

Japan Advanced Institute of Science and Technology

Earned Value Management System (EVMS)  
or Earned Value Management Analysis  
in Brief

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# NOTICE

*The contents of this presentation are a summary of the online tutorial published by the Department of Energy of the United States of America*

<http://management.energy.gov/1066.htm>

# EVMS: What is it?

- It is an industry standard method that measures the *progress* of a project at any given point in time, allowing to determine *true cost* and *schedule variance* between *plan* and material *work accomplished* of the project at any time.
- What it does basically is to compare the planned amount of work to what has actually been completed.
  - First, some part of the budget is assigned to the different tasks of the project,
  - then, as the work is completed, part of its assigned budget is considered "earned".

- **Inputs**

1. **Work Breakdown Structure (WBS)**
2. **Organizational Breakdown Structure (OBS)**
3. **Schedule**
4. **Time-phased Baseline Budget**

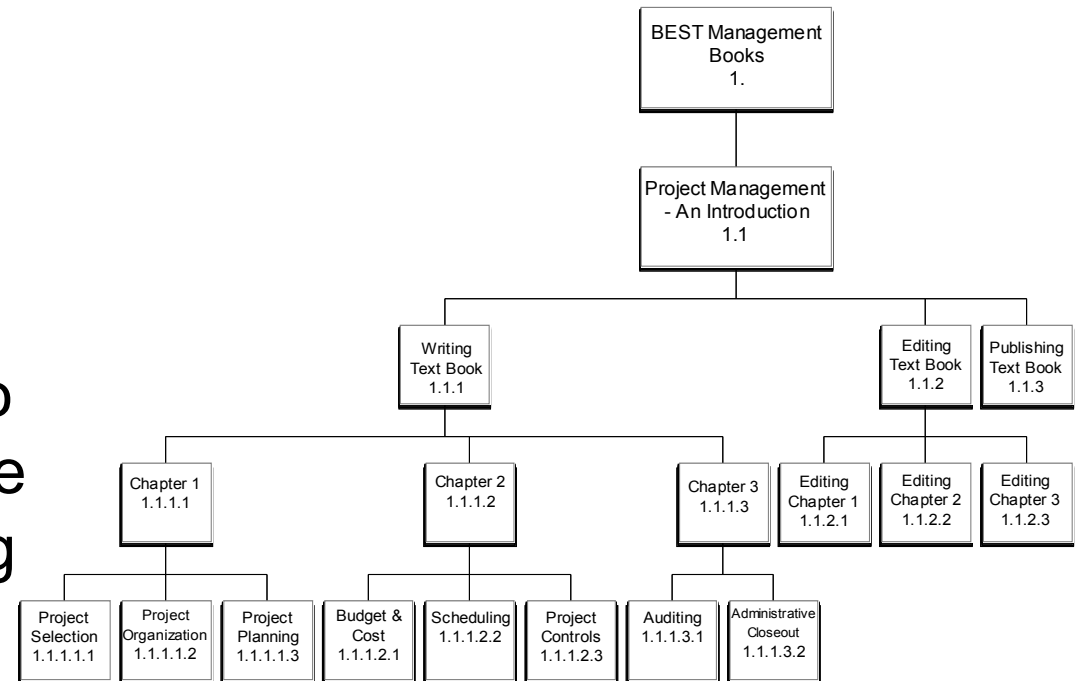
- **Method**

1. Initial Metrics: PV, EV, AC, BAC
2. Performance Measurement
3. Forecasting
4. Integrated Baseline Review

- **Outputs**

## 2. Work Breakdown Structure (WBS)

It helps to define and to **organize** the total scope of a project by grouping the **project's work elements**



WBS	Activity List
1.1	Start Development of Project Management Book
1.1.1.1.1	Writing Project Selection section for Chapter 1
1.1.1.1.2	Writing Project Organization section for Chapter 1
1.1.1.1.3	Writing Project Planning section for Chapter 1
1.1.1.2.1	Writing Budget and Cost section for Chapter 2
1.1.1.2.2	Writing Scheduling section for Chapter 2
1.1.1.2.3	Writing Project Controls section for Chapter 2
1.1.1.3.1	Writing Auditing section for Chapter 3
1.1.1.3.2	Writing Administrative Closeout section for Chapter 3
1.1.2.1	Editing Chapter 1
1.1.2.2	Editing Chapter 2
1.1.2.3	Editing Chapter 3
1.1.3	Publishing Project Management Book
1.1	Finished Development of the Project Management Book

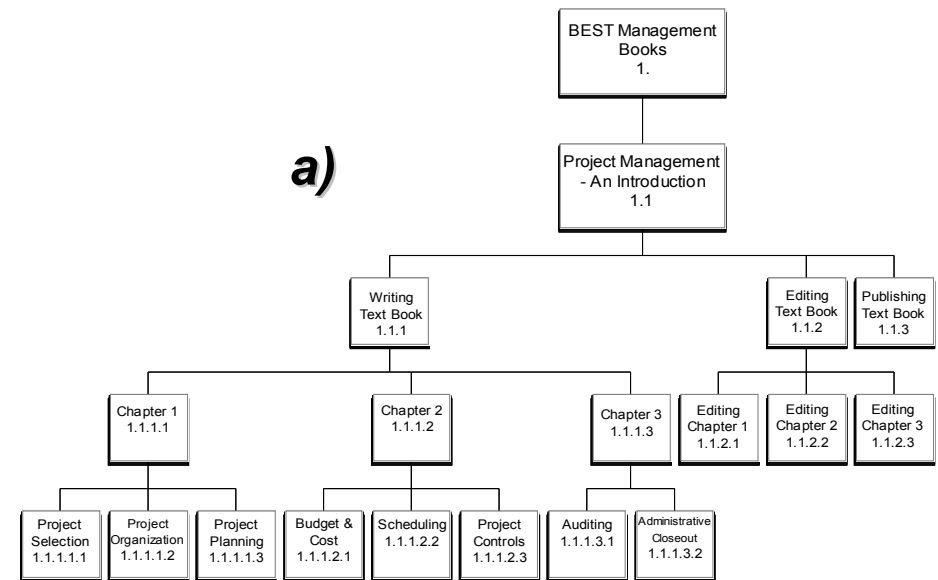
## 3. Organizational Breakdown Structure (OBS)

- It is used for assigning work responsibilities.
- By Merging the WBS and the OBS the Project Manager creates a Responsibility Assignment Matrix (RAM). This integration *identifies specific responsibility* for *specific project tasks*. ⇒ Giving detail of time/cost to perform such a task.

# EVMS: Inputs

## 4. Schedule

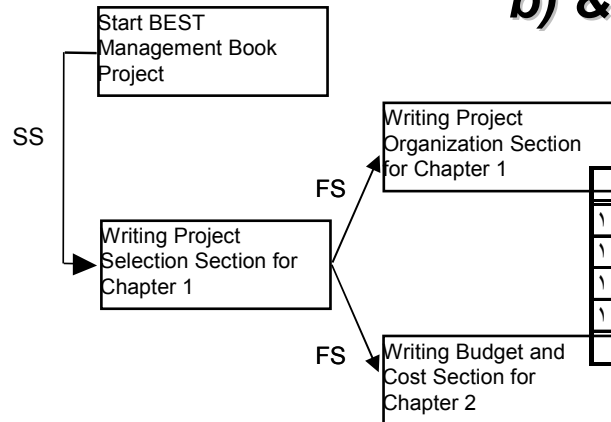
- Develop a list of project activities (from the WBS)
- Sequencing the activities
- Determine the relationship among them
- Establish the duration of each activity
- Determine the Project duration (One additionally can have the Critical path)



WBS	Activity List
1.1	Start Development of Project Management Book
1.1.1.1.1	Writing Project Selection section for Chapter 1
1.1.1.1.2	Writing Project Organization section for Chapter 1
1.1.1.1.3	Writing Project Planning section for Chapter 1
1.1.1.2.1	Writing Budget and Cost section for Chapter 2
1.1.1.2.2	Writing Scheduling section for Chapter 2
1.1.1.2.3	Writing Project Controls section for Chapter 2
1.1.1.3.1	Writing Auditing section for Chapter 3
1.1.1.3.2	Writing Administrative Closeout section for Chapter 3
1.1.2.1	Editing Chapter 1
1.1.2.2	Editing Chapter 2
1.1.2.3	Editing Chapter 3
1.1.3	Publishing Project Management Book
1.1	Finished Development of the Project Management Book

# EVMS: Inputs

SS – Start to Start  
 FS – Finish to Start  
 FF – Finish to Finish  
 SF – Start to Finish



b) & c)

d)

Early Start to finish

WBS	Activity	Duration	ES	EF	LS
1.1	Start Development of Project Management Book	0 wks	1/1	1/1	
1.1.1.1.1	Writing Project Selection section for Chapter 1	8 wks	1/1	2/20	
1.1.1.1.2	Writing Project Organization section for Chapter 1	10 wks	2/26	5/6	
1.1.1.2.1	Writing Budget and Cost section for Chapter 2	9 wks	2/26	4/29	

Last Start Late to Finish

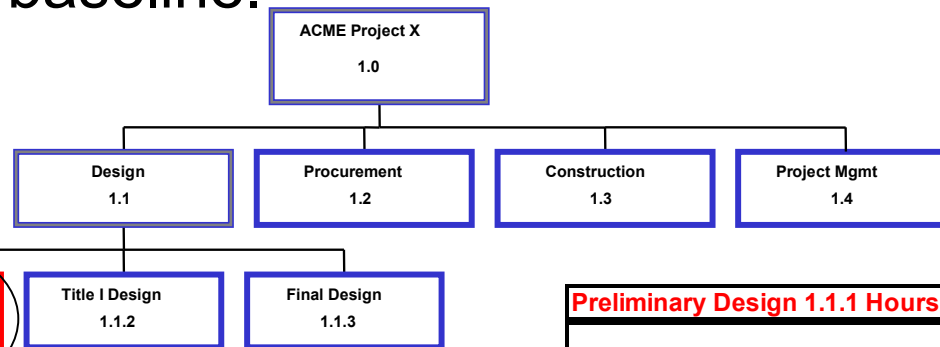
WBS	Activity	Duration	ES	EF	LS	LF
1.1	Start Development of Project Management Book	0 wks	1/1	1/1		
1.1.1.1.1	Writing Project Selection section for Chapter 1	8 wks	1/1	2/25		
1.1.1.1.2	Writing Project Organization section for Chapter 1	10 wks	2/26	5/6		
1.1.1.2.1	Writing Budget and Cost section for Chapter 2	9 wks	2/26	4/29		
1.1.1.1.3	Writing Project Planning section for Chapter 1	9 wks	5/7	7/8		
1.1.1.2.2	Writing Scheduling section for Chapter 2	5 wks	4/30	6/3		
1.1.1.2.3	Writing Project Controls section for Chapter 2	7 wks	6/4	7/22		
1.1.1.3.1	Writing Auditing section for Chapter 3	2 wks	7/23	8/5		
1.1.1.3.2	Writing Administrative Closeout section for Chapter 3	1 wk	8/6	8/12		
1.1.2.1	Editing Chapter 1	8 wks	7/9	9/2	7/23	9/16
1.1.2.2	Editing Chapter 2	8 wks	7/23	9/16	7/23	9/16
1.1.2.3	Editing Chapter 3	4 wks	8/13	9/9	8/20	9/16
1.1.3	Publishing Project Management Book	4 wks	9/17	10/14	9/17	10/14
1.1	Finish Development of the Project Management Book	0 wks	10/14	10/14	10/14	10/14



# EVMS: Inputs

## 5. Time-Phased Baseline Budget

WBS activities are scheduled and then the project budget is allocated across the activities and time  $\Rightarrow$  Project's integrated baseline.



**Schedule Baseline**

<b>Preliminary Design 1.1.1 Hours</b>	Jan	Feb	Mar	Apr	May
1.1.1.1 Define Specifications & Req.	1,500	1,000			
1.1.1.2 Develop Preliminary Design		2,000	2,000		
1.1.1.3 Review Preliminary Design			500	500	
1.1.1.4 Incorporate Comments				320	320
1.1.1.5 Preliminary Design Complete					1,000

- **Inputs**

1. Work Breakdown Structure (WBS)
2. Organizational Breakdown Structure (OBS)
3. Schedule
4. Time-phased Baseline Budget

- **Method**

1. **Initial Metrics: PV, EV, AC, BAC**
2. **Performance Measurement**
3. **Forecasting**
4. **Integrated Baseline Review**

- **Outputs**

# EVMS: Method

## 1.1 Planned Value (PV) or Budget Cost of Work Scheduled (BCWS).

It is the *planned budget* for activities approved.

Client/Server Project - WBS 1.1.1 Software Design					
	Dollars				
	JAN	FEB	MAR	APR	MAY
PV	3000	3000	3000	3000	3000

*PV (current) : 3000*

*PV (cumulative) : 9000*

**Now**

## 1.2 Budget At Completion (BAC).

It is the sum of all budgets allocated to a project scope. For our previous example  $BAC = PV \text{ (cumulative)} = 9000$

# EVMS: Method

## 1.3 Actual Cost (AC) or Actual Cost of Work Performed (ACWP)

It is the sum of the **actual cost** for the activities performed.

Client/Server Project - WBS 1.1.1 Software Design						
	Dollars					
	JAN	FEB	MAR	!	APR	MAY
PV	3000	3000	3000	!	3000	3000
AC	1100	900	1200	!		

AC (current) : 1200      **Now**

AC (cumulative) : 3200

## 1.4 Earned Value (EV) of Budgeted Cost of Work Performed (BCWP).

### What is it?

Tells you what the project has *accomplished physically*, in terms of the *budget (PV)*.

### How to calculate it?

#### c) Fixed Formula

0/100 : Start  $\Rightarrow$  0% Budget, Completed  $\Rightarrow$  100% Budget

50/50: Start  $\Rightarrow$  50% Budget, Completed  $\Rightarrow$  100% Budget

25/75: Start  $\Rightarrow$  25% Budget, Completed  $\Rightarrow$  100% Budget

#### g) Milestone weights.

Assigns budget value to each milestone. And only until the **full completion** of the milestones the budget is earned.

# EVMS: Method

- Milestone Weights with % complete.

Assigns budget to each milestone. And the budget earned is:

*% of completion \* milestone's budget.*

- b) Units Complete.

Uses a physical count to determine what is earned. *Units* must be identical or similar so they *have the same budget value.*

- Subjective percent complete.

*A % of completion* is applied to the Budget At Competition (BAC) for a given activity.  $\Rightarrow$  *based on the manager assessment of the WP progress*

- f) Level Of Effort,

A monthly value earned with the passage of time and is always equal to the *monthly PV.*

# EVMS: Method

Activity	EV Method
Pour Foundation	Fixed Formula: 0/100
Install Patio	Subjective % Complete
Frame Exterior Walls	Subjective % Complete
Pour Stairway	Fixed Formula: 25/75

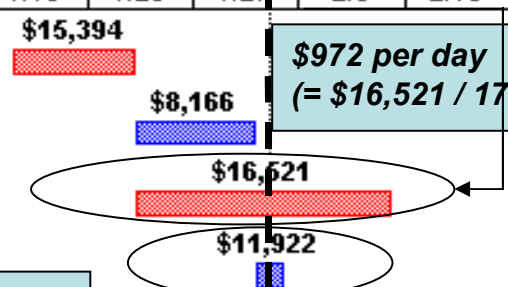
Monthly Status Report  
January 31th

Activity	Actual Star	Actual Finish	% Complete	PV	EV
Pour foundation	1/15	1/22	100%	\$15,394	= 100%PV = \$15,394
Install Patio	1/23	1/30	100%	\$8,166	=100%PV = \$8,166
Pour Stairway	1/31		25%	\$5,961	=BAC*0.25 = \$2,981
Frame Exterior Walls	1/23		40%	=9 days * \$972 = \$8,748	=BAC*0.4 = \$6,608

ID	Task Name	Start	Finish	January					February		
				12/30	1/6	1/13	1/20	1/27	2/3	2/10	
4	1.1.1.1 Pour foundation	1/15/02	1/22/02								
5	1.1.1.2 Install Patio	1/23/02	1/30/02								
9	1.1.2.1 Frame exterior walls	1/23/02	2/8/02								
6	1.1.1.3 Pour stairway	1/31/02	2/1/02								

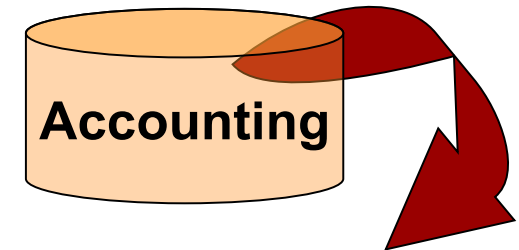
\$5,961 per day  
(= \$11,922 / 2 days)

\$972 per day  
(= \$16,521 / 17 days)



# EVMS: Method

## Monthly Status Report January 31th



Activity	Actual Star	Actual Finish	% Complete	PV	EV	AC
Pour foundation	1/15	1/22	100%	\$15,394	\$15,394	\$15,850
Install Patio	1/23	1/30	100%	\$8,166	\$8,166	\$7,200
Pour Stairway	1/31		25%	\$5,961	\$2,981	\$6,250
Frame Exterior Walls	1/23		40%	\$8,748	\$6,608	\$3,100
<b>TOTAL</b>				<b>\$38,269</b>	<b>\$33,149</b>	<b>\$32,400</b>



## 2. Performance Measurement

It looks at project *cost* and *schedule* performance by analyzing *variance* and *efficiency*:

Cost of Variance (CV):  $EV - AC$

**(-) : over-run**  
**(+) : under-run**

Schedule Variance (SV):  $EV - PV$

**(-) : behind-schedule**  
**(+) : on-schedule**

Cost Performance Index:  $EV/AC$

**(<1) : over-run**  
**(>1) : under-run**

Schedule Performance Index:  $EV/PV$

**(<1) : behind-schedule**  
**(>1) : ahead-schedule**

## 2.1 Performance Measurement (Cost)

$$CV = EV - AC$$

$$CV = \$33,149 - \$32,400$$

$$CV = \$749$$

(+) CV



**The *real cost* to accomplish the work was less than it was budgeted (planned)**



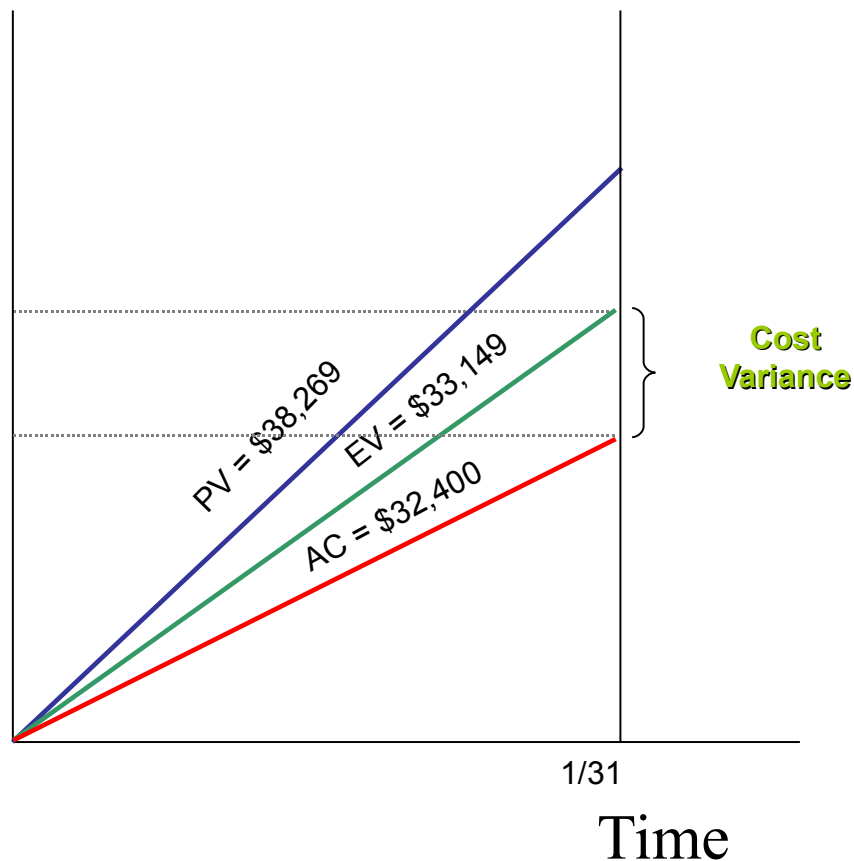
(CPI > 1)

$$CPI = EV/AC$$

$$CPI = \$33,149/\$32,400$$

$$CPI = 1.02$$

Cost



## 2.2 Performance Measurement (Schedule)

$$SV = EV - PV$$

$$SV = \$33,149 - \$38,269$$

$$SV = -\$5,120$$

↓  
**(-) SV**

**What was earned to date is less than what was *planned* to be accomplished ⇒ Behind the schedule**

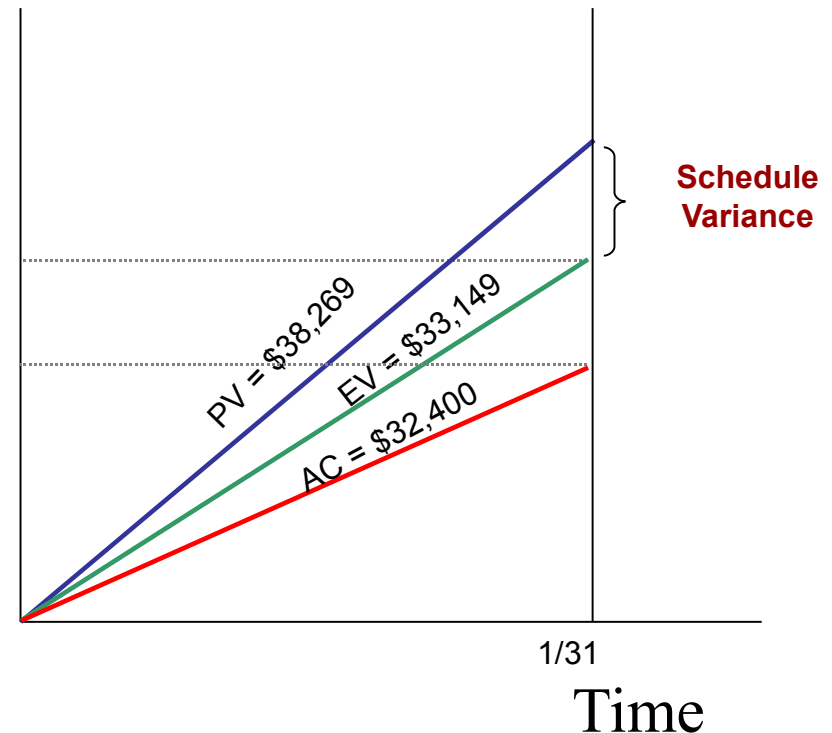
↑  
**SPI < 1**

$$SPI = EV/PV$$

$$SPI = \$33,149/\$38,269$$

$$SPI = .87$$

Cost



# EVMS: Method

as of 1/31	PV	EV	AC	SV	CV	SPI	CPI
Foundation	\$15,394	\$15,394	\$15,850	0	-456	1.00	0.97
Patio	\$8,166	\$8,166	\$7,200	0	966	1.00	1.13
Exterior Walls	\$8,748	\$6,608	\$6,250	-2,140	358	0.76	1.06
Stairway	\$5,961	\$2,981	\$3,100	-2,980	-119	0.50	0.96
Project Total	\$38,269	\$33,149	\$32,400	-5,120	749	0.87	1.02

In general:

- The Project is 13% behind schedule (**SPI = .87**)
- But It is ahead on cost by 2% (**CPI = 1.02**)

Reviewing activities particularly:

- Stairway and Exterior Walls are the activities causing the project to be behind schedule (**SPI = .50 and .76**) .
- On the cost side, the Installation of the Patio is costing less then budgeted (**CV =\$966**) and is the main reason for the project under-running its budget.

## 3. Forecasting

**Variance At Completion  $VAC = BAC - EAC$**

**(-) : forecast an over-run**  
**(+) : forecast an under-run**

**EAC (Estimate At Completion):**

- EAC = the actual cost to date (AC) + an objective *estimate* of cost *to complete* the remaining *work* (ETC).

- $EAC = AC/EV \times BAC$ ,  $EAC = BAC/CPI$

Both formulas assume that the “burn-rate” will be the same for the remaining of the project

- $EAC = (AC/EV) ([\text{Cost of Work Completed and In-progress}] + [\text{Cost of Work Not yet Begun}])$

This formula assumes that the work not yet begun will be completed as planned.

- $EAC = AC + [1/CPI (BAC-EV)]$

## 4. Integrated Base Line Review (IBR).

It is an event, in a **continuing process**, to **ensure**:

- Understanding of the Performance Measurement Baseline (PMB).

*The PMB captures the entire scope of work and It is consistent in all its parts (budget, schedule, performance data, accomplishment data, etc).*

- The validity of data (budgets, schedules, etc) and methods used.
- Identify potential risks

- **Inputs**

1. Work Breakdown Structure (WBS)
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- **Method**

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- **Outputs**

# EVMS: Output

Reporting: There are several reports which may be used for Earned Value Management Reporting and Analysis.

- Cost Performance Reports (CPR). The most used are:
  - Work Breakdown Structure (WBS). Includes current period, cumulative, and at complete values for each WBS element.
  - Variance Analysis Report. Provides narrative explanation of cost, schedule, and other problems related to total contract, undistributed budget (UB), management reserve (MR), PMB, and manpower.
- Cost/Schedule Summary Report (C/SSR).
  - Similar to the WBS Format.



# EVMS: Conclusion

- EVA is an industry standard method that measures project's progress at any given point in time by analyzing variances in the schedule and budget as the project proceeds;
- Furthermore, it allows to forecast the project completion date and final cost.
- Commonly a simple set of parameters are used and shown in a single two-dimensional diagram to determine if the cost, schedule, and work accomplished are progressing in accordance with the plan.

For more information, please refer to:  
<http://management.energy.gov/1066.htm>

Comments  
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