When is a Baseline Not a Baseline? Problems and Solutions of Using the P6 Baseline Function

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Abstract

Many people interchangeably use the phrases “project schedule baseline” and “P6™ baseline schedules”. Fundamental differences exist between the project baseline and the baselines that P6 uses and these differences can cause significant confusion. The project schedule baseline is the point of reference and the basis for earned value measurements whereas P6 baselines are just snapshots of schedules in time.

The fact that any P6 project snapshot can be easily assigned as a “baseline” brings with it inherent risks. What if the snapshot attached as a project baseline is inadvertently changed? The variance analysis and earned value measurements would be flawed.

Moreover, the fact that the P6 baselines can be modified and updated so easily is both a blessing and a curse. What baseline schedule is actually being referenced and what are the earned value measurements based upon: the original baseline, current baseline, or something in between? It is necessary to ask how the baseline assignment process can be made more transparent.

Oracle doesn’t make the scheduler’s life easier either. The snapshots are supposed to be “images” frozen in time. However, this is not totally true, as some changes in the active schedules also affect the attached snapshots. What fields are affected? What does this do to the variance analysis? This paper addresses these questions.

Introduction

Many people interchangeably use the phrases “project schedule baseline” and “P6™ baseline schedules”. However, as fundamental differences exist between the project baseline and the baselines that P6 uses, these differences can cause significant confusion.

To better highlight those differences, some common definitions describing the baseline schedule as a reference plan and basis of earned value (EV) measurements are provided below. Starting with a broader definition, the AACE Recommended Practice 78R-13 “Original Baseline Schedule Review - As Applied in Engineering, Procurement, and Construction” [1] states that the accepted initial schedule is often referred to as the baseline schedule. The AACE Recommended Practice 91R-16 “Schedule Development" [2] defines baseline schedule as a fixed project schedule that reflects all formally authorized scope and schedule changes against which project performance is measured.

And finally, as per the AACE Recommended Practice 10S-90 “Cost Engineering Terminology" [3], the schedule baseline in earned value reflects the baseline start and completion dates used for integration with work authorization and costs. It is considered the time element of the performance measurement baseline (PMB).

In contrast, a Primavera P6 baseline, as defined in the Oracle documentation [4], is a complete copy of a project plan that can be compared to the current schedule to evaluate progress. Within layouts, baseline data can be displayed in graphical and column data format to perform cost and schedule analysis. The user’s schedule management processes define what the copy of the project represents and controls its required revisions.

This paper will focus on describing the Primavera P6 baselines in order to make the most out of its various features and help users identify critical control points for its management.

Characteristics of P6 Baselines

Many people think of a P6 baseline schedule as a ‘snapshot’ of the current schedule at the time it was created. A P6 baseline schedule is not so much a snapshot of a schedule as an actual schedule with the following saved features:

- Risks
- Issues and Thresholds
- Reports
- Documents
- Funding Sources
- Summary Data
- Notebooks

- WBS Milestones
- Work Products & Documents
- Activities
- Relationships
- Resources & Role Assignments
- Expenses
- Activity Codes
- Notebooks
- Steps
- Financial Period Data

When a P6 baseline is created, it is not visible to the users in the enterprise project structure (EPS) structure and can only be accessed through the P6 baseline function. P6 administrators using SQL queries can differentiate a baseline schedule from a 'real' schedule based on whether the project field, *Original Baseline ID,* is blank or not. All the baselines will have the same WBS parent project ID but only the active schedule will have a blank *Original Baseline ID* field.

Working with Baselines in P6

One of the pillars of project management is the project baseline's establishment. The schedule baseline reflects the original plan, both in terms of project scope and execution strategy agreed upon. Throughout the project lifecycle, the current schedule will be compared with the baseline, to identify variances to the plan. The project management team relies on variance analysis results to develop mitigation plans in order to eliminate or reduce those variances that would otherwise negatively impact the project's key milestones.

Primavera P6 facilitates the variance analysis exercise through the baseline creation and assignment processes. P6 developed two types of baselines: project and user baselines. The project baseline is used for project / activity usage spreadsheets and profiles. It can also be used for EV calculations. For any given project, there can only be one project-level baseline set at any given time.

P6 also designed three user baselines, named primary, secondary and tertiary baseline. The user's primary baseline can also be used for EV calculations.

In the project settings tab, users select the baseline to retain for the EV calculation, either the project baseline or the user's primary baseline, as shown in Figure 1 below.

Figure 1: Project Settings Tab

Baselines are also used for a multitude of variance analysis, thanks to the numerous fields that Primavera makes available for displaying the information stored. The number of fields varies based on whether a specific baseline is assigned to the project or not. When a project baseline is assigned, there are 37 fields available for reference, as shown in Figure 2 below:

	A	B
1	Available Fields	37
2	BL Project Activity % Complete	
3	BL Project Activity Status	
4	BL Project Actual Duration	
5	BL Project Actual Expense Cost	
6	BL Project Actual Finish	
7	BL Project Actual Labor Cost	
8	BL Project Actual Labor Units	
9	BL Project Actual Material Cost	
10	BL Project Actual Nonlabor Cost	
11	BL Project Actual Nonlabor Units	
12	BL Project Actual Start	
13	BL Project Actual Total Cost	
14	BL Project Completed Activities	
15	BL Project Cost % Complete	
16	BL Project Duration	
17	BL Project Duration % Complete	
18	BL Project Early Finish	
19	BL Project Early Start	
20	BL Project Expense Cost	

	A	B
1	Available Fields	37
21	BL Project Finish	
22	BL Project Free Float	
23	BL Project In-Progress Activities	
24	BL Project Labor Cost	
25	BL Project Labor Units	
26	BL Project Late Finish	
27	BL Project Late Start	
28	BL Project Material Cost	
29	BL Project Nonlabor Cost	
30	BL Project Nonlabor Units	
31	BL Project Not-Started Activities	
32	BL Project Percent Complete Type	
33	BL Project Physical % Complete	
34	BL Project Remaining Duration	
35	BL Project Start	
36	BL Project Total Cost	
37	BL Project Total Float	
38	BL Project Units % Complete	

Figure 2: Available Project Baseline Fields

The same fields are available when the primary baseline is assigned, but these fields are labeled BL1 instead of BL Project.

Any combination of these fields can be used in the variance analysis process, helping to provide a comprehensive picture of the current project's status.

If no project or primary baseline is assigned by the user, Primavera will assign by default the current project as the project and / or primary baseline and the number of fields available for variance analysis is reduced to 13, as shown in Figure 3 below:

Available Fields	13
BL Project Completed Activities	
BL Project Duration	
BL Project Expense Cost	
BL Project Finish	
BL Project In-Progress Activities	
BL Project Labor Cost	
BL Project Labor Units	
BL Project Material Cost	
BL Project Nonlabor Cost	
BL Project Nonlabor Units	
BL Project Not-Started Activities	
BL Project Start	
BL Project Total Cost	

Figure 3: Project Baseline Fields Available When No Project Baseline is Assigned by the User

The secondary and tertiary baselines can also serve as the basis for variance analysis, but with a more limited utilization than the project or primary baselines, as the number of fields made available for display is limited to 8, as shown in Figure 4 below.

Available Fields	8		Available Fields	8
BL2 Actual Finish			BL3 Actual Finish	
BL2 Actual Start			BL3 Actual Start	
BL2 Early Finish			BL3 Early Finish	
BL2 Early Start			BL3 Early Start	
BL2 Finish			BL3 Finish	
BL2 Late Finish			BL3 Late Finish	
BL2 Late Start			BL3 Late Start	
BL2 Start			BL3 Start	

Figure 4: Secondary and Tertiary User Baseline Schedule Fields

While the project-level baseline is intended to store the approved schedule, that reflects contractual requirements or agreements with the project stakeholders, user baselines can display other snapshots captured during the project execution, such as the project's previous schedule updates. Another possible utilization for the user baselines would be variance analysis performed when developing scenarios or what-ifs schedules, situations when the date variances are the primary focus.

To assist users in the baseline management process, Primavera P6 has designed two main functionalities: **Maintain** and **Assign** baselines. Both functionalities are fairly simply to use, and this could be seen as a blessing. The main limitations lie in the administrative settings of the user's profile or the data limits of the application settings.

Maintain Baselines allows users that have the *Add / Edit / Delete Project Baselines* privilege to manage the project baselines by: adding, deleting, copying, updating and restoring them.

Adding a baseline can be done either by saving a copy of the existing schedule or by converting another project into a baseline from any enterprise project structure node where the user has the appropriate privileges (*Delete Projects* and *Edit Project Details Except Costs/Financials*). The number of baselines that can be saved within a project is practically limited by the administrative preferences settings, as Oracle set the application limit at 999,999,999 in the most recent P6 releases[1].

When a baseline schedule is created by *converting another project*, that project will disappear from the EPS listing and will now only be accessible from the P6 baseline functions. The **Maintain Baseline** screen's *Last Update Date* field could be used to determine if the baseline was created by making a copy of the existing file, as it will store the date the copy was made, and this will remain fixed until an update is actually performed on it. Figure 5 below shows such an example.

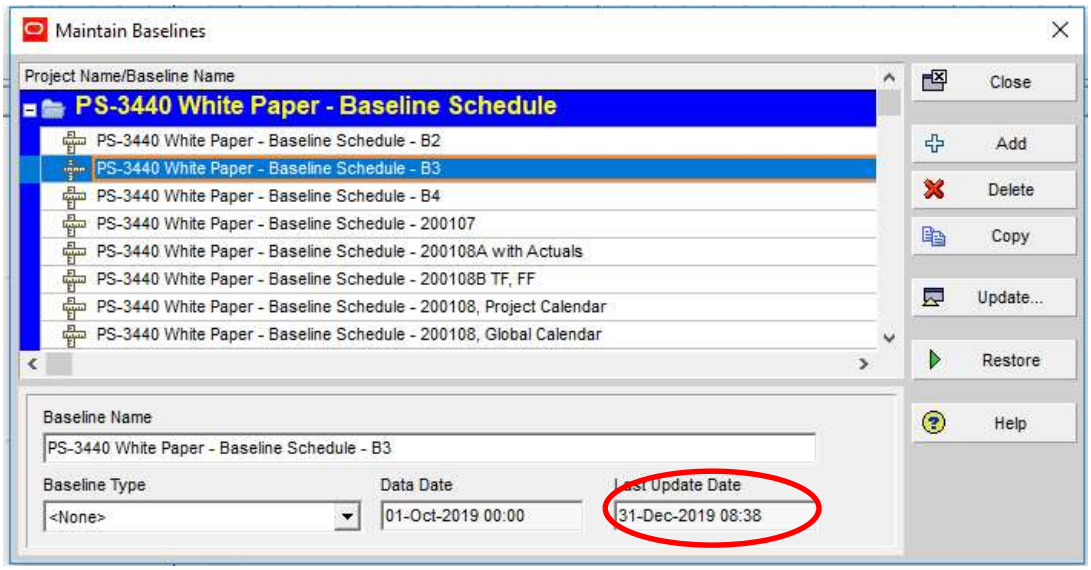


Figure 5: Baseline Schedule Created from a Copy

[1] Primavera P6 Professional 17, Release 17.12.13 was used for the development of this paper.

If the baseline schedule was created by converting it from another active schedule, then the *Last Update Date* field will be left blank until an update is actually performed on it, as shown in Figure 6 below.

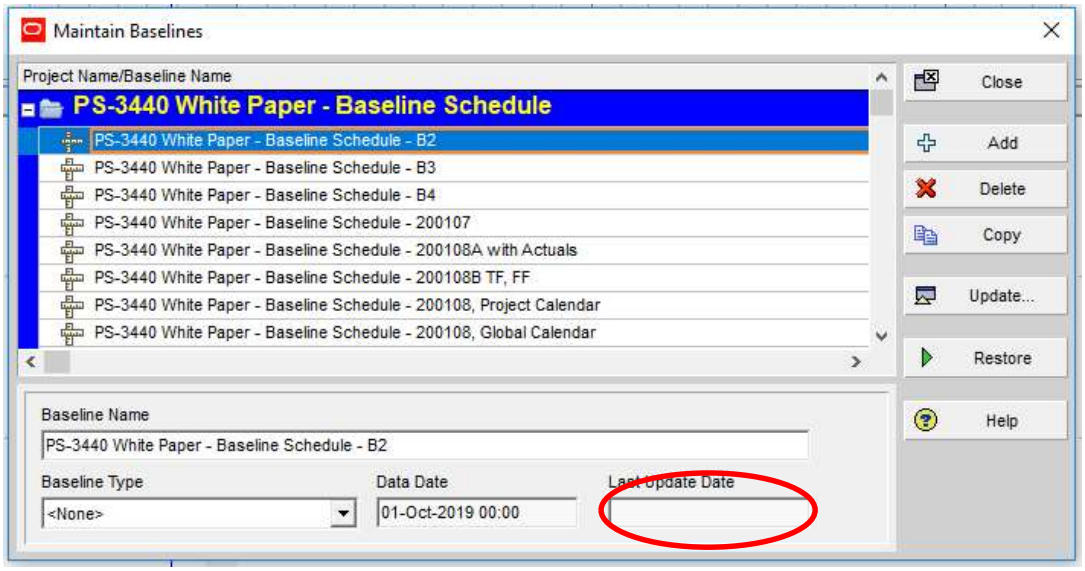


Figure 6: Baseline Schedule Created from an Active Schedule

As the information displayed in the *Last Update Date* field is dependent on whether or not the baseline was subsequently updated, its utilization is somewhat limited. P6 practitioners would greatly benefit from an additional field, *Baseline Creation Date*, that would capture this time stamp with no possibility of overwriting.

The baseline's name can be modified by users, and since there is no rule in P6 preventing duplicate names, this can cause confusion. In Figure 7 below, the two baselines have the same name. This was an intentional change to illustrate the point.

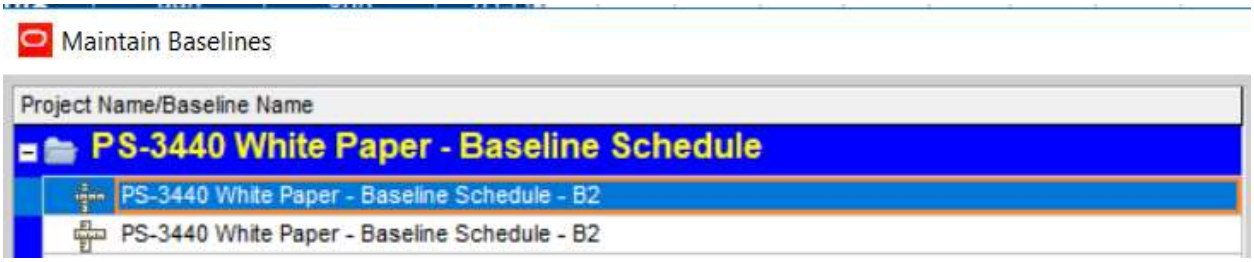


Figure 7: Two Baseline Schedules with the Same Name

If P6 does not allow the use of a specific schedule ID, returning the error "the value entered for Project ID must be unique", and a duplication is not evident, the duplicate may be a 'hidden' baseline schedule. This is especially problematic as users cannot see the baseline schedule's ID until after restoring it.

When the baseline schedule is restored, its 'hidden' ID will be revealed, and the name previously displayed in the **Project → Maintain Baselines** dialog box will be preserved. In Figure 8 below, the baseline renamed B2 was restored and its unique ID revealed.

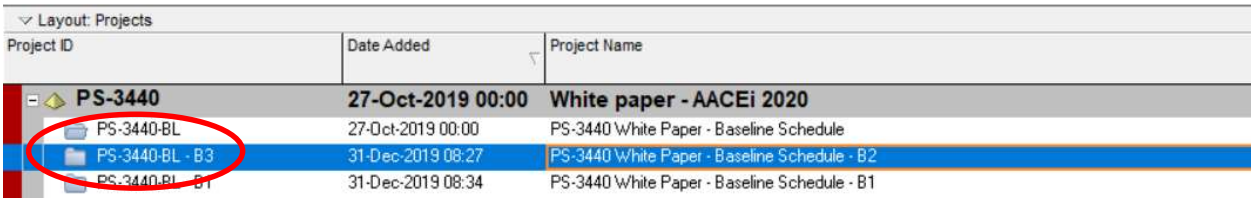


Figure 8: EPS Showing Restored Baseline Schedule

Ideally, Primavera P6 should have a way of allowing users to see the IDs of the schedules assigned as baselines as it would help in the version control process. Third party software such as Schedule Analyzer [5] has a way of investigating the database and revealing this information, as shown in Figure 9 below.

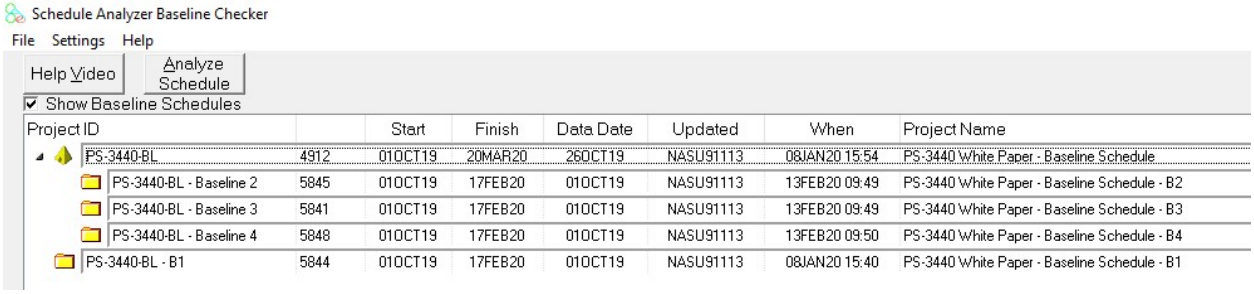


Figure 9: A Third-Party Display of Baseline Information

The second option available in the **Maintain Baselines** dialog box allows *deleting* any of the saved baselines. This function is only active for baseline schedule that are not designated as active baselines in either the *project* or *user baseline* categories. Primavera allows reusing the schedule ID of a deleted copy, so users should keep track of the copies made.

A third option allows users to *copy* any of the saved baselines to produce exact replicas of a given snapshot. When copying a saved baseline, P6 will apply the same numbering convention as the one used when initially creating the baselines, by adding the "– Bx" sequential number to the active project's ID. The *Last Update Date* field will display the information from the copied schedule, so it could be a given value or just a blank field. There is no other indication to help users determine the source of the newly created copy. This could be problematic when multiple snapshots of the project were already created and any of them could have served as the source for the new copy. A schedule log, containing information on all copies made, including the data source and the date of the copy, is therefore strongly recommended.

Updating the baselines presents a large array of options to choose from in terms of data to be updated. This is not covered here, as it is adequately described in detail in other publications, such as “Creating Half-Step Schedules Using P6™ Baseline Update” [6]. There is currently no method to determine if this functionality was actually used.

Finally, *restore* would detach any of the saved baselines and make them available in the enterprise project structure as independent project files in the same EPS node where the active project resides. This functionality would mainly be used for analyzing, manually updating, or incorporating the approved change order information, or calculating a baseline schedule. Once modified, the schedule could then be re-attached to the active project. At a minimum, this functionality could be utilized by users to see the otherwise “hidden" project IDs of the restored snapshots and the date the snapshots were actually created.

Assign baselines allows users to designate any of the saved snapshots as either *project baseline* or *user baseline*, based on their project profile. The *Assign Project Baselines* privilege is required to be able to set a *project baseline* and without it, the users can only set *user baselines*. By design, each project has to have a project baseline and a primary baseline. The secondary and tertiary user baselines assignments are optional.

Even for users that do not use P6 for EV measurements, the baseline designation and the EV calculation settings are extremely important as they will determine the way P6 calculates and reports the baseline dates [7, 8].

When no baseline is assigned by the user, the baseline start and finish dates reflect the planned start and planned finish dates and their calculation is based on the activity status.

For activities that are not started, the baseline start and finish dates are equal with the early start and early finish dates and with the start and finish dates.

For activities that are in progress (have an actual start but no actual finish) or are completed (have actual start and actual finish), the baseline project start date will capture the date displayed when the actual start was first set on the activity. This date will remain fixed and changes to the activity’s actual start value will not be reflected in the baseline start date field. The baseline project finish date is the result of a calculation: the actual start date plus the activity’s original duration (using the activity calendar). If the original duration value does not change, this date will also remain fixed and subsequent changes to the actual finish date value will not be reflected in the baseline finish date.

As the baseline bars are drawn based on the planned start and planned finish dates and not on the start and finish dates, it can cause the baseline bars to not visually match the current bar in the Gantt chart.

When a project or primary baseline is assigned by the user, the dates of the baselines are determined by the EV calculation option, set in the *Administrative Preferences*, as shown in Figure 10 below.

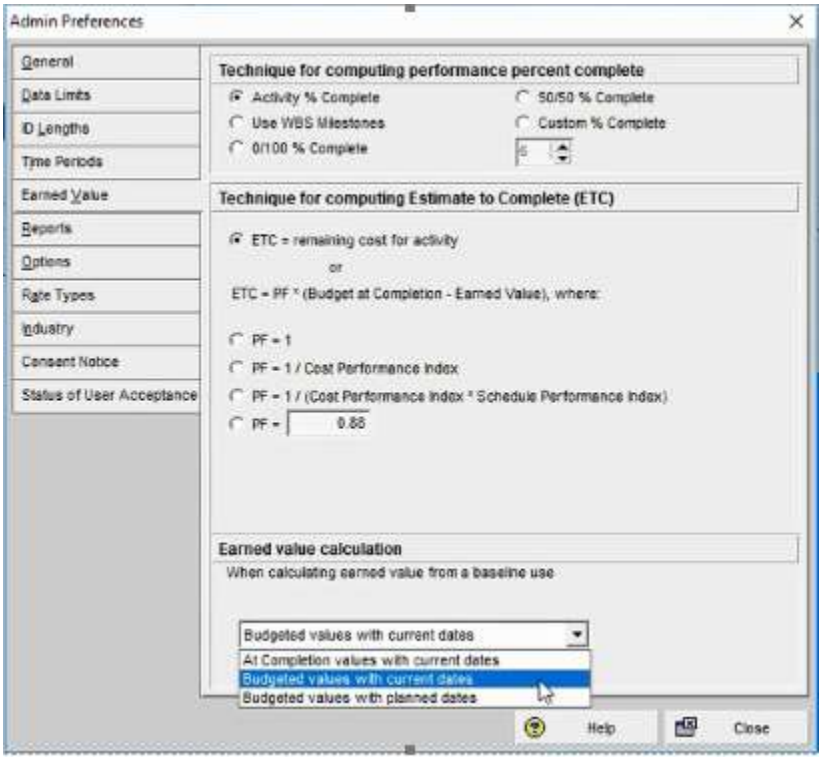


Figure 10: Available Admin Preferences for Earned Value Calculation

The *Budgeted values with planned dates* option will yield the same results as if no baseline is selected and the current schedule is the default baseline.

The *Budgeted values with current dates* and the *At Completion values with current dates* options will both use the start and finish dates of the assigned baselines' activities.

When earned value is used, if the baseline dates are different than the current project dates, the schedule performance index (SPI) will change between using planned dates or current dates. If the baseline at completion cost is different that the planned cost, SPI will not change between using *At Complete costs with current dates* vs *Planned costs with current dates*, but the individual earned value and planned value costs will be different [9].

Proper Baseline Management – The Challenge

As part of the standard schedule management process, upon approval, the project schedule is stored as a baseline. Using the approved schedule baseline and ensuring that this baseline

remains *frozen* during the project execution are essential pillars of schedule management. An unchanging baseline ensures a good depiction of the current project status and correct EV measurements.

As shown above, creating a baseline in the Primavera P6 software can be done by saving a copy of the current file or by converting another schedule into a baseline. In the first case, care should be taken to ensure the schedule has not been altered in the time elapsed between the issue for approval and the receipt of the approval notice.

When using the second approach, activities in active schedules that are converted into baseline schedules may not have matching activities in the master schedule. P6 merely compares the non-unique activity IDs from both schedules to pair the activities in reports and graphics. There are no internal keys used to ensure the matchups. No warnings are logged to caution the user that the baseline schedule does not match the existing schedule. Users should take care to ensure that the correct schedule is chosen for baselining. Active schedules that go missing might be inappropriately attached to the wrong schedule as a baseline.

In a less obvious mistake, the wrong project copy might also be converted to a baseline and since the project IDs of the snapshots are not visible to Primavera users, the project's name remains the only identifier of the baseline source. Care should be taken to properly name all project copies and to keep a detailed schedule log containing all schedule copies and revisions.

As soon as a project schedule is agreed upon and is converted into a baseline via the **Maintain Baseline** functionality, there is an expectation that this schedule should remain unchanged. The only modification to the baseline schedule should come from an approved scope change. However, just by looking at a given schedule printout, readers are unable to confirm that the information displayed as *baseline information* is really reflecting the approved baseline schedule. Using the **Assign Baseline** functionality, the schedule baselines can be easily swapped for others. Due to the simplicity of this process, swapping baselines proves to be very convenient when performing variance analysis using past periods snapshots. It is common to create baselines with every project update, be it monthly, biweekly or weekly. The user simply chooses from the multitude of baselines and assigns one as a project baseline for variance analysis purposes. The swap might very well be intended to be temporary but reversing the assignments may be forgotten in the bustle and confusion of workplace issues and priorities.

Primavera P6 offers two fields in the project view to store information related to the project baseline, namely the *Baseline name* and the *Baseline Data Date*, as shown in Figure 11 below.

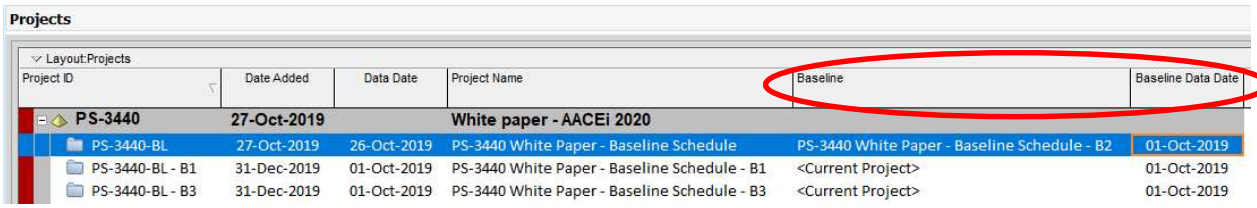


Figure 11: Project View Baseline Information

The project baseline information is also displayed in the status bar, as shown in Figure 12 below:

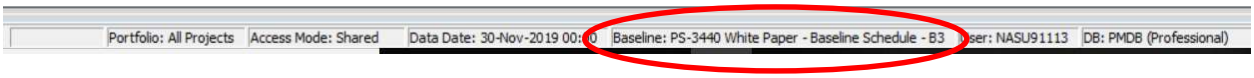


Figure 12: Status Bar Baseline Information

However, there are no equivalent fields to display the user primary baseline.

Even if users choose to work with the project baseline, they need to have the discipline and the good reflexes to check this information routinely. If a temporarily swapped baseline remains assigned, printouts and variance analysis reports will inadvertently display the wrong baseline information. The schedule printouts will display the baseline start and finish dates, but what schedule do they really reference? The challenge for proper schedule management is to go *behind the curtain* to find out.

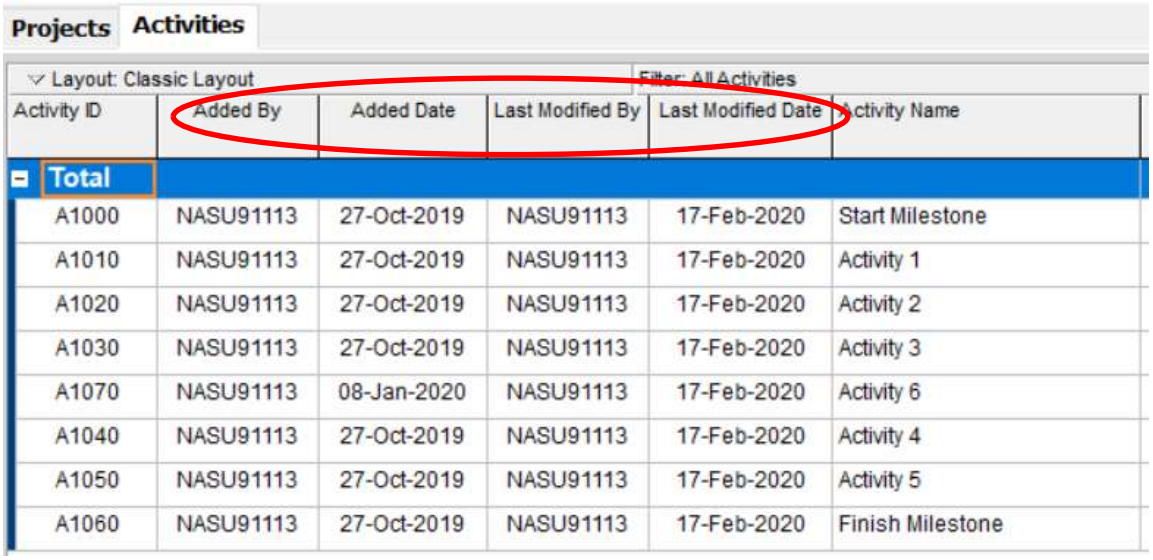
Moreover, in Primavera P6, schedule baselines cannot be locked and so they are subject to possible modifications. Using the *Update baseline* functionality, the saved snapshot can be partially or entirely modified with minimum effort and no restrictions prevent this modification other than the ones coming from the privileges' settings.

Other project management systems have a stricter way of securing the baseline information, especially the project cost management systems. More recently, other enterprise-type scheduling products have also implemented a similar functionality. For example, Microsoft PPM solution is offering two categories of baselines: *Protected Baselines* and *Unprotected Baselines* [10]. Using PPM security permission settings, it is possible to lock down any of the saved baselines, with a preference to restrain modifications on the protected baselines category. Primavera P6 does not have a similar feature and it would benefit from the application of such restrictions, as the baseline schedule should be protected from unwanted alterations. An Oracle Enhancement Request (ER) #26915 has been raised by this author for the ability to lock a project-level baseline schedule, and the scheduling community will need to vote in favor of this important functionality to make it an Oracle development priority.

There are legitimate reasons for modifying a baseline schedule. Incorporating change orders raised to add or delete contractual work is one such instance. When the schedule baseline

does need to be modified, the issue at hand is how to check if the modifications are limited to the approved scope change.

Primavera P6 offers a series of auditing fields available in the *Activity window*: *Added By*, *Added Date*, *Last Modified By* and *Last Modified Date*, as shown in Figure 13 below.



Projects | Activities

Layout: Classic Layout — Filter: All Activities

Activity ID	Added By	Added Date	Last Modified By	Last Modified Date	Activity Name
Total					
A1000	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Start Milestone
A1010	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Activity 1
A1020	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Activity 2
A1030	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Activity 3
A1070	NASU91113	08-Jan-2020	NASU91113	17-Feb-2020	Activity 6
A1040	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Activity 4
A1050	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Activity 5
A1060	NASU91113	27-Oct-2019	NASU91113	17-Feb-2020	Finish Milestone

Figure 13: Auditing Fields

These fields only pertain to basic activity information and using them for auditing purposes does not guarantee that the baseline has not been modified.

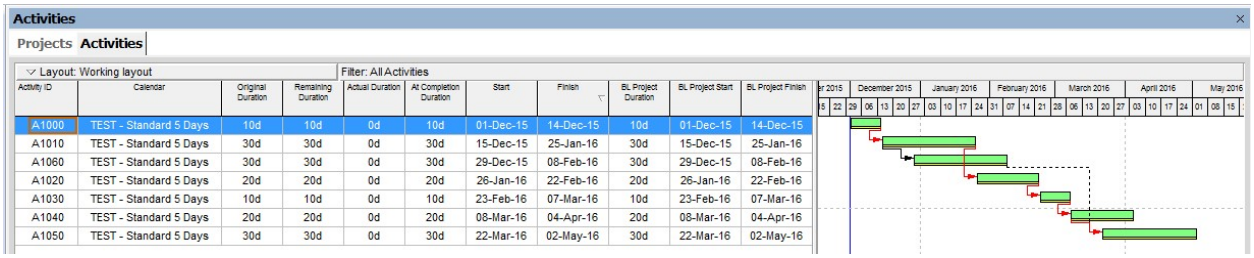
For example, the *Modified By* field will pick up changes to activity name, durations (original and remaining), resource loading (adding or replacing resources, changes in units etc). Changes in activity codes or user defined fields (UDF) will not be picked up. Changes to relationships (adding, deleting or modifying lags or leads) will not be marked out unless the schedule is calculated. Moreover, after the schedule calculation (F9), all activities whose dates are impacted will appear as *modified* and so all notifications about previous changes will be lost. So, the feature, while potentially useful to spot certain baseline modifications, has limited utilization on a regular basis.

It is interesting to point out that comparable auditing fields for such data as activity codes, UDF fields, and relationships are indeed kept by the P6 database. The display of these fields is only available using SQL Reports that a database manager would execute or other 3rd party software [5].

Another issue challenging the concept of P6 baselines being snapshots *frozen in time* concerns the calendars management, as changes to calendars can affect the saved baselines that

reference them. For example, if a global calendar is used, any change to it will be reflected in the baseline schedule and a recalculation of the baseline schedule with the updated global calendar will yield different results.

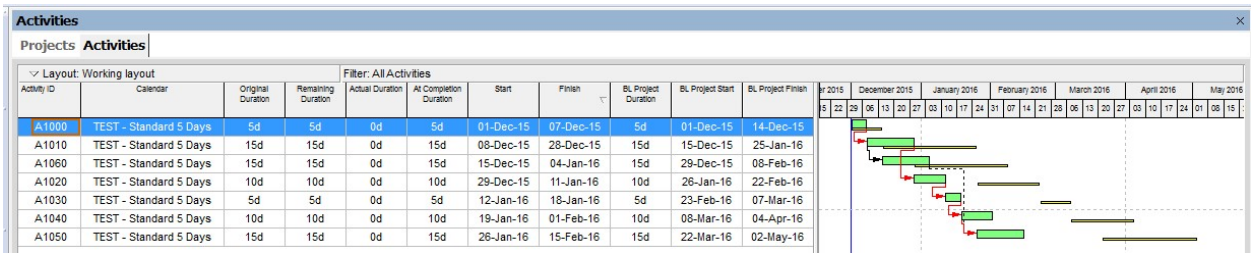
In the example below, a standard 8 hour per day, 5 day per week global calendar was used as shown in Figure 14.



Activity ID	Calendar	Original Duration	Remaining Duration	Actual Duration	At Completion Duration	Start	Finish	BL Project Duration	BL Project Start	BL Project Finish
A1000	TEST - Standard 5 Days	10d	10d	0d	10d	01-Dec-15	14-Dec-15	10d	01-Dec-15	14-Dec-15
A1010	TEST - Standard 5 Days	30d	30d	0d	30d	15-Dec-15	25-Jan-16	30d	15-Dec-15	25-Jan-16
A1060	TEST - Standard 5 Days	30d	30d	0d	30d	29-Dec-15	08-Feb-16	30d	29-Dec-15	08-Feb-16
A1020	TEST - Standard 5 Days	20d	20d	0d	20d	26-Jan-16	22-Feb-16	20d	26-Jan-16	22-Feb-16
A1030	TEST - Standard 5 Days	10d	10d	0d	10d	23-Feb-16	07-Mar-16	10d	23-Feb-16	07-Mar-16
A1040	TEST - Standard 5 Days	20d	20d	0d	20d	08-Mar-16	04-Apr-16	20d	08-Mar-16	04-Apr-16
A1050	TEST - Standard 5 Days	30d	30d	0d	30d	22-Mar-16	02-May-16	30d	22-Mar-16	02-May-16

Figure 14: Schedule Using Global Calendar before Modification

Subsequently, Figure 15 shows what happens in the active project when the global calendar was changed to a 16 hours per day, 5 days per week work calendar.

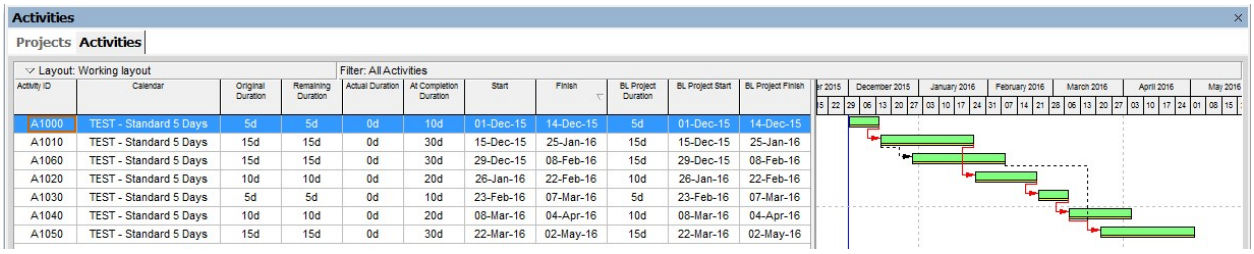


Activity ID	Calendar	Original Duration	Remaining Duration	Actual Duration	At Completion Duration	Start	Finish	BL Project Duration	BL Project Start	BL Project Finish
A1000	TEST - Standard 5 Days	5d	5d	0d	5d	01-Dec-15	07-Dec-15	5d	01-Dec-15	14-Dec-15
A1010	TEST - Standard 5 Days	15d	15d	0d	15d	08-Dec-15	28-Dec-15	15d	15-Dec-15	25-Jan-16
A1060	TEST - Standard 5 Days	15d	15d	0d	15d	15-Dec-15	04-Jan-16	15d	29-Dec-15	08-Feb-16
A1020	TEST - Standard 5 Days	10d	10d	0d	10d	29-Dec-15	11-Jan-16	10d	26-Jan-16	22-Feb-16
A1030	TEST - Standard 5 Days	5d	5d	0d	5d	12-Jan-16	18-Jan-16	5d	23-Feb-16	07-Mar-16
A1040	TEST - Standard 5 Days	10d	10d	0d	10d	19-Jan-16	01-Feb-16	10d	08-Mar-16	04-Apr-16
A1050	TEST - Standard 5 Days	15d	15d	0d	15d	26-Jan-16	15-Feb-16	15d	22-Mar-16	02-May-16

Figure 15: Schedule with Changed Global Calendar

The baseline was then restored and a snapshot of it was taken to illustrate the effect of the calendar change.

Figure 16 shows the baseline schedule once restored, with its snapshot attached as project baseline.



Activity ID	Calendar	Original Duration	Remaining Duration	Actual Duration	At Completion Duration	Start	Finish	BL Project Duration	BL Project Start	BL Project Finish
A1000	TEST - Standard 5 Days	5d	5d	0d	10d	01-Dec-15	14-Dec-15	5d	01-Dec-15	14-Dec-15
A1010	TEST - Standard 5 Days	15d	15d	0d	30d	15-Dec-15	25-Jan-16	15d	15-Dec-15	25-Jan-16
A1060	TEST - Standard 5 Days	15d	15d	0d	30d	29-Dec-15	08-Feb-16	15d	29-Dec-15	08-Feb-16
A1020	TEST - Standard 5 Days	10d	10d	0d	20d	26-Jan-16	22-Feb-16	10d	26-Jan-16	22-Feb-16
A1030	TEST - Standard 5 Days	5d	5d	0d	10d	23-Feb-16	07-Mar-16	5d	23-Feb-16	07-Mar-16
A1040	TEST - Standard 5 Days	10d	10d	0d	20d	08-Mar-16	04-Apr-16	10d	08-Mar-16	04-Apr-16
A1050	TEST - Standard 5 Days	15d	15d	0d	30d	22-Mar-16	02-May-16	15d	22-Mar-16	02-May-16

Figure 16: Baseline Schedule Restored

The calendar information in Figure 17 reflects the most up-to-date changes.

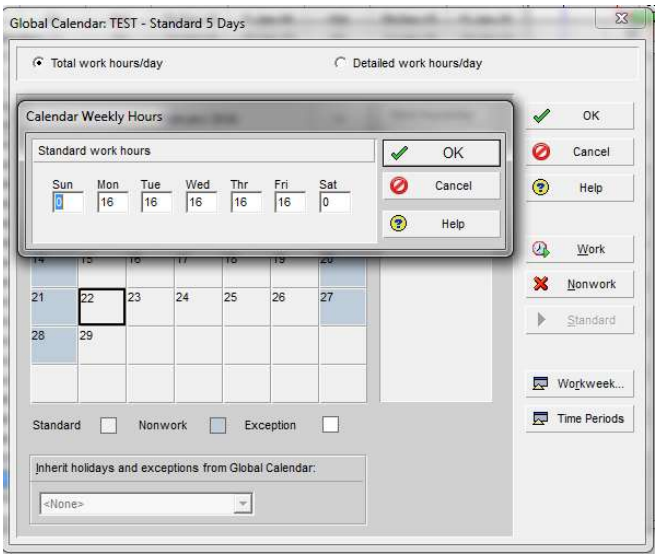


Figure 17: Modified Calendar Information

Figure 18 shows the result after the restored baseline was calculated, thus effectively applying the calendar changes to the affected activities.

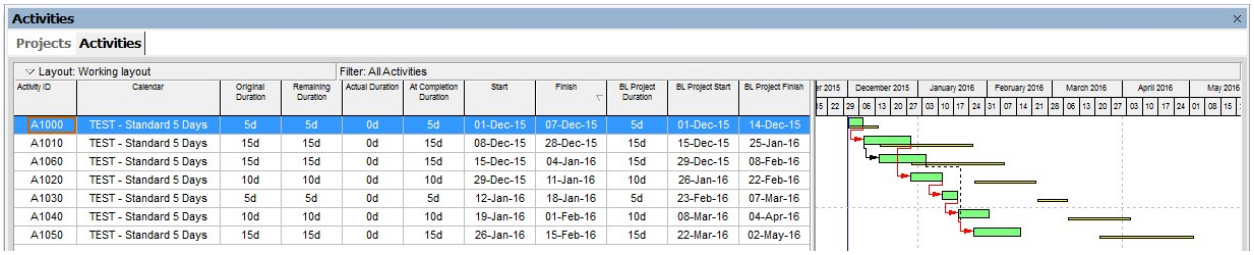
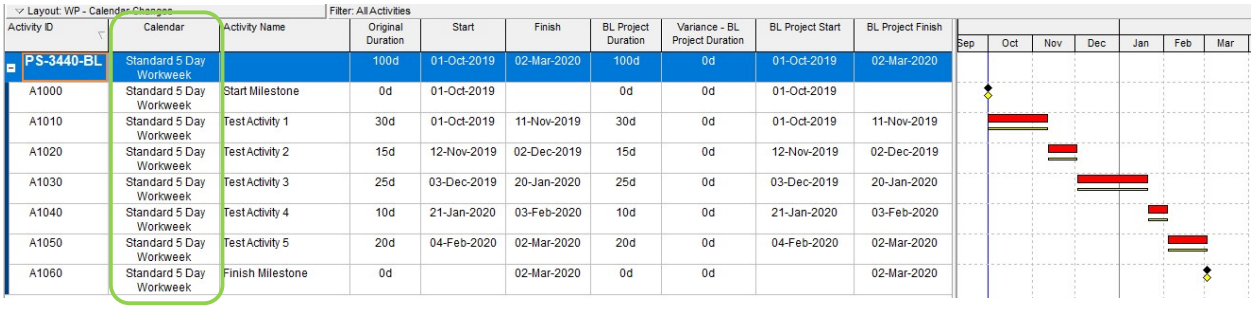


Figure 18: Schedule Result of Calendar Changes on Restored Baseline

If project calendars are used instead of global ones, these calendars are saved with the original baseline and would be deemed *frozen*. This seems like the best practice to adopt while working with various calendars types.

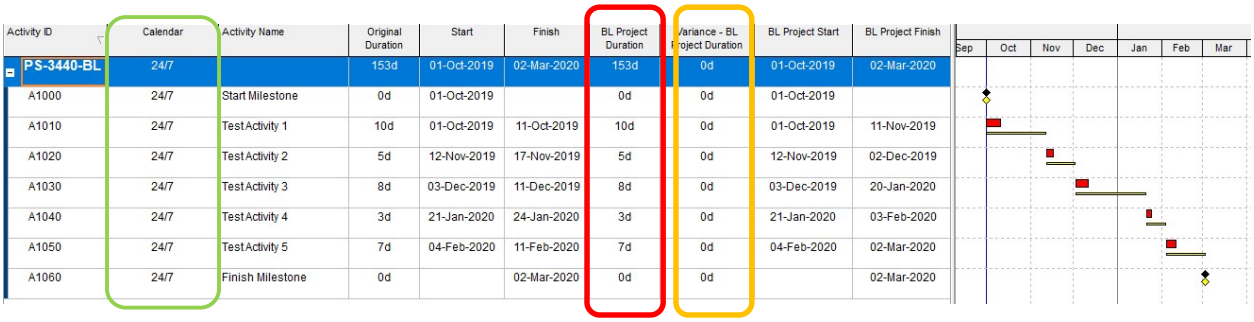
However, irrespective of the calendar type used, changes to the calendar seem to be impacting the baselines. In Figure 19 below, a standard 5-day workweek project calendar was assigned to all the activities in the schedule. A snapshot was taken and assigned as project baseline.



Activity ID	Calendar	Activity Name	Original Duration	Start	Finish	BL Project Duration	Variance - BL Project Duration	BL Project Start	BL Project Finish
PS-3440-BL	Standard 5 Day Workweek		100d	01-Oct-2019	02-Mar-2020	100d	0d	01-Oct-2019	02-Mar-2020
A1000	Standard 5 Day Workweek	Start Milestone	0d	01-Oct-2019		0d	0d	01-Oct-2019	
A1010	Standard 5 Day Workweek	Test Activity 1	30d	01-Oct-2019	11-Nov-2019	30d	0d	01-Oct-2019	11-Nov-2019
A1020	Standard 5 Day Workweek	Test Activity 2	15d	12-Nov-2019	02-Dec-2019	15d	0d	12-Nov-2019	02-Dec-2019
A1030	Standard 5 Day Workweek	Test Activity 3	25d	03-Dec-2019	20-Jan-2020	25d	0d	03-Dec-2019	20-Jan-2020
A1040	Standard 5 Day Workweek	Test Activity 4	10d	21-Jan-2020	03-Feb-2020	10d	0d	21-Jan-2020	03-Feb-2020
A1050	Standard 5 Day Workweek	Test Activity 5	20d	04-Feb-2020	02-Mar-2020	20d	0d	04-Feb-2020	02-Mar-2020
A1060	Standard 5 Day Workweek	Finish Milestone	0d		02-Mar-2020	0d	0d		02-Mar-2020

Figure 19: Second Schedule Prior to Changes

Subsequently, Figure 20 shows how the activities were assigned a different, 24 hour per day and 7 day per week project calendar.

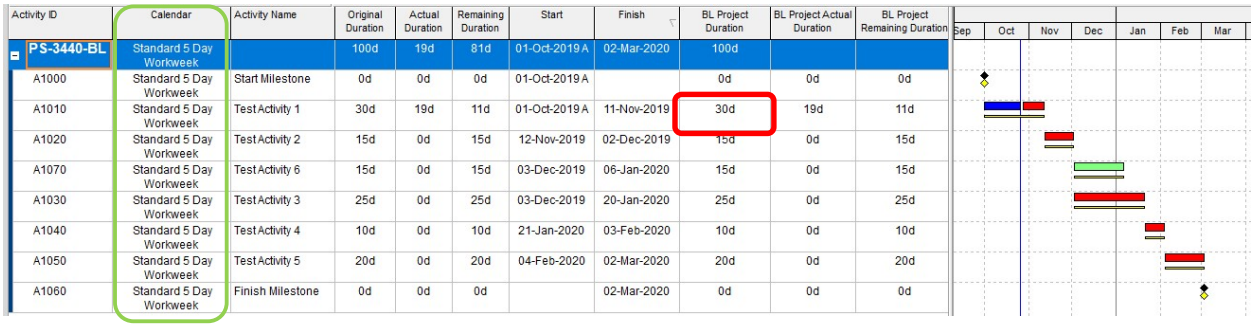


Activity ID	Calendar	Activity Name	Original Duration	Start	Finish	BL Project Duration	Variance - BL Project Duration	BL Project Start	BL Project Finish
PS-3440-BL	24/7		153d	01-Oct-2019	02-Mar-2020	153d	0d	01-Oct-2019	02-Mar-2020
A1000	24/7	Start Milestone	0d	01-Oct-2019		0d	0d	01-Oct-2019	
A1010	24/7	Test Activity 1	10d	01-Oct-2019	11-Oct-2019	10d	0d	01-Oct-2019	11-Nov-2019
A1020	24/7	Test Activity 2	5d	12-Nov-2019	17-Nov-2019	5d	0d	12-Nov-2019	02-Dec-2019
A1030	24/7	Test Activity 3	8d	03-Dec-2019	11-Dec-2019	8d	0d	03-Dec-2019	20-Jan-2020
A1040	24/7	Test Activity 4	3d	21-Jan-2020	24-Jan-2020	3d	0d	21-Jan-2020	03-Feb-2020
A1050	24/7	Test Activity 5	7d	04-Feb-2020	11-Feb-2020	7d	0d	04-Feb-2020	02-Mar-2020
A1060	24/7	Finish Milestone	0d		02-Mar-2020	0d	0d		02-Mar-2020

Figure 20: Second Schedule with 24/7 Calendar

One might find it difficult to explain why the *Baseline Project Duration* appears to have changed, in sync with the *Original Duration* values, when the duration of the activities in the baseline schedule actually did not change. At the same time, the *Variance against the Baseline Project Duration* is reported to be zero, when it should have indicated a positive number.

Restoring the baseline as an independent schedule in Figure 21 below shows the correct activity durations information, as originally stored.

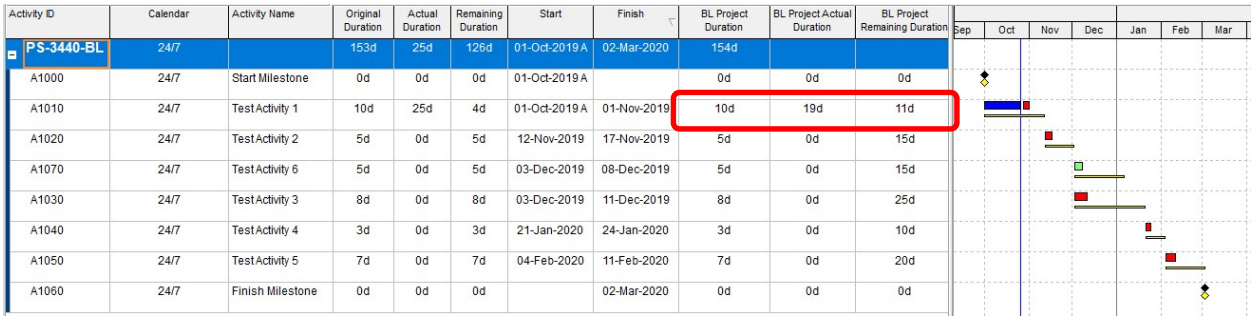


Activity ID	Calendar	Activity Name	Original Duration	Actual Duration	Remaining Duration	Start	Finish	BL Project Duration	BL Project Actual Duration	BL Project Remaining Duration
PS-3440-BL	Standard 5 Day Workweek		100d	19d	81d	01-Oct-2019 A	02-Mar-2020	100d		
A1000	Standard 5 Day Workweek	Start Milestone	0d	0d	0d	01-Oct-2019 A		0d	0d	0d
A1010	Standard 5 Day Workweek	Test Activity 1	30d	19d	11d	01-Oct-2019 A	11-Nov-2019	30d	19d	11d
A1020	Standard 5 Day Workweek	Test Activity 2	15d	0d	15d	12-Nov-2019	02-Dec-2019	15d	0d	15d
A1070	Standard 5 Day Workweek	Test Activity 6	15d	0d	15d	03-Dec-2019	06-Jan-2020	15d	0d	15d
A1030	Standard 5 Day Workweek	Test Activity 3	25d	0d	25d	03-Dec-2019	20-Jan-2020	25d	0d	25d
A1040	Standard 5 Day Workweek	Test Activity 4	10d	0d	10d	21-Jan-2020	03-Feb-2020	10d	0d	10d
A1050	Standard 5 Day Workweek	Test Activity 5	20d	0d	20d	04-Feb-2020	02-Mar-2020	20d	0d	20d
A1060	Standard 5 Day Workweek	Finish Milestone	0d	0d	0d		02-Mar-2020	0d	0d	0d

Figure 21: Baseline Schedule Restored

Reattaching the baseline converts the duration back to what was shown above in Figure 20. Interesting enough, only the project baseline duration (*BL Project Duration*) is changed when the

calendar changes, and not the baseline actual duration (*BL Project Actual duration)* or baseline project remaining duration (*BL Project Remaining Duration)*, as shown in Figure 22.



Activity ID	Calendar	Activity Name	Original Duration	Actual Duration	Remaining Duration	Start	Finish	BL Project Duration	BL Project Actual Duration	BL Project Remaining Duration
PS-3440-BL	24/7		153d	25d	126d	01-Oct-2019 A	02-Mar-2020	154d		
A1000	24/7	Start Milestone	0d	0d	0d	01-Oct-2019 A		0d	0d	0d
A1010	24/7	Test Activity 1	10d	25d	4d	01-Oct-2019 A	01-Nov-2019	10d	19d	11d
A1020	24/7	Test Activity 2	5d	0d	5d	12-Nov-2019	17-Nov-2019	5d	0d	15d
A1070	24/7	Test Activity 6	5d	0d	5d	03-Dec-2019	08-Dec-2019	5d	0d	15d
A1030	24/7	Test Activity 3	8d	0d	8d	03-Dec-2019	11-Dec-2019	8d	0d	25d
A1040	24/7	Test Activity 4	3d	0d	3d	21-Jan-2020	24-Jan-2020	3d	0d	10d
A1050	24/7	Test Activity 5	7d	0d	7d	04-Feb-2020	11-Feb-2020	7d	0d	20d
A1060	24/7	Finish Milestone	0d	0d	0d		02-Mar-2020	0d	0d	0d

Figure 22: Second Schedule with the Baseline Reattached

The same behavior is observed when working with global calendars.

Following investigation, Oracle deems the behavior a bug (Bug Number-30735089) and, as of the publication of this paper, there is no resolution for it.

Proper Baseline Management – Recommendations

As software packages become more and more complex, the need for transparency in their underlying features increases as well. The scheduling community has already highlighted some of the weaknesses of commercial scheduling tools, with full papers addressing the issues. A paper published in 2006 called, Making CPM More Transparent [11] provides suggestions for the CPM software industry to adopt. Of the 21 suggested transparency issues, the issue of *current baselines* is not one of them but should be added to the list.

The following section focuses on providing recommendations in response to the challenges identified in the baseline management process when Primavera P6 is the selected scheduling tool. Some of these recommendations are of general use, while others are specific to the schedules' end-users, be them owners, owners' representatives or contractors.

Use of a Schedule Log

To help in the schedule management process, the utilization of a *Schedule Log* is proposed in AACE Recommended Practice 93R-17 "Schedule Logs" [12]. The *basic schedule log* format proposed in this RP is a good start in capturing the minimum information on the various versions of the developed schedules. However, some additional fields would be beneficial to capture the entire history of the schedule development and maintenance process. An example of such a schedule log is shown below in Figure 23.

Date:	11-06-2014							
Project ID	EPS ID	EPS Name	Date Added	Project Name	Data Date	Resp Manager	Added By	Source
H/30000-F4-001	H/30000-C	GK - Current	12-Mar-13	GK Project - CURRENT Schedule	31-Jan-13	H/30000	user1	Original file, Active
H/30000-F4-001 - B1			05-Jul-13	B01 - BEFORE Mitigation 2014 Ice Road 05-Jul-13	01-Jul-13	H/30000	user1	Snapshot of Original file
H/30000-F4-001 - B2			16-Jul-13	B02 - Eng. Update 16-Jul-13	01-Jul-13	H/30000	user1	Snapshot of Original file
H/30000-F4-001 - B3			26-Jul-13	B03 - BASELINE signed-off 26-Jul-13	15-Jul-13	H/30000	user1	Snapshot of Original file
H/30000-F4-001 - B4	H/30000-B	GK - Baselines	26-Jul-13	B04 - BASELINE COPY - signed-off 26-Jul-13	15-Jul-13	H/30000	user1	Copy of stored Baseline B3

Figure 23: Sample Schedule Log

In the absence of a dedicated Primavera field to store the baseline creation date, users would benefit from indicating the creation date in the schedule title for immediate use, and in the schedule log for future reference.

Recording the information on the various baselines' data source in the schedule log is also a good practice, as users can not currently determine the source of a schedule when creating snapshots using the *Copy baseline* functionality.

As a recommended best practice, upon approval, the baseline schedule needs to be properly identified and archived [13]. Storing the baseline copy in a dedicated EPS node with restricted access could prove useful.

Calendars Management

As shown in the previous section, saved baselines that are using global calendars are subject to change when these calendars are modified during the project lifetime. To avoid these possible changes, a good practice is the use of project calendars instead of the global calendars. When project calendars are used, Primavera makes copies of the calendars used and stores them with the snapshot, thus preventing any future alteration.

During the project's execution, there might be a need to change the calendars applied on some activities, leading to variances against the baseline. This situation is more difficult to identify in P6 as, unfortunately, there is currently no field to identify the calendar used on the baseline project's activities. One would need to restore the baseline and look for this information directly in the restored file or use a third-party schedule investigation tool.

Schedule Submittals

A variance analysis between the current schedule and the baseline is an essential part of schedule performance analysis performed by the owner, their representative, peer reviewers, or even the update scheduler as a regular schedule maintenance and control process. In the variance analysis effort, validating that the portrayed schedule baseline is the approved revision is of utmost importance. When provided with only the pdf extractions of the schedule update, this validation is very difficult, if not impossible.

As a general rule, pdf schedule submittals alone are not sufficient for an in-depth schedule review, but such submissions are a frequent occurrence. In the absence of an electronic submittal, the reviewer is left to rely on only the visual cues. Therefore, any identification of the baseline revision, including the baseline name, baseline project ID, its data date and its last modified date, clearly displayed in the schedule layout would be very helpful.

Currently, in P6 there is an option to include in the layout's header or footer information on the baseline name. However, this option works only for the primary baseline, and not for the project baseline. Oracle could not confirm why this functionality is set like this but recommends adding an enhancement request to ensure the project baseline can also be displayed in the header or footer. Until this enhancement request is raised and resolved, users need to manually add this information. This manual entry is less reliable and prone to errors, minimizing the value of the information displayed, but a robust QA/QC processes can overcome this weakness.

When electronic schedule submittals are requested, the schedule export format should be specified. The available export formats are shown in Figure 24 below:

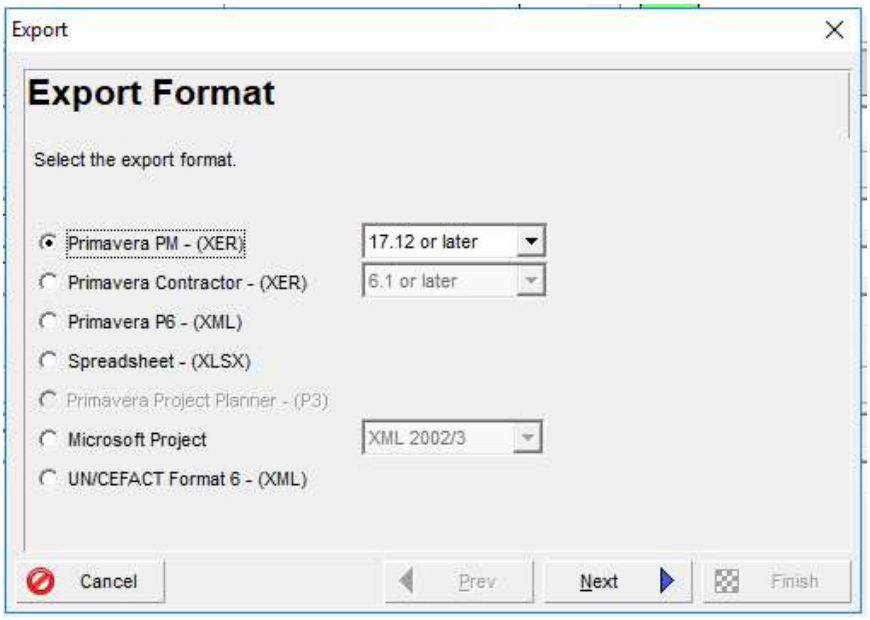


Figure 24: Primavera Schedule Export Format

Two of the most frequent export formats are the Primavera PM – (.xer) and the Primavera P6 – (.xml) types. While the first option allows users to export only the active schedules, the second option offers the possibility to export the project's baseline(s) as well. This latter functionality could prove useful if Primavera would implement control points to validate the baseline authenticity. At the moment, following the import of an .xml file containing a baseline, when selecting the baseline in the **Manage baseline** dialog box, the *Last Update Date* field reflects the date of the import, and not the "last update date" as one might expect.

Note that when the same baseline is detached from the schedule using the *Restore* function, the *Date Added* field in the **Projects** window shows the date and time the baseline was originally attached to the file, which is the sought for information.

Upon an .xml file import, the activity auditing fields *Last Modified Date* and *Last Modified By* reflect the date of the import and the credentials of the user that performed the import, so these fields cannot be used to validate the authenticity of a baseline.

In the example below, the activity A1020 was modified using the *Update Baseline* functionality. Restoring the baseline allows users to note the change (Figure 25).

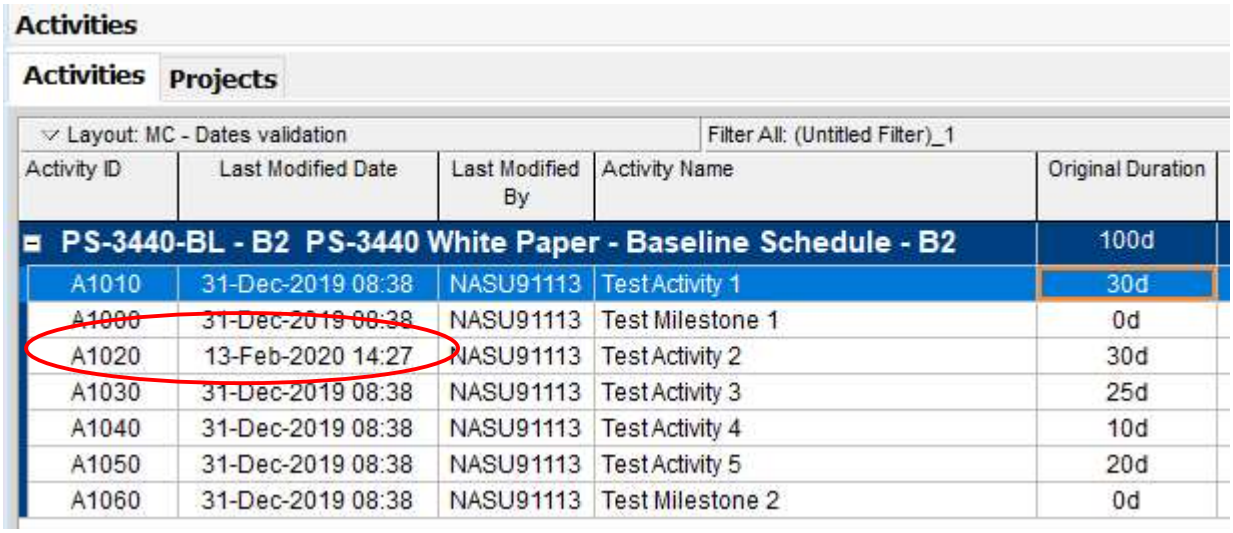


Figure 25: Original Last Modified Date

Following the .xml import, this information was then lost, as shown in Figure 26. The initial modification is replaced by the import date.

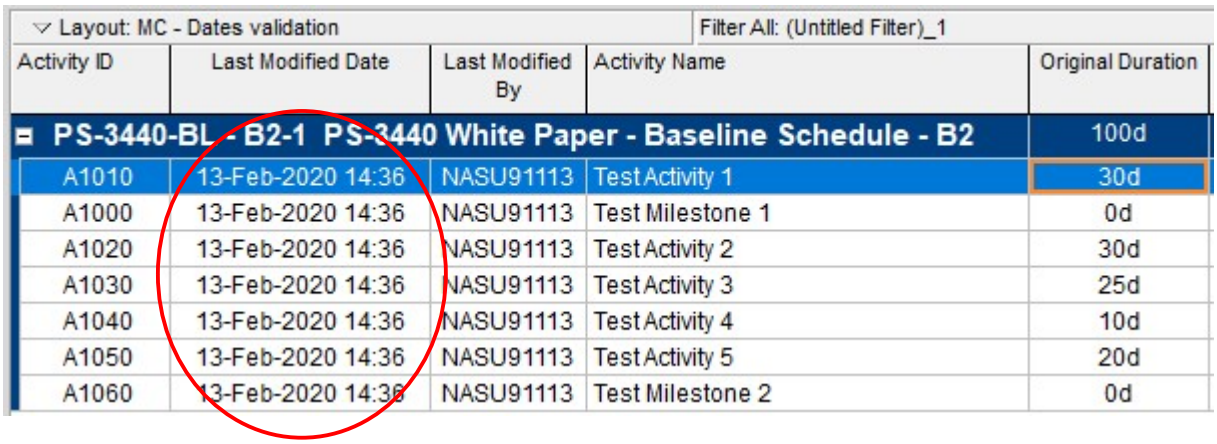


Figure 26: Last Modified Date Reset Following the .xml Import

The baseline inclusion in the .xml export, while conceptually useful, is missing a baseline control mechanism, as any saved snapshot can be included in the export as *baseline*. And, in the absence of an adequate baseline auditing functionality in Primavera P6, the best way to ensure use of the correct schedule baseline version is to rely on the original submitted and stored copy to prepare variance analysis reports. These reports can then be compared with the ones submitted by others and any difference should be clarified. This practice would encourage schedulers to adopt appropriate measures to prevent any unapproved alterations of the baseline files.

Therefore, it cannot be stressed enough the importance of having the owners specify submission of schedules in both pdf and native formats, and ensuring that all efforts are put in place to enforce this request.

Auditing

As shown before, the *Last Update Date* field in the **Maintain Baselines** dialog box can be used to determine when a baseline was last updated. If the date shown in this field is different from the date the baseline is known to have been approved, it is an indication that the baseline might have been altered. To find out what activities were modified, the attached baseline can be restored and the auditing field *Last Modified Date* can be used to highlight the differences, as shown in Figure 27 below.

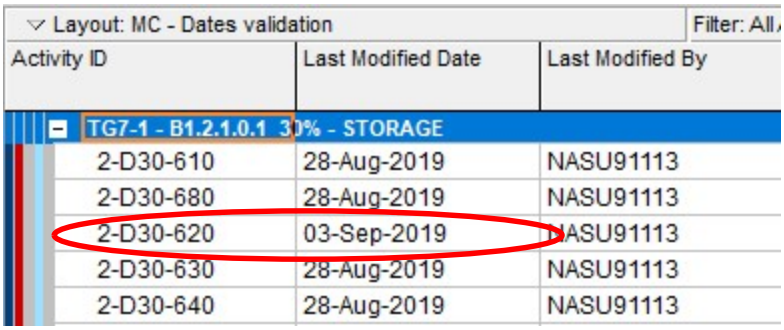


Figure 27: Activity Auditing Fields

The example in the above figure shows that activity 2-D30-620 was the only activity updated on September 3, 2019.

For a baseline that was modified using the *Update Baseline* functionality, it is possible to identify the newly added activities by restoring the updated baseline and looking for either early start, early finish, late start, late finish, total float or free float value, as these fields are empty, as shown in Figure 28 below. These values are calculated by the software [6].

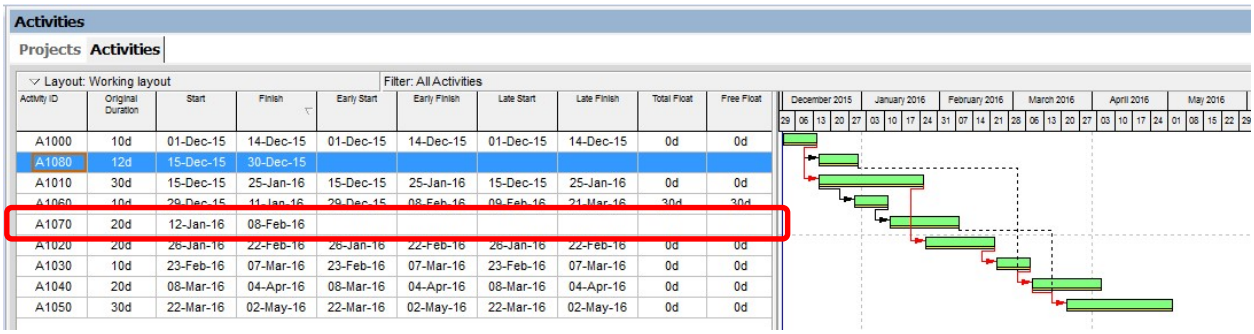


Figure 28: Newly Added Activity (A1070) via the Update Baseline Functionality

User Privilege Settings

The user privilege settings control some of the baseline management and assignment processes. Figure 29~~Figure 29~~ below indicates the available options P6 administrators have to configure the project security profiles.

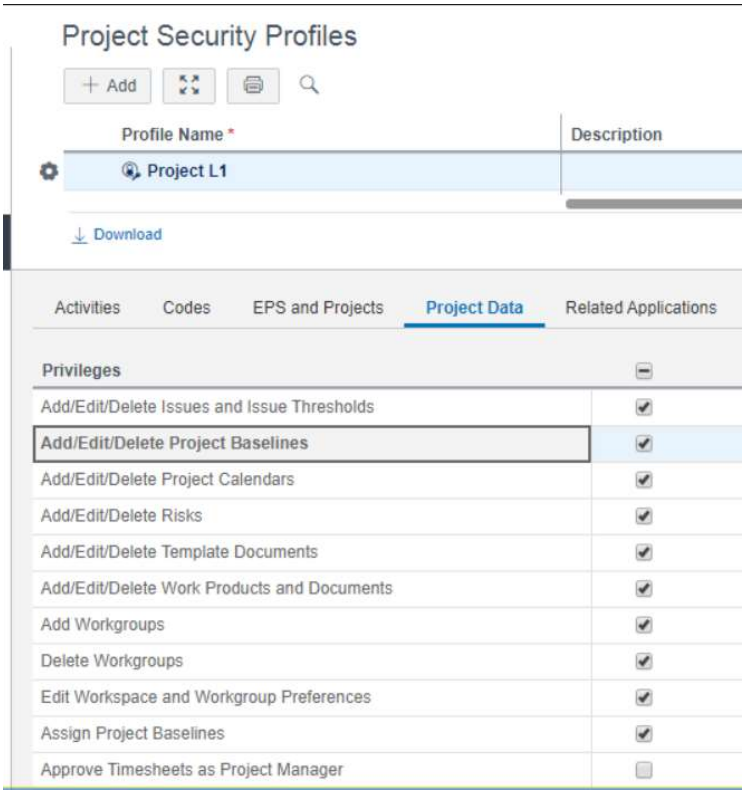


Figure 29: Project Security Privileges

As seen above, *add, edit* and *delete project baselines* are all included in the same privilege. *Add Baseline* is a very important feature, allowing users the flexibility to add snapshots as required.

However, by granting it, users gain automatically access to the *edit / delete* privileges that should be otherwise controlled. As such, for a better control of the baseline revisions, these privileges should be kept separate. An enhancement request will be raised with Oracle to address this issue.

Assign Project Baseline privilege controls the assignment process. This privilege could be used to lock-in the project-level baseline, once it is assigned. As such, users with higher privileges could perform the action or a process could be put in place to modify the users' profile after the baseline has been set, thus preventing an accidental swap. The *user baselines* would then be used for variance analysis against prior periods, as shown above.

No setting exists to control the assignment of the primary baseline and this can be problematic if the primary baseline is used for the EV measurements.

Other than the current available privilege settings options, the possibility to differentiate between *assigned* or *unassigned* baselines when performing an update could prove useful. With such an option, the original baseline could be created, assigned and then locked-in. If the baseline would need to be subsequently changed as a result of the configuration management process, it could be copied and the changes applied on the newly created copy with an *Edit Unassigned Baseline* privilege, leaving the original baseline intact.

The current configuration settings leaves users with an all-or-nothing approach that force P6 administrators to make compromises. These compromises can affect data integrity and the software's usability.

Conclusion

Establishing the schedule baseline is the starting point in the schedule monitoring and control process. Once the baseline schedule is agreed upon and approved, ensuring that the right file is used as project level baseline and protecting it from unapproved alterations remains a challenge in the P6 environment.

Storing the baseline copy in a dedicated EPS node with restricted access will prove useful. When there are reasons to believe that the project-level baseline was inadvertently altered, this copy can always be used for comparison purposes using the *Schedule Comparison* functionality of P6 or third-party software.

Keeping track of all schedule copies and versions used in a project can be difficult if schedulers rely only on the P6 environment. In the absence of a P6 cataloguing function, using a schedule log to document all schedules proves to be a good practice. Information beyond what is stored in the *Basic Schedule Log* proposed by RP 93R-17 can help with the schedule control process.

Additional fields such as ID and name of the EPS node, information on when the copy was created in the database and by whom (*Date Added* and *Added By*), and the source of the copy are good examples.

Contrary to the belief that P6 baselines are schedules frozen in time, the use of global calendars can create conditions that lead to alterations of the saved copies, without any warnings. To prevent modifications of the baseline schedules driven by global calendars changes, project calendars should be consistently used.

Until Primavera implements a baseline lock-in feature or any other mechanism for controlling and auditing the schedule revisions, owners and owners' representatives should continue to use the baseline native file submittal for completing the variance analysis process. This is true even if P6 exporting capabilities offer the choice of including the schedule baseline in the .xml export file.

For increased transparency, the ability to display in the header or footer the information on the selected baseline's project ID, project name, baseline creation date time stamp would be of great interest to practitioners. Until Primavera implements these features, a manual entry should be deployed and rigorously controlled. P6 does not offer sufficient control measures to protect the baseline information, therefore rigorous change control and auditing processes need to be put in place to compensate for the software's limitations.

Primavera auditing fields can be used to investigate the activities that were modified after the baseline establishment, with some limitations. This method can only be used in the original database where the file resides, as an import action into a different database removes all historical data logs. P6 *Schedule comparison* functionality or third-party software can be used to easily compare modified attributes of the baseline activities. Then, the change control process can help segregate the approved changes from the unauthorized ones.

Privilege settings could be used to prevent users from swapping the baseline project assignments, but this would limit the variance analysis options for comparison to other schedule revisions. Primavera could help by making the fields created for the project and primary baselines available for the secondary and tertiary user baselines.

In conclusion, ample knowledge of the Primavera P6 software capabilities and limitations for baseline management, combined with rigorous project controls procedures and processes, will lead to increased confidence in the information displayed as schedule baseline.

References

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