

Quantitative Risk Analysis: Earned Value Management

An Example

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Presentation Summary

- A step-by-step walk-through of the Earned Value Management process
- Discuss what is required to support the implementation of Earned Value Management in an organization

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Features - 3 Variables

- PV - Planned Value
 - The value of the work that we plan to do
- EV - Earned Value
 - The value of the work that we have actually performed
- AC - Actual Cost
 - The actual cost of the resources that were required to undertake the work and, if the work package is complete, complete the work

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The 3 Variables

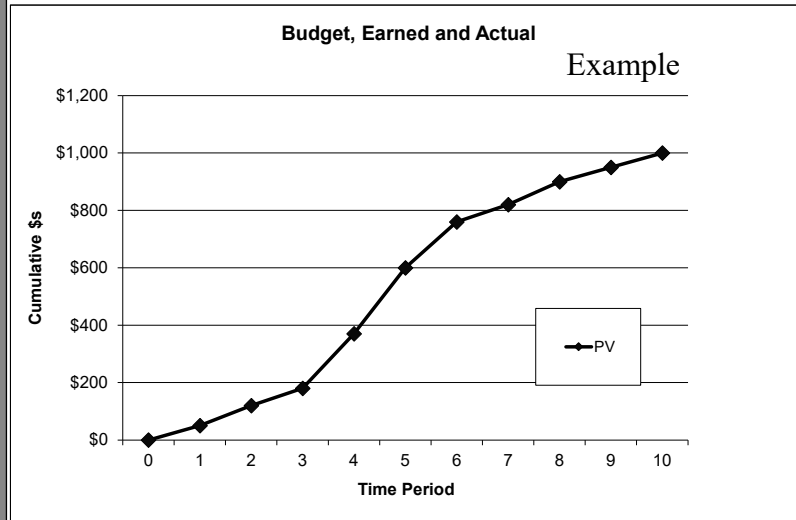
- PV
 - Planned Value
 - The value of the work that we plan to do
 - Requires that we have:
 - Defined the scope of the work packages
 - Determined the resources required to do the work
 - Estimated the cost of those resources
 - Developed the critical path and project schedule
 - Established the budget baseline
 - Formerly called the "Budgeted Cost of the Work Scheduled" (BCWS)

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PV – Planned Value



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The 3 Variables

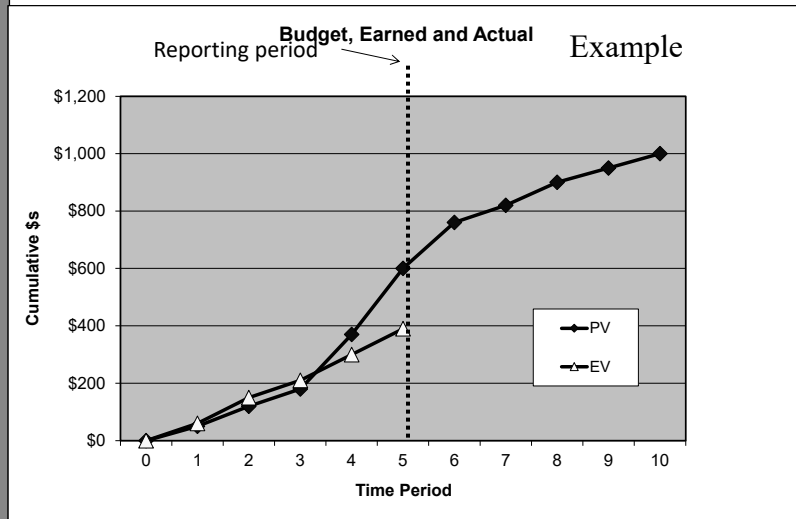
- EV
 - Earned Value
 - The value of the work that we have actually performed
 - Requires that we have:
 - Know how much of the work of a work package has been performed and is that work completed
 - Know what work of a work package remains to be completed
 - How long uncompleted work of the package will take to complete
 - Formerly called the "Budgeted Cost of the Work Performed" (BCWP)

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EV – Earned Value



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The 3 Variables

- AC
 - Actual Cost
 - The actual cost of the resources that were required to undertake the work and, if the work package is complete, complete the work.
 - Requires that we have:
 - Know the cost of the resources that expended effort in doing the work and the cost of purchased goods and services required to complete the work
 - Formerly called the "Actual Cost of the Work Performed" (ACWP)

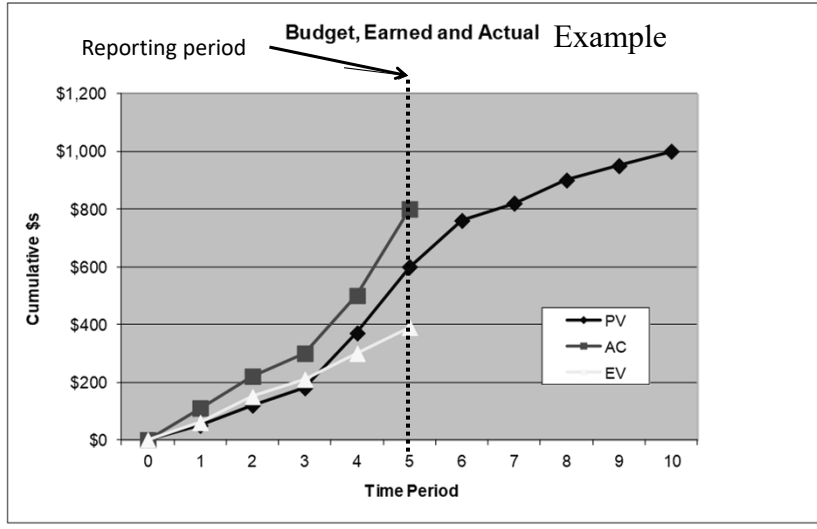
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Quantitative Risk Assessment: EVM

EAC – Actual Cost



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Quantitative Risk Assessment: EVM

Performance Information Gathering and Processing System

- Project Information Management System
 - Work package-based performance reporting system
 - Timely Information gathering, processing and reporting
 - Requires the discipline of all project resources to log their work routinely

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Calculating EV

- EV
 - Combination of work done, work remaining and judgment of whether work performance (outcome) is/has achieved expectations (quality)

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Calculating EV Specific Deliverable:

1. PV:
 - \$10,000
 - 10 weeks
 - 10 widgets
2. Progress:
 - 4 widgets
 - 5 weeks
3. $EV = 4 \text{ widgets} * \$1,000 \text{ per widget} = \$4,000$

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Calculating EV Percentage Complete:

- Ask those doing the work for the % of completion
 - Not accurate: estimate usually larger than actual
- Progressively more difficult to estimate completion as end of task approaches
- Last 20 % of activity takes 80% of the time
- Example:
 - 75% completed widgets
 - $EV = 75\% * \$10,000 = \$7,500$

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Calculating EV 0 – 100% Rule

- Task is either 0 or 100% complete
- Easy accounting
- Difficult to judge progress until total completion of task
- Alleviates the 20%/80% rule
- Example:
 - 4 widgets of 10 completed
 - $EV = 0\% * \$10,000 = \0

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Calculating EV 50-50% Rule

- At beginning of task, 50% of the work deemed complete
- At completion of task, remaining 50% deemed completed
- Does not give indication of progress
- Example:
 - 1 widgets of 10 completed
 - $EV = 50\% * \$10,000 = \$5,000$

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Calculating EV Time Remaining

- Ask those performing work how much time remains to complete the task
- Subtract from baseline amount
- $EV = (1 - \text{Remaining}/(\text{Remaining} + AC))$

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Calculating EV – Time Remaining

- Example:

- PV = \$5,000

- Widget task = 50 man-hours @ \$100/hr.

- AC = \$3,000

- 25 man-hours remaining

- EV = $(1 - (\$2,500 / (\$2,500 + \$3,000))) * \$5,000$
= $(1 - 0.45) * \$5,000$
= \$2,750

The Variances

- SV

- Schedule Variance

- The difference between the PV and the EV

- $EV - PV = SV$

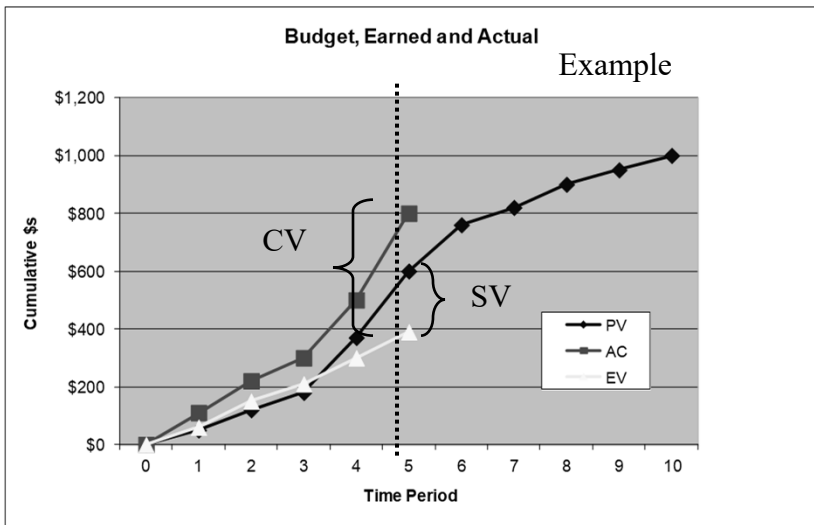
- CV

- Cost Variance

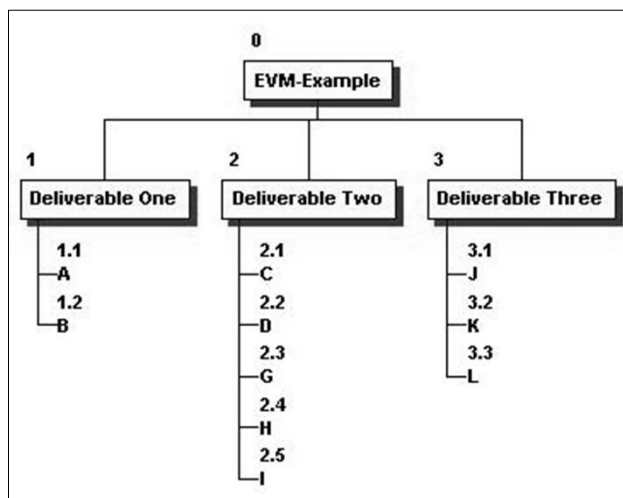
- The Difference between the PN and the AC

- $EV - AC = CV$

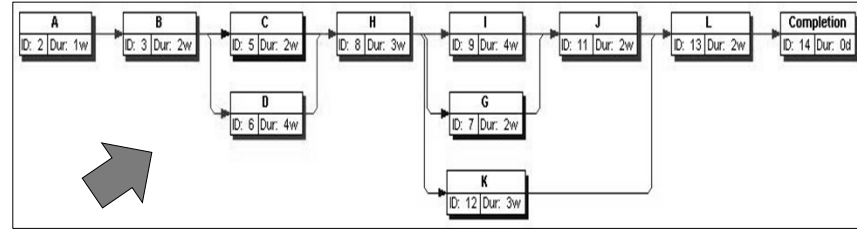
PV and CV



The Work Breakdown Structure



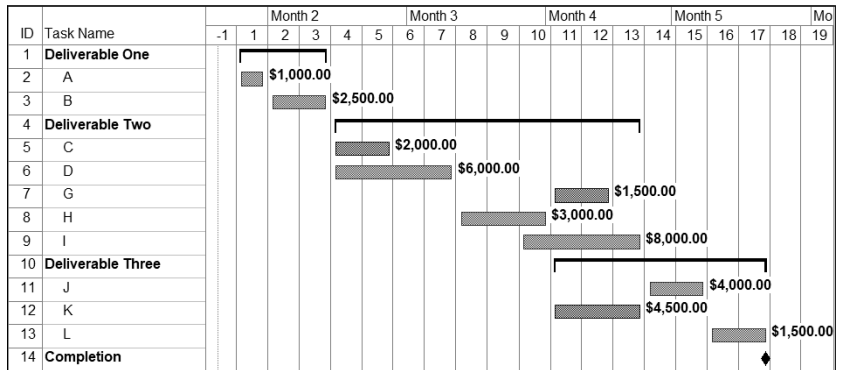
The Critical Path



Estimating Resource Costs

Earned Value Management Example		WBS and Cost Estimation										Total Work Package Cost
WBS	Package Name	Department 'Q' Resources			Department 'R' Resources			Department 'S' Resources			Purchased Goods and Services	
		Q1	Q2	Q3	R1	R2	R3	S1	S2	S3		
Deliverable One												
1.1	Package A	250	350				250				150	1000
1.2	Package B		800	700						1000		2500
Deliverable Two												
2.1	Package C	1000		1000								2000
2.2	Package D			1000	2000		1000	1000			1000	6000
2.3	Package G			1000		500	250		250			2000
2.4	Package H				500		3000	500	2000			6000
2.5	Package I						2000	3000	1000		2000	8000
Deliverable Three												
3.1	Package J								2000	2000		4000
3.2	Package K	1000							1500	2000		4500
3.3	Package L									750	750	1500
Total Resource Cost		2250	1150	3700	2500	750	6250	4500	6750	5750	3900	37500

The Gantt Chart

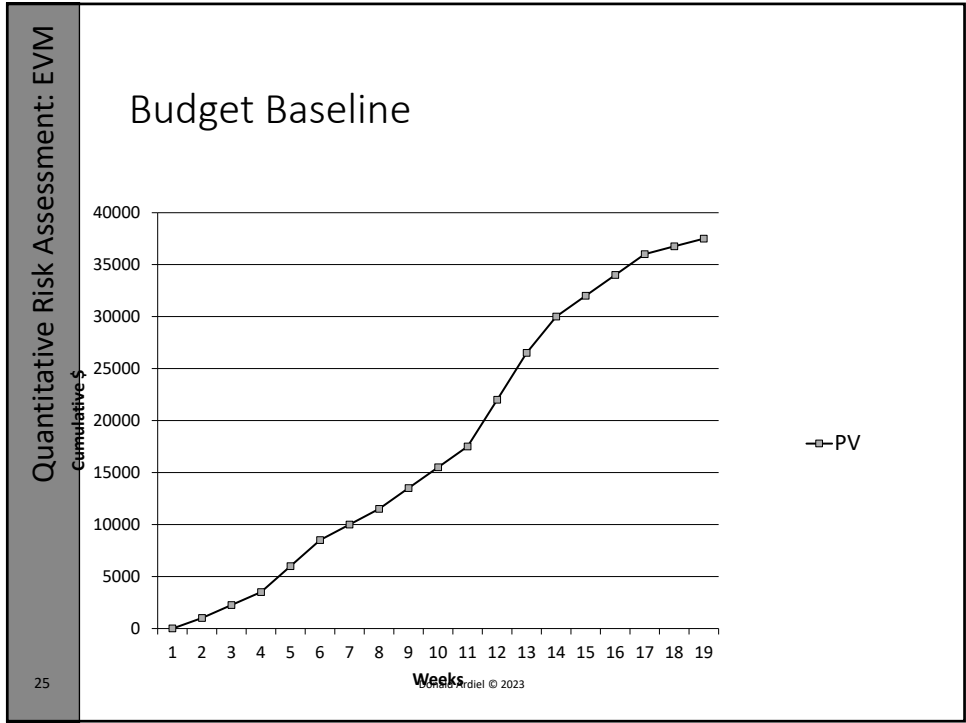


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The Planned Value

Task	Weeks																		Estimated Work Package Cost
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
A	1000																		1000
B		1250	1250																2500
C				1000	1000														2000
D				1500	1500	1500	1500												6000
G										1000	1000								2000
H								2000	2000	2000									6000
I										2000	2000	2000	2000						8000
J														2000	2000				4000
K										1500	1500	1500							4500
L																	750	750	1500
PV per week	1000	1250	1250	2500	2500	1500	1500	2000	2000	2000	4500	4500	3500	2000	2000	2000	750	750	37500
PV	1000	2250	3500	6000	8500	10000	11500	13500	15500	17500	22000	26500	30000	32000	34000	36000	36750	37500	

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9th week Reporting Period

Task		Weeks																		Work Package PV	Work Package AC	Work Package EV	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18				
A	PV	1000																		1000		1200	
	AC	1200																					
	EV	1000																				1000	
B	PV		1250	1250																	2500		
	AC		1000	1300																		2300	
	EV		1250	1250																		2500	
C	PV				1000	1000															2000		
	AC				850	1150																2100	
	EV				1000	1000																2000	
D	PV				1500	1500	1500	1500													6000		
	AC				1450	3000	3500	3500														7950	
	EV				2000	2000	2000	2000														6000	
G	PV									1000	1000										2000		
	AC																					0	
	EV																					0	
H	PV							2000	2000	2000											6000		
	AC							2500	2500	2200												7200	
	EV							2000	2000	2000												6000	
I	PV										2000	2000	2000	2000							8000		
	AC																					0	
	EV																					0	
J	PV														2000	2000					4000		
	AC																					0	
	EV																					0	
K	PV										1500	1500	1500								4500		
	AC																					0	
	EV																					0	
L	PV																750	750				1500	
	AC																						0
	EV																						0
PV per week		1000	1250	1250	2500	2500	1500	1500	2000	2000	4500	4500	3500	2000	2000	2000	750	750			37500	20750	17500
PV		1000	2250	3500	6000	8500	10000	11500	15000	15000	20000	20000	25000	30000	32000	34000	36000	36750	37500				
AC per week		1200	1000	1300	2300	4250	3500	2500	500	2200													
AC		1200	2200	3500	5800	10050	13550	16050	14550	20750													
EV per week		1000	1250	1250	3000	3000	2000	2000	3000	2000	4500	4500	3500	2000	2000	2000	750	750					
EV		1000	2250	3500	6500	9500	11500	13500	15500	17500													

"Snap shot" date

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Variances – At Week 9

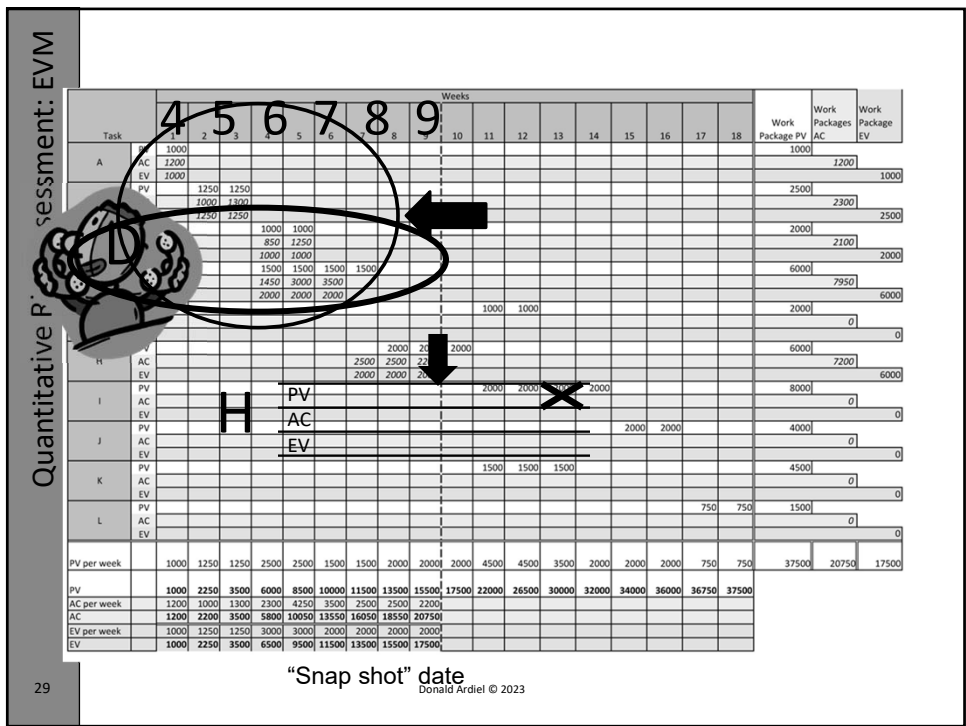
- PV = 15,500
- AC = 20,750
- EV = 17,500

- Schedule Variance = $EV - PV$
= $17,500 - 15,500$
= $\$2,000$

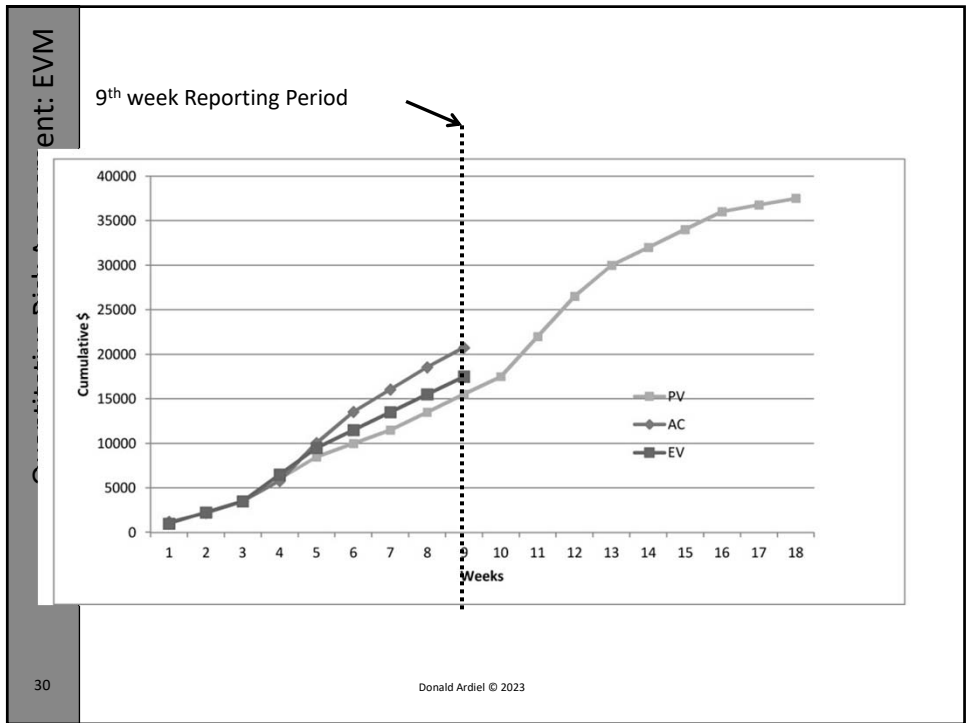
Variances – At Week 9

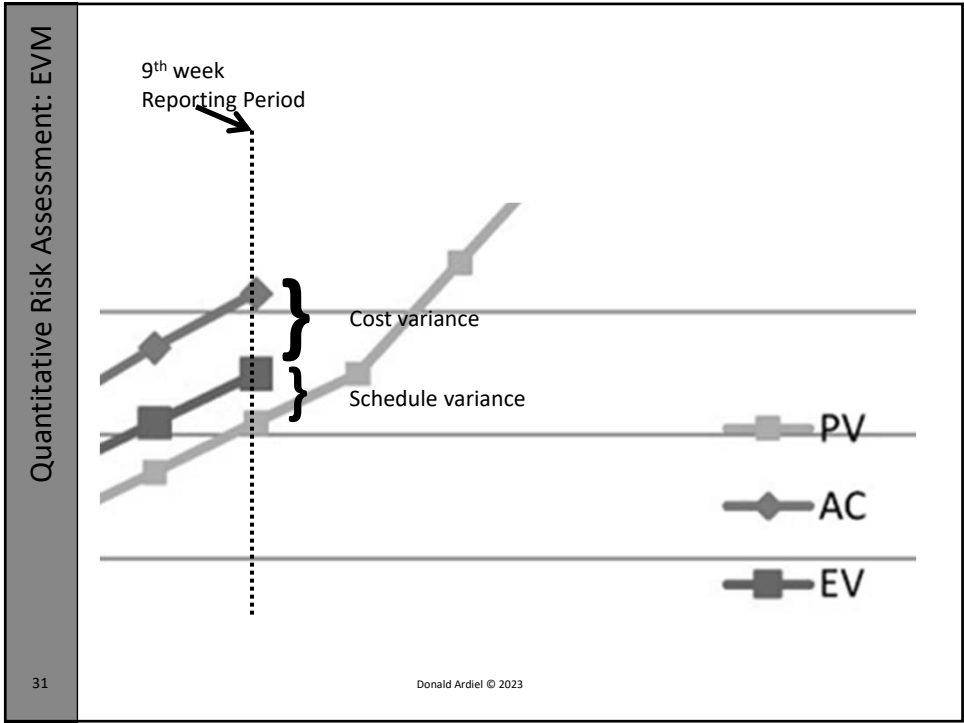
- PV = 15,500
- AC = 20,750
- EV = 17,500

- Cost Variance = $EV - AC$
= $17,500 - 20,750$
= $-\$3,250$

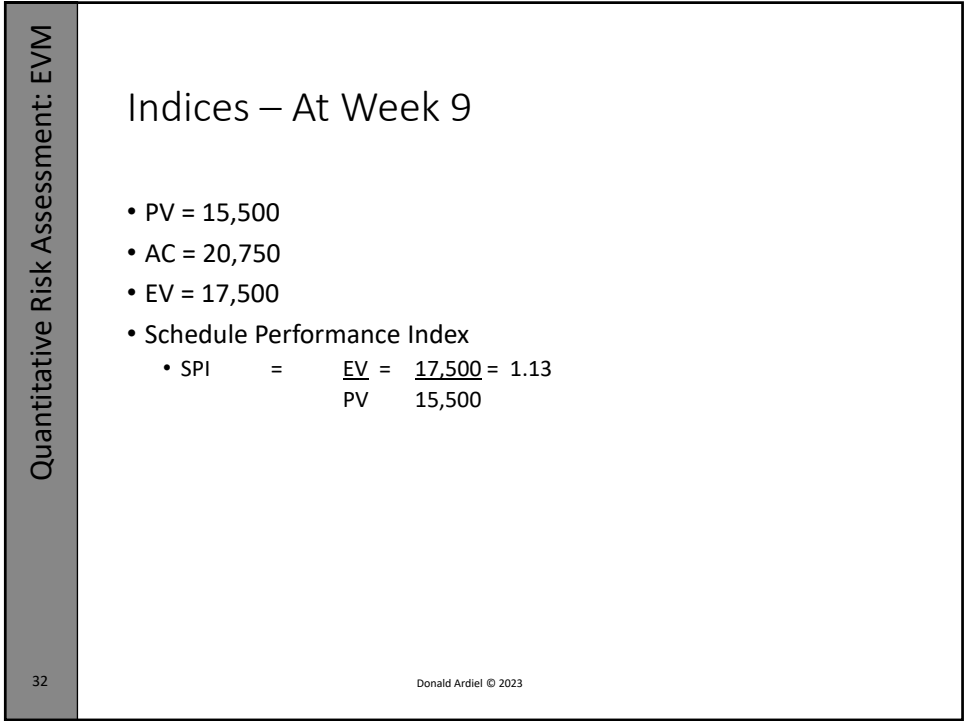


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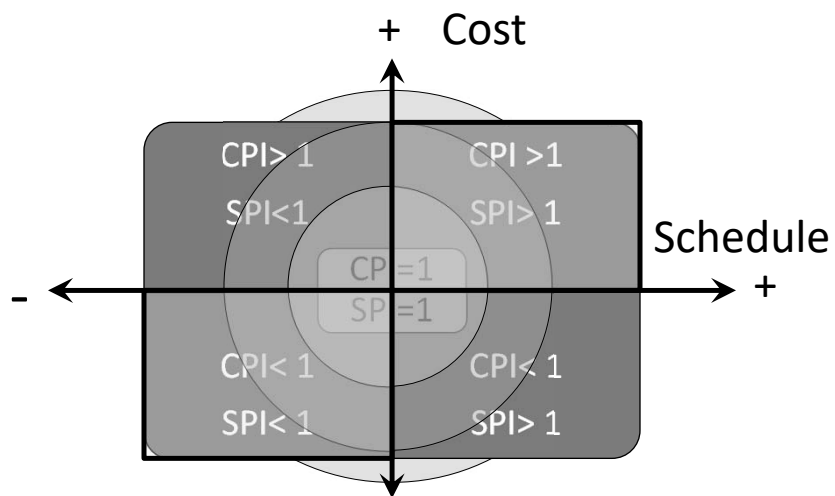


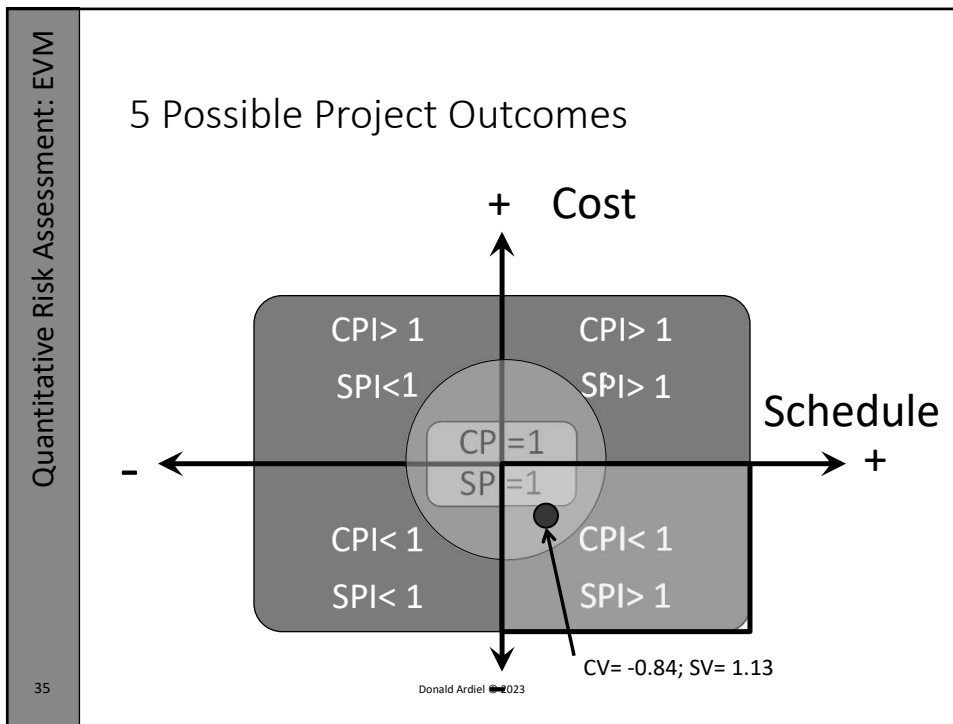
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Indices – At Week 9

- PV = 15,500
- AC = 20,750
- EV = 17,500
- Cost Performance Index
 - $CPI = \frac{EV}{AC} = \frac{17,500}{20,750} = 0.84$

5 Possible Project Outcomes





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Quantitative Risk Assessment: EVM

Future Cost Calculations

- Takes the cost up to now and applies a performance factor (PF) against remaining budgeted work
- Assumes performance remains constant

$$EAC = AC + (BAC - EV) / PF$$

EAC – Estimated at completion
 ETC – Estimated to Complete
 BAC – Budgeted at completion – the cumulative PV
 PF – Performance factor

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Future Cost Calculations

- The PF may be any of the following:
 - cumulative CPI
 - Most recent 6 month CPI
 - cumulative SPI
 - Most recent 6 month SPI
 - $(0.2 * SPI + 0.8 * CPI)$
 - Other combination

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Constant Cost Efficiency: Cost

- ETC = $(BAC - EV) / CPI$
= $(37,500 - 17,500) / 0.84$
= \$23,810
- EAC = ETC + AC
= 23,810 + 20,750
= \$44,560

- Estimated to Complete = ETC

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Constant Cost Efficiency: Schedule

- $ETC = (BAC - EV) / SPI$
 $= (37,500 - 17,500) / 1.13$
 $= \$17,700$
- $EAC = ETC + AC$
 $= 17,700 + 20,750$
 $= \$38,450$

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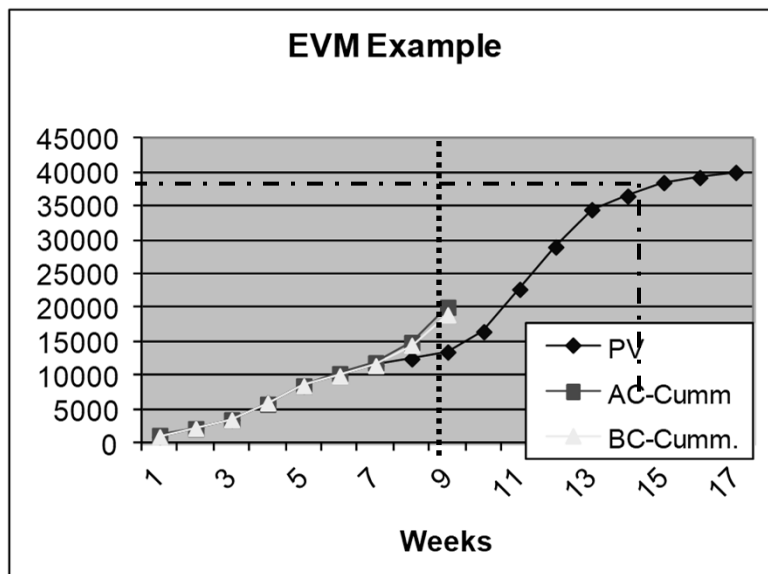
Constant Cost Efficiency: Schedule

- This suggests that the project will finish slightly over budget ~ \$1,000 and 2 ½ weeks ahead of schedule.

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Constant Cost Efficiency

- Future Cost Calculation:
 - performance factor = $(0.2 * SPI + 0.8 * CPI)$
 - $EAC = AC + (BAC - EV) / (0.2 SPI + 0.8 CPI)$

$$= 20,750 + (37,500 - 17,500) / (0.23 + 0.67)$$

$$= 20,750 + (20,000 / 0.9)$$

$$= 20,750 + 22,220$$

$$= 42,970$$
- Original budget: \$37,500
- Projected cost overrun: \$5,470
- The project is project to finish 2 weeks ahead of schedule.

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EVM and Project Decision Support

Reduce Costs – Lengthen project

- Identify tasks in the critical path where experienced and more expensive resources could be replaced with less expensive juniors



Maintain current schedule – accept costs

- Stay the course and accept the additional costs

RISK

Higher



Lower

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Presentation Summary

- A step-by-step walk-through of the Earned Value Management process
- Discuss what is required to support the implementation of Earned Value Management in an organization

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