


Software Engineering Economics (CS656)

Earned Value Management System

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SINCE 1971


What is EVMS?

“A project management technique for estimating how a project is doing in terms of its budget and schedule.”
- <http://en.wikipedia.org>

“An integrated management control system for assessing, understanding and quantifying what a contractor or field activity is achieving with program dollars”

- Integrates technical, cost, schedule, with risk management
- Allows objective assessment and quantification of current project performance
- Helps predict future performance based on trends.

- <http://evm.nasa.gov>



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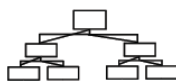
Standard Data Elements of EVMS

- Relate time-phased budgets to contract tasks
- Integrate cost, schedule, and technical performance
- Indicate work progress objectively
- Are valid, timely and auditable
- Are from the internal system the contractor uses to manage
- Are at a practical level of summarization

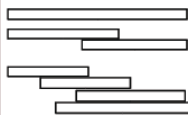
Establish the Performance Measurement Baseline

- An Iterative 3-Step Process

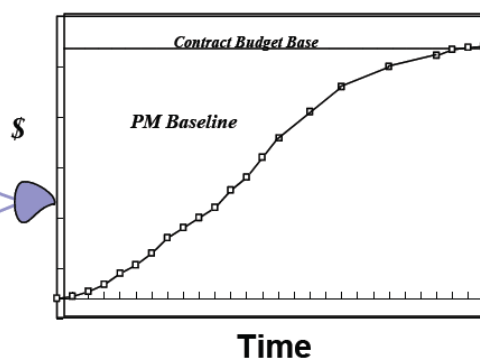
1. Define the Work



2. Schedule the Work



3. Allocate Budgets



Management Systems w/o Earned Value

In these systems, you budget work and then record actual expenditures.

Example: I budgeted 5 widgets at 100hrs per widget.
At the end of the month 400 hrs had been expended.

Budget (BCWS)	vs	Actual (ACWP)	Variance (difference)
500		400	100

GREAT! I'm 100hrs
under budget!

But what does this mean? Is this really the true status of work? What did I accomplish?

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Earned Value Myths

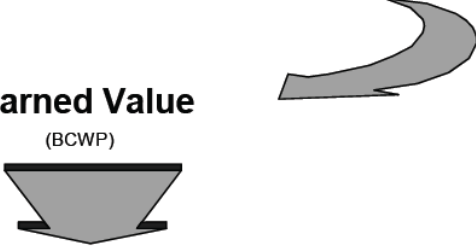
- Actual Cost is not an Indication of Work Progress, But Only an Indicator of Hours/Money Spent

Well, I've spent 400 hrs,
Does that mean I've
accomplished 400 hrs
of Work?

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Earned Value Management

Earned Value adds a new dimension to traditional budget vs actual tracking



Earned Value
(BCWP)


Budget (BCWS)	vs	Actual (ACWP)	Variance
500		400	100

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Management Using Earned Value

Earned Value - an objective measure of how much work has been accomplished

Example: I plan to build 5 widgets this month. Each widget should take 100hrs.
I will measure Earned Value based on # widgets completed




<u>Budget Plan</u>	<u>Earned Value</u>	<u>Actual</u>
500	300 (3 Widgets * 100 hrs)	400

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Earned Value

An *Objective* Measure of how much Work has been Accomplished based on the Planned Value.....




What we got for what we Spent!

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Using Earned Value

<u>Budget Plan</u> 500hrs		<u>Earned Value</u> 300hrs		<u>Actual</u> 400hrs
	Schedule Variance (200)		Cost Variance (100)	



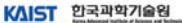
Oh boy! I better figure out what is going on. I've got 200hrs worth of work to catch up on, and I've already overspent by 100 hrs.

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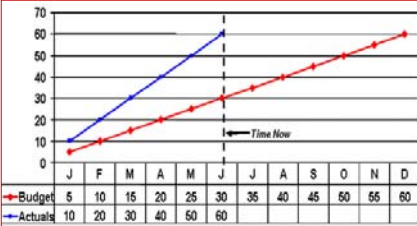
Use the Data for Decision Making

- Behind Schedule
 - How critical is schedule?
 - Can I afford to work overtime to recover?
 - Can I do tasks concurrently?
 - Are there technical innovations which could speed up the process?
 - Am I driving to over spec?
- Over Cost
 - Can I reschedule tasks? (Time-phasing)
 - Is there a less costly facility I can use?
 - Are there tasks which can be deleted?

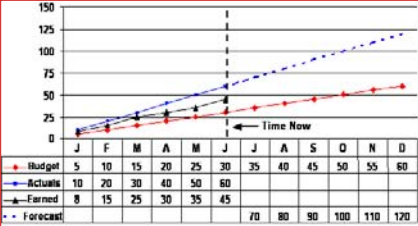

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Traditional Mgmt. vs. Earned Value Mgmt.

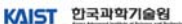
Traditional Mgmt.	Earned Value Mgmt.
- Two data sources, the budget (or planned) expenditures and the actual expenditures - No way to determine the physical amount of work performed	- Three data sources, the budget (or planned) value of work scheduled, the actual value of work completed, and the "earned value" of the physical work completed - Able to compare the budgeted value of work scheduled and compare it to the "earned value of physical work completed" and the actual value of work completed



	J	F	M	A	M	J	J	A	S	O	N	D
Budget	5	10	15	20	25	30	35	40	45	50	55	60
Actuals	10	20	30	40	50	60						



	J	F	M	A	M	J	J	A	S	O	N	D
Budget	5	10	15	20	25	30	35	40	45	50	55	60
Actuals	10	20	30	40	50	60						
Earned	8	15	25	30	35	45						
Forecast						70	80	90	100	110	120	


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EVMS Criteria

- Five Categories of 32 criteria for developing an EVMS (DoD 5000.2-R)
 - compliant with the ANSI/EIA Standard 748-98
- Organization
- Planning and Budgeting
- Accounting
- Analysis and Management Reporting
- Revisions and Data Maintenance

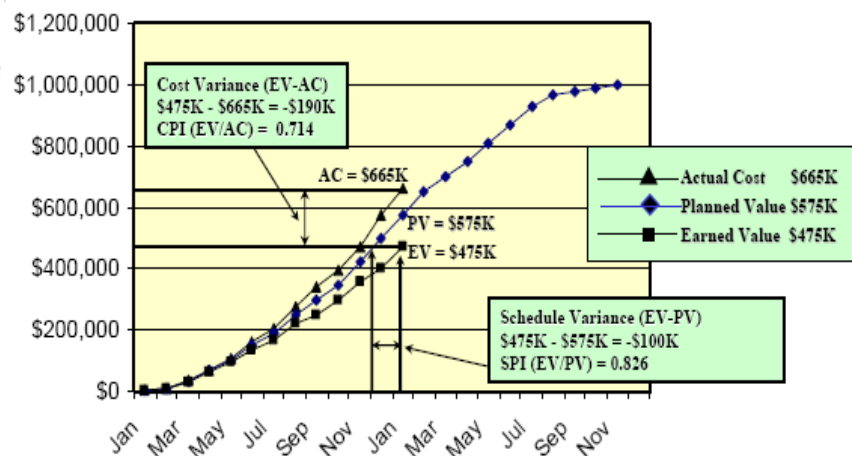
Three Basic Values

- Budgeted Cost of Work Performed (*BCWP* or *Earned Value*)
 - Cost originally budgeted to accomplish the work that has been completed as of the analysis date
- Budgeted Cost of Work Scheduled (*BCWS* or *Planned Value*)
 - Total budgeted cost up to the analysis date
- Actual Cost of Work Performed (*ACWP* or *Actual Cost*)
 - Cost to accomplish the work completed as the analysis date

Derived Metrics for EVA

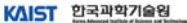
- **Schedule Variance (SV) = BCWP – BCWS**
 - If $SV = 0$: right on schedule; <0 : behind schedule; >0 : ahead of schedule
 - Schedule Performance Index (**SPI**)
 - If $SPI = 1$: right on schedule; <1 : behind schedule; >1 : ahead of schedule
- **Cost Variance (CV) = BCWP – ACWP**
 - If $CV = 0$: right on budget; <0 : over budget; >0 : under budget
 - Cost Performance Index (**CPI**)
 - If $CPI = 1$: right on budget; <1 : over budget; >1 : under budget

Example: Where You Are??

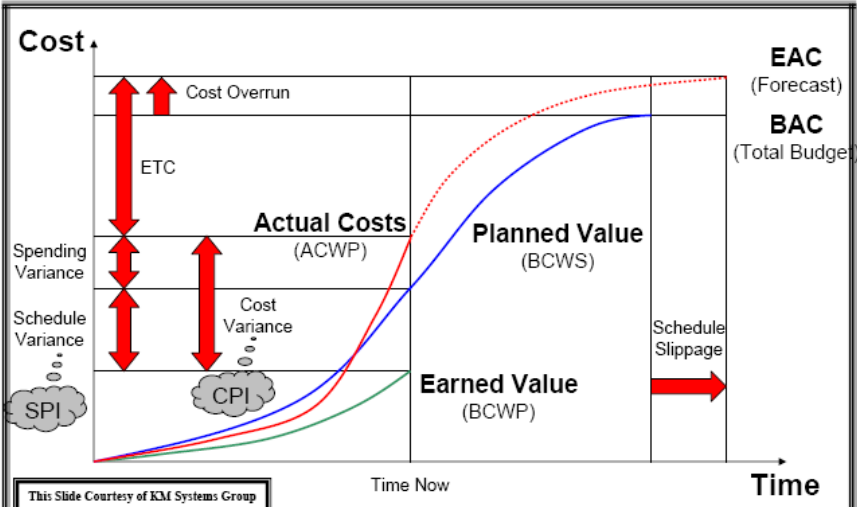


Additional Metrics in Forecasting

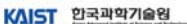
- **Budget At Completion (BAC)**
 - Total original budgeted cost
 - The same as BCWS at completion
- **Estimate At Completion (EAC)**
 - Estimate of the amount of money you will spend on the project, Based on your judgement
- **Independent Estimate At Completion (IEAC)**
 - Projected final cost of the project, based on performance so far: Can be forecast: $IEAC = BAC / CPI$
- **Independent Schedule At Completion (ISAC)**
 - Projected duration of the project, based on performance so far: Can be forecast: $ISAC = Schedule / SPI$
- **Variance At Completion (VAC)**
 - Forecast of final cost variance
 - $VAC = BAC - IEAC$


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EVMS Result



This slide Courtesy of KM Systems Group


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Can We Catch Up?? - I


- Suppose that our project is behind schedule or over budget
- *“To-Complete” Performance Index (TCPI)*
 - An indication of how we must perform for the duration of the project in order to meet our desired cost goal
 - $TCPI = (\text{Budget} - BCWP) / (EAC - ACWP)$
 - If $EAC = IEAC$, then $TCPI = CPI$
 - If $TCPI > 1$, we must perform better than planned
 - If $TCPI < 1$, we can get by with performing under our plan

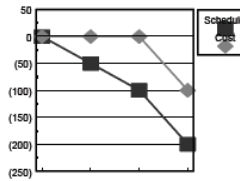
Can We Catch Up?? - II

- *“To-Complete” Schedule Performance Index (TSPI)*
- *Can we complete project as planned?*
 - $TSPI = \text{Plan Remaining} / \text{Time Remaining}$
 $= (PD - ES) / (PD - AT)$
 - Where $(PE - ES) = PDWR$ (Planned Duration for Work Remaining)
 - If $TSPI \leq 1$; Achievable
 - If $TSPI > 1.1$; Not Achievable

Benefits of using Earned Value

Detail planning at levels where work is performed allows management attention to be directed to areas where significant problems are indicated





Item	Value
Cost Account	
Cost Variance	(100)
Schedule Variance	(200)

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Q & A



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