SAND2013-5715P

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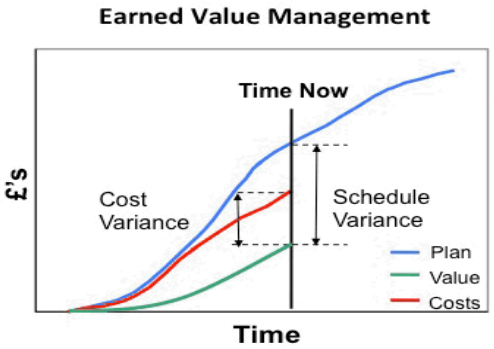

Resource Loaded Baseline and Earned Value

Eric Boatman, MBA, PMP

U.S. DEPARTMENT OF ENERGY | NNSA

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Overview

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What is a resource loaded baseline?

How do you create a resource loaded baseline?

What is the baseline useful for?

What is earned value management?

How does earned value help you manage your project?

What is a Resource Loaded Baseline?

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- Once the schedule is reviewed and approved, the schedule can then be resource loaded
- Resource loading is the process of developing a cost estimate for each activity through the assignment of all labor and non-labor resources and their respective quantities (i.e. hours for labor, dollars for services or purchases) required to complete the work
- Completing the resource-loading and review process results in a time-phased cost estimate for the project
- It is a detailed explanation of how you plan to do the work, when the activities will occur, and how much funding you need to execute

How to Create a Resource Loaded Baseline

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1. Determine if the required resources are available when needed to complete the work
2. Make assignment changes as necessary
3. Estimate the total costs per activity
4. Total all of the activity costs to get a project estimate
5. If the resulting cost estimate exceeds the projected budget, the program will determine if the technical design should be modified or if there are different ways to perform the work, reduce the scope, or postpone work until additional budget is awarded
6. Once reviewed and approved, the schedule and associated time-phased cost estimate are baselined

Using the Baseline: Tracking Performance

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- Once the resource loaded baseline has been approved it is locked into place
- The baseline provides the plan to track progress against
- Earned value management is a tool that uses the baseline to provide an analysis of cost and schedule performance data

Overview of Earned Value

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- Earned Value Management integrates cost, schedule, and technical (scope)
- Performance is measured based on the physical work accomplished
- Earned Value is expressed in terms of the budget assigned to that scope of work

Why is Earned Value Useful?

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EVM tells me:

- Whether I'm on budget
- Whether I'm on schedule
- If I'm over costed, what is causing cost increases
- If my schedule is slipping, what is causing the slippage

What are the Steps of Earned Value?

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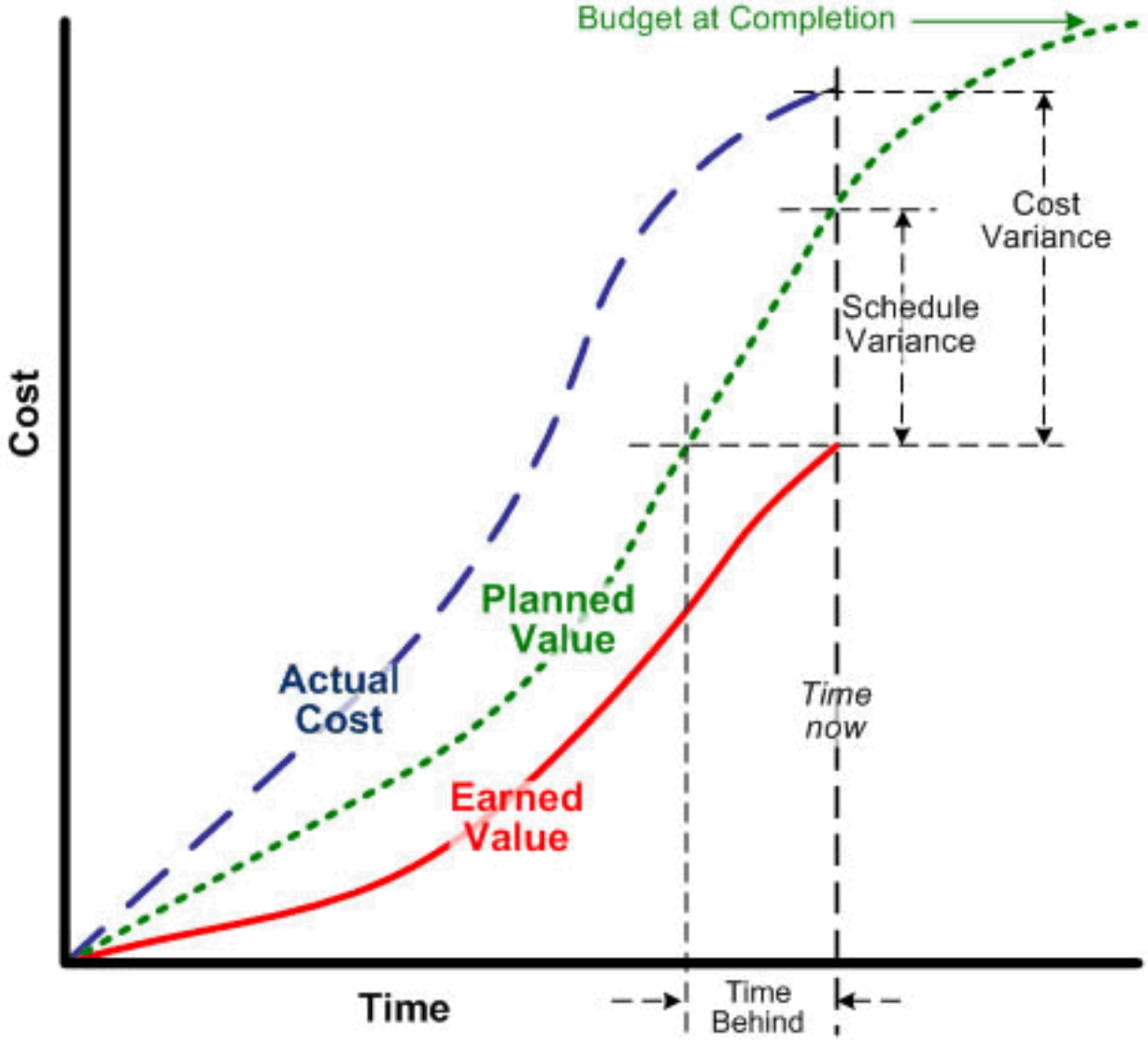
1. Define the budgeted cost of work scheduled
2. Determine the earned value or % of budgeted cost of work performed
3. Track actual costs
4. Prepare metrics and performance management indices
5. Look for early warnings and trending
6. Prepare Estimates at Completion
7. Monitor the integrated cost and schedule baseline
8. Perform change control

EVM Graph


Budget at Completion
Cost Variance
Schedule Variance
Cost
Planned Value
Actual Cost
Time now
Earned Value
Time
Time Behind

Monitoring Variance

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Cost Variance (CV) = EV – AC	Schedule Variance (SV) = EV – PV
If the result is POSITIVE→ "Underrun" If the result is NEGATIVE→ "Overrun"	If the result is POSITIVE → "On Schedule" If the result is NEGATIVE → "Behind Schedule"

Schedule Performance

The **Schedule Performance Index (SPI)** is a measure of Schedule Efficiency. The SPI measures the value of work performed against the work scheduled.

Schedule Performance Index (SPI) = EV/PV

If result is less than 1.0, project is "BEHIND" schedule
If the result greater than 1.0, project is "AHEAD of schedule

Example 1:

PV = $950
EV = $1000
AC = $ 900

$$SPI = \frac{\$1000}{\$950} = 1.05$$

Example 2:

PV = $1100
EV = $1000
AC = $1200

$$SPI = \frac{\$1000}{\$1100} = .91$$

Schedule Performance Analysis

- Potential Causes of Unfavorable (-) Schedule Variance:
  - Regulatory delays
  - Scope creep
  - Worker shortage
  - Late delivery of product or service from supplier
  - Rework

- Potential Causes of Favorable (+) Schedule Variance:
  - Work Efficiencies
  - Work less complicated than planned
  - Early delivery of product or service from supplier

Cost Performance

The **Cost Performance Index (CPI)** is a measure of Cost Efficiency. The CPI measures the value of work performed against the actual cost.

Cost Performance Index (CPI) = EV/AC

If the result is less than 1.0, cost is GREATER than budgeted

If the result is greater than 1.0, cost is LESS than budgeted

Example 1:

PV = $950
EV = $1000
AC = $ 900

$$CPI = \frac{\$1000}{\$900} = 1.11$$

Example 2:

PV = $1100
EV = $1000
AC = $1200

$$CPI = \frac{\$1000}{\$1200} = .83$$

Cost Performance Analysis

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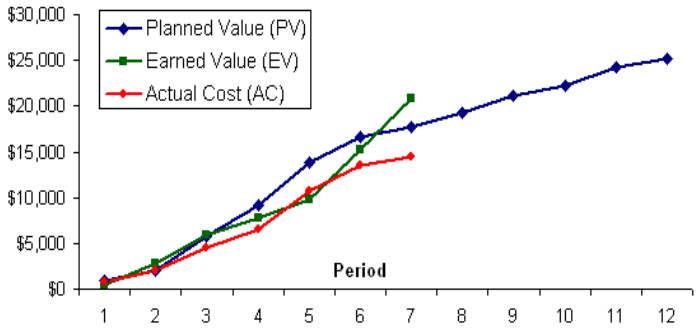
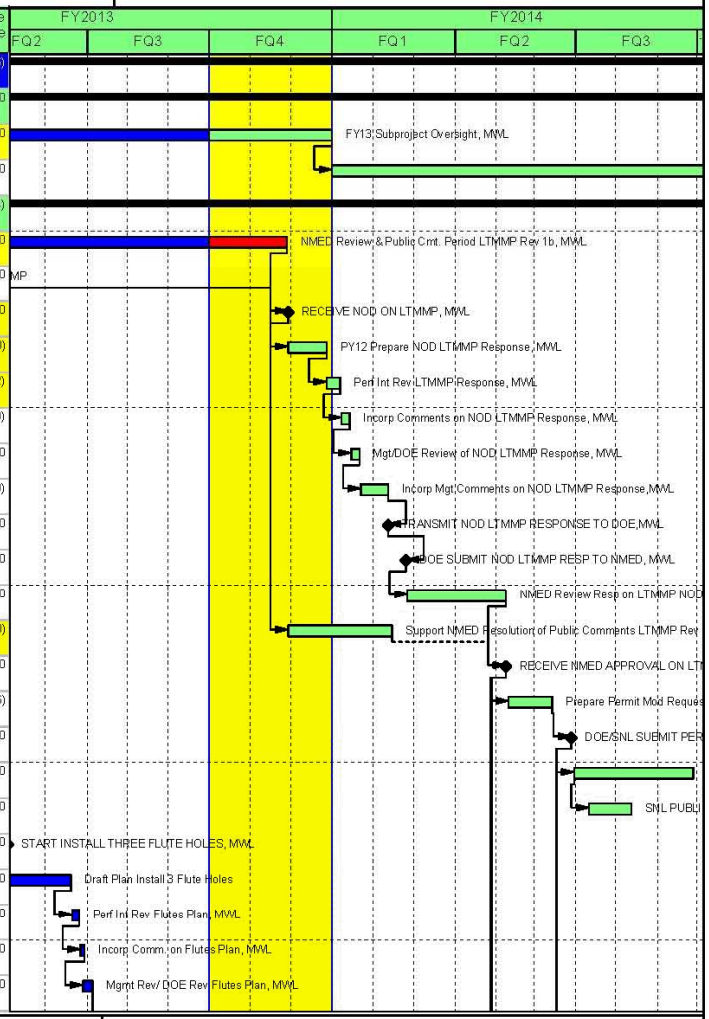
- Potential Causes of Unfavorable (-) Cost Variance:
  - Work more complicated than planned
  - Labor rate increases
  - Rework
- Potential Causes of Favorable (+) Cost Variance:
  - Delays in sub-contractor billing
  - Work Efficiencies
  - Work less complicated than planned
  - Labor rate decreases/ new resources

Project Controls: How to Maintain the Baseline

- Status Meetings
- Monthly Managers' Reports
- Quarterly Reviews
- Annual Work Plans
- Approved Baseline Changes



Activity ID	Activity Name	Original Duration	Physical % Complete	Start	Finish	Budgeted Total Cost	Earned Value Cost	Schedule Variance
WBS 1.01: REGULATORY CLOSURE		648d		01-Oct-12 A	28-Oct-14	$1,804,275.14	$680,620.23	($537,417.56)
RC: SUBPROJECT OVERSIGHT		499d		01-Oct-12 A	30-Sep-14	$332,370.40	$123,641.79	$0.00
MWL 0024	FY13 Subproject Oversight, MWL	250d	74.4%	01-Oct-12 A	30-Sep-13	$166,185.20	$123,641.79	$0.00
MWL 0026	FY14 Subproject Oversight, MWL	250d	0%	01-Oct-13	30-Sep-14	$166,185.20	$0.00	$0.00
RC: MIXED WASTE LANDFILL		648d		01-Oct-12 A	28-Oct-14	$994,157.62	$528,055.00	($132,491.64)
MWL 0491N0	NMED Review & Public Cmt. Period LTMMP Rev 1b, MWL	65d	85%	01-Oct-12 A	28-Aug-13*	$0.00	$0.00	$0.00
MWL 0491N0A	NMED Public Meeting LTMMP	5d	100%	11-Oct-12 A	17-Oct-12 A	$14,133.40	$14,133.40	$0.00
MWL 0491NA	RECEIVE NOD ON LTMMP, MWL	0d	0%	29-Aug-13		$0.00	$0.00	$0.00
MWL 0491NC	PY12 Prepare NOD LTMMP Response, MWL	20d	0%	29-Aug-13	26-Sep-13	$31,211.10	$0.00	($31,211.10)
MWL 0491NE	Perf Int Rev LTMMP Response, MWL	7d	0%	27-Sep-13	07-Oct-13	$4,336.72	$0.00	($4,336.72)
MWL 0491NG	Incorp Comments on NOD LTMMP Response, MWL	5d	0%	08-Oct-13	14-Oct-13	$8,983.60	$0.00	($8,983.60)
MWL 0491NJ	Mgt/DOE Review of NOD LTMMP Response, MWL	5d	0%	15-Oct-13	21-Oct-13	$0.00	$0.00	$0.00
MWL 0491NL	Incorp Mgt Comments on NOD LTMMP Response,MWL	15d	0%	22-Oct-13	11-Nov-13	$8,983.60	$0.00	($8,983.60)
MWL 0491NN	TRANSMIT NOD LTMMP RESPONSE TO DOE,MWL	0d	0%		11-Nov-13	$0.00	$0.00	$0.00
MWL 0491NP	DOE SUBMIT NOD LTMMP RESP TO NMED, MWL	0d	0%		25-Nov-13	$0.00	$0.00	$0.00
MWL 0491NR	NMED Review Resp on LTMMP NOD, MWL	46d	0%	26-Nov-13	07-Feb-14	$0.00	$0.00	$0.00
MWL 0495	Support NMED Resolution of Public Comments LTMMP Rev 1b, MWL	55d	0%	29-Aug-13	14-Nov-13	$24,816.40	$0.00	($24,816.40)
MWL 0510	RECEIVE NMED APPROVAL ON LTMMP Rev 1b, MWL	0d	0%		07-Feb-14	$0.00	$0.00	$0.00
MWL 0515AA	Prepare Permit Mod Request, Justification Binder, Poster,MWL	25d	0%	10-Feb-14	14-Mar-14	$66,183.84	$0.00	($35,932.76)
MWL 0515AC	DOE/SNL SUBMIT PERMIT MOD REQ#11 TO NMED, MWL	0d	0%		28-Mar-14	$0.00	$0.00	$0.00
MWL 0515AE	NMED Act on Request/90 Day Public Comment Period, MWL	64d	0%	31-Mar-14	27-Jun-14	$0.00	$0.00	$0.00
MWL 0515AF	SNL PUBLIC MTG ON MWL CLASS 3 MOD	22d	0%	11-Apr-14	12-May-14	$21,160.24	$0.00	$0.00
MWL 0565	START INSTALL THREE FLUTE HOLES, MWL	0d	100%	01-Feb-13 A		$0.00	$0.00	$0.00
MWL 0572	Draft Plan Install 3 Flute Holes	30d	100%	01-Feb-13 A	20-Mar-13 A	$54,161.20	$54,161.20	$0.00
MWL 0572A	Perf Int Rev Flutes Plan, MWL	5d	100%	21-Mar-13 A	26-Mar-13 A	$14,303.92	$14,303.92	$0.00
MWL 0572B	Incorp Comm. on Flutes Plan, MWL	5d	100%	27-Mar-13 A	30-Mar-13 A	$10,105.92	$10,105.92	$0.00
MWL 0572C	Mgmt Rev/ DOE Rev Flutes Plan, MWL	5d	100%	29-Mar-13 A	05-Apr-13 A	$0.00	$0.00	$0.00



Project Start Date: 3-Oct-11

Project End Date: 15-Jun-21

Data Date: 01-Jul-13

Run Date: 11-Jul-13

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Environmental Resoration

BCP# 13-001, BL13-a-2

ER Baseline Layout/ E. Boatman

Date	Revision	Checked	Approved
05-Nov-12	BCP#13-001, FY13 Baseline up...		

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MONTHLY MANAGERS' REPORTS

SNL Environmental Restoration Operations

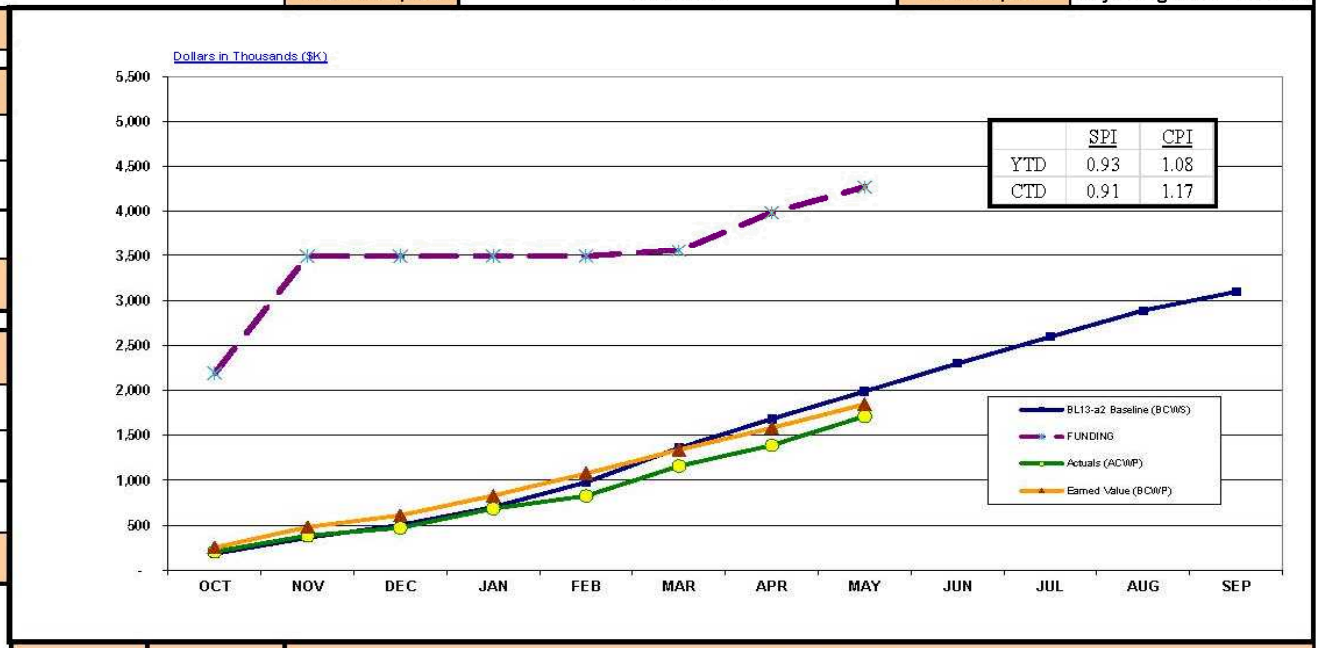
Operable Unit Summary

TOTAL ER OPERATIONS ACTIVITIES

Data Date: 03-Jun-2013

45.5% Complete | WBS: 1422 | 42.1% Spent | Project Mgr: John Cochran

SNL NM/CA Total Operations	
Cost Variances:	
Groundwater	(53.5)
Ops Mgmt & Cntrls	81.3
Regulatory Closure	107.2
Total Cost Variance	**135.0**
Schedule Variances:	
Groundwater	(36.9)
Ops Mgmt & Cntrls	2.3
Regulatory Closure	(108.6)
Total Schedule Variance	**(143.2)**



		FY13 Authorized	Prior FY Scope* and Carryover	Based on FY13 Operations Baseline											
				OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CUMULATIVE Y-T-D VALUES	BL13-a2 Baseline (BCWS)		964	183	362	503	700	976	1,360	1,681	1,988	2,299	2,594	2,887	3,095
	Earned Value (BCWP)			252	480	608	828	1,074	1,338	1,582	1,845	-	-	-	-
	Actuals (ACWP)			206	385	471	685	826	1,157	1,387	1,710	-	-	-	-
PERIOD VALUES	BL13-a2 Baseline (BCWS)			183	179	141	197	276	384	321	307	311	295	293	208
	Earned Value (BCWP)			252	228	128	220	247	263	244	263	-	-	-	-
	Actuals (ACWP)			206	179	86	214	141	331	230	322	-	-	-	-
FUNDING		**2,084**	**2,187**	**2,187**	**3,491**	**3,491**	**3,491**	**3,491**	**3,560**	**3,987**	**4,271**				
VARIANCES WITH PRIOR-YEAR SCOPE	CV (BCWP-ACWP)			46	95	137	143	249	181	194	135	-	-	-	-
	COST % (CV/BCWP)			18%	20%	23%	17%	23%	14%	12%	7%				
	SV (BCWP-BCWS)			69	118	105	128	98	(22)	(99)	(143)				
	SCHEDULE % (SV/BCWS)			38%	33%	21%	18%	10%	-2%	-6%	-7%				

Conclusion

- The Resource Loaded Baseline provides a detailed, time phased project estimate
- It provides the foundation for earned value analysis
- Earned Value:
  - Gives a big picture of the project status and an objective evaluation of its health
  - Provides early warning signals that can help you avert project disasters before they get uncontrollable
  - It allows time to recover from an issue
  - It allows timely request for additional funds

References

- The Project Management Institute www.pmi.org

- A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013