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 e-mail: michael@pmi.org

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 24 hours talk around the clock in support for children and families from Ukraine

Project Managers 4 The World



Governing and Leading Projects using Earned Value Management (EVM)

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<https://mosaicprojects.com.au/PMKI-SCH.php>



EV - Definition

- Earned value management is a structured method used to provide a performance measurement system for the review of past, and to forecast future, performance
- Performance includes managing scope, time and cost in an integrated framework

EV - The Key Requirements

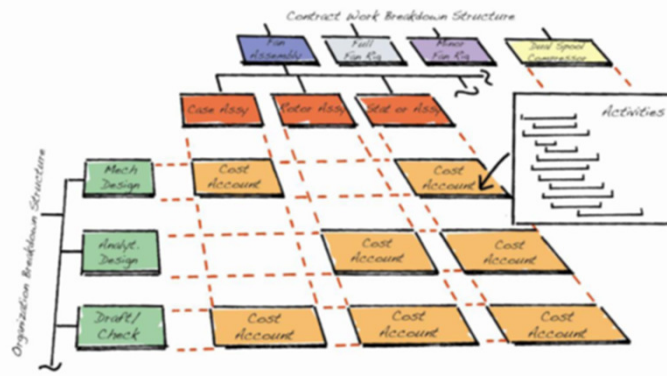
1. The project decomposed into management cells using an effective **WBS**
2. An effective *schedule* linked to the **WBS**
3. An effective *cost plan* linked to the **WBS**
4. Management authority and responsibility linked to the **WBS**

WBS = Work Breakdown Structure:

https://mosaicprojects.com.au/WhitePapers/WP1011_WBS.pdf

The Key Requirement

- **Effective EVM operates at the work package level**

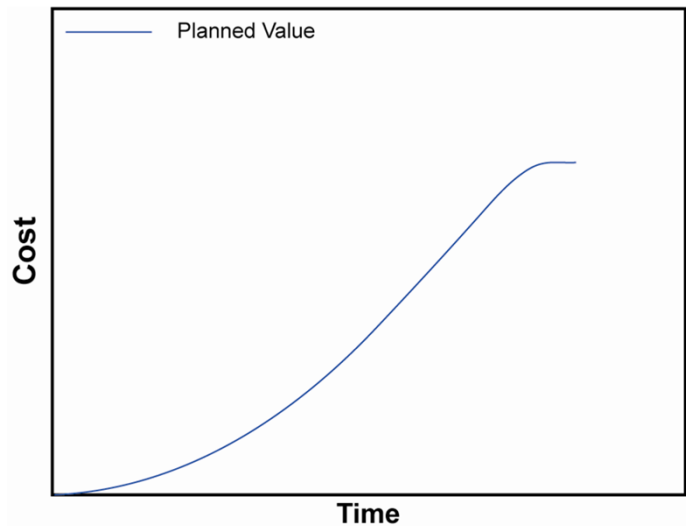


EV - The Key Requirements

- EV operates at the Work Package level
 - A manager is responsible for delivering a defined product or service
 - The value and duration of the WP are significant
 - The span of responsibility covers many related
 - Schedule activities
 - Cost plan 'line items'

Overview of Earned Value

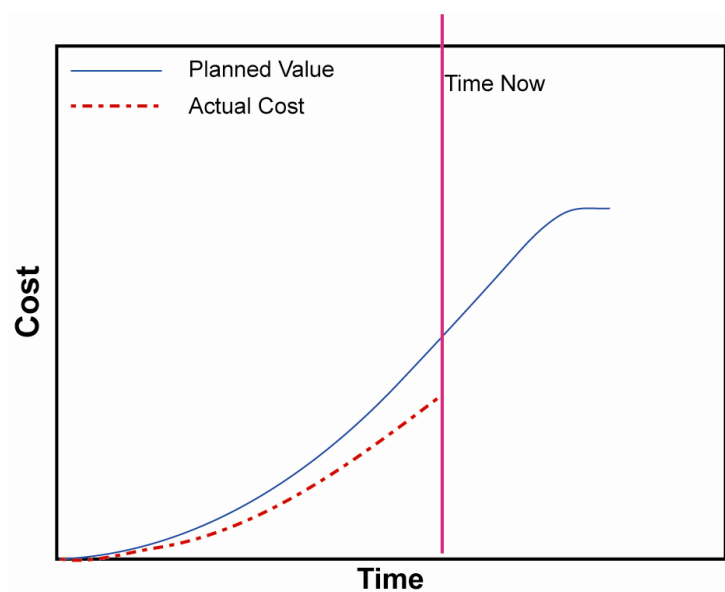
- The foundation is a time phased budget



Overview of Earned Value

- Measuring actual costs adds little extra value

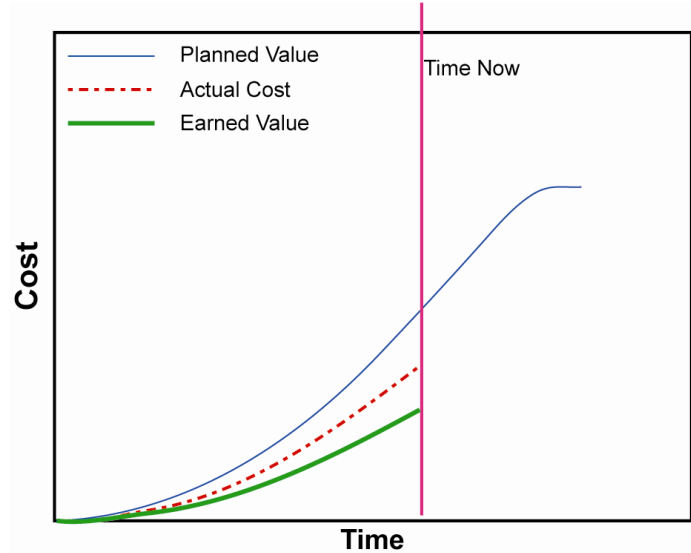
Is this project profitable or behind schedule?



Overview of Earned Value

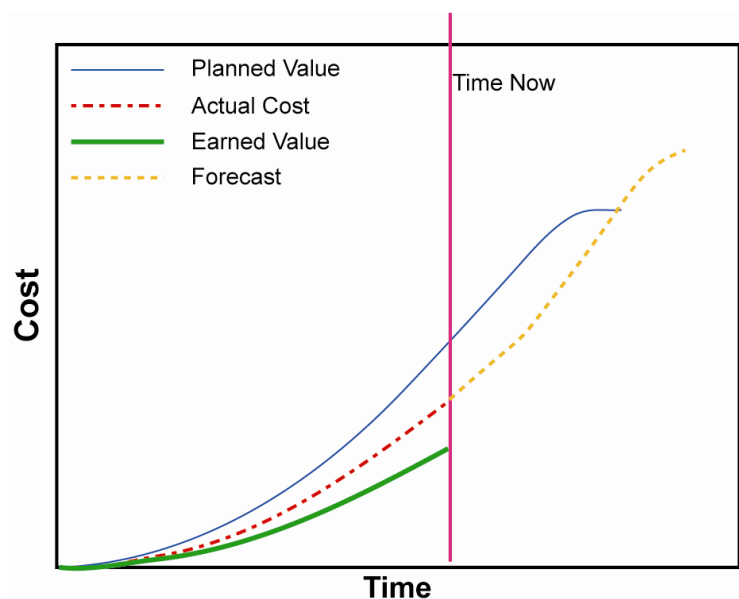
- Earned value measures what has been accomplished to highlight the real situation

This project is losing money and behind schedule!



Overview of Earned Value

- EVM also calculates the forecast to completion based on the performance to date



AS 4817/ISO 21508

- Earned Value Performance Management requires:
 - Knowing what work is to be done, by whom & when
 - Applying objective measures of progress
 - Reporting significant deviations
 - Planning and implementing corrective actions
 - Forecasting completion costs and dates*
 - Managing changes

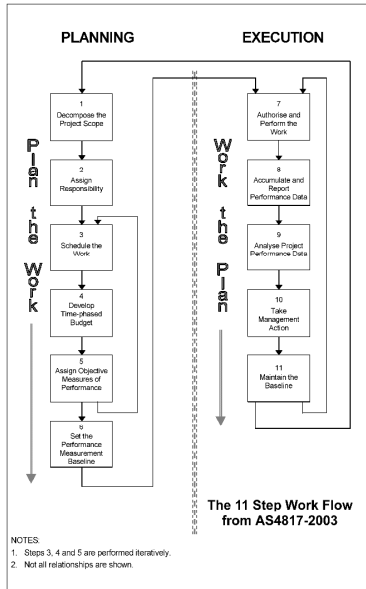
* Using Earned Schedule

ISO 21508

- Describes how to accomplish this in 11 steps

1. Decompose the Project Scope
2. Assign Responsibility
3. Schedule the Work
4. Develop Time-Phased Budget
5. Assign Objective Measures of Performance
6. Set the Performance Measurement Baseline (PMB)
7. Authorize and Perform the Work
8. Accumulate & Report Performance Data
9. Analyze Project Performance Data
10. Take Management Action
11. Maintain the Baseline

ISO 21508



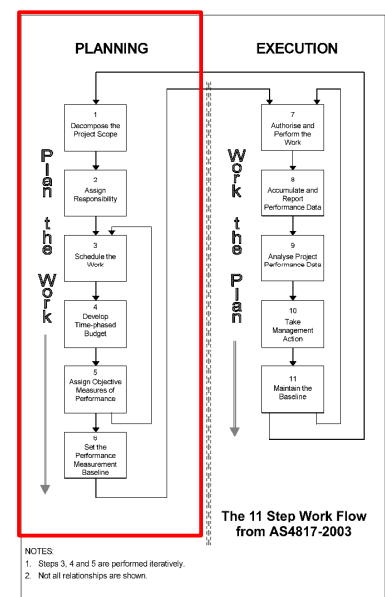
These 11 steps are consistent across:

- AS 4817 2003 The original Australian Standard
- AS 4817 2006 The updated Australian Standard
- ISO 21508 2018 International standard.
- AS 4817 2019 Australian adoption of ISO 21508 with modifications*.

* Modification incorporated a normative annex for use in commercial contracts.

ISO 21508

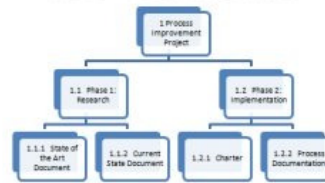
- Steps 1 through 6 create the plan and set the 'performance management baseline' (PMB) for the project



Step 1: Decompose the Project Scope

- Decompose via WBS
- WBS includes all work (100% rule)
- Scope of items mutually exclusive
- Lowest level Work Packages or Planning Packages*

WBS – Chart Format



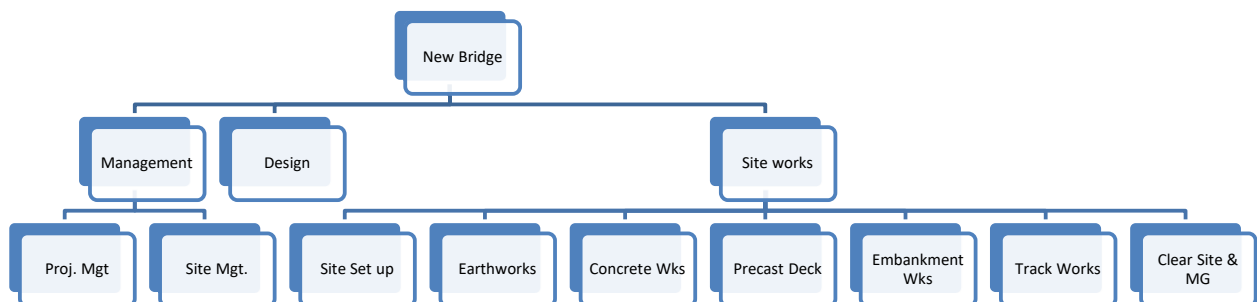
WBS – Outline Format

- 1 Process Improvement Project
- 1.1 Phase 1: Research
- 1.1.1 State of the Art Document
- 1.1.2 Current State Document
- 1.2 Phase 2: Implementation
- 1.2.1 Charter
- 1.2.2 Process Documentation

* Planning packages are expanded into work packages later

Step 1: Decompose the Project Scope

New Rail Bridge – WBS



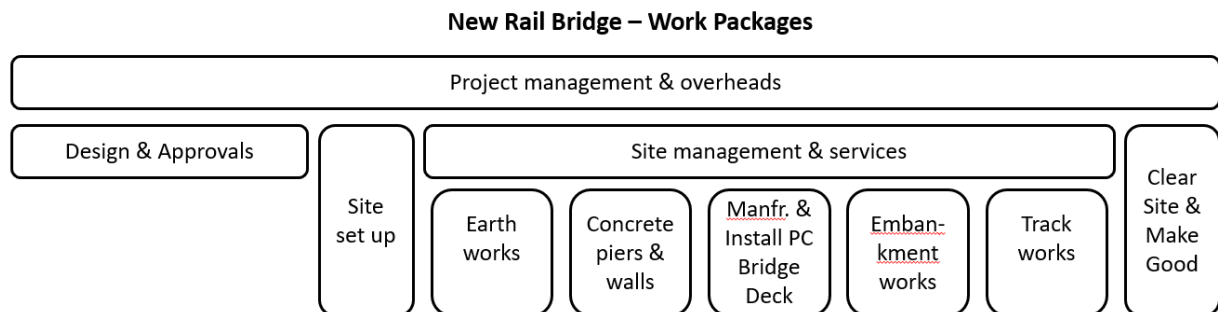
For more on the **WBS** see:

https://www.mosaicprojects.com.au/WhitePapers/WP1011_WBS.pdf

Also: ISO 21511 Work breakdown structures for project and programme management

Step 1: Decompose the Project Scope

- **Every WBS element creates a set of defined deliverables**

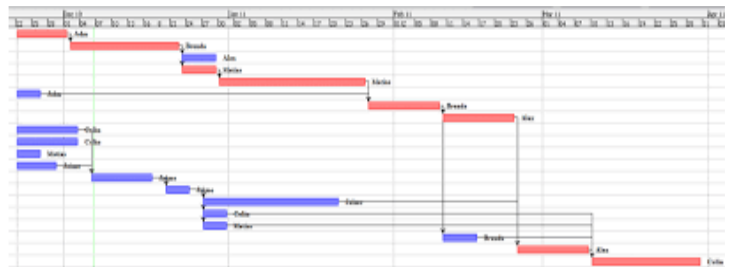


Step 2: Assign Responsibility

- Responsibility assigned to a person for
 - Each element of the WBS
 - The overall project
- Responsibility clearly defined
- Internal managers assigned to oversee external work

Step 3: Schedule the Work

- Schedule activities fit below work packages
- Key interfaces and constraints are defined
- Sequences and interdependencies
- Schedule planned, developed and managed



Step 4: Develop Time-Phased Budget

- Budgets assigned in measurable units (\$) to:
 - Work Packages
 - Planning Packages
- Management Reserve & Undistributed Budget identified and recorded
- Reconcile to Project Budget

Step 5: Assign Objective Measures of Performance

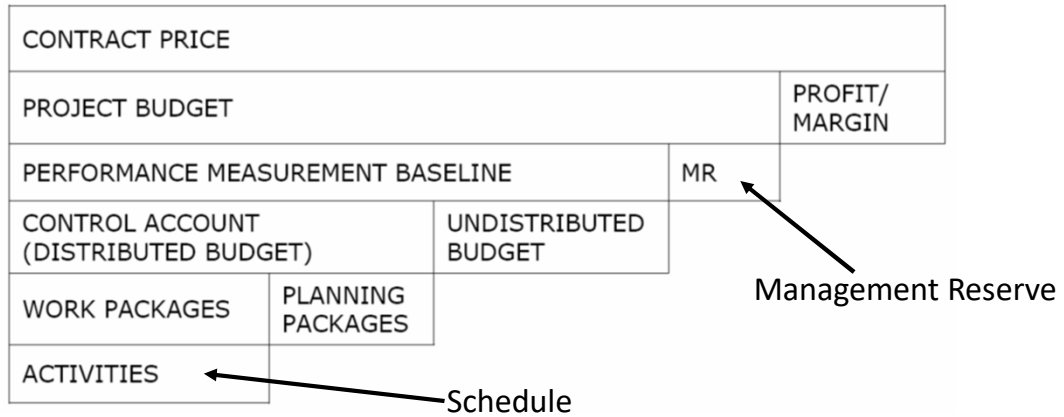
- Accomplishment expressed as EV
- Objective performance measures set
- 1 measure per Work Package
- Progress and costs accumulated in same way
- EV at 100% complete = budget

Step 6: Set the Performance Measurement Baseline (PMB)

- Scope clearly identified and recorded
- Schedule clearly identified and recorded
- Budget clearly identified and recorded
- Scope, schedule, budget formally approved
- PMB* becomes a controlled document

* Performance Measurement Baseline

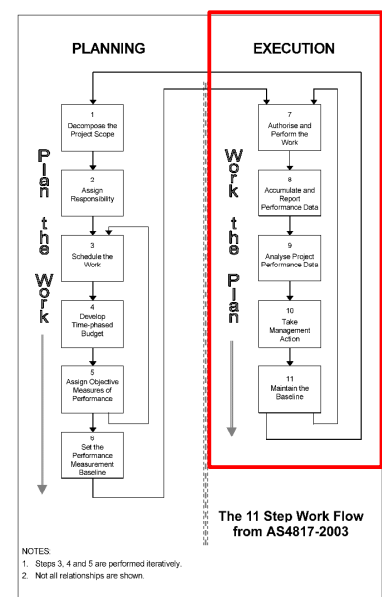
Setting the PMB



- Components of the Performance Management Baseline

ISO 21508

- Steps 7 through 11 manage the work of the project to achieve the PMB
- These steps are repeated each month (project update) or as needed



Step 7: Authorise and Perform the Work

- Source of authority clearly defined
- Work planned before authorized
- Work authorized as planned
- Responsibility and measures clearly identified as part of authorization

Step 8: Accumulate & Report Performance Data

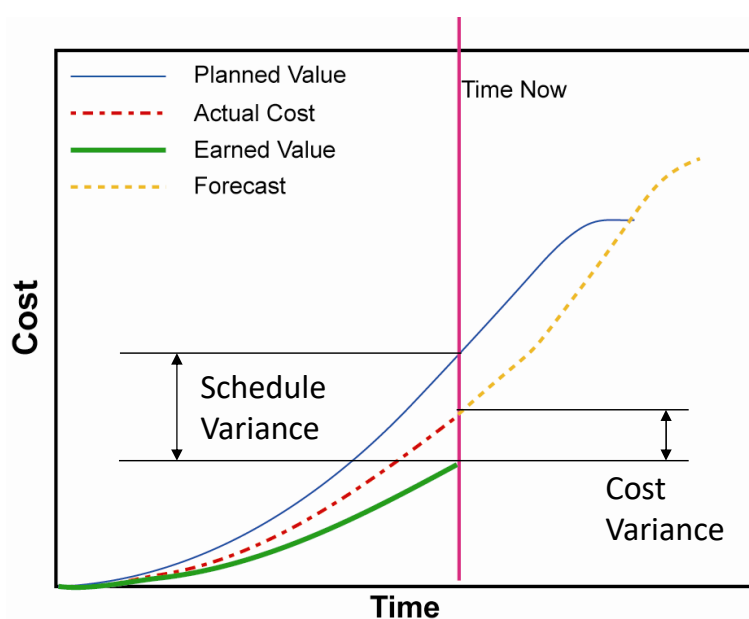
- Data accumulated consistently and periodically
 - Progress measured and accumulated (Earned Value)
 - Actual costs accumulated (including accruals)
 - Schedule performance measured
- Variances compared to the PMB identified
- Responsible manager informed (CAM)

Step 9 – Analyse Project Performance Data

- Schedule progress and forecasts compared with baseline:
 - Earned Value compared with Planned Value
 - Earned Value compared with Actual Costs
- Variance analyzed – corrective actions proposed
- EACs* generated and compared to budget

* Estimate At Completion

Analysing Performance Data



- The two variances offer 9 possible combinations

Analysing Performance Data

Performance Measures		Schedule		
		SV > 0 & SPI > 1.0	SV = 0 & SPI = 1.0	SV < 0 & SPI < 1.0
Cost	CV > 0 & CPI > 1.0	Ahead of Schedule Under Budget	On Schedule Under Budget	Behind Schedule Under Budget
	CV = 0 & CPI = 1.0	Ahead of Schedule On Budget	On Schedule On Budget	Behind Schedule On Budget
	CV < 0 & CPI < 1.0	Ahead of Schedule Over Budget	On Schedule Over Budget	Behind Schedule Over Budget

- The responsible manager needs to explain
 - What caused the variance
 - What is being done about the variance

Analysing Performance Data

- The big picture is not enough:

mosaic Easy EVM Workbook		Sample Rail Bridge EVM										Update Date:	21-Feb-22	ETC:	\$10,867,781.44	EAC:	\$15,059,281.44	VAC:	-\$59,281.44
WP #	WP Description	Baseline Values		Actual This Update						Planned Value	Earned Value	SV	SPI	CV	CPI	Errors			
		Start	End	\$ Budget	Start	End	Account Costs	Actual Costs	AC								%*		
Project totals =		15-Nov-21	15-Sep-22	\$15,000,000.00	15-Nov-21	-	\$3,669,000.00	\$922,500.00	\$4,191,500.00	-	\$4,010,642.33	\$4,175,000.00	\$164,357.67	1.041	-\$16,500.00	0.996			
1.1	Project management and overheads	15-Nov-21	15-Sep-22	\$850,000.00	15-Nov-21		\$266,000.00	\$8,000.00	\$274,000.00	32.00%	\$274,013.16	\$272,000.00	-\$2,013.16	0.993	-\$2,000.00	0.993			
1.2	Site management and services	02-Jan-22	15-Sep-22	\$600,000.00	10-Jan-22		\$82,000.00	\$9,500.00	\$91,500.00	15.00%	\$117,187.50	\$90,000.00	-\$27,187.50	0.768	-\$1,500.00	0.984			
2	Design & Approvals	15-Nov-21	31-Jan-22	\$1,550,000.00	15-Nov-21	20-Jan-22	\$1,558,000.00		\$1,558,000.00	100.00%	\$1,550,000.00	\$1,558,000.00	\$8,000.00	1.000	-\$8,000.00	0.995			
3.1	Site set up	02-Jan-22	31-Jan-22	\$300,000.00	15-Jan-22	10-Feb-22	\$255,000.00	\$60,000.00	\$315,000.00	100.00%	\$300,000.00	\$300,000.00	\$0.00	1.000	-\$15,000.00	0.952			
3.2	Earth works	20-Jan-22	20-Mar-22	\$1,500,000.00	25-Jan-22		\$900,000.00	\$210,000.00	\$1,110,000.00	75.00%	\$813,559.32	\$1,125,000.00	\$311,440.68	1.383	\$15,000.00	1.014			
3.3	Manfr. & Install PC Bridge Deck	02-Jan-22	25-Jul-22	\$3,900,000.00	20-Dec-21		\$600,000.00	\$190,000.00	\$790,000.00	20.00%	\$955,882.35	\$780,000.00	-\$175,882.35	0.816	-\$10,000.00	0.987			
3.4	Concrete piers & walls	01-Mar-22	30-May-22	\$2,900,000.00	15-Feb-22		\$8,000.00	\$45,000.00	\$53,000.00	2.00%		\$58,000.00	\$58,000.00	N/A	\$5,000.00	1.094			
3.5	Embankment works	30-May-22	10-Jul-22	\$1,200,000.00															
3.6	Track works	26-Jul-22	30-Aug-22	\$1,700,000.00															
3.7	Clear Site & Make Good	30-Aug-22	15-Sep-22	\$500,000.00															

We are looking good

For more detail on this project see:

https://mosaicprojects.com.au/Mag_Articles/AA015_Practical_EVM.pdf

Analysing Performance Data

- The big picture is not enough:

mosaic Easy EVM Workbook												Update Date: 21-Feb-22		ETC: \$10,867,781.44	EAC: \$15,059,281.44	VAC: -\$59,281.44	
WP #	WP Description	Baseline Values			Actual This Update				Planned Value	Earned Value	SV	SPI	CV	CPI	Errors		
		Start	End	\$ Budget	Start	End	Account Costs	Accrual Costs								AC	%*
Project totals =		15-Nov-21	15-Sep-22	\$15,000,000.00	15-Nov-21	-	\$3,669,000.00	\$522,500.00	\$4,191,500.00	-	\$4,010,642.33	\$4,175,000.00	\$164,357.67	1.041	-\$16,500.00	0.996	
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We are looking good

Or are we?

For more detail on this project see:

https://mosaicprojects.com.au/Mag_Articles/AA015_Practical_EVM.pdf

Analysing Performance Data

- For each Work Package and Control account:
 - **What's** occurred is easy
 - **Why** is harder
 - **What** can be done about it requires skill
- Focus on what matters!**

Variance Analysis Report									
Project	Bicycle	Report Period	Period-6	Schedule Variance					
Date	February 8, 2010	WBS Element	I.1.1 Braking System	CV	CV%	SV	SV%		
Current Period	\$3,920	EV	\$1,176	AC	\$2,000	(\$824)	-70%	(\$2,744)	-70%
Cumulative	\$3,920	EV	\$1,176	AC	\$2,000	(\$824)	-70%	(\$2,744)	-70%
At Completion	BAC	EAC	VAC						
	\$11,440	\$12,000	(\$560)						
SCHEDULE VARIANCE									
Problem Analysis - Cause									
Several delivered components from one vendor have failed receipt inspection, resulting in approximately \$3,000 of parts associated with the handle lever that were returned to the vendor for modifications. These parts were planned to be delivered by February 25, however they are anticipated to be returned on March 11. It is anticipated that the schedule variance will go to zero at that time.									
Program/Task Impact									
The braking system is on the critical path of the program. Delays in these deliveries may impact all downstream activity including the shifting system, integration, assembly, and test. The anticipated impact to the braking system is a 2-week delay in completion.									
Corrective Action Plan (Include Expected Recovery Date)									
The braking system team is working with the project manager and other component teams on a mitigation plan to recover some of the 2-week delay. Specifically, some component tests and product tests may begin without the braking system. In addition, we are working with the shifting system team to assess if activities can be performed simultaneously rather than serially as planned. Anticipate completion of the braking system by March 11, and program impact is still being managed and assessed.									
COST VARIANCE									
Problem Analysis - Cause									
\$560 of the cost variance is due to a higher than anticipated cost associated with the brake calipers and pads. The remaining \$264 is labor associated with managing early receipt of wiring components.									
Program/Task Impact									
The \$560 pad and caliper overrun cannot be mitigated and is included in the braking system EAC. No impact projected for the labor variance.									
Corrective Action Plan (Include Expected Recovery Date)									
The \$264 of labor variance is level of effort activity performed earlier than anticipated. Since the associated wiring components have arrived early, these LOE activities will not have to be performed when anticipated in late February, and the \$264 variance will go to zero at that time.									
Impact to Estimate At Completion (EAC)									
Purchase orders released to vendors for braking system parts, primarily the pads and calipers, were negotiated \$560 higher than budgeted. Cost impacts associated with part inspection failures are still being evaluated, but a potential \$1,500 - \$2,000 EAC impact is possible.									

Analysing Performance Data

- For each Work Package and Control account:

- What is easy

- What

The trend is your friend

... about

... requires skill

- **Focus on what matters!**

Variance Analysis Report					
Project	Bicycle		Report Period	Period-6	
Date	February 8, 2010		WBS Element	1.4.1 Braking System	
	PV	EV	AC	Cost Variance	% Variance
Current Period	\$3,920	\$1,176			-70%
Cumulative	\$3,920				-70%
At Completion					

... to be delivered by ... schedule variance will go to zero

... program. Delays in these deliveries may impact all downstream activity including ... The anticipated impact to the braking system is a 2-week delay in completion.

... Plan (Include Expected Recovery Date)

... braking system team is working with the project manager and other component teams on a mitigation plan to recover some of the 2-week delay. Specifically, some component tests and product tests may begin without the braking system. In addition, we are working with the shifting system team to assess if activities can be performed simultaneously rather than serially as planned. Anticipate completion of the braking system by March 11, and program impact is still being managed and assessed.

COST VARIANCE

Problem Analysis - Cause
\$560 of the cost variance is due to a higher than anticipated cost associated with the brake calipers and pads. The remaining \$264 is labor associated with managing early receipt of wiring components.

Program/Task Impact
The \$560 pad and caliper overrun cannot be mitigated and is included in the braking system EAC. No impact projected for the labor variance.

Corrective Action Plan (Include Expected Recovery Date)
The \$264 of labor variance is level of effort activity performed earlier than anticipated. Since the associated wiring components have arrived early, these LOE activities will not have to be performed when anticipated in late February, and the \$264 variance will go to zero at that time.

Impact to Estimate At Completion (EAC)
Purchase orders released to vendors for braking system parts, primarily the pads and calipers, were negotiated \$560 higher than budgeted. Cost impacts associated with part inspection failures are still being evaluated, but a potential \$1,500 - \$2,000 EAC impact is possible.

Step 10 – Management Action

- Corrective actions developed & implemented
- Preventative actions developed & implemented
- Forecasts may be revised based on actions
- No retroactive changes to performance data
- Corrective & preventative actions monitored for effectiveness

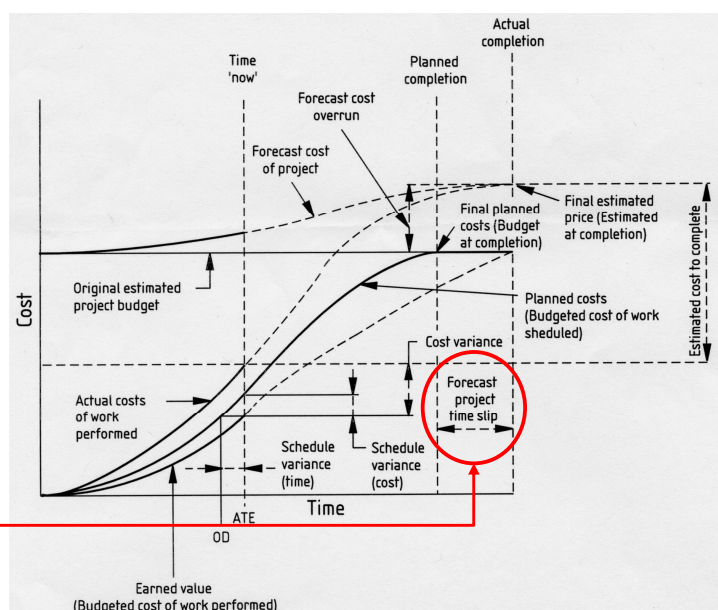
Step 11 – Maintain the Baseline

- Baseline changes are authorized, controlled, and approved
 - changes to scope, schedule, budget baselines
- Changes are documented and traceable
- No retroactive changes to plan

It's All In The Numbers

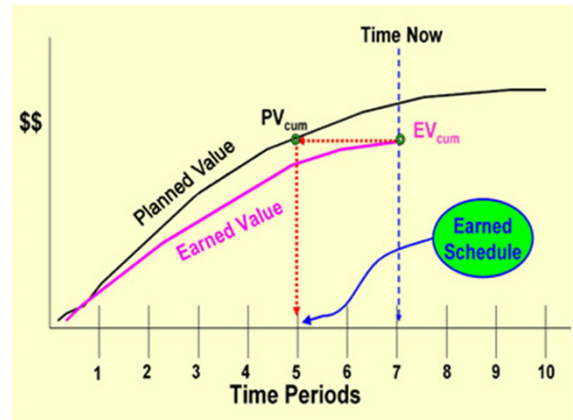
- The complete picture is needed for effective governance and control

Traditional EVM cannot predict time slippage



Earned Schedule

- Earned Schedule predicts time outcomes based on performance
- As accurate as EV
- Uses the same data as EV
- Is freely available from:
<http://www.earnedschedule.com>



Uncertainty / Risk

- There is no such thing as a 'risk free project'
- Every estimate is uncertain
- Every process has a degree of variability
- **Successful projects manage risk and uncertainty**



Uncertainty / Risk

- Profit margin creates organizational resilience
- Management reserves are held outside of the PMB for unforeseen issues
- Contingencies are calculated for identified risks and managed within the PMB

Reporting Options

**Data is not information,
information is not knowledge,
knowledge is not understanding,
understanding is not wisdom.**

Clifford Stoll

Effective reporting gets you to 'information' and helps with 'understanding'

Reporting Options

- Elegant report development is a art!
- KISS - Less is better
- Consistency is critical
- For more on communication see:
<https://mosaicprojects.com.au/PMKI-PBK-040.php>

Reporting Options

Which map is more useful
If you are looking for the Dojo



Summary

- Everyone can tell a project is late after it finishes late
- Ditto cost overruns
- Generally time issues manifest before cost issues (SV or schedule)



3½ years late, £4 Billion over budget
Reporting on-time and-on budget 4 months
before original opening date ☹️

Summary

- Project control systems focus on finding problems early
 - But human nature wants to avoid problems
- Management is responsible for making sure they are fixed
- This requires a rigorous controls system



Summary

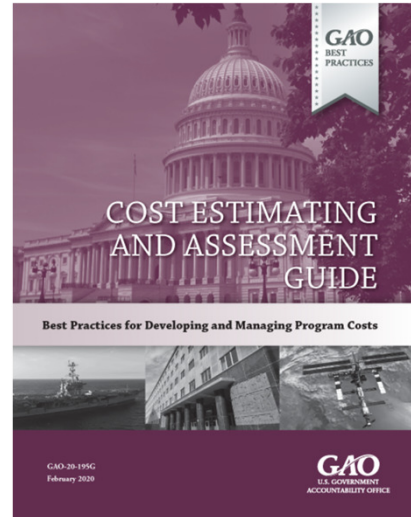
- EVM cannot 'control the future'
- **Neither can contracts**
(but this does not stop lawyers trying)
- The EVMS need to be designed:
 - To optimise the method of working and coordinate the work of the teams
 - As an effective communication tool!

Summary

- The organisations governance system is responsible for:
 - Requiring management to establish and fund a robust project controls system
 - Ensuring management are skilled in the use of controls information
 - Requiring accurate project performance information

Invaluable Resources

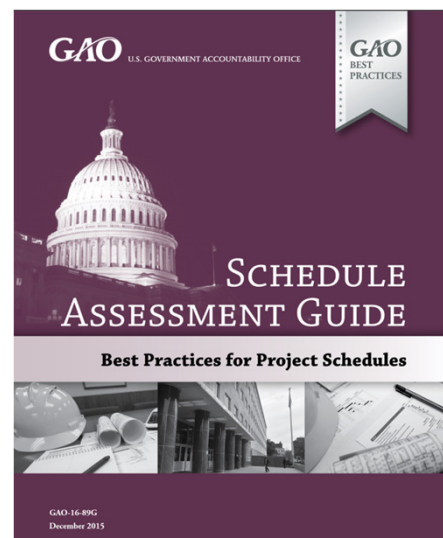
- **GAO COST ESTIMATING AND ASSESSMENT GUIDE**
GAO-20-195G
Published: March, 2020



Free to download & use

Invaluable Resources

- **GAO SCHEDULE ASSESSMENT GUIDE: Best Practices for Project Schedules**
GAO-16-89G
Published: Dec 22, 2015



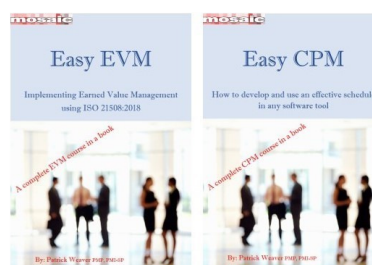
Free to download & use

Invaluable Resources

- ISO 21508: Earned value management in project and programme management
 - Australian adoption pending
 - Modified to include normative appendix
- ISO 21511: Work breakdown structures for project and programme management

Invaluable Resources

- Mosaic EVM links:
<https://mosaicprojects.com.au/PMKI-SCH-040.php>
- Mosaic Scheduling links:
<https://mosaicprojects.com.au/PMKI-SCH-010.php>



Conclusions

- EVM provides the framework for an effective project management and governance system
- It is flexible in the **how** of its structure and implementation (work packages)
- It is rigorous in the **what** of measurement, visibility and accountability
- **Predicts cost outcomes accurately**

Conclusions

- CPM* is good for motivation and direction
 - Assumes future work will go as planned
- Monte Carlo can calculate contingencies
- Earned Schedule can predict likely schedule outcomes based on performance
 - But cannot be used as a 'control' tool

*Critical Path Method schedule

Conclusions

- All four are needed for a full understanding of the current situation
 - Monte Carlo to understand uncertainty
 - CPM to direct and plan use of resources
 - EVM (cost) to predict and manage cost outcomes
 - ES to predict time outcomes

mosaic

Governing and Leading Projects using Earned Value Management (EVM)



Questions??



patw@mosaicprojects.com.au

<https://mosaicprojects.com.au/PMKI-SCH.php>