



Earned Value Management and Critical Chain Project Management with Sciforma PS8

1. Introduction

The goal of this document is to describe how to track Earned Value with Sciforma PS8.5 when using the Critical Chain Scheduling Method.

Earn Value management was first implemented in Sciforma Project Scheduler 4 (1988) and has been continuously used by a number of customers since that time. With the introduction of Critical Chain support in Sciforma PS8 (1999), the question of tracking Earned Value metrics on a CCPM Project has come up many times.

First we will explain, or refresh, the basics of Earned Value tracking and analysis features of Sciforma PS8. Then we will describe how PS8 can support Earned Value analysis on CCPM Schedule.

2. Tracking Earned Value with PS8

2.1. Basic Concepts

One of the key features in PS8 is the ability to track Budgeted Cost of Work Performed (BCWP) and Budgeted Cost of Work Scheduled (BCWS). PS8 can also calculate all standard Earned Value metrics such as Cost Variance, Schedule Variance, CPI, SPI and EAC/ETC.

Here is a simple explanation:

When executing a schedule, you may find that the cost of the work for a resource differs from the cost that was originally budgeted for the work. For example, you may have originally scheduled a painter who makes \$80.00 per day to paint one room in one day. At the end of day 1, the painter is only 50% done with the room. At this pace, it will take two days for the painter to complete the task. You can record a discrepancy of this sort in the BCWP field and then perform an analysis of the task status. BCWP is \$40.00, BCWS is \$80.00, and the new Total Cost is \$160.00.

Because the painter was supposed to have completed \$80.00 worth of work, but only completed \$40.00 worth of work, the task is behind schedule. When BCWP is greater than BCWS, the task is ahead of schedule. When BCWP is less than BCWS, the task is behind schedule.

The concept of "work" in this explanation refers to the quantity of items completed (number of rooms in the example above).

BCWS represents the amount of work (calculated and displayed in dollars) that the resource was scheduled to accomplish up to the completion of the As Of Date.

BCWP is the amount of work (calculated and displayed in dollars) that was performed on the task by the resource based on the current schedule. BCWP is what the completed work should have cost according to the original schedule, not what that work actually cost. BCWP, also known as "Earned Value," tells you how much work you have actually accomplished so far in terms of the Base Cost. For example, if you have completed half of the necessary work on your project, your BWCP should be 50% of the Base Cost. You can tell whether you are ahead of or behind schedule by comparing BCWP to BCWS.

Tracking Earned value on your schedule requires collecting and inputting the following data:

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- **Project As Of Date:** The date through which the project's data has been updated.
- **Actual Cost (or ACWP):** The total cost amount charged by the resources assigned to the task to it. Actual Cost is available for each Resource assignments, for each WBS level and for the overall project.
- **Base Cost % Complete:** The percentage of work originally planned that has been actually completed on the task. Since we need to compare apples with apples, this value is expressed in a percentage of the base costs that have been converted into BCWP for the task.
Changing the value in this field in PS8 changes the BCWP field accordingly. Similarly, changing BCWP changes the value in this field. The Base Cost % Complete is available for each Resource assignments and for each WBS level.

Based on the previous inputs, PS8 automatically calculates the following fields up to the As of Date:

- **BCWP**
- **BCWS**
- **Cost Variance:** $BCWP - Actual\ Cost$.
- **% Cost Variance:** $(BCWP - Actual\ Cost) / BCWP * 100.$
- **Schedule Variance:** $(BCWP - BCWS)$
- **%Schedule Variance:** $(BCWP - BCWS) / BCWS * 100$
- **SPI (Schedule Performance Index):** $(BCWP/BCWS) * 100$
- **CPI (Cost Performance Index):** $(BCWP/Actual\ Cost) * 100$

When relevant, all fields and calculations in PS8 are “Time distributed” and/or “Cumulative”

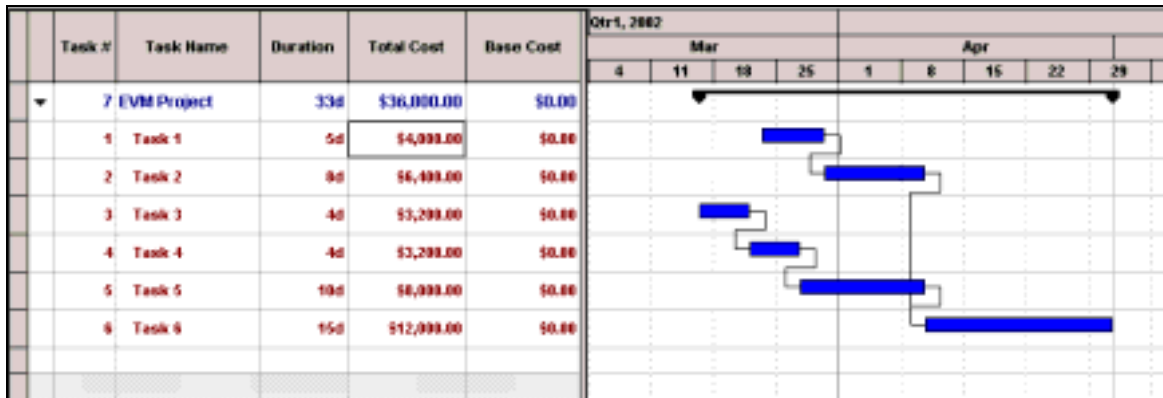
In addition, PS8 provides several Earned Value Analysis reports with different level of details (Project/ Tasks/ Resource Assignments). These reports can be customized and published within a website with no additional software.

PS8 also features a Graph engine to generate an S-type curve. All graphs can also be posted within a website.

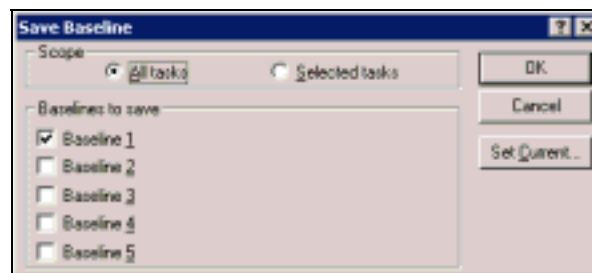
Finally, all field names can be renamed using an Alias name. That way, you can choose to apply your own internal terminology.

2.2. Example on a Critical Path Project

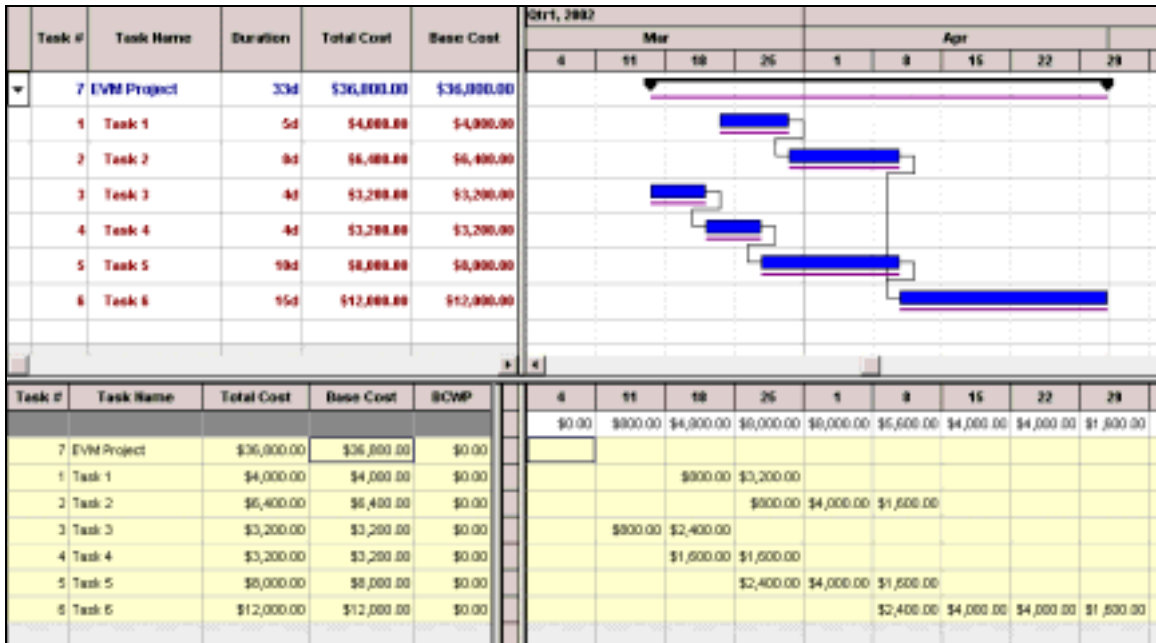
In the following project, the same “Resource A” has been assigned to every task and its rate is a \$100/h. The total cost of the project is \$36,800.00.



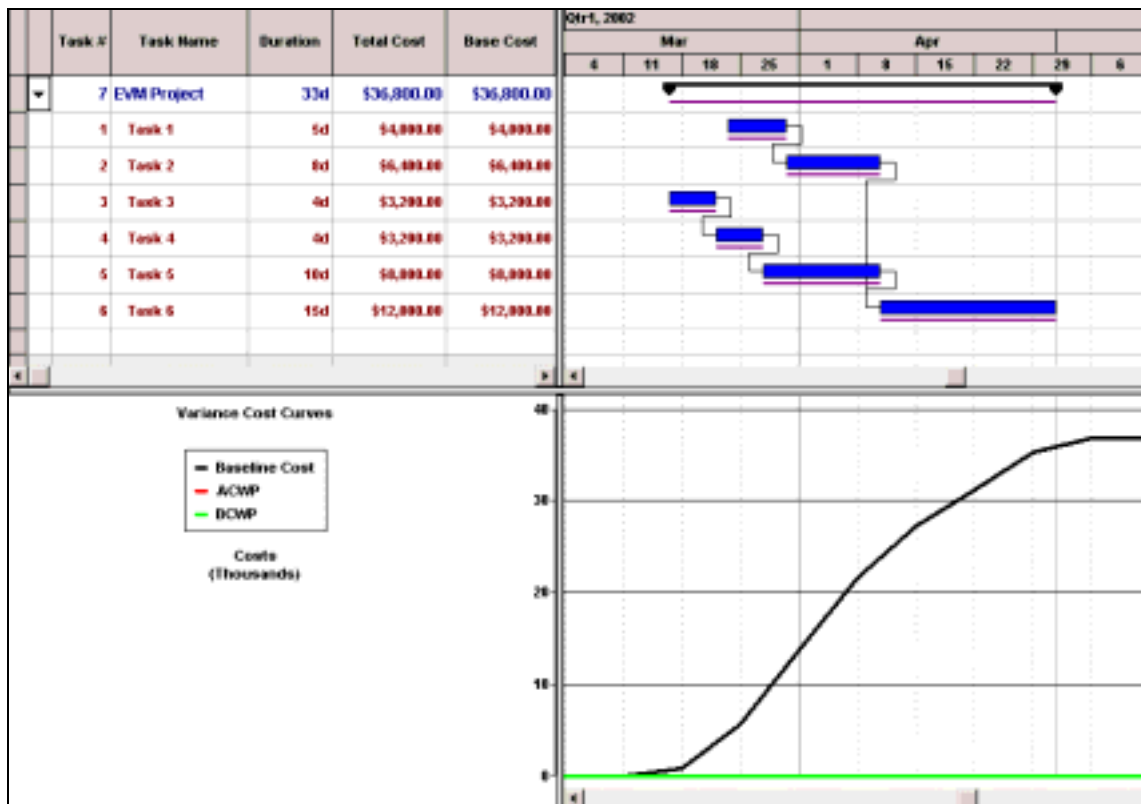
PS8 allows saving up to 5 baselines (budgets) per project. The **Base Cost** field always displays the value for the current baseline. When choosing **Baseline/ Save...** from the **Tools** menu, the total cost is captured and store in the selected baseline.



The result of saving a baseline can be viewed in multiple ways. The following images display Baseline 1 represented by a purple line on the Gantt chart view along with the Distribution Spreadsheet View of PS8 presenting a weekly distribution of the base cost. You can zoom in or out to obtain the same view with an Hourly, Daily, Weekly, Monthly and Quarterly time distribution.



The Base cost can also be viewed in the Graph view using a cumulative curve:





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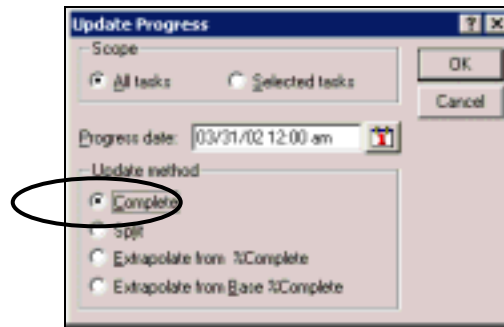
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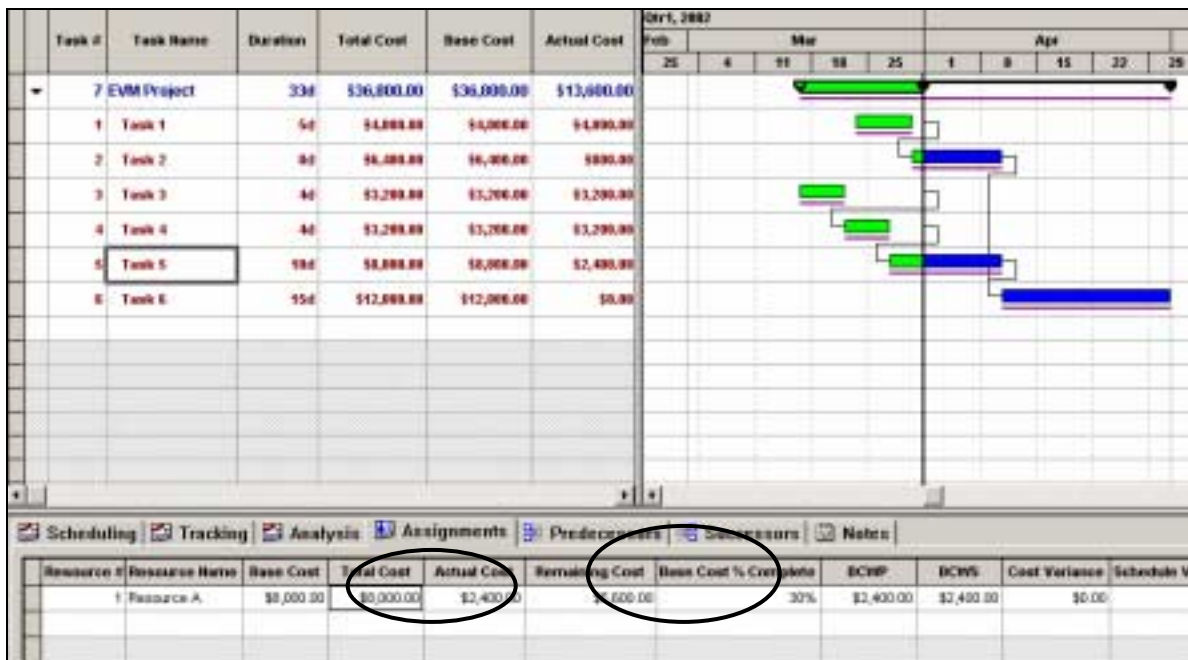


Now let's update the project at the end of March. The project As Of Date is 03/31/02 and can be displayed as a vertical line on the Gantt chart.

For this example, we will use the **Update progress** tool of PS8 to automatically update progress up to the As Of Date. By using this tool, we are making the assumption that all the project tasks started on schedule and their durations stayed the same. This is not going to be the case in the real world, but there is no need to discuss this right now.



The following example shows our project with a progress date of 3/31/02. The bottom part of the screen shows the Assignment details for Task 5. By default, PS8 has automatically accrued the Actual Cost and the BCWP up to the As of Date as if everything went as scheduled, but this is an option that can be turned off in PS8.

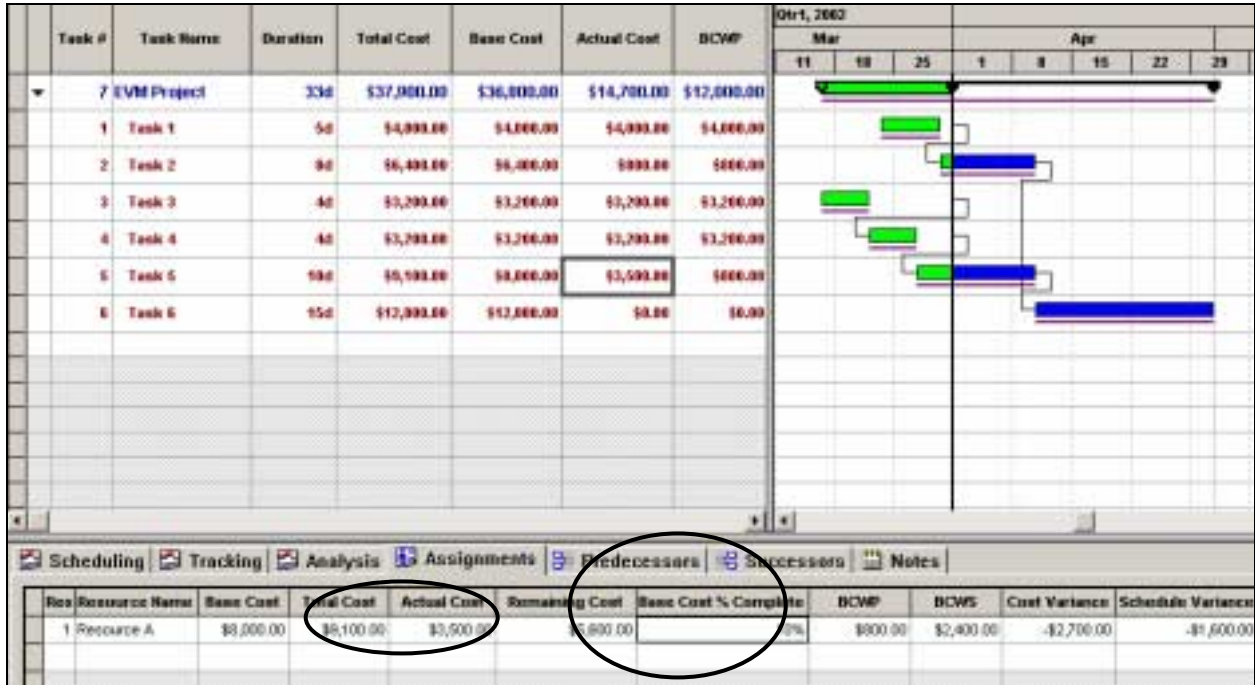


30% of the time has elapsed, and since the resource was uniformly assigned, 30% of the cost has been spent (actual cost = \$2,400.00) and 30% of the work has been completed (Earned Value = \$2,400.00). Again, in the real world, this may not happen! To reflect the reality of the project, we now must enter (or import):

- The Actual "incurred" Cost for each resource assigned to the task.
- The percent of work actually performed by the resource on the task. This value is defined in PS8 as the **Base Cost % Complete**. Note that, if there is more than one resource assigned to the task, the Base Cost % Complete can be entered directly at the task level and passed down to each assignment.



In our example, the actual cost incurred for Task 5 is \$3,500.00 (taking into account some upfront costs) and only 10% of the work has been performed.



PS8 will provide the following information:

For Task 5:

- BCWP: \$800.00
- BCWS: \$2,400.00
- Cost Variance: -\$2,700.00
- % Cost Variance: -337.5 %
- Schedule Variance: -\$1,600.00
- % Schedule Variance: -66.67 %

For the Project:

- BCWP: \$12,000.00
- BCWS: \$13,600.00
- Cost Variance: -\$2,700.00
- % Cost Variance: -22.5%
- Schedule Variance: -\$1,600.00
- % Schedule Variance: -11.76%
- CPI: 81.63%
- SPI: 88.24%

The following Earned Value Report and S-type Curve can be viewed dynamically in PS8 or can be posted on your Intranet using PS8's web site generator. All data can also be exported to an ODBC Compliant Database or to a Text Format file.



Earned Value Report

Project ID	Project Name	Project Manager	As Of Date						
2NMNTRS	Earned Value Example CPM		03/31/02						
Schedule Method: Critical Path Current Baseline: 1 CPI: 81.63% SPI: 88.24% EAC: \$51,891 ETC: \$38,388									
Task #	Name	% Complete	ACWP	BCWP	BCWS	Cost Variance	Schedule Variance	Base Cost	Total Cost
7	EVM Project	33.33%	14,700	12,000	13,600	-2,700	-1,600	36,900	37,900
1	Task 1	100%	4,000	4,000	4,000	0	0	4,000	4,000
2	Task 2	12.5%	800	800	800	0	0	6,400	6,400
3	Task 3	100%	3,200	3,200	3,200	0	0	3,200	3,200
4	Task 4	100%	3,200	3,200	3,200	0	0	3,200	3,200
5	Task 5	30%	3,500	900	2,400	-2,700	-1,600	6,000	9,100
6	Task 6	0%	0	0	0	0	0	12,000	12,000
Project Totals:			14,700	12,000	13,600	-2,700	-1,600	36,900	37,900



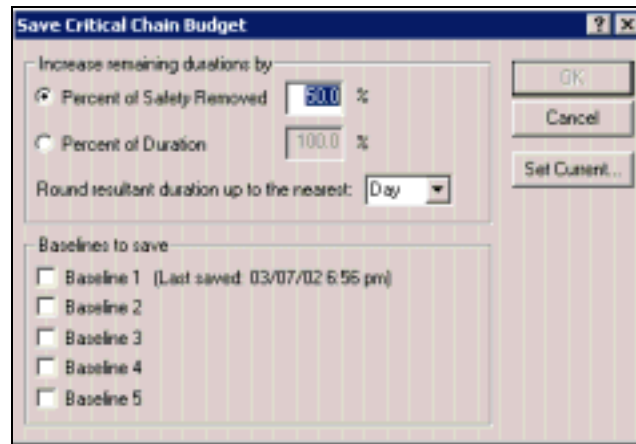
3. Tracking Earned Value on a Critical Chain Project

3.1. Concepts

Tracking BCWP on a CCPM project is possible with PS8 because the software package allows saving multiple baselines for the same project and also because PS8 “remembers” what method was originally used to calculate and insert buffers into the plan.

A CCPM schedule is, more or less, an aggressive plan obtained by removing some of the hidden safety of each task and by pooling this safety into feeding and project buffers. Yet, because the schedule is very aggressive, it is more than likely that the project team will use a significant portion of the buffer(s) when executing the project plan. Therefore, the budget set aside for the project must take into account the “expected” duration of the project, inclusive of the buffers. Sciforma PS8 features a unique tool to allow recording this “non-aggressive” baseline for your project.

If you have a Critical Chain Type of project opened in PS8, choose Tools/Critical Chain/Save Critical Chain Budget.



When using this tool, PS8 will, in one operation, dissolve existing buffers, increase each task’s duration using the parameters set in top section of the dialog - At that point, this is pretty much the non-aggressive version of plan that would be available – then save the selected baseline before restoring the initial durations and buffers. By using this tool, you will obtain in the same schedule, an aggressive plan and a non-aggressive budget.

As for a Critical Path Schedule, BCWP will be expressed in terms of a % of the Base Cost. In this case, we will use the Baseline saved previously using the “Save Critical Chain Budget” of PS8.

Before we develop the example, we need to make the following comments:

The manipulation required for capturing BCWP against the Critical Chain Budget in PS8 is not different from the one used for a Critical Path Schedule (see section 2.1). The difficulty resides more in the interpretation of the variances, S-Curve and indexes (CPI and SPI) because, when looking at these values, one must take into consideration the aggressive character of the schedule.

It is generally easier to consider the % of Cost variance than the actual \$ value to assess the overall performance on a given task. If, for example, you used a 50% duration method for saving the Critical Chain Budget, your budget has been increased by a half for each task. Therefore, if you stay perfectly on your aggressive schedule, you can expect a 33.33% cost variance when the task will be complete. If you have a variance between 0% and 33%, you are still in the budget even though you didn’t performed as fast as scheduled.



In other words, at the completion of the task, the Earned value will correspond to the non-aggressive budget for the task. If you succeed in applying the Critical Chain concepts and managed to complete the task faster, you will “earn” more value than the total cost planned for the task.

Task Name	Duration	Total Cost	Base Cost	Actual Cost	BCWP	March 2002					
						Mar 11			Mar 18		
						14	15	18	19	20	21
Task 1	3d	\$2,400.00	\$1,600.00	\$2,400.00	\$1,600.00						

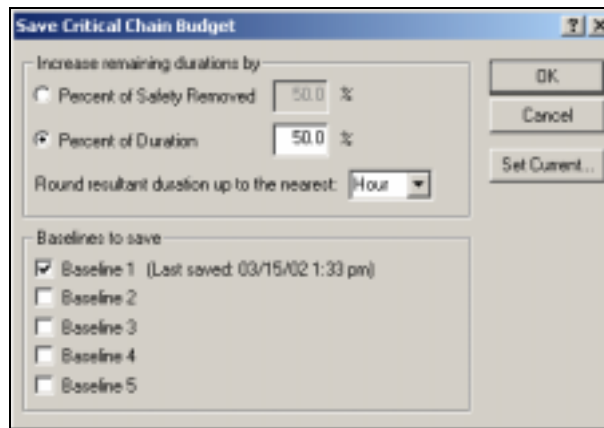
3.2. Example on a Critical Chain Project

In the following Critical Chain project, we have used a 50% of Duration method to insert the buffers.

The task durations have been reduced to their aggressive estimates and the same resource (\$100/h) has been assigned to every tasks. As a result, the overall duration of the project is the same as in the Critical Path example (i.e. 33d) but the Total cost of the project is now \$24,000.00.

Task #	Task Name	Duration	Total Cost	Base Cost	Qtr1, 2002						
					Mar			Apr			
					11	18	25	1	8	15	22
7	EVM Project	33d	\$24,000.00	\$0.00							
1	Task 1	3d	\$2,400.00	\$0.00							
2	Task 2	5d	\$4,900.00	\$0.00							
9	Feeding Buffer	4d	\$0.00	\$0.00							
3	Task 3	2.5d	\$2,900.00	\$0.00							
4	Task 4	2.5d	\$2,900.00	\$0.00							
5	Task 5	7d	\$6,900.00	\$0.00							
6	Task 6	10d	\$9,900.00	\$0.00							
8	Project Buffer	11d	\$0.00	\$0.00							

When using the Save Critical Chain Budget tool of PS8 previously described, the project shows a Base cost of \$36,000.00.



Note how the baseline is spread across the entire duration of the project



When updating progress As of 3/31/02, assuming everything went perfectly well, we obtain the following values for Task 5: 85.71% of the time has elapsed (because we are on a shorter schedule), and since the resource was uniformly assigned, 85.71% of the cost has been spent (actual cost = \$4,800.00) and 85.71% of the work has been completed (Earned Value = \$7,200.00).





After updating the Actual Cost and Base % Complete values to respectively \$6,950.00 and 30% for Task 5, we get the following values:



For Task 5:

- BCWP: \$2,520.00
- BCWS: \$2,800.00
- Cost Variance: -\$4,430.00
- % Cost Variance: -175.79 %
- Schedule Variance: -\$280.00
- % Schedule Variance: -10 %

For the Project:

- BCWP: \$18,120.00
- BCWS: \$17,600.00
- Cost Variance: 770.00
- % Cost Variance: 4.25%
- Schedule Variance: \$520.00
- % Schedule Variance: 2.95%
- CPI: 104.44%
- SPI: 102.95%

A PS8's Earned value Report will then provide the following details:

Project ID	Project Name	Project Manager						As Of Date	
2NMNTRS	Earned Value Example CPM							03/31/02	
Schedule Method: Critical Chain		Current Baseline: 1	CPI: 104.44%	SPI: 102.95%	EAC: \$33,461	ETC: \$17,126			
Task #	Name	% Complete	ACWP	BCWP	BCWS	Cost Variance	Schedule Variance	Base Cost	Total Cost
7	EvM Project	50.33%	17,368	18,120	17,600	770	520	36,988	26,158
1	Task 1	100%	2,400	3,600	3,600	1,200	0	3,600	2,400
2	Task 2	100%	4,000	6,000	5,200	2,000	800	6,000	4,000
3	Task 3	100%	2,000	3,000	3,000	1,000	0	3,000	2,000
4	Task 4	100%	2,000	3,000	3,000	1,000	0	3,000	2,000
5	Task 5	30%	6,950	2,520	2,800	-4,430	-280	8,400	7,750
6	Task 6	0%	0	0	0	0	0	12,000	8,000
Project Totals:			17,368	18,120	17,600	770	520	36,988	26,158