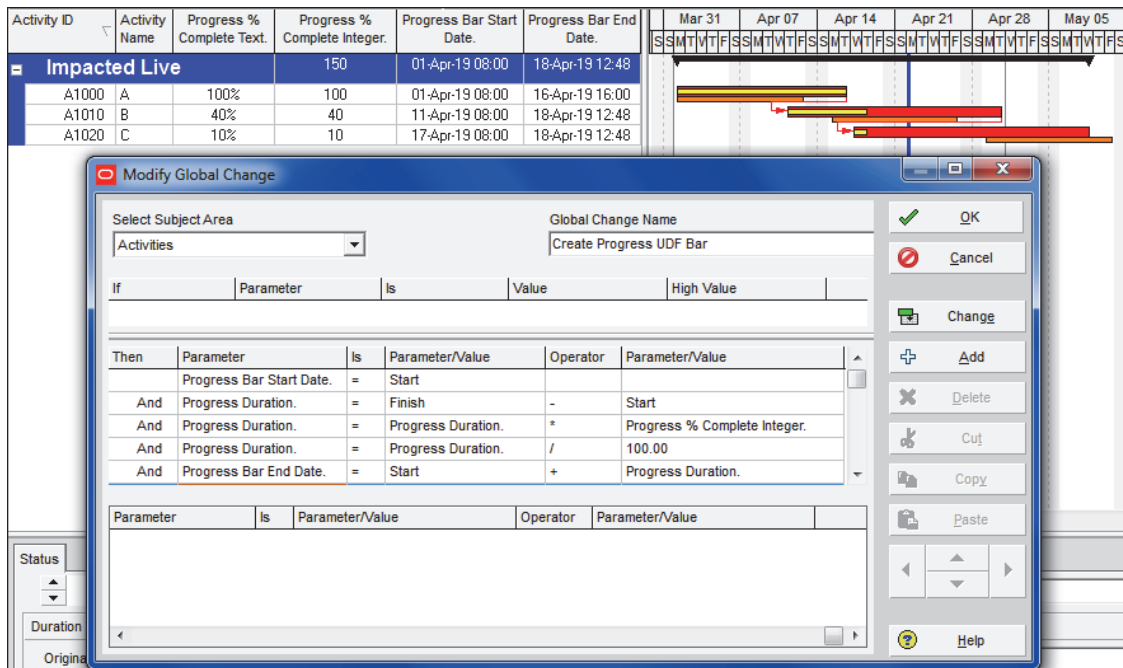


Figure 33 – P6 Impacted Live with % complete bar.

Advantages of P6

The advantages of P6 are:

- P6 is far easier and quicker to update a schedule than Microsoft Project when one requires a properly updated schedule using the Impacted with Actuals technique.
- The ability to record an unlimited number of baselines which are complete copies of the current project and the ability display and compare up to 4 baseline bars against one current schedule.
- It calculates the **Actual Duration** from the **Actual Start** to the **Data Date** or **Suspend Date** and a change to the **Duration % Complete** does not change the **Actual Duration** only the **Remaining Duration**.
- It always schedules uncompleted work in the future.
- It allows four types of logic relationships between two activities making creating a Closed CPM Network far simpler than Microsoft Project.

Disadvantages of P6

Some of the scheduling issues with P6 are:

- The default Activity Views have a number of bar formatting issues which need to be reformatted to ensure that Baselines and relationships are displayed correctly in the Gantt Chart.
- Users must understand the planned dates issues and how to avoid them being displayed as baseline dates when no baseline has been set.
- Scheduling does not automatically schedule progress set in the future back into the past.

- Users must always show the time to ensure constraints and actual dates are not entered at irrelevant times. When the time is not displayed, activity Actual Start dates, Actual Finish dates, and Constraints are often set at midnight resulting in actual durations displayed one day shorter than they actually took.
- There is no built-in ability to create multiple splits in the past and future, but this may be achieved by either:
 - Assigning a calendar to an activity and necking the activity bar to show non-work periods, or
 - Creating multiple activities to represent the splits. The disadvantage is that only the original activity will have baseline dates and will display a baseline bar.

The option of adding multiple new activities to represent the splits and converting the original activity to a LOE with the intention of leaving the Baseline with the LOE activity does not work. Once an activity type is changed from a Task to LOE then P6 does not read the original baseline dates or display a baseline bar.

Asta Powerproject

Asta Powerproject is one of the few products that allows all three techniques to be utilised with relative ease.

Un-impacted- Asta Powerproject

The project below has had:

- The **Report Date** set to 22 April,
- The task **Percent complete** (% duration) entered and
- The project has not been scheduled.

Figure 34 below displays an Un-impacted schedule:

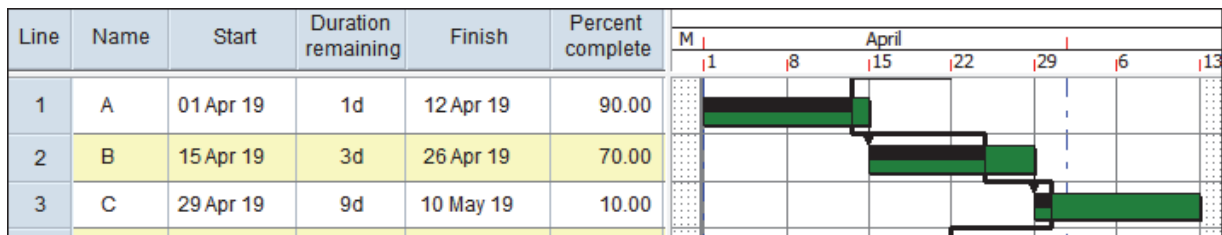


Figure 34 – Asta Powerproject Un-impacted.

The **Report Date** is displaying a **Jagged Progress** line, but this may be displayed as a straight line if required and force completed work into the past and uncompleted work into the future.

This is an optional function that may be turned off.

Impacted with Actuals- Asta Powerproject

One common technique used to update a schedule is to straighten the **Progress** line. The schedule from Figure 34 above has had a baseline set and the **Progress Line** straightened. The software has used **Move part completed activities** (Retained Logic) turned on in the calculation:

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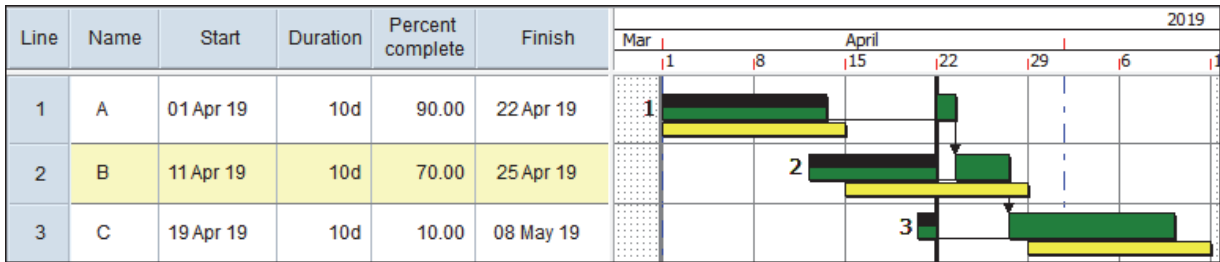


Figure 35 – Asta Powerproject Impacted with Actuals.

This process has moved:

- All incomplete work to the past,
- All complete work to the future,
- **Actual Start** dates have been modified when there was completed work in the future.

At this point in time **Actual Start**, **Duration** and **Actual Finish** dates of all splits in the past and future may be edited and **Duration remaining** may be edited to reflect when incomplete work should be scheduled in the future:

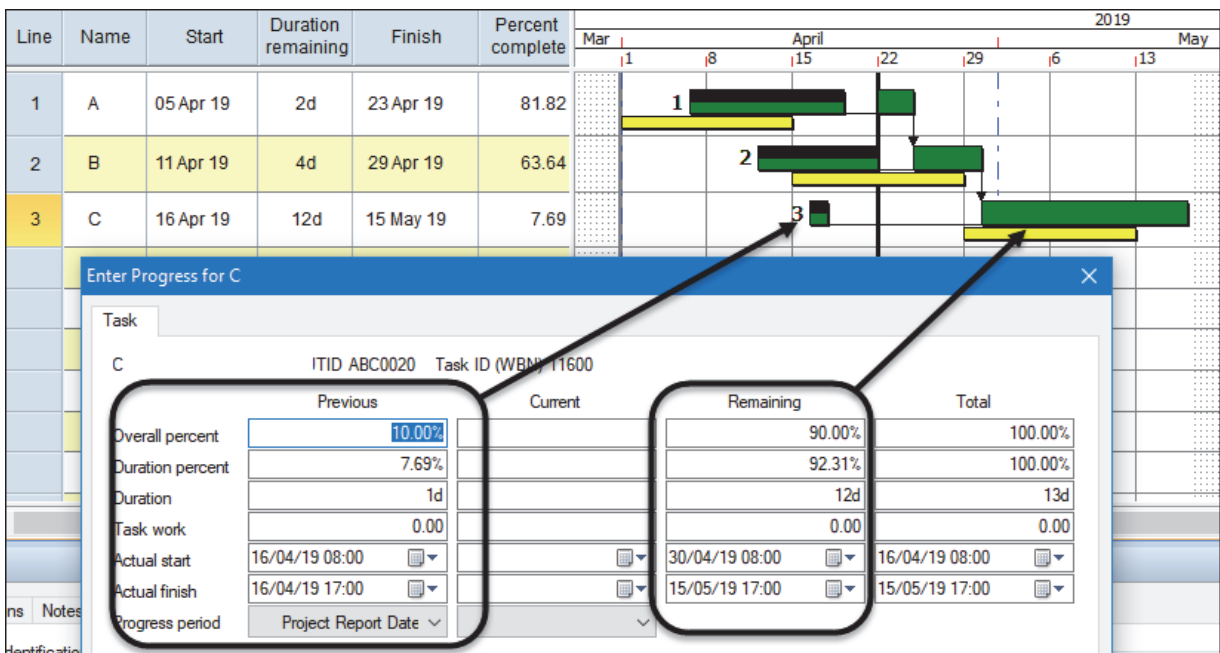


Figure 36 – Asta Powerproject updating spl tasks.

Edits may be made to split portions of activities by:

- Dragging the tasks, or
- Entering the relevant data in the **Enter Progress** form.

You may turn off the **Move part completed activities** (Progress Override) as per the calculation; the result is shown in Figure 37 below:

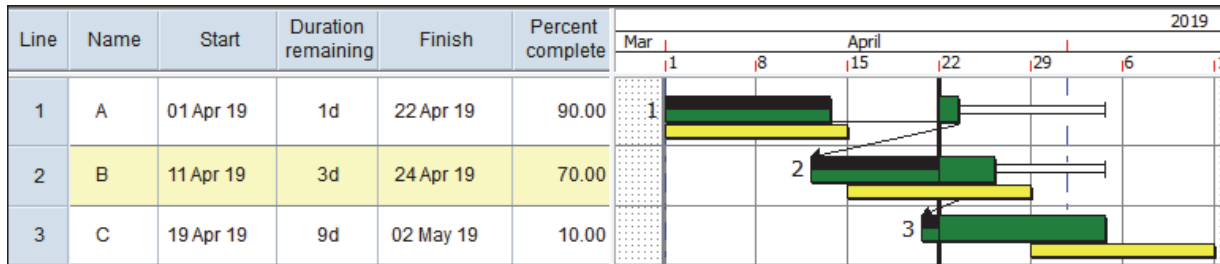


Figure 37 – Asta Powerproject Impacted with Actuals and Move part completed activities turned off.

Impacted Live- Asta Powerproject

This technique is possible with Asta using the process outlined below with the results displayed in Figure 38:

- The data date may be drawn using a number of options:
 - The **Date Zone, Grids, Variable Date** function, but this is not the best option, or
 - The **Date Zone, Shading** function, where the dates may be set from the **Date Picker** and the width and colour formatted, or
 - Displaying the **Report Date** as a straight line by selecting the **Format Bar Chart, Progress** tab, **Line style**, selecting **Straight (draw to report date)** and then the **Report Date** line will be displayed as a vertical straight line. This is the best option.
- The baseline has been displayed on its own line in the Gantt Chart and therefore displays the Baseline values on the second line. Unlike P6 and Microsoft Project it allows any baseline data to be read and displayed with the current schedule,
- Dates and durations are calculated in the normal way,
- The task percent complete may be recorded using the Asta **User percent complete** field,
- The percent complete may not be displayed on a bar,
- The red bar border displays the baseline and current schedule critical path,
- There are multiple splits in the future and past on task C.

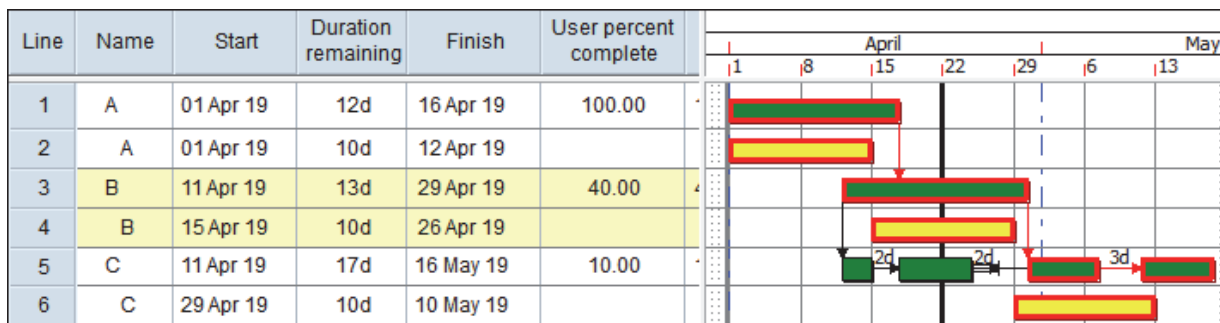


Figure 38 – Asta Powerproject Impacted with multiple splits in the past and future.

Advantages of Asta Powerproject

Asta Powerproject has many more scheduling options and functions than either P6 or Microsoft project. Those features relevant to the three schedule updating techniques are:

- An unlimited number of links between activities, allowing a partial critical path through activities,

- Multiple splits in the past and future,
- Scheduling options to allow the imitation of either Microsoft Project or P6 scheduling,
- Unlimited number of baselines may be saved which are complete copies of the project,
- Up to 10 baseline bars may be displayed,
- Multiple **Report Dates** (data dates) set at the start of the projects and the appropriate **Report Date** displayed at each update,
- View all baseline data from a current project view, including data items such as each individual resource properties and the baseline critical path

Disadvantages of Asta Powerproject

Asta Powerproject does not have a high market penetration in some countries and often contracts will specify a scheduling software such as P6 or Microsoft Project which have a high market penetration, thus making Asta Powerproject less likely to be nominated in a contract.

Asta Powerproject has many more scheduling options and functions than either P6 or Microsoft project and as a result takes longer to learn. This issue may be overcome by the creation of templates and writing of procedures for users to follow.

User defined bars may not be created and formatting of total and free float is weaker than other products.

Summary of the Three Techniques

There are three techniques that may be used to update a schedule, these have been demonstrated and in summary are:

- **Un-impacted.** A baseline is not set and only the % Complete is assigned to activities and no activity dates are changed in the update process.
- **Impacted with Actuals.** A baseline should be set. With this technique actual dates are assigned in the past to completed activities and complete portions of in-progress activities. Unstarted activities and incomplete portions of in-progress activities are scheduled in the future. Scope changes are added and the project scheduled to provide a revised end date.
- **Impacted Live.** A baseline should be set. The software inbuilt **% Complete, Actual Duration, Actual Start** and **Actual Finish** fields are not used. Completed activities are manipulated so they are scheduled when they actually occurred, in-progress activities are adjusted so they start when they actually started and will finish when they are planned to finish, un-started activities are scheduled into the future and scope changes added. This technique provides a revised end date for the project.

The Advantages and Disadvantages of Each Technique

- **Un-Impacted.** This technique provides the status of each activity but does not provide a revised end date for the schedule. This technique results in a schedule that may not be used for managing a project or claims analysis.
- **Impacted with Actuals.** This is how most software is intended to be used. This schedule may be used for managing a project and this technique opens up the opportunity to perform a Windows Analysis and the Half Step method to evaluate delay claims.
- **Impacted Live.** This schedule may be used for managing a project and this technique maintains an As-Built Critical Path allowing a “Collapsed As-Built” technique to be used to evaluate claims. Also the removal of delay activities allows a Collapsed As-Built analysis to be performed on a schedule that has been built during the execution of the project. As this schedule is built up over time, it would help negate the criticisms of the Collapsed As-Built windows analysis not reflecting reality because it was updated on a regular basis and may be reviewed after each update.

How each software package supports the three techniques

The table below summarizes the ability of each package to be used for each technique and provides the author’s opinion of how simple it is to use the technique with the software.

Technique Software	Un-Impacted	Impacted with Actuals	Impacted Live
Microsoft Project	<p>This process is simple with Microsoft Project. An untrained user may update a project using this process by simply entering the % Complete against tasks. The Status Date should be set and displayed, but is usually not displayed because there are no Views supplied with Microsoft Project that display the Status Date. Untrained users often do not work out how to display the Status Date on the rare occasions that the Status Date is set.</p>	<p>This technique is a much more time consuming than other products. This is mainly because the default calculation mode ignores the Status Date and allows complete work in the future and incomplete work in the past. Significant manual intervention is required to ensure the schedule is updated properly. Most users attempting to update a schedule using this method usually end up with complete work in the future and incomplete work in the past. This is often due to ignorance of how the % Complete field calculates and what it represents, plus the difficulty in understanding the many functions and options available to update a Microsoft Project schedule.</p>	<p>This process is very simple with Microsoft Project. The Physical % Complete may be used to record progress against unstarted tasks in columns. The Status Date may be displayed as the data date because Microsoft Project ignores the Status Date in the normal mode of calculation. The Physical % Complete may be used to display as progress on the bars.</p>

Technique Software	Un-Impacted	Impacted with Actuals	Impacted Live
Oracle Primavera P6	This technique could be used with difficulty, but this is not how the software is designed to be used. Unlike Microsoft Project the inbuilt percent complete functions may not be used to display progress. Many companies move to P6 to implement a more disciplined approach to schedule management and to stop schedulers using this technique.	P6 is designed to use this technique and does not allow incomplete work in the past when a project has been scheduled to a new data date. It is very simple to update a schedule in P6 with this technique and it is how most companies use P6. Training is essential to ensure users understand the issues with the planned dates, baseline bars, how to display the time and the correct process to update a project.	This technique may be used with P6. The percent complete must be displayed in a UDF. The data date may be displayed as the Data Date but it is must be reset to the Project Planned Start when scheduling, or a Curtain may be used to display the data date. The % Complete is difficult to display on the Gantt Chart without the use of UDFs and Global Changes.
Asta Powerproject	The software is designed to use this technique using the Jagged progress line . Unlike P6, with a Jagged progress line Asta allows complete work in the future and incomplete work in the pasts. The use of this function is optional.	The software is designed to manage this technique with the function to Straighten the Progress line . Asta Powerproject has a lot more scheduling and graphical functions than other software, which results in users taking more time to learn the software. This issue may be overcome with templates and procedures.	This technique may be used with Asta Powerproject. The User percent complete field may be used to store the % Complete . There are several ways of displaying the data date. The % Complete may not be displayed as a bar on the Gantt Chart because Asta does not display the User percent complete as a bar and there are no functions to display user dates as bars.

Conclusions

Unimpacted Technique

A schedule should not be updated using the Unimpacted technique as this technique only provides the status of activities against the original plan and may not be used for managing a project or to analyze delays in support of Extension of Time claims.

Impacted with Actuals Technique

A schedule should be updated using the Impacted with Actuals technique when it is required to:

- Managing a project with the schedule, and
- Analyze delays to support Extension of Time claims.

The reasons for using the Impacted with Actuals technique are:

- It is the method identified in AACE International, Recommended Practice 90R-17, Stating the CPM Schedule,
- The Impacted with Actuals technique uses the software in the way it was designed, and
- This method has wide industry acceptance, whereas the other two methods are usually not accepted.

Impacted Live Technique

This technique has some disadvantages over the Impacted with Actuals technique:

- It does not use the software packages discussed in this paper in the way they are designed to be used, and
- It is a difficult technique to use and significantly more complex than the Impacted with Actuals technique.

The reasons for using the Impacted Live technique are:

- The schedule may be used for managing a project.
- This technique maintains an As-Built Critical Path allowing a “Collapsed As-built” technique to be used to evaluate claims, and
- This technique will help negate the criticisms of the Collapsed As-Built windows analysis not reflecting reality because it was updated on a regular basis as the project was executed and may be reviewed after each update.
- The resulting schedule would be useful in providing contemporary, not forensic, delay analysis and time impact evaluation (including responsibility for delay).

Software suitability for the Impacted with Actuals technique

The Impacted with Actuals technique is the recommended technique:

- Microsoft Project has the highest industry penetration, but it is difficult and time consuming to use the Impacted with Actuals technique and it is very simple to end up with a schedule with either uncompleted work in the past or completed work in the future.

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- Primavera P6 has wide industry acceptance and provides a straight forward process to update a schedule using the Impacted with Actuals technique.
- Asta Powerproject has a lower market penetration, but it has many more useful scheduling functions than either P6 or Microsoft Project. A schedule may be more easily updated with the Impacted with Actuals or the Impacted Live technique.

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