Successfully

Presenting Earned Value

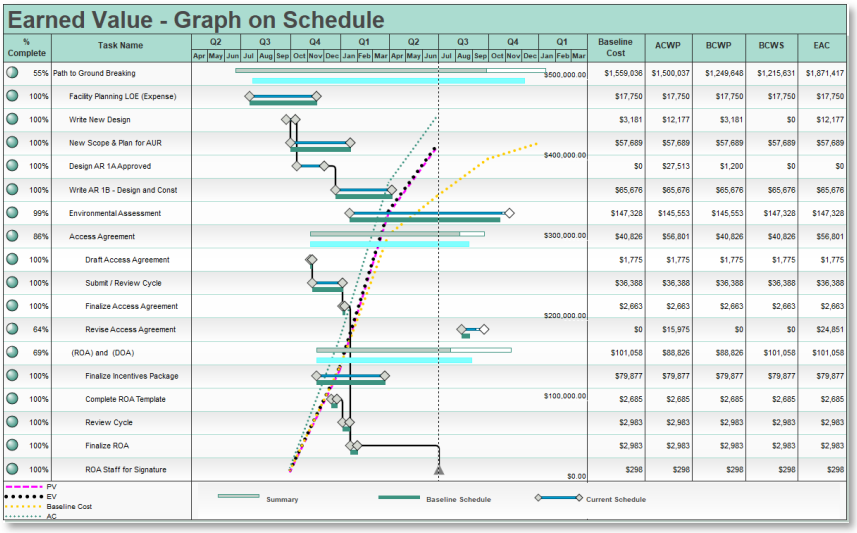
Your guide to Earned Value Management

What is Earned Value Management?

Earned Value Management (EVM) is a project management system which combines schedule performance and cost performance to answer the question, “What did we get for the money we spent?”

Basic concepts of EVM:

- All project steps “earn” value as work is completed.
- The Earned Value (EV) can then be compared to actual costs and planned costs to determine project performance and predict future performance trends.
- Physical progress is measured in dollars, so schedule performance and cost performance can be analyzed in the same terms.



Earned Value has been used since the 1960’s by the Department of Defense as a central part of the C/SCSC (Cost/Schedule Control Systems Criteria). Recently, the DOD revised the 35 criteria contained in the C/SCSC and produced the 32 criteria for EVMS (Earned Value Management Systems).

These criteria have since been accepted by the American National Standards Institute/Electronic Industry Association as a new standard, called ANSI/EIA 748. Now, EVM is being used in a wider variety of government contracts, and is spreading through the private sector as a valuable tool for project managers.

Milestones Professional, a tool by KIDASA Software, includes built-in earned value calculations which make possible a wide variety of earned value graphs and reports to support your project. All examples shown in this guide were created with Milestones Professional. Visit www.kidasa.com to download a free trial and to learn more.

What are the benefits of using Earned Value Management?

In a typical plan, physical progress is not taken into account when analyzing cost performance. Instead, a project's actual costs to date are simply compared to planned costs, often with misleading results.

Example:

A task has a planned value (PV) of $1000, and actual costs (AC) of $1000. It appears this task has perfect cost performance, and is in good shape to finish on-budget (Figure 1). However, if physical progress is taken into account, the results may differ.

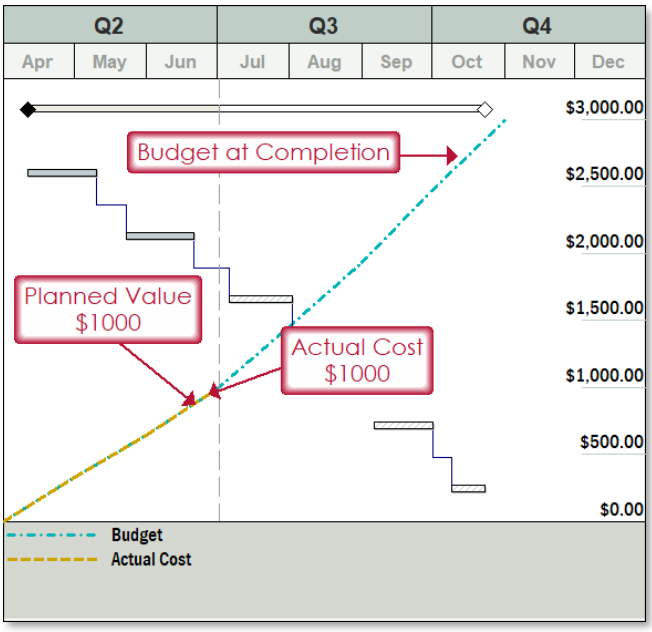


Figure 1

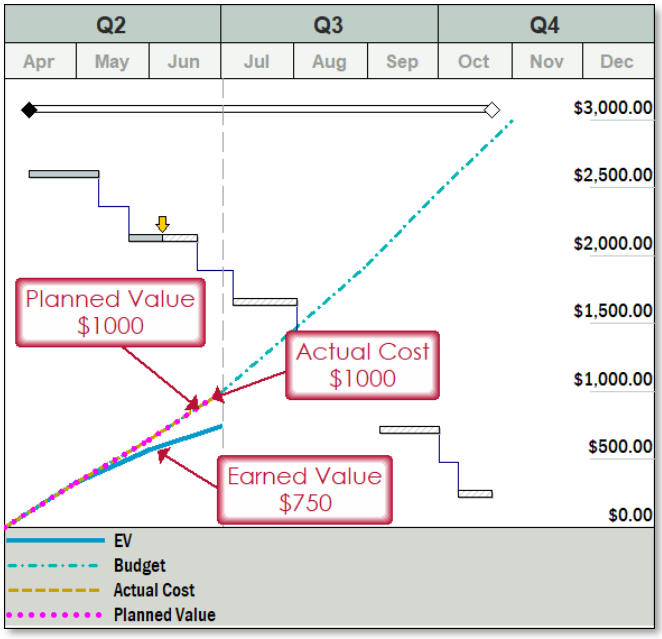


Figure 2

In Figure 2, the project has spent $1000 in actual costs but has only achieved $750 of Earned Value.

This is called a cost overrun, and this project would have a Cost Variance (CV) of -$250.

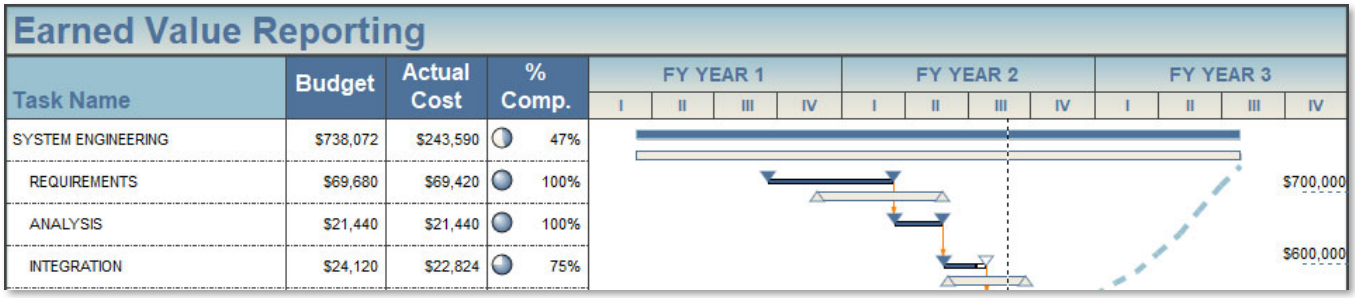
From this example, we can see that EVM expands on the two-dimensional analysis - "Has this project spent more or less money than planned?"– by adding the third dimension– "What did we get for the money we spent?"

Building Blocks of Earned Value Analysis

In addition to more accurate project status assessment, EVM makes it easy for a project manager to analyze both schedule and cost performance in a variety of ways. Using a limited set of basic task information, it is possible not only to determine how a project has been performing, but to predict future performance as well.

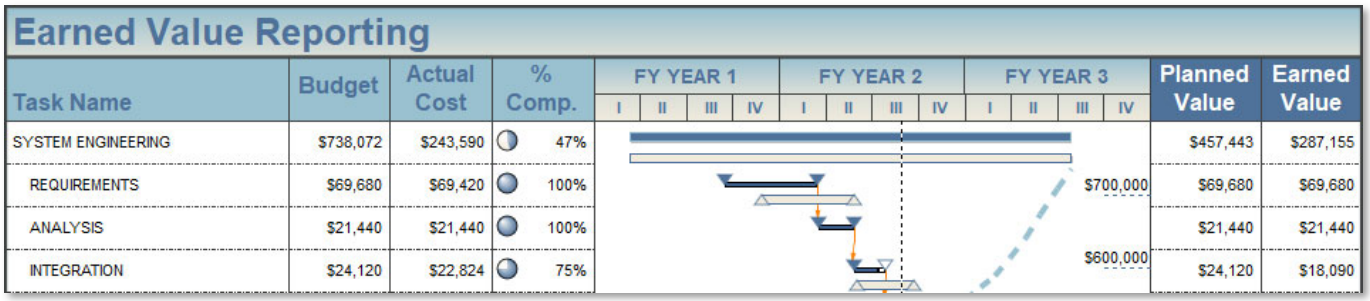
Basis for Earned Value Analysis:

- Budget at Completion (BAC) = Overall approved budget for a task.
- Actual Costs (AC) = Total amount spent on a task up to the current date.
- Percent Complete = Task progress, related as either EV/BAC, or simply physical progress shown by the fill of the task bar.



Once these three measurements have been established, the following calculations can be performed:

- Earned Value (EV) = BAC x Percent Complete. The budgeted cost of completed work as of the current date.
- Planned Value (PV) = The point along the time-phased budget that crosses the current date. Shows the budgeted cost of scheduled work as of the current date.



Building Blocks of Earned Value Analysis (continued)

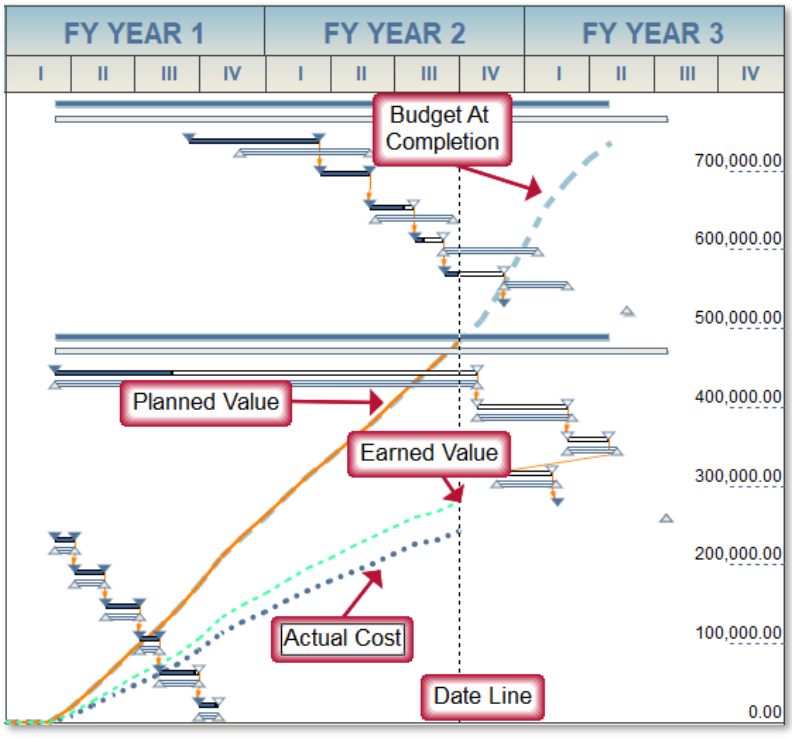
Earned Value Reporting

Task Name	FY YEAR 1 I	II	III	IV	FY YEAR 2 I	II	III	IV	FY YEAR 3 I	II	III	IV	% Comp.	Budget	Actual Cost	Planned Value	Earned Value
SYSTEM ENGINEERING													47%	$738,072	$243,590	$457,443	$287,155
REQUIREMENTS													100%	$69,680	$69,420	$69,680	$69,680
ANALYSIS													100%	$21,440	$21,440	$21,440	$21,440
INTEGRATION													75%	$24,120	$22,824	$24,120	$18,090

$700,000

$600,000

View detailed EVM data in actual dollars as part of a presentation schedule...

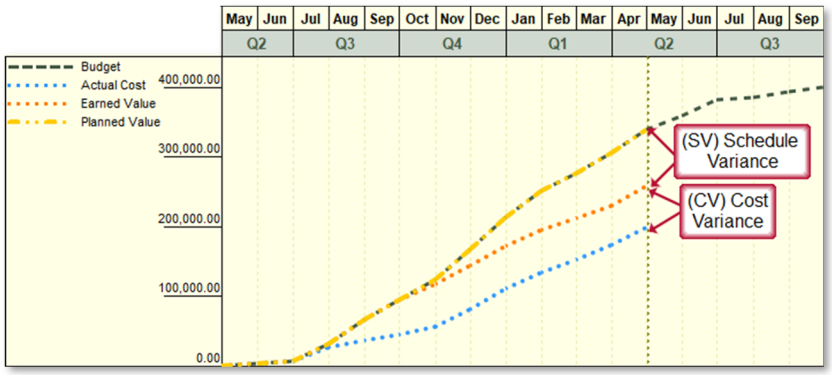


...or use an easy-to-read DataGraph for at-a-glance visual analysis of project trends.

Performance Indices and Variance

Once Earned Value and Planned Value are known, they can then be used to determine schedule and cost variance, and calculate performance efficiency.

- Schedule Variance (SV) = Earned Value – Planned Value. The difference between what was planned to be completed and what has actually been completed as of the current date.
- Cost Variance (CV) = Earned Value – Actual Costs. The difference between the work that has been accomplished (in dollars) and how much was spent to accomplish it.

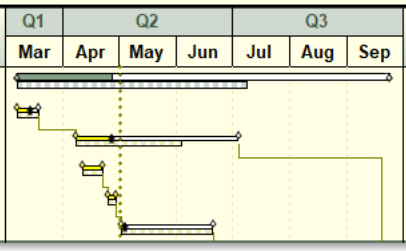


In the figure to the left, the project shown has a negative SV, because it has "earned" less value than was planned, as of the current date. However, it has a positive CV, because the Earned Value is greater than the Actual Costs accrued.

- Schedule Performance Index (SPI) = Earned Value / Planned Value. SPI is Schedule variance related as a ratio instead of a dollar amount. A ratio less than 1 indicates that work is being completed slower than planned.
- Cost Performance Index (CPI) = Earned Value / Actual Costs. CPI is Cost variance related as a ratio instead of a dollar amount. A ratio less than 1 indicates that the value of the work that has been accomplished is less than the amount of money spent.

Earned Value Performance Review

%	Budget	Task Name	PV	Actual Cost	EV	CPI	SPI
26%	$41,320	Land and Building Lease Activities	$11,779	$7,500	$10,547	1.41	0.90
60%	$2,983	Land Survey to Include Topography	$2,983	$1,000	$1,790	1.79	0.60
21%	$17,899	Construction Management Plan	$4,619	$4,000	$3,785	0.95	0.82
100%	$2,685	Security Management Orientation	$2,685	$1,500	$2,685	1.79	1.00
100%	$1,492	Submit to South Division	$1,492	$1,000	$1,492	1.49	1.00
7%	$10,740	Submit to Headquarters	$0	$0	$796	0.00	0.00



In the figure above, some tasks have a CPI greater than 1.00. This indicates that the task has been earning value faster than it has been accruing costs.

Some of those same tasks also have a SPI value that is less than 1.00. Although Actual Costs are low, they are behind schedule, so they have not earned as much value as was planned.

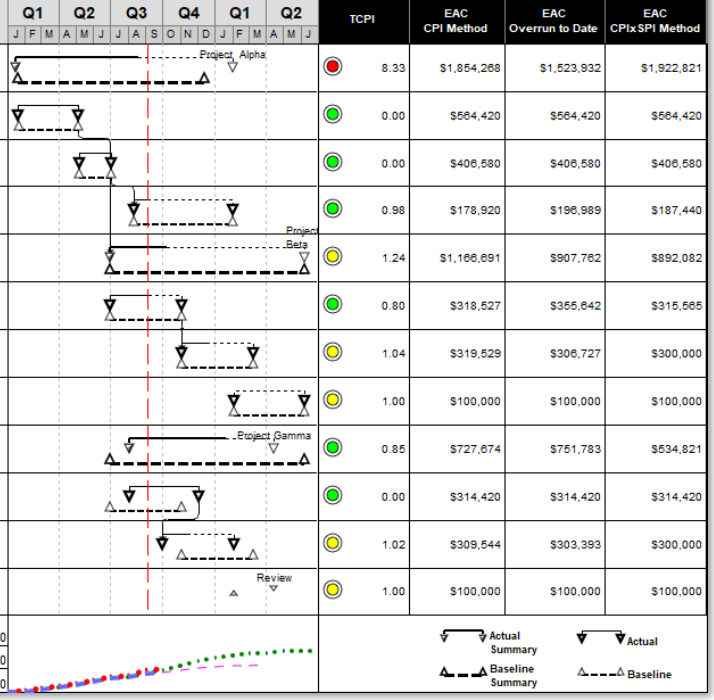
Forecasting Future Performance Trends

The Schedule Performance and Cost Performance Indices (SPI and CPI) not only monitor current project performance, they can also be used to predict future performance trends.

- To-Complete Performance Index (TCPI) = (BAC-EV) / (BAC-AC). Indicates the CPI required throughout the remainder of the project to stay within the stated budget.

Earned Value Dashboard

Name	Budget at Completion (BAC)	Actual Cost (AC)	BCWS	Earned Value (EV)	SPI	CPI	TCPI	EAC CPI Method	EAC Overrun to Date	EAC CPIxSPI Method
Project Alpha	$1,100,000	$1,042,180	$618,248	$670,438	0.92	0.59	8.33	$1,854,268	$1,523,932	$1,922,821
Design	$500,000	$564,420	$500,000	$500,000	1.00	0.89	0.00	$564,420	$564,420	$564,420
Test	$400,000	$406,580	$400,000	$400,000	1.00	0.98	0.00	$406,580	$406,580	$406,580
Review	$200,000	$25,560	$28,571	$30,159	0.95	1.12	0.98	$178,920	$196,989	$187,440
Project Beta	$800,000	$342,864	$235,102	$156,735	1.50	0.69	1.24	$1,166,691	$907,762	$892,082
Design	$400,000	$173,420	$217,778	$213,333	1.02	1.26	0.80	$318,527	$355,642	$315,565
Test	$300,000	$110,060	$103,333	$0	0.00	0.94	1.04	$319,529	$306,727	$300,000
Review	$100,000	$0	$0	$0	0.00	0.00	1.00	$100,000	$100,000	$100,000
Project Gamma	$800,000	$485,116	$533,333	$109,290	4.88	1.10	0.85	$727,674	$751,783	$534,821
Design	$400,000	$314,420	$400,000	$111,111	3.60	1.27	0.00	$314,420	$314,420	$314,420
Test	$300,000	$110,060	$106,667	$0	0.00	0.97	1.02	$309,544	$303,393	$300,000
Review	$100,000	$0	$0	$0	0.00	0.00	1.00	$100,000	$100,000	$100,000



- Estimate at Completion (EAC) forecasts the expected total costs to be accrued over the life of the project based on current trends. There are three different methods to calculate EAC. These three methods are available in the Milestones Professional software:
  - ***EAC: Overrun-to-Date Method***: (Budget-at-Completion - Earned Value) + Actual Cost. Assuming spending patterns remain the same, EAC: Overrun-to-Date forecasts the total amount to be spent by adding costs incurred to date to the remaining work to be earned. <u>This method assumes that there will be no additional overruns.</u>
  - ***EAC: Cumulative CPI Method***: EAC = ((Budget-at-Completion - Earned Value) / CPI) + Actual Cost. The EAC: Cumulative CPI Method forecasts the total amount to be spent by adding costs incurred to date to the remaining work to be earned, which has been weighted against the current CPI performance value.
  - ***EAC: Cumulative CPIxSPI Method***: EAC = ((Budget-at-Completion - Earned Value) / CPIxSPI) + Actual Cost. The EAC: Cumulative CPIxSPI Method forecasts the total amount to be spent by adding costs incurred to date to the remaining work to be earned, which has been weighted against the combined current CPI and SPI performance values.

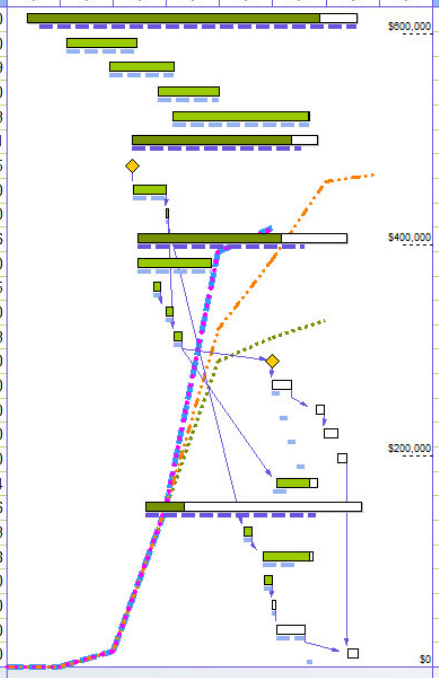
Forecasting Future Performance Trends (continued)

- Variance at Completion (VAC) forecasts the difference between the Budget-at-Completion and the expected total costs to be accrued over the life of the project based on current trends. Generally, it is the BAC - EAC. In Milestones Professional, three options are available for the VAC, depending on the EAC method selected:
  - ***VAC*: Overrun-to-Date Method:** VAC = EAC: Overrun-to-Date minus Budget-at-Completion.
  - ***VAC*: Cumulative CPI Method:** VAC = EAC: Cumulative-CPI-Method minus Budget-at-Completion.
  - ***VAC*: Cumulative CPIxSPI Method:** VAC = EAC: Cumulative-CPIxSPI-Method minus Budget-at-Completion.

NOTE: Refer to details on the previous page of this book for more details on the three methods for calculating the EAC.

Condensed Earned Value

Task Name	Budget at Completion	Actual Cost	Year 1 Q3	Year 1 Q4	Year 2 Q1	Year 2 Q2	Year 2 Q3	Year 2 Q4	Year 3 Q1	Year 3 Q2	EAC-Overrun to Date	VAC-Overrun to Date	EAC CPI Method	VAC CPI Method	EAC CPIxSPI	VAC CPIxSPI
Path to Ground Breaking	$468,214	$550,000									$602,024	($133,810)	$618,750	($150,536)	$596,979	($128,765)
Facility Planning LOE	$17,750	$17,900									$17,900	($150)	$17,900	($150)	$17,900	($150)
New Scope & Plan for	$57,689	$57,689									$57,689	$0	$57,689	$0	$57,689	$0
Write AR 1B - Design and	$65,676	$64,800									$64,800	$876	$64,800	$876	$64,800	$876
Environmental	$147,328	$145,553									$147,297	$32	$147,296	$32	$146,253	$1,076
Access Agreement	$40,826	$56,801									$62,506	($21,680)	$66,028	($25,202)	$62,328	($21,502)
Draft Access Agreement	$1,775	$1,775									$1,775	$0	$1,775	$0	$1,775	$0
Submit to Redstone	$36,388	$37,000									$37,000	($612)	$37,000	($612)	$37,000	($612)
Finalize Access	$2,663	$2,580									$2,580	$83	$2,580	$83	$2,580	$83
Report of Availability	$101,058	$88,826									$120,284	($19,226)	$128,974	($27,916)	$113,777	($12,719)
Finalize Incentives	$79,877	$80,000									$80,000	($123)	$80,000	($123)	$80,000	($123)
Complete ROA	$2,685	$2,685									$2,685	$0	$2,685	$0	$2,685	$0
Review Cycle	$2,983	$3,000									$3,000	($17)	$3,000	($17)	$3,000	($17)
Finalize ROA	$2,983	$2,983									$2,983	$0	$2,983	$0	$2,983	$0
ROA Staff for Signature	$298	$190									$190	$108	$190	$108	$298	$0
Submit to Installation	$2,983	$0									$2,983	$0	$2,983	$0	$2,983	$0
Submit to INCOM	$2,983	$0									$2,983	$0	$2,983	$0	$2,983	$0
Submit to Office of the	$2,983	$0									$2,983	$0	$2,983	$0	$2,983	$0
DOA Submitted to	$3,282	$0									$3,282	$0	$3,282	$0	$3,282	$0
Determination of	$5,966	$11,634									$12,828	($6,861)	$14,543	($8,577)	$5,966	$0
Land and Building Lease	$33,412	$22,076									$49,436	($16,024)	$121,876	($88,464)	$229,993	($196,581)
Land Survey to Include	$2,983	$2,983									$2,983	$0	$2,983	$0	$2,983	$0
Construction	$11,933	$16,408									$17,177	($5,245)	$17,539	($5,606)	$11,933	$0
Security Assistance	$2,685	$2,500									$2,500	$185	$2,500	$185	$2,685	$0
Submit to South Atlantic	$1,492	$0									$1,492	$0	$1,492	$0	$1,492	$0
Submit to Headquarters	$10,740	$0									$10,740	$0	$10,740	$0	$10,740	$0
Approval From HQs	$2,088	$0									$2,088	$0	$2,088	$0	$2,088	$0



Planned Value
Earned Value
Baseline Cost
Actual Cost

How do I get started using Earned Value Management?

Identify and Organize all Project Steps

First, identify all tasks that need to be accomplished and organize the tasks into subgroups Breaking down activities into the smallest possible steps makes it easier to pinpoint schedule and cost performance problems. The schedule to the right uses WBS numbers to identify project tasks.

Wonderful New Widget Project Plan

WBS	Task	Year 1			Year 2			
		October	November	December	January	February	March	April
1	Task 1							
1.a	Task 1-A							
1.b	Task 1-B							
1.c	Task 1-C							
2	Task 2							
2.a	Task 2-A							
2.b	Task 2-B							
2.c	Task 2-C							
3	Task 3							
3.a	Task 3-A							
3.b	Task 3-B							
3.c	Task 3-C							

Summary Plan

Wonderful New Widget Project Plan

WBS	Dur.	Task	Year 1			Year 2			
			October	November	December	January	February	March	April
1	41d	Task 1							
1.a	17d	Task 1-A							
1.b	10d	Task 1-B							
1.c	14d	Task 1-C							
2	121d	Task 2							
2.a	39d	Task 2-A							
2.b	41d	Task 2-B							
2.c	41d	Task 2-C							
3	161d	Task 3							
3.a	65d	Task 3-A							
3.b	46d	Task 3-B							
3.c	50d	Task 3-C							

Summary Plan

Schedule the Tasks

Each task should have a specific duration which provides the basis for monitoring actual costs and physical progress.

Allocate the Budget

Each activity in the project should have a planned Budget-at-Completion (BAC). All subsequent earned value calculations will be based on this amount.

Wonderful New Widget Project Plan

WBS	Dur.	Task	Budget (BAC)	Year 1			Year 2			
				October	November	December	January	February	March	April
1	41d	Task 1	$950							
1.a	17d	Task 1-A	$300							
1.b	10d	Task 1-B	$400							
1.c	14d	Task 1-C	$250							
2	121d	Task 2	$1,300							
2.a	39d	Task 2-A	$725							
2.b	41d	Task 2-B	$225							
2.c	41d	Task 2-C	$350							
3	161d	Task 3	$1,775							
3.a	65d	Task 3-A	$550							
3.b	46d	Task 3-B	$800							
3.c	50d	Task 3-C	$425							

Summary Plan

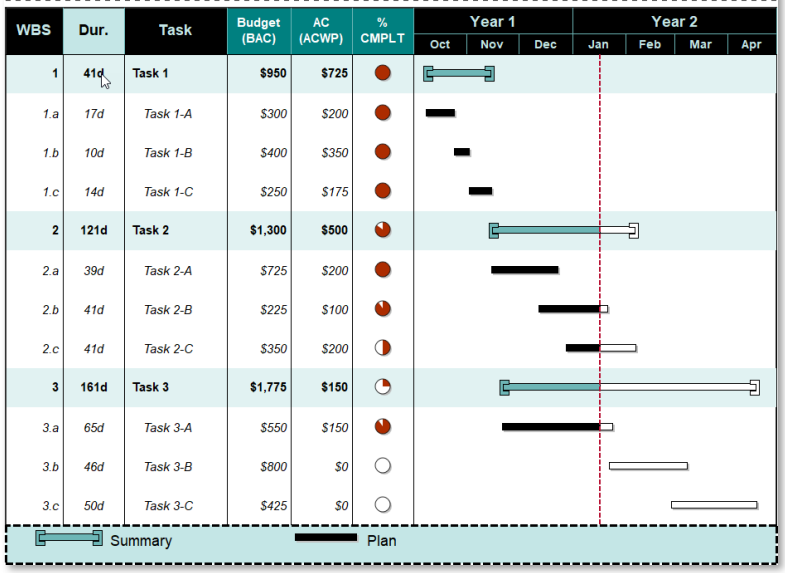
How do I get started using Earned Value Management? (continued)

Update Status and Enter Actual Costs

As the project progresses, the percent complete for unfinished tasks should be updated and monitored. Actual cost for each task should also be updated as the project progresses.

Wonderful New Widget Project Plan

WBS	Dur.	Task	Budget (BAC)	AC (ACWP)	% CMPLT
1	41d	Task 1	$950	$725	
1.a	17d	Task 1-A	$300	$200	
1.b	10d	Task 1-B	$400	$350	
1.c	14d	Task 1-C	$250	$175	
2	121d	Task 2	$1,300	$500	
2.a	39d	Task 2-A	$725	$200	
2.b	41d	Task 2-B	$225	$100	
2.c	41d	Task 2-C	$350	$200	
3	161d	Task 3	$1,775	$150	
3.a	65d	Task 3-A	$550	$150	
3.b	46d	Task 3-B	$800	$0	
3.c	50d	Task 3-C	$425	$0	



The Project's Earned Value

Earned Value (EV) is determined by relating this physical progress to the BAC. Along with task status and budget, it is necessary to maintain actual costs accrued for each task to calculate cost performance.

Wonderful New Widget Project Plan

WBS	Dur.	Task	Budget (BAC)	AC (ACWP)	% CMPLT	PV (BCWS)	EV (BCWP)
1	41d	Task 1	$950	$725		$950	$950
1.a	17d	Task 1-A	$300	$200		$300	$300
1.b	10d	Task 1-B	$400	$350		$400	$400
1.c	14d	Task 1-C	$250	$175		$250	$250
2	121d	Task 2	$1,300	$500		$1,093	$1,093
2.a	39d	Task 2-A	$725	$200		$725	$725
2.b	41d	Task 2-B	$225	$100		$198	$198
2.c	41d	Task 2-C	$350	$200		$171	$171
3	161d	Task 3	$1,775	$150		$482	$482
3.a	65d	Task 3-A	$550	$150		$482	$482
3.b	46d	Task 3-B	$800	$0		$0	$0
3.c	50d	Task 3-C	$425	$0		$0	$0

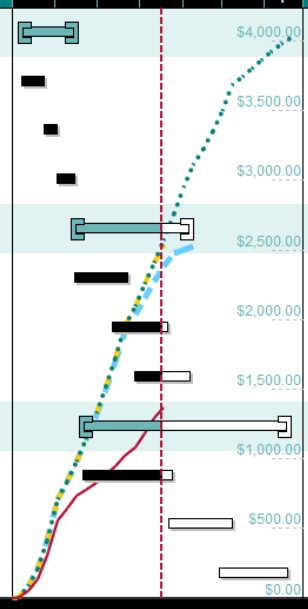
How do I get started using Earned Value Management? (continued)

Use the Data to Make Informed Decisions

When all tasks have been scheduled, and the BAC, EV, Percent Complete, and AC are known, further analysis can be performed, including schedule and cost variances, performance efficiency, and estimates-at-completion.

Wonderful New Widget Project Plan

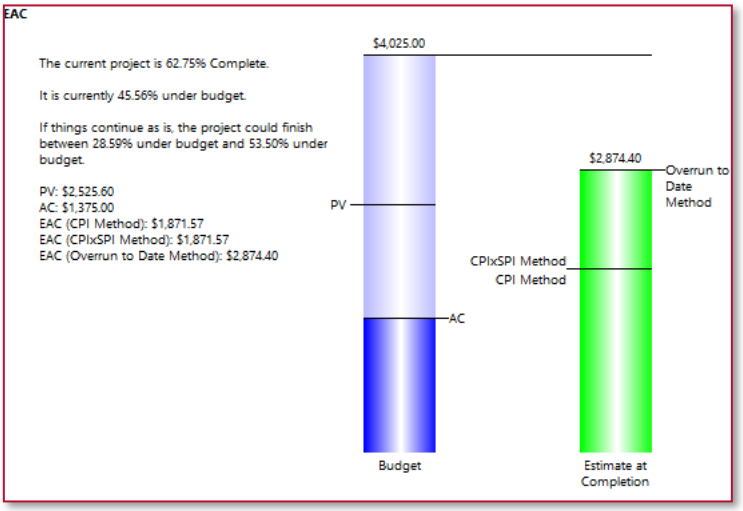
WBS	Dur.	Task	Budget (BAC)	AC (ACWP)	% CMPLT	PV (BCWS)	EV (BCWP)	CPI	TCPI	CV	SPI
1	41d	Task 1	$950	$725		$950	$950	1.31	0.00	$225	1.00
1.a	17d	Task 1-A	$300	$200		$300	$300	1.50	0.00	$100	1.00
1.b	10d	Task 1-B	$400	$350		$400	$400	1.14	0.00	$50	1.00
1.c	14d	Task 1-C	$250	$175		$250	$250	1.43	0.00	$75	1.00
2	121d	Task 2	$1,300	$500		$1,093	$1,093	2.19	0.26	$593	1.00
2.a	39d	Task 2-A	$725	$200		$725	$725	3.62	0.00	$525	1.00
2.b	41d	Task 2-B	$225	$100		$198	$198	1.98	0.22	$98	1.00
2.c	41d	Task 2-C	$350	$200		$171	$171	0.85	1.20	($29)	1.00
3	161d	Task 3	$1,775	$150		$482	$482	3.22	0.80	$332	1.00
3.a	65d	Task 3-A	$550	$150		$482	$482	3.22	0.17	$332	1.00
3.b	46d	Task 3-B	$800	$0		$0	$0	0.00	1.00	$0	0.00
3.c	50d	Task 3-C	$425	$0		$0	$0	0.00	1.00	$0	0.00



PV (BCWS)
EV (BCWP)
Budget
ACWP

Summary Plan

Estimate at Completion Report

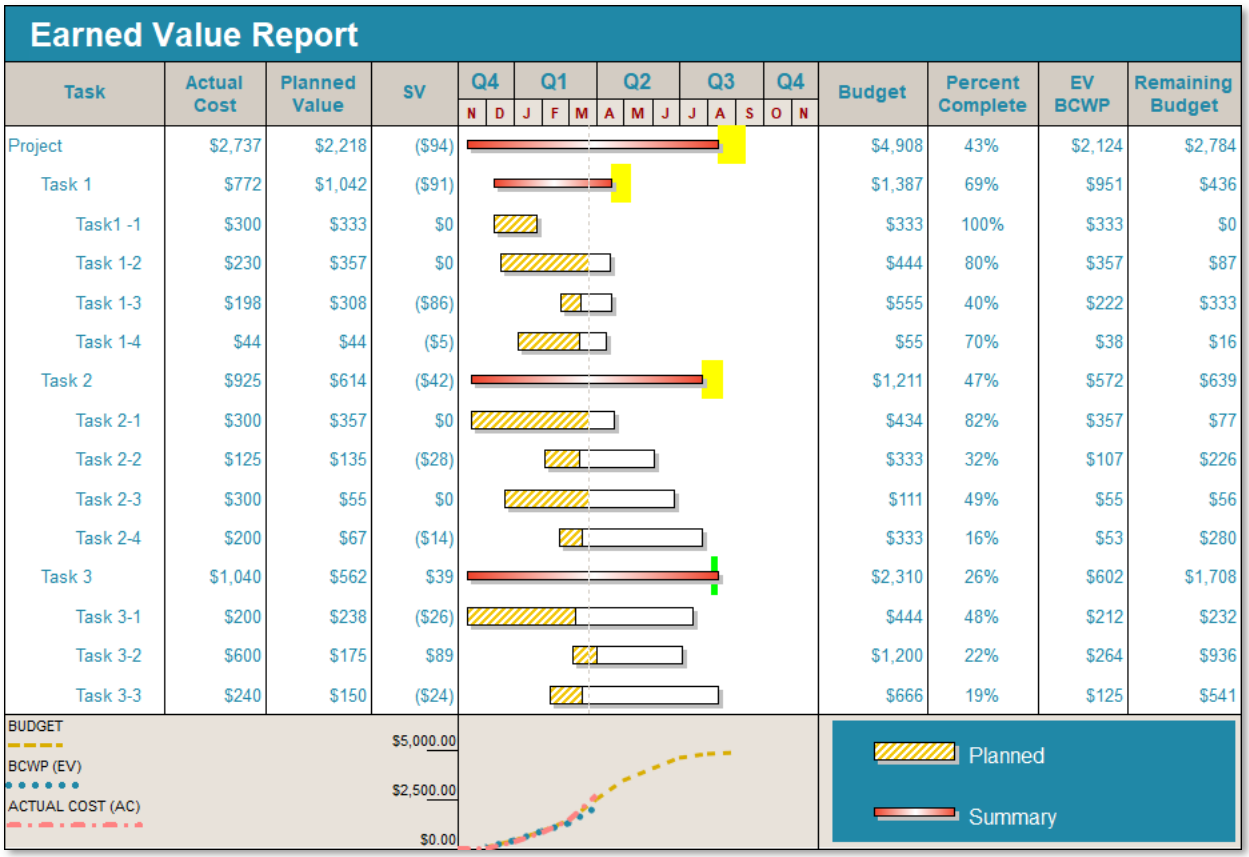


Earned Value Reporting using Milestones Professional

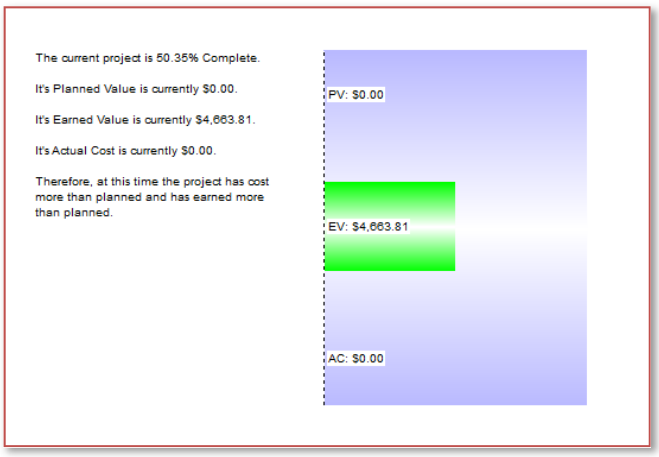
Milestones Professional by KIDASA Software offers built in earned value calculations conforming to the ANSI/EIA 748 standard. In addition to building project schedules with earned value within Milestones Professional, scheduled tasks (with BAC, % complete, and Actual Cost) can be imported from Microsoft Project. Once imported, calculations can be made to yield Earned Value (BCWP), Planned Value (BCWS), CPI, SPI and other Earned Value fields. Milestones Professional users can get complete instructions for working with Earned Value by searching for Earned Value in the Help Topics (Help tab - Help Topics.)

Earned Value Report

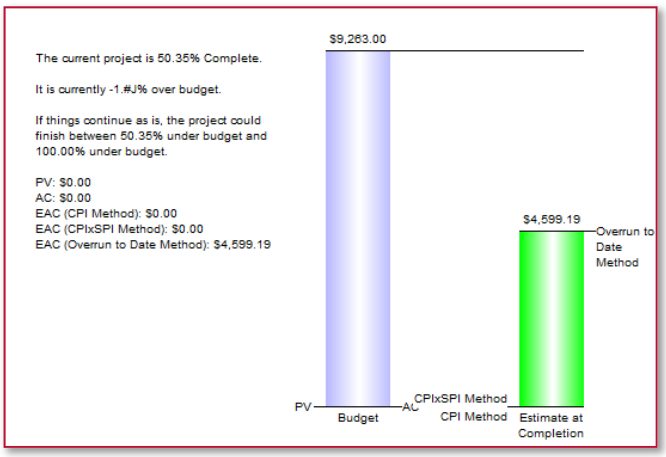
Task	Actual Cost	Planned Value	SV	Budget	Percent Complete	EV BCWP	Remaining Budget
Project	$2,737	$2,218	($94)	$4,908	43%	$2,124	$2,784
Task 1	$772	$1,042	($91)	$1,387	69%	$951	$436
Task1 -1	$300	$333	$0	$333	100%	$333	$0
Task 1-2	$230	$357	$0	$444	80%	$357	$87
Task 1-3	$198	$308	($86)	$555	40%	$222	$333
Task 1-4	$44	$44	($5)	$55	70%	$38	$16
Task 2	$925	$614	($42)	$1,211	47%	$572	$639
Task 2-1	$300	$357	$0	$434	82%	$357	$77
Task 2-2	$125	$135	($28)	$333	32%	$107	$226
Task 2-3	$300	$55	$0	$111	49%	$55	$56
Task 2-4	$200	$67	($14)	$333	16%	$53	$280
Task 3	$1,040	$562	$39	$2,310	26%	$602	$1,708
Task 3-1	$200	$238	($26)	$444	48%	$212	$232
Task 3-2	$600	$175	$89	$1,200	22%	$264	$936
Task 3-3	$240	$150	($24)	$666	19%	$125	$541



Actual Cost/Planned Value Earned Value Report



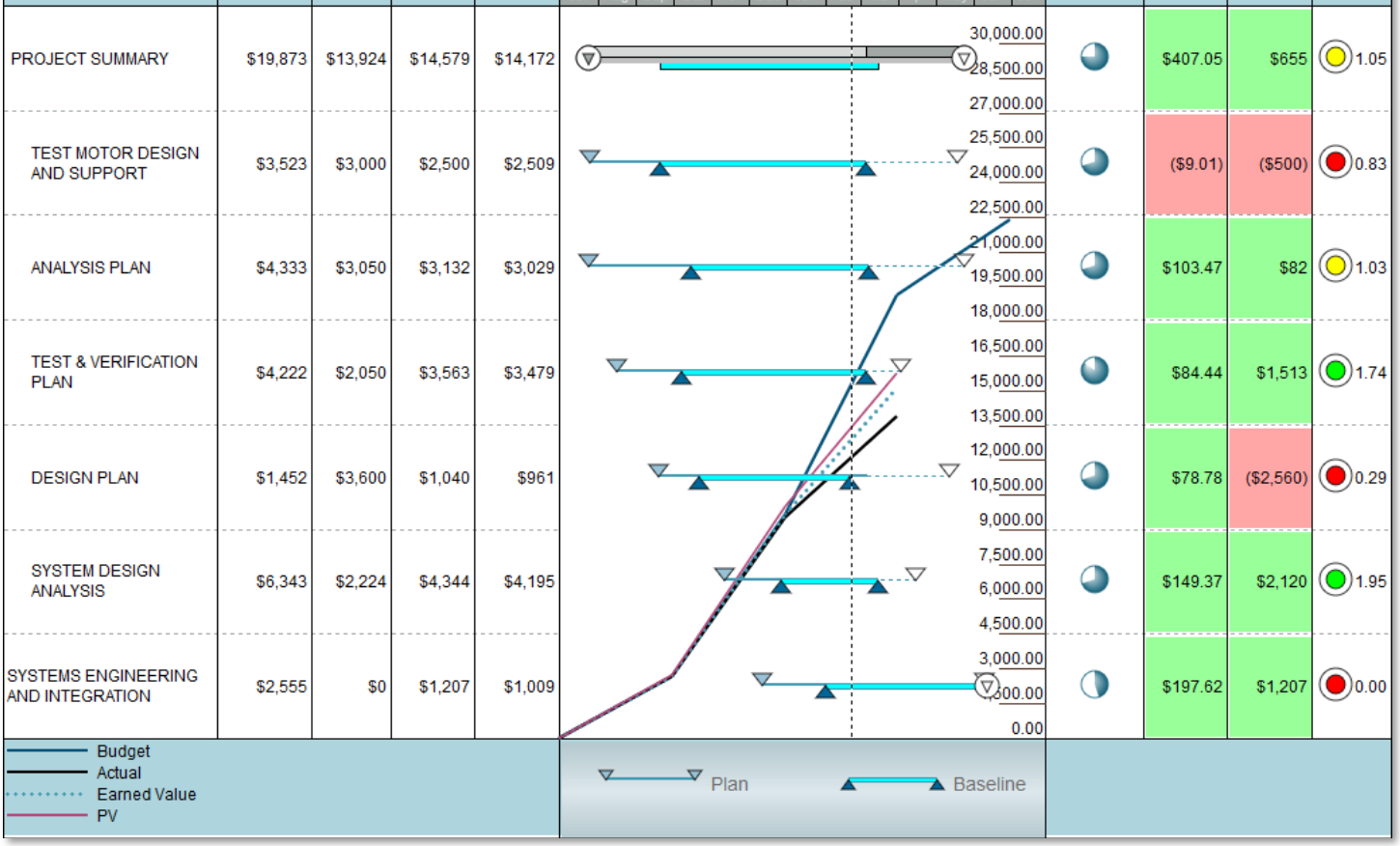
Estimate At Completion Report



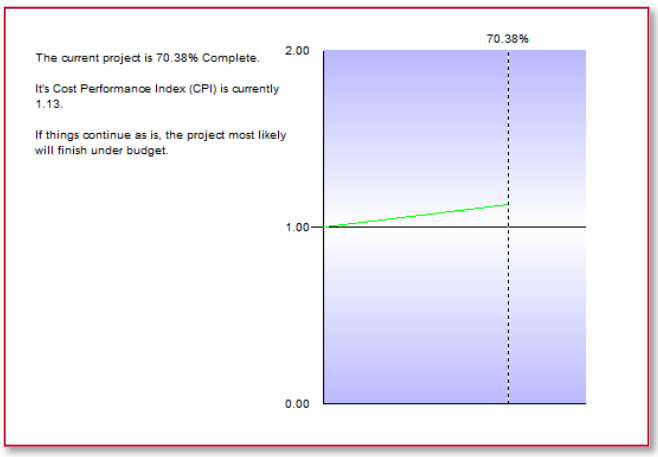
Milestones Professional Earned Value Examples

Earned Value Dashboard

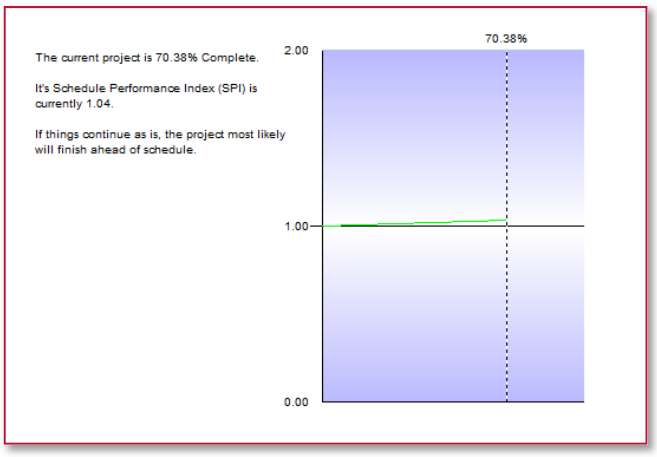
Name	Baseline Cost	Actual Cost	EV (BCWP)	PV (BCWS)	Percent Complet	SV	CV	CPI
PROJECT SUMMARY	$19,873	$13,924	$14,579	$14,172		$407.05	$655	1.05
TEST MOTOR DESIGN AND SUPPORT	$3,523	$3,000	$2,500	$2,509		($9.01)	($500)	0.83
ANALYSIS PLAN	$4,333	$3,050	$3,132	$3,029		$103.47	$82	1.03
TEST & VERIFICATION PLAN	$4,222	$2,050	$3,563	$3,479		$84.44	$1,513	1.74
DESIGN PLAN	$1,452	$3,600	$1,040	$961		$78.78	($2,560)	0.29
SYSTEM DESIGN ANALYSIS	$6,343	$2,224	$4,344	$4,195		$149.37	$2,120	1.95
SYSTEMS ENGINEERING AND INTEGRATION	$2,555	$0	$1,207	$1,009		$197.62	$1,207	0.00



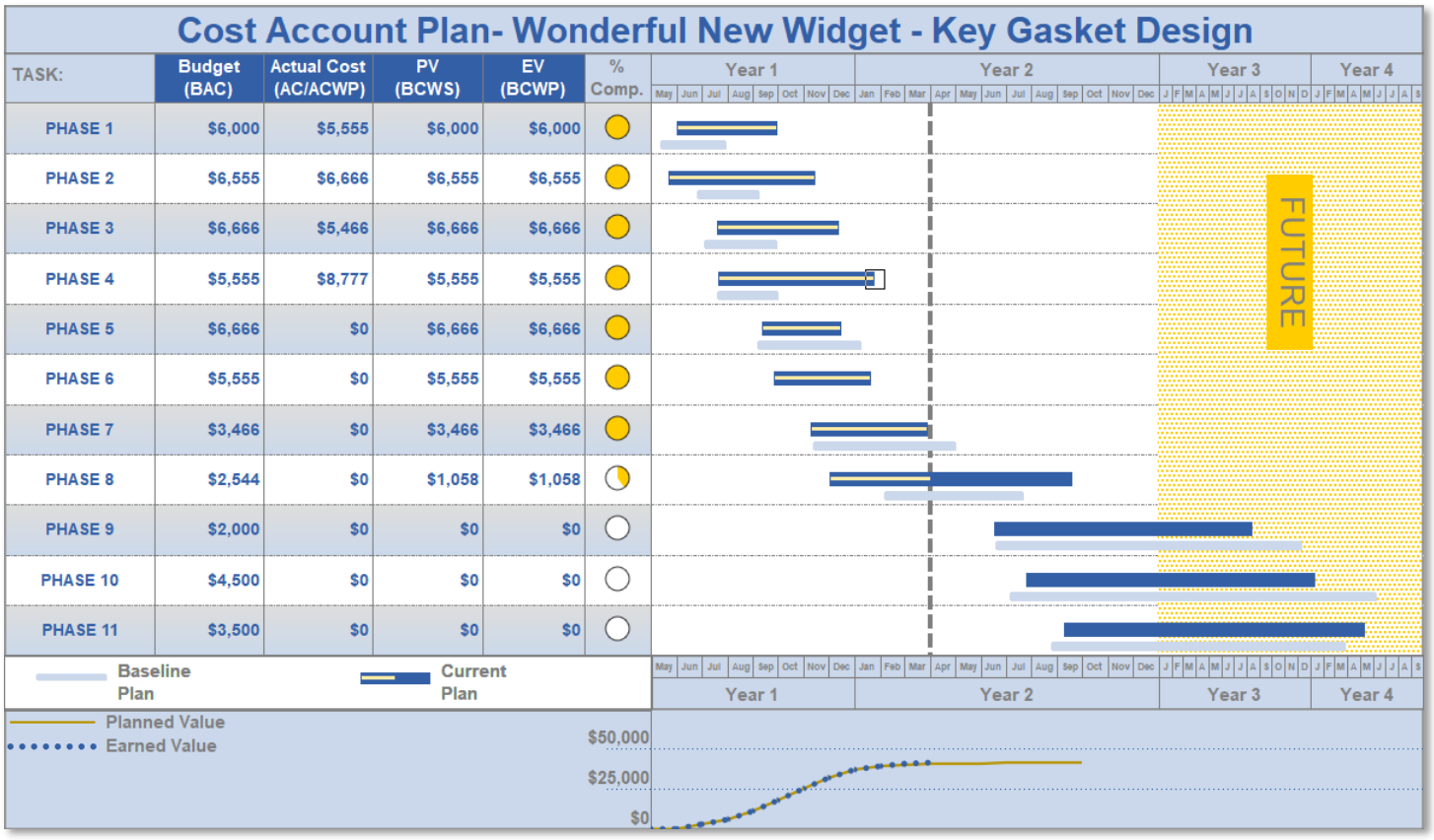
Cost Performance Index Report



Schedule Performance Index Report



Example Report and Resources



Materials for further Earned Value Management research:

Fleming, Q., & Koppelman, J. (2000). Earned Value Project Management. 2nd Ed. Pennsylvania: Project Management Institute.

Lewis, J. (2000). The Project Manager's Desk Reference. New York: McGraw-Hill.

Portny, S. (2001). Project Management for Dummies. New York: Hungry Minds, Inc.

KIDASA.com - Home of KIDASA Software, Inc., makers of Milestones Professional.

EarnedValueManagement.com - All about Earned Value. Definitions, examples, and more.

PMI.org - Home of the Project Management Institute, and a variety of PM resources.

http://www.acq.osd.mil/evm/ - DOD web site which contains useful reference material and links to other DOD earned value web sites.

Milestones Professional users can get complete instructions for working with Earned Value by searching for Earned Value in the Help Topics (Help tab - Help Topics.)