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Earned Value Management Refresher

Gary C Humphreys

Humphreys & Associates, Inc.

January 21, 2012

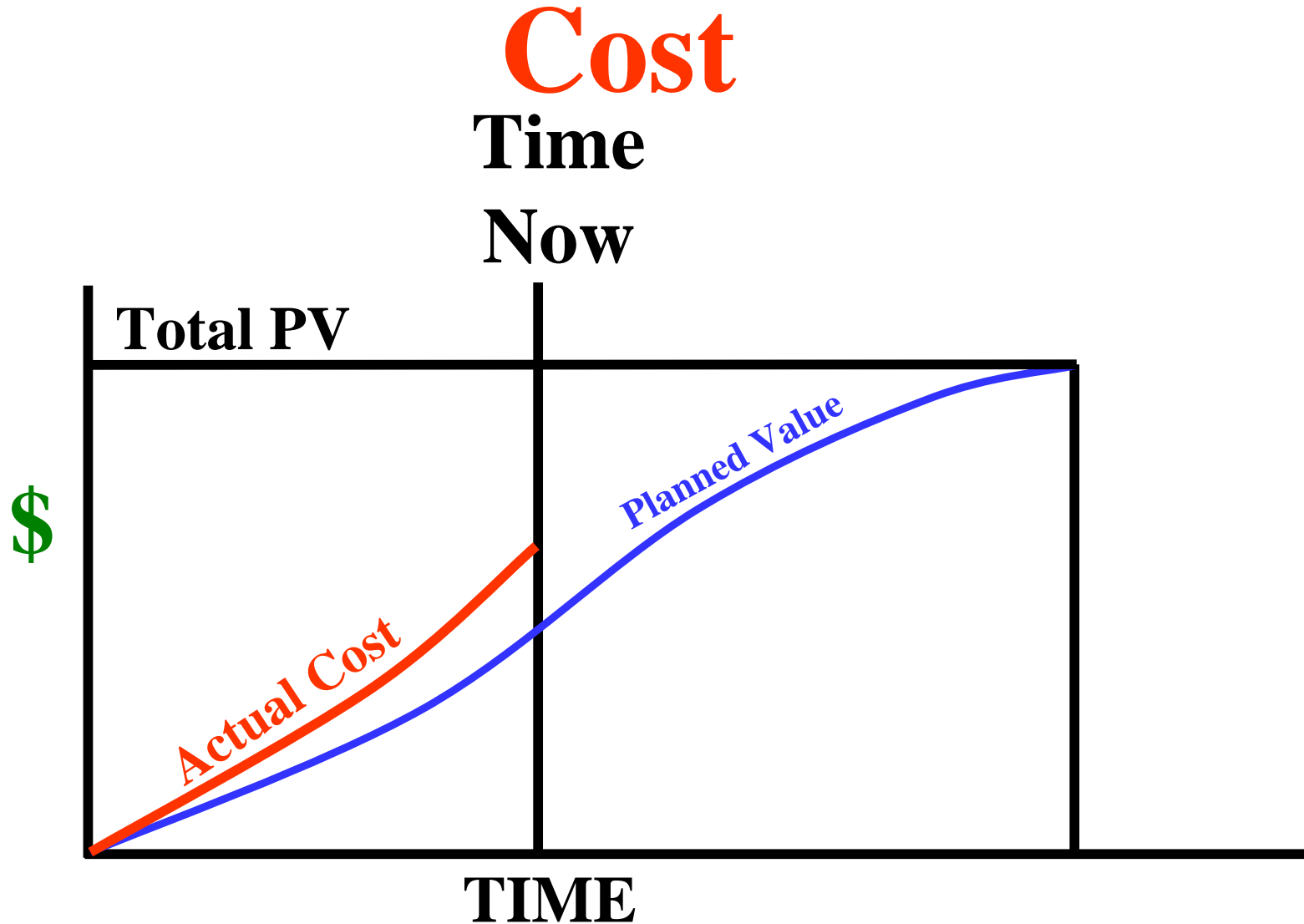
Earned Value Management System (EVMS) Guidelines

ANSI/ EIA Standard 748-B

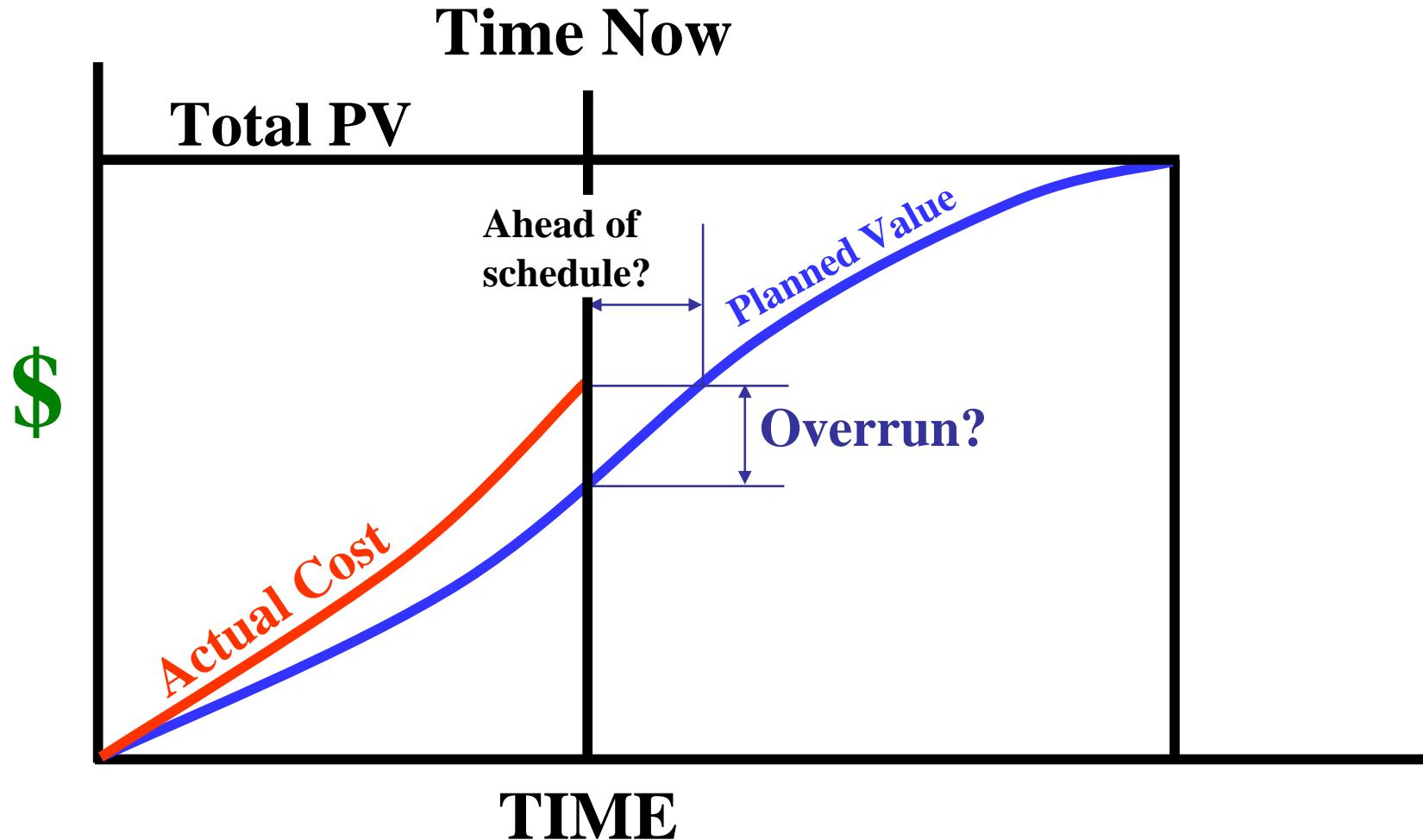
**Government-accepted, Industry-wide standard
for
Earned Value Management Systems**

- The EVMS Guidelines set forth the capabilities that a good Earned Value Management System should possess**
- Contractors internal systems must meet these guidelines to be considered acceptable by the procuring agency**

Planned Value Versus Actual



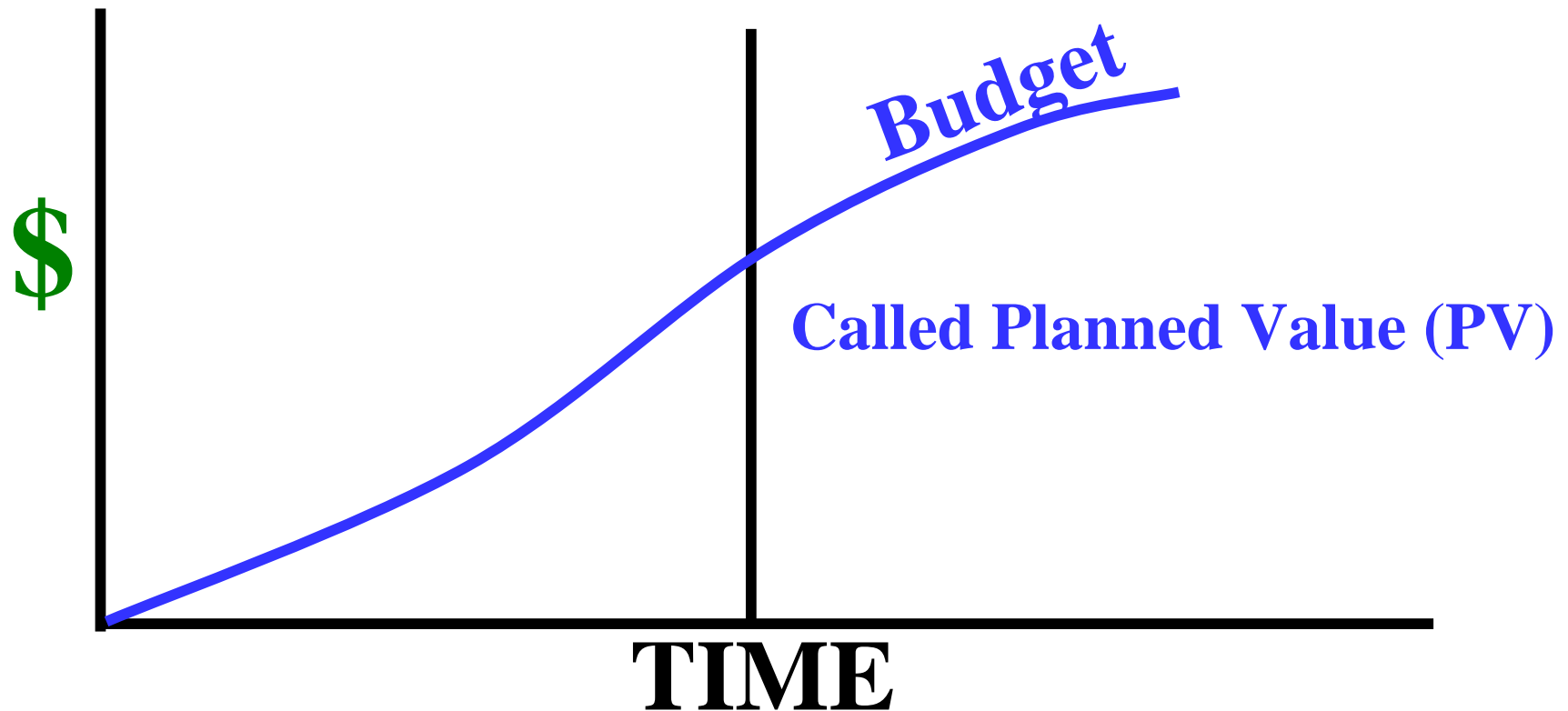
Overrun or Ahead of Schedule?



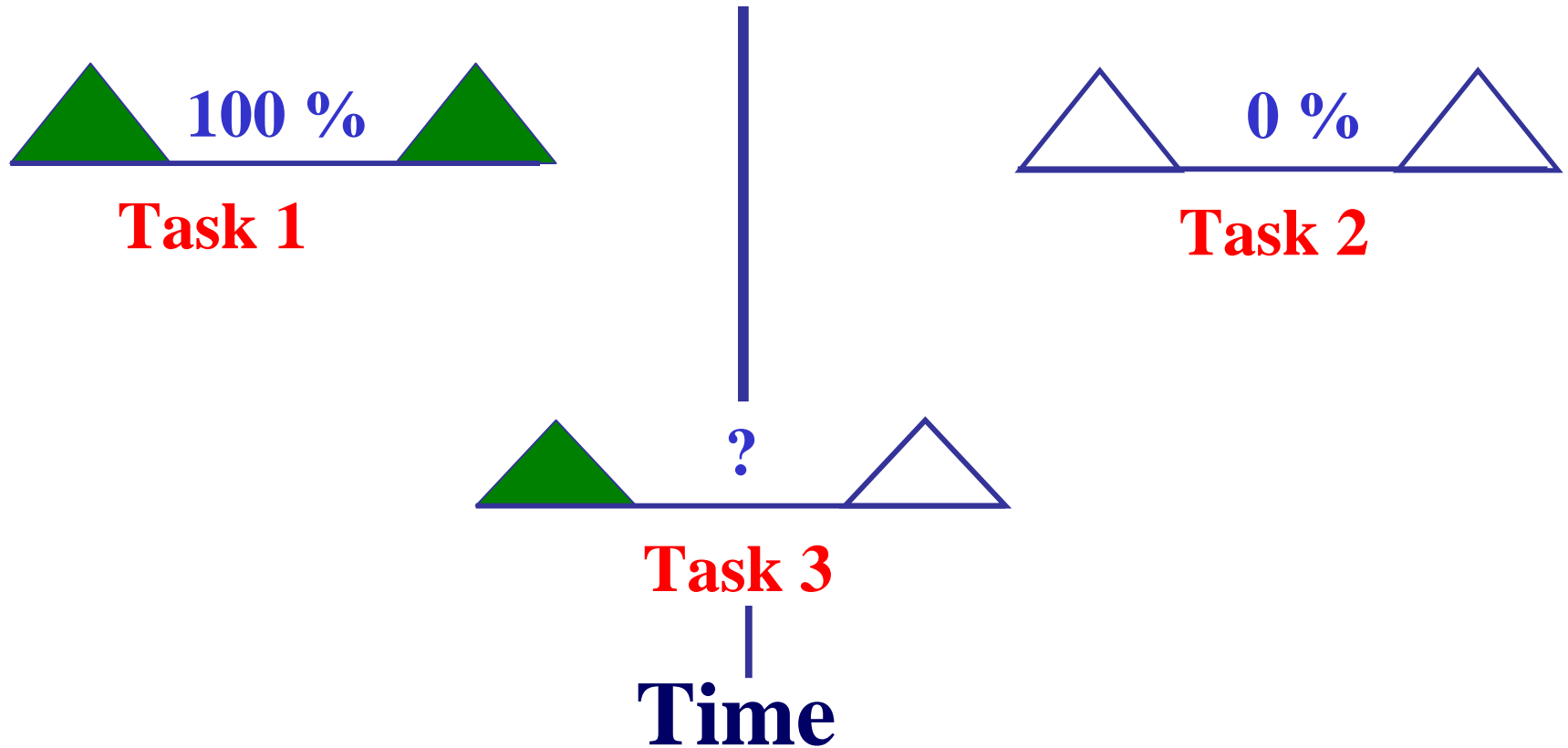
What Has Been Accomplished?

- **Tests performed**
- **Design review performed**
- **Lines of code designed/coded/tested**
- **Drawings completed**
- **Reports delivered**
- **Units delivered**

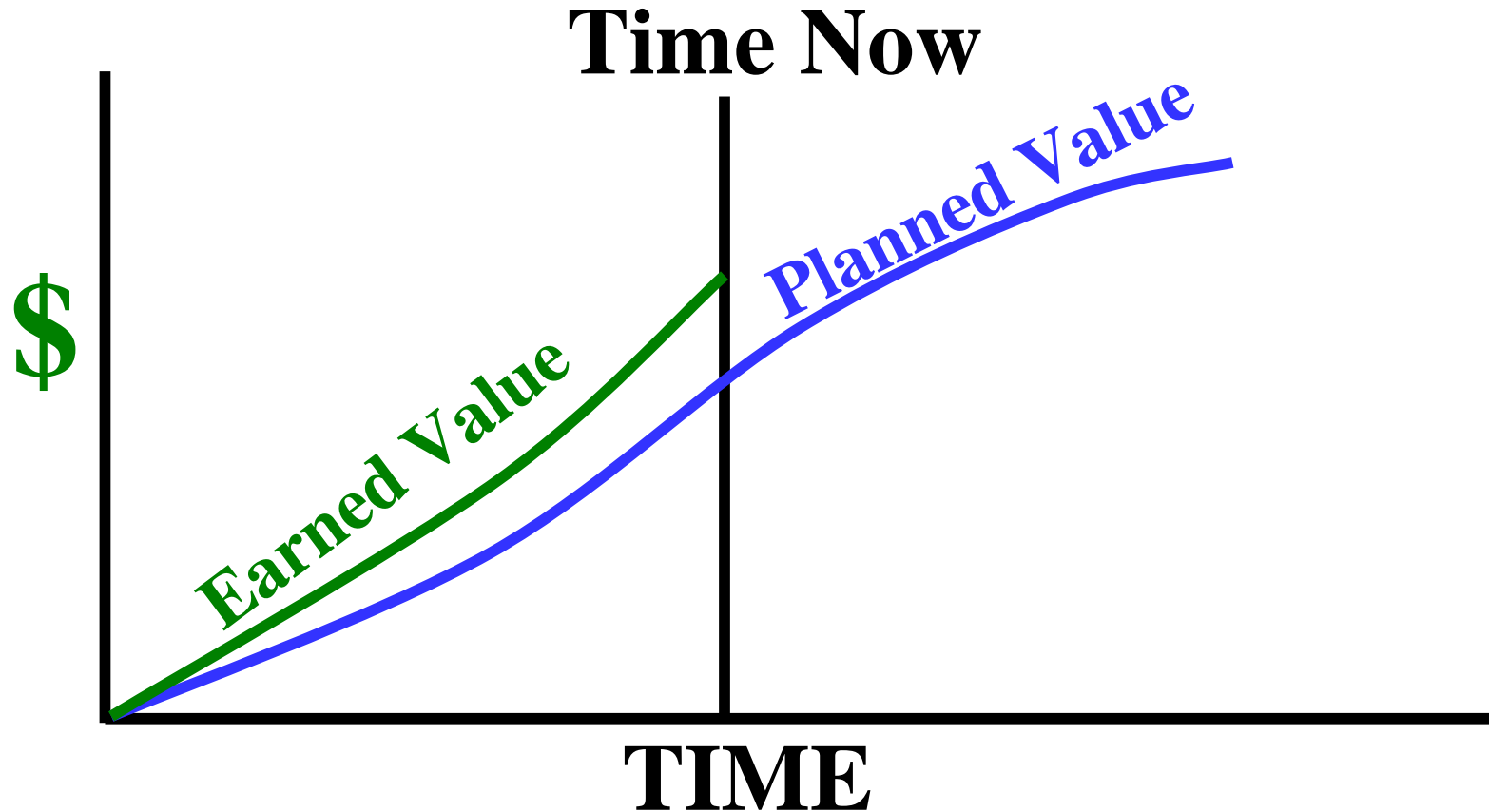
Planned Accomplishment



Earned Value

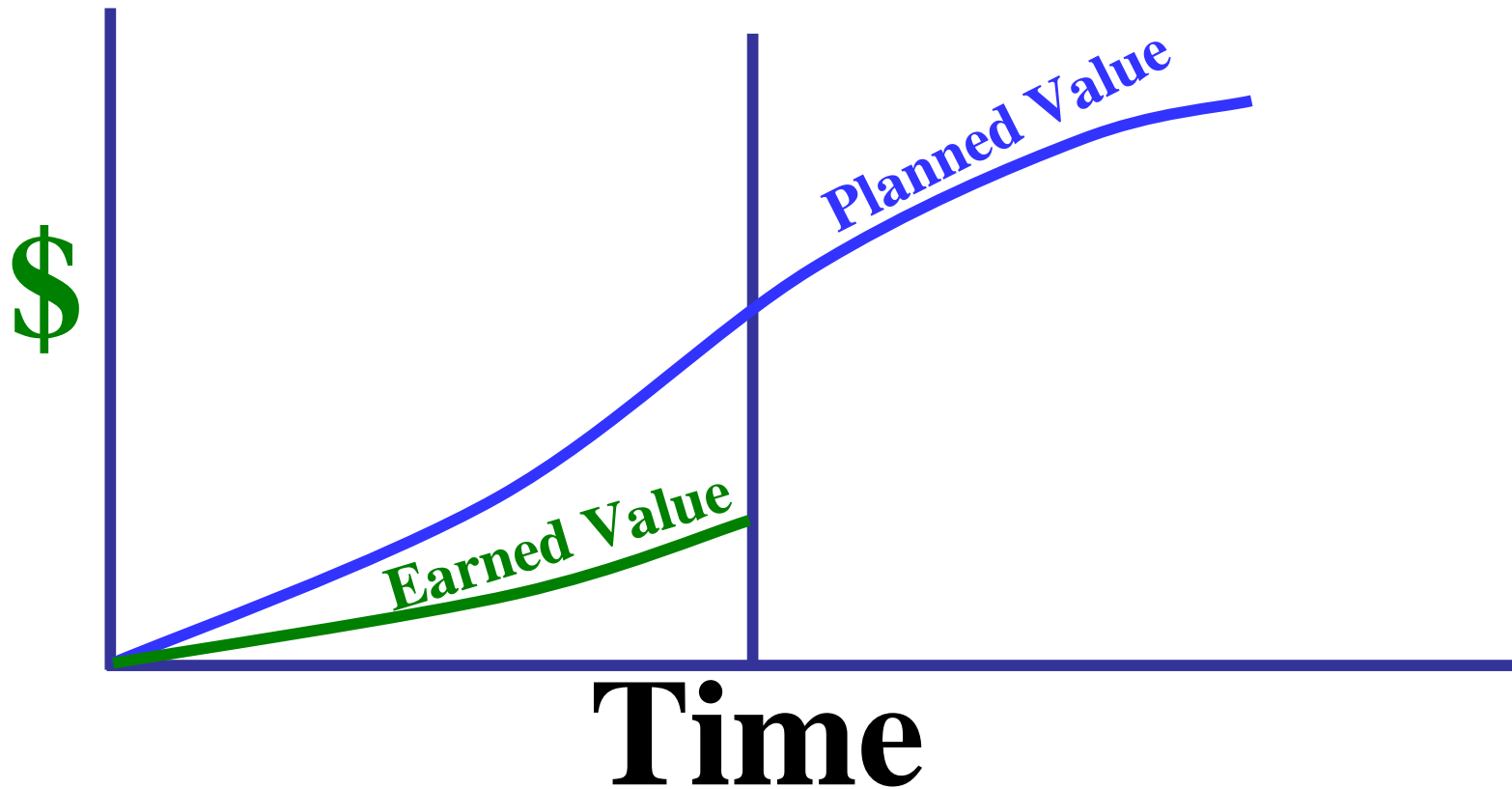


Planned versus Actual Accomplishment

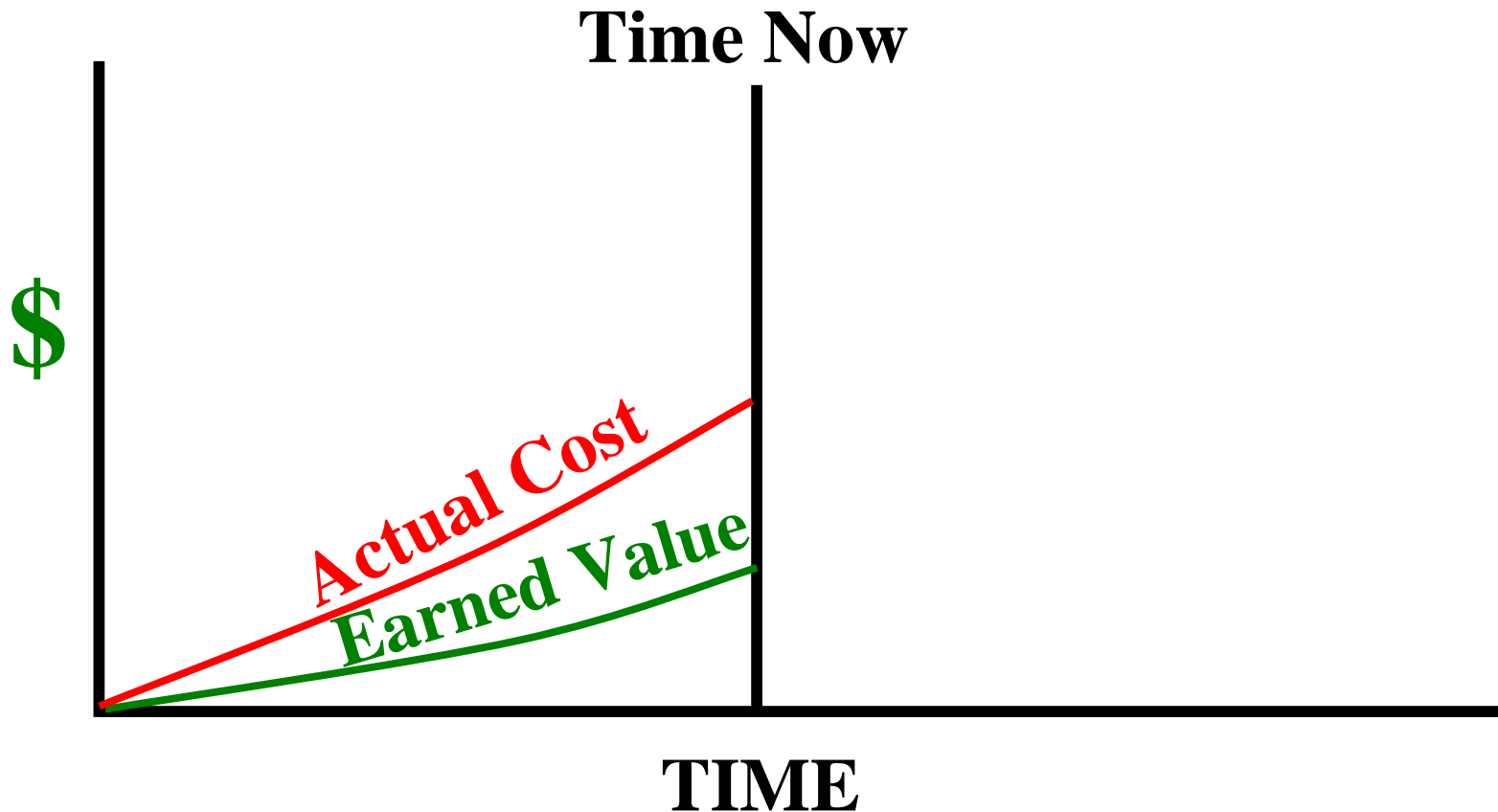


Planned versus Actual Accomplishment

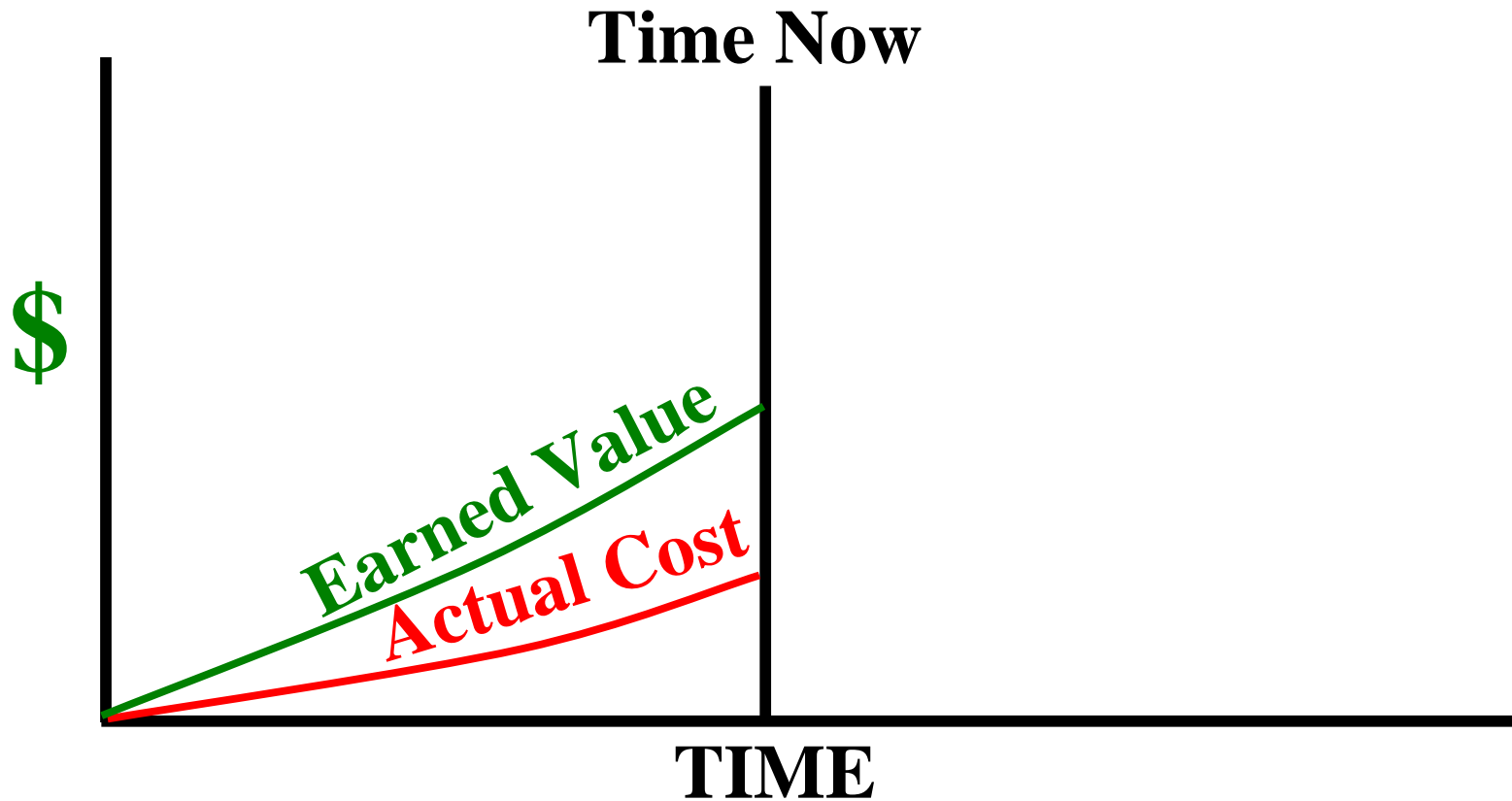
Time Now



What's Been Accomplished? What Did It Cost?

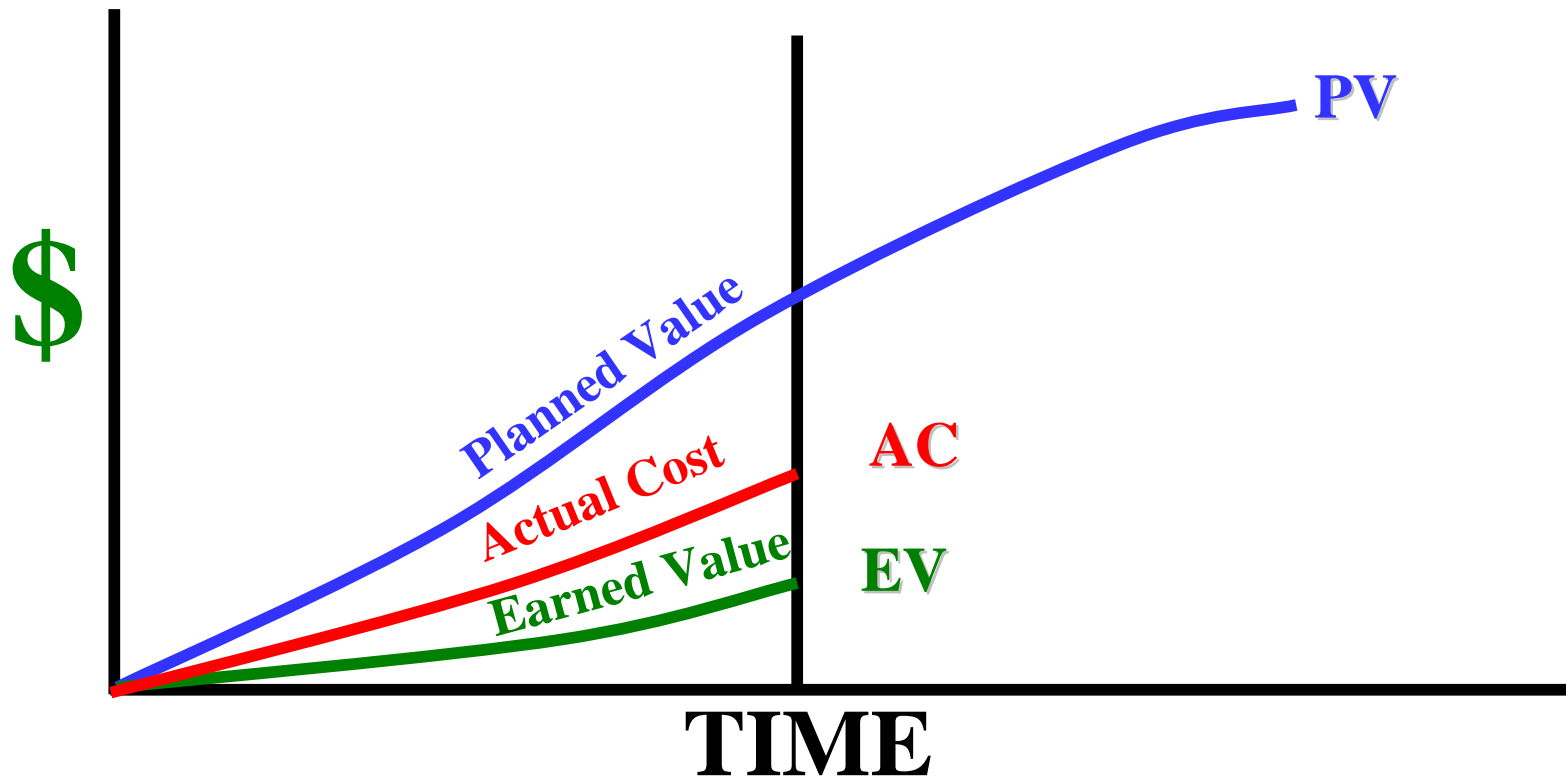


What's Been Accomplished? What Did It Cost?

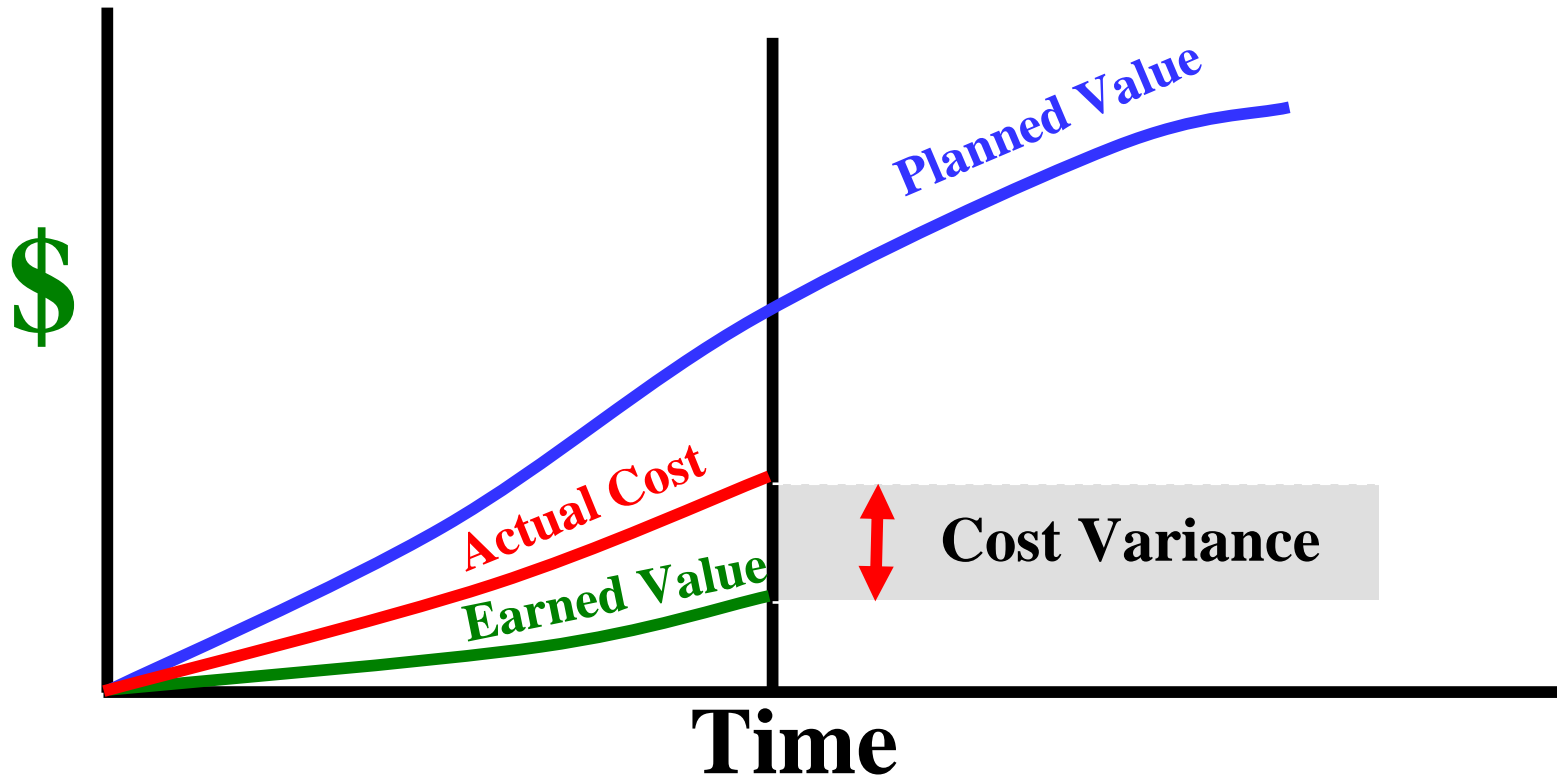


Earned Value

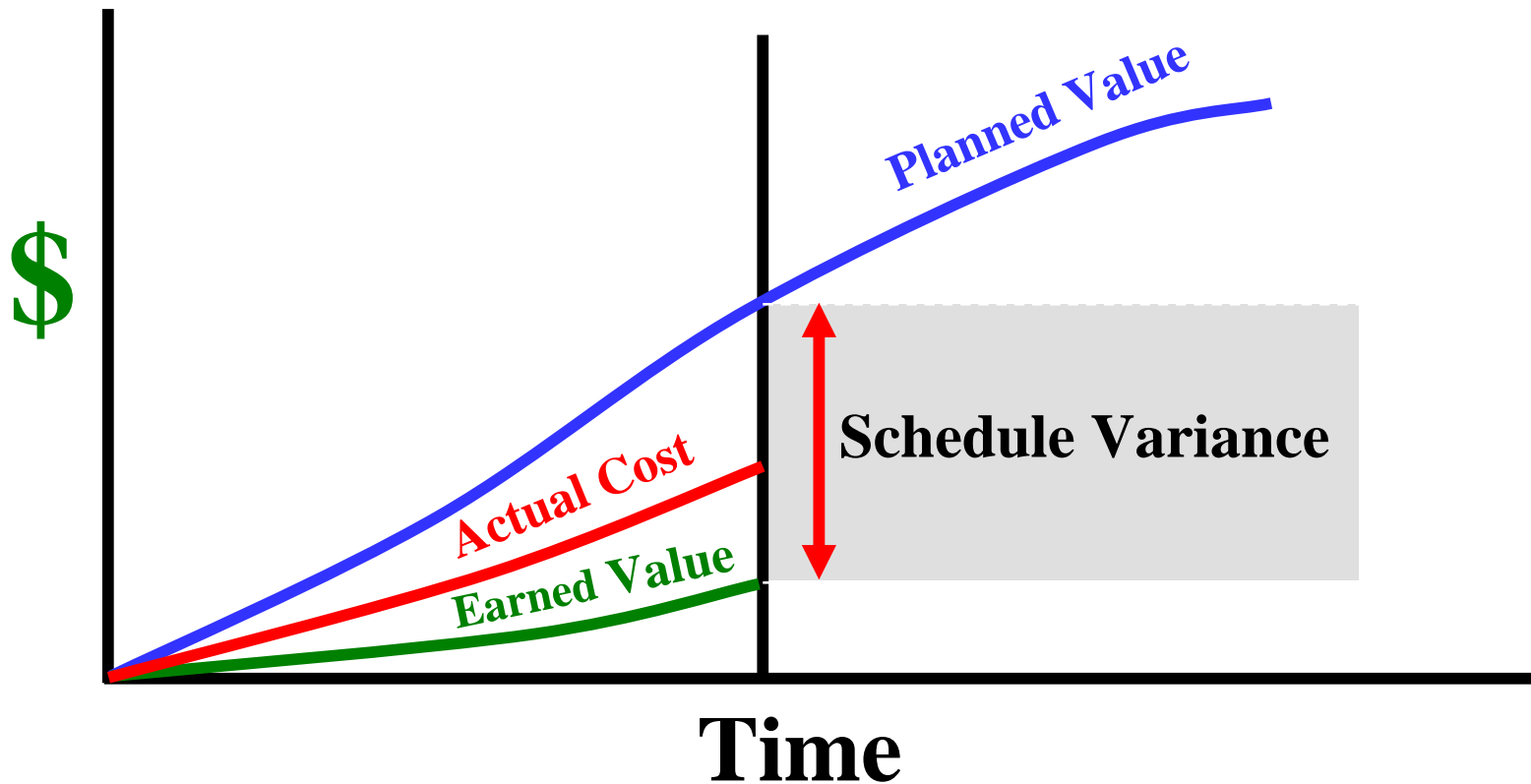
Is A Good Approximation



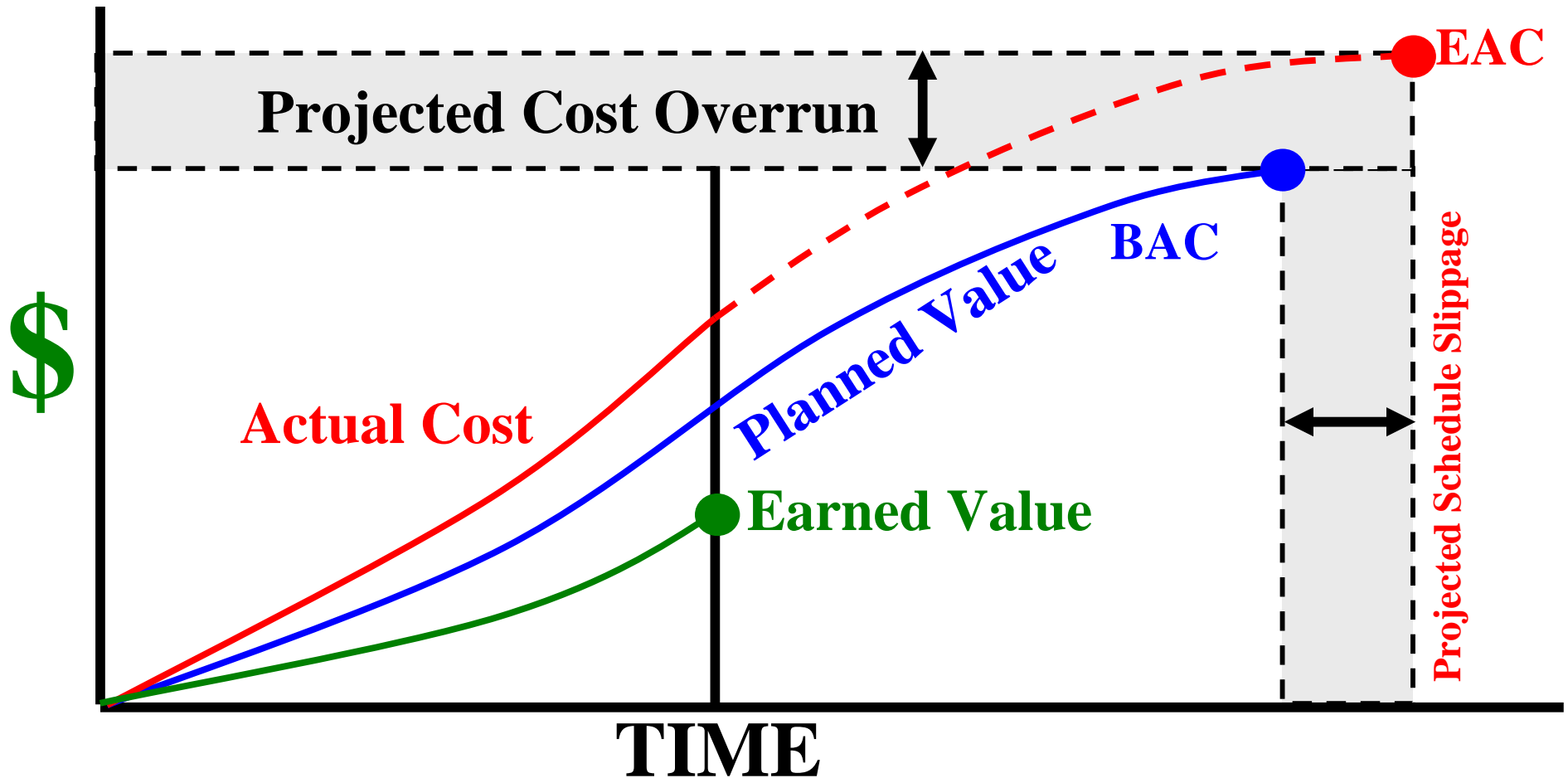
Cost Variance



Schedule Variance



Cost & Schedule Impacts



Planned Value versus Actual Cost

Technical: Build a brick wall six feet high, two feet wide, and sixteen feet long

Schedule: Four days

Cost:	Four people at \$250 each for four days	\$ 4,000
	Materials	\$ 6,000
	Total planned cost	<u>\$10,000</u>

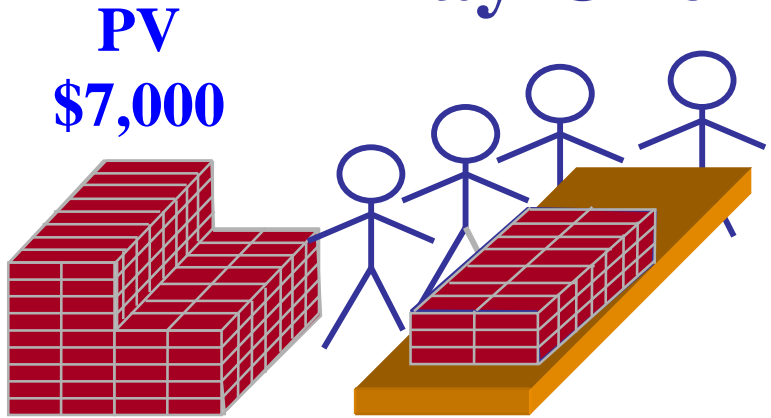
Planned Value versus Actual Cost

Cost Element	Time (in days)				Total
	One	Two	Three	Four	
Labor	\$1,000	\$1,000	\$1,000	\$1,000	\$4,000
Material	\$6,000	- 0 -	- 0 -	- 0 -	\$6,000
Total	\$7,000	\$1,000	\$1,000	\$1,000	\$10,000

The Plan

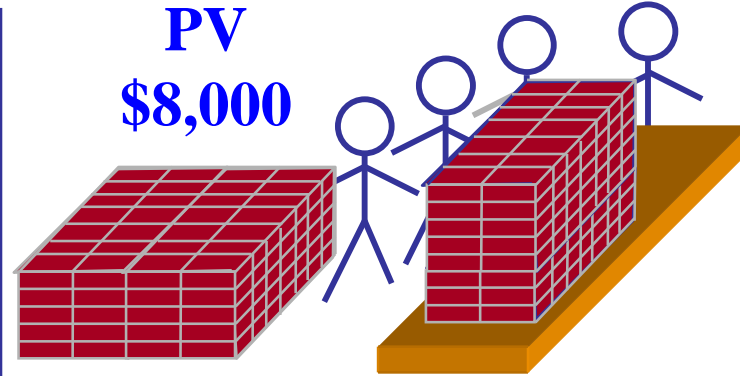
Planned Value versus Actual Cost

Day One



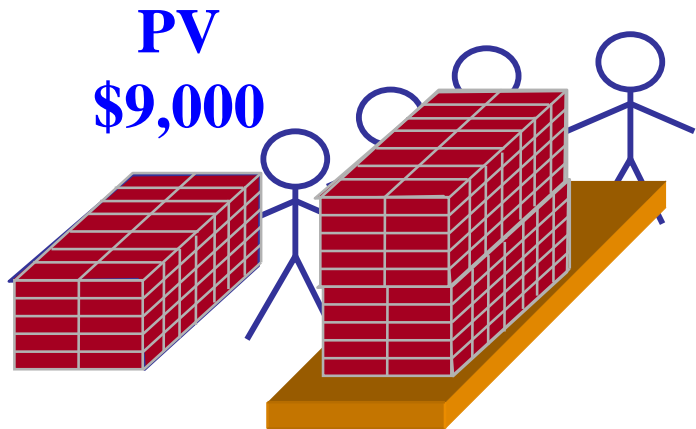
AC
\$7,200
?

Day Two



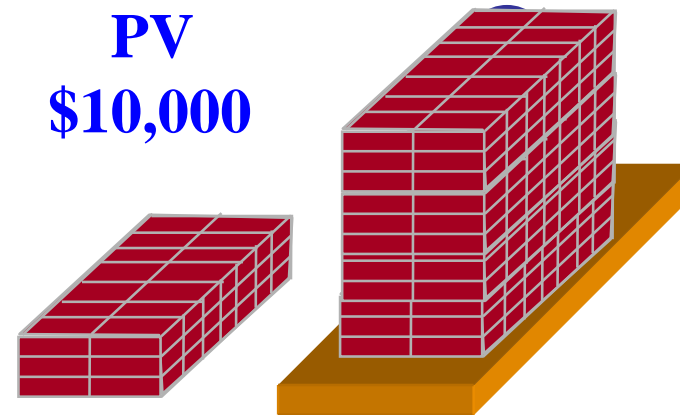
AC
\$8,500
?

Day Three



AC
\$9,500
?

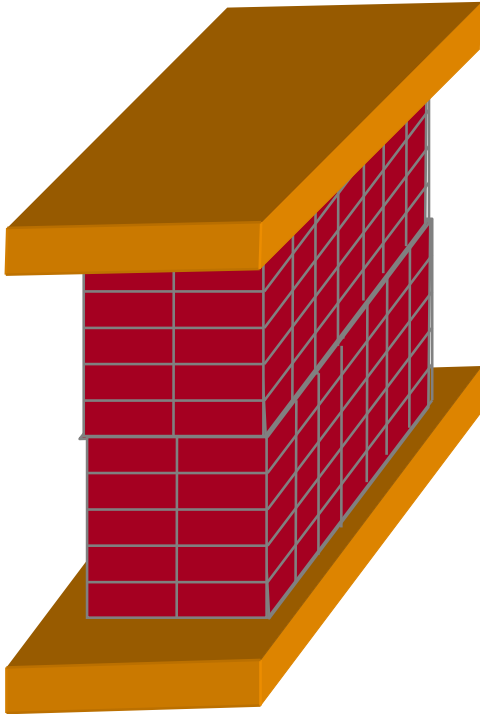
Day Four



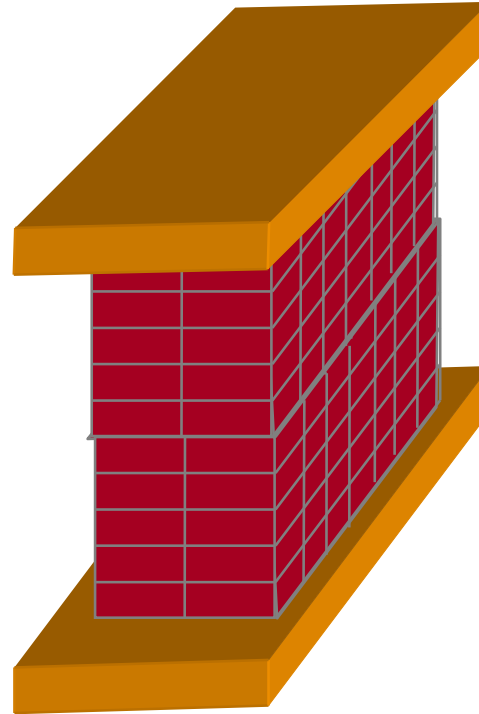
AC
\$10,500
?

Planned Value versus Actual Cost Day Five

PV
\$10,000



AC
\$11,000



A Comparison Between

Planned Value versus Actual Cost

and

Earned Value

Technical: Build a brick wall six feet high, two feet wide, and sixteen feet long

Schedule: Four days

Cost: Four people with hand tools assigned for four days at a planned cost of \$250 per day per person:

Total planned labor: \$4,000

Materials for the brick wall delivered on site prior to the start of construction include mortar, bricks, reinforcing, lumber and concrete:

6,000

Total planned material \$

Total planned cost \$10,000

Planning Using Earned Value

Cost Element	Time (in days)				Total
	One	Two	Three	Four	
Labor	\$1,000	\$1,000	\$1,000	\$1,000	\$4,000
Material	\$500	\$2,000	\$2,000	\$1,500	\$6,000
Total	\$1,500	\$3,000	\$3,000	\$2,500	\$10,000

Material: \$6,000 ÷ 6.0 feet

First day 0.5 feet = \$ 500

Second day 2.0 feet = \$2,000

Third day 2.0 feet = \$2,000

Fourth day 1.5 feet = \$1,500

Total 6.0 feet = \$6,000

Detailed Planning For Day One

Using Earned Value

Task	Schedule
<u>Excavate footing</u> Labor 1/4 day	△ PV 250 △
<u>Form work and supports</u> Labor 1/4 day Material \$50	△ PV 300 △
<u>Pour foundation</u> Labor 1/4 day Material \$150	△ PV 400 △
<u>Construct 0.5 feet of brick wall</u> Labor 1/4 day Material \$300	△ PV 550 △

Total planned value

Labor

\$1,000

Material

\$ 500

\$1,500

Earned Value After Day One

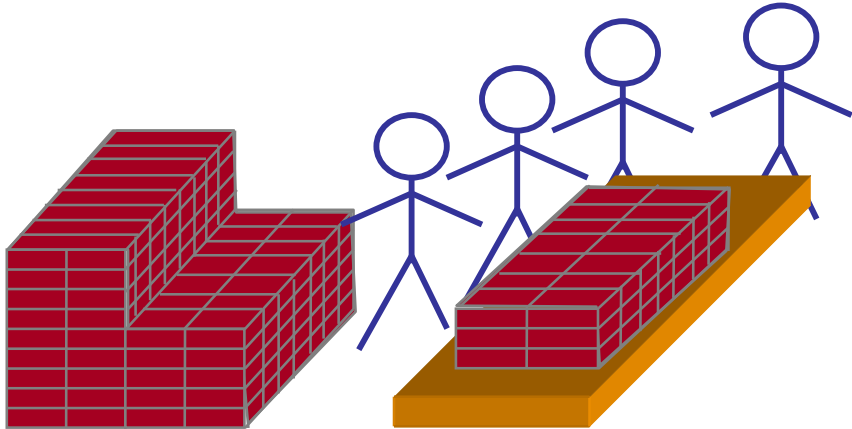
Task	Schedule
<u>Excavate footing</u> Labor 1/4 day	
<u>Form work and supports</u> Labor 1/4 day Material \$50	
<u>Pour foundation</u> Labor 1/4 day Material \$150	
<u>Construct 0.5 feet of brick wall</u> Labor 1/4 day Material \$300	

	Planned Value (PV)	Earned Value (EV)	Actual Cost (AC)
Excavate	\$ 250	\$ 250	\$ 300
Forms	300	300	300
Foundation	400	400	650
Brick Wall	550	0	0
Total	\$1,500	\$ 950	\$1,250

Earned Value

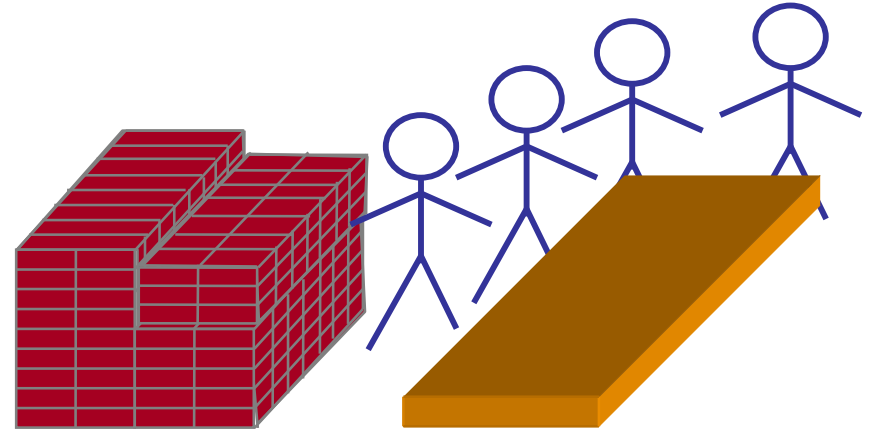
Day One

Plan



Planned Value \$1,500

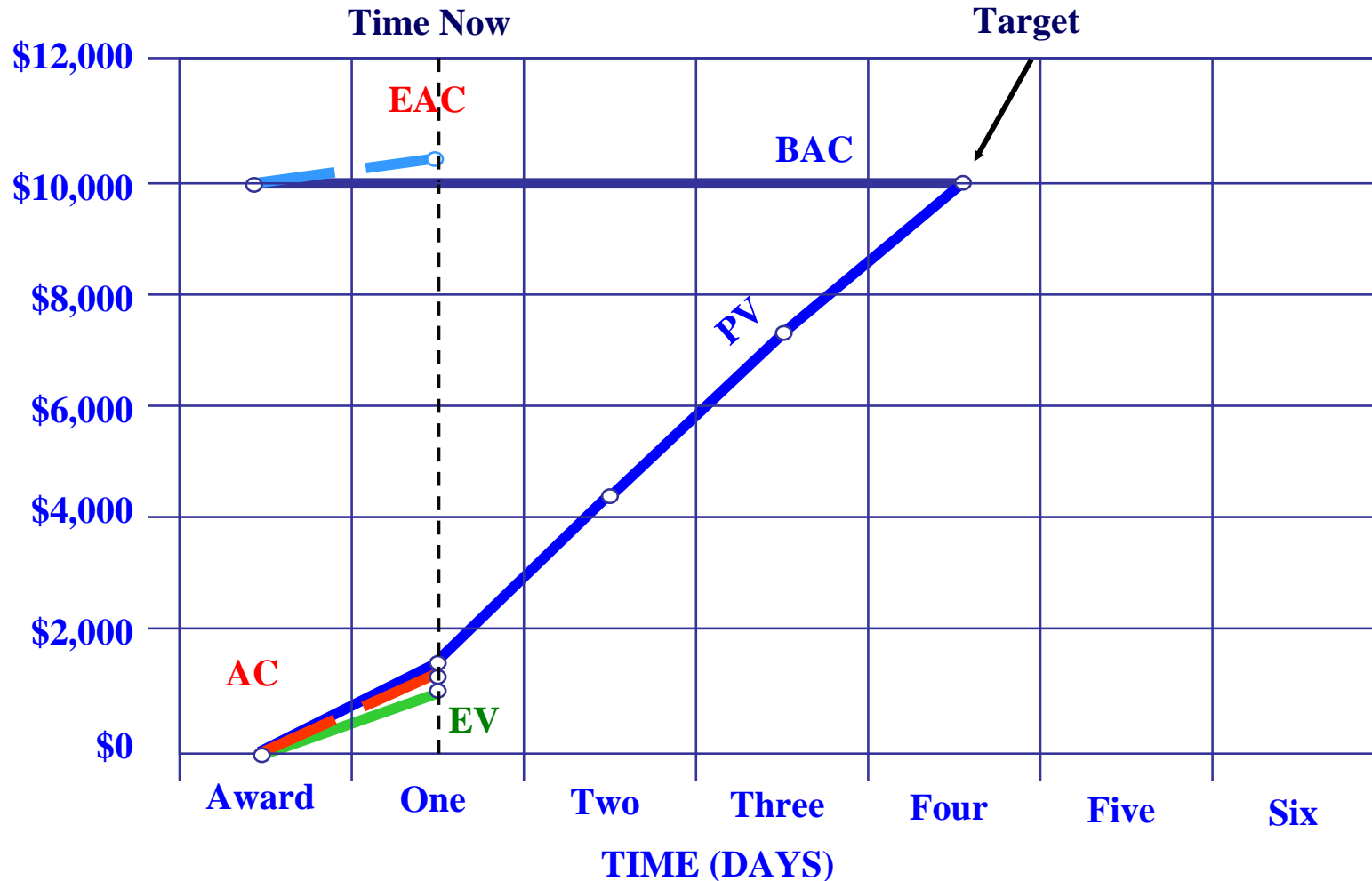
Actual



Planned Value (PV)	\$1,500	>	(\$550) SV
Earned Value (EV)	\$ 950	>	(\$300) CV
Actual Cost (AC)	\$1,250	>	

Earned Value

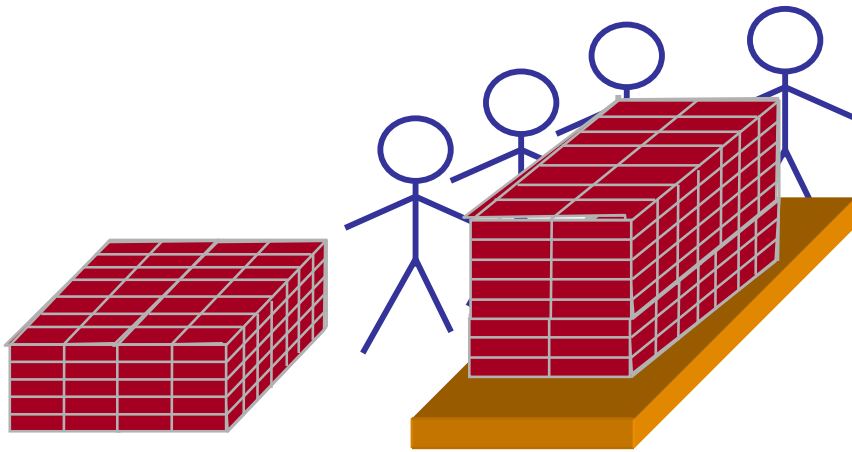
Day 1 Graphics



Earned Value

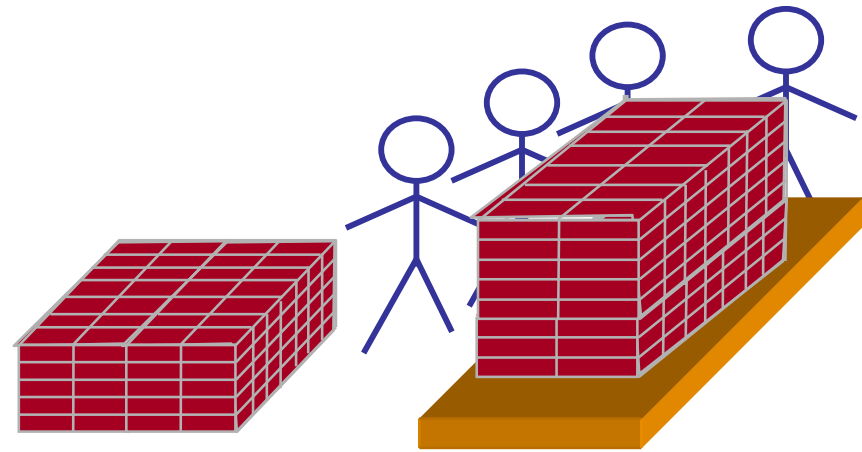
Day Two

Plan



Planned Value \$4,500

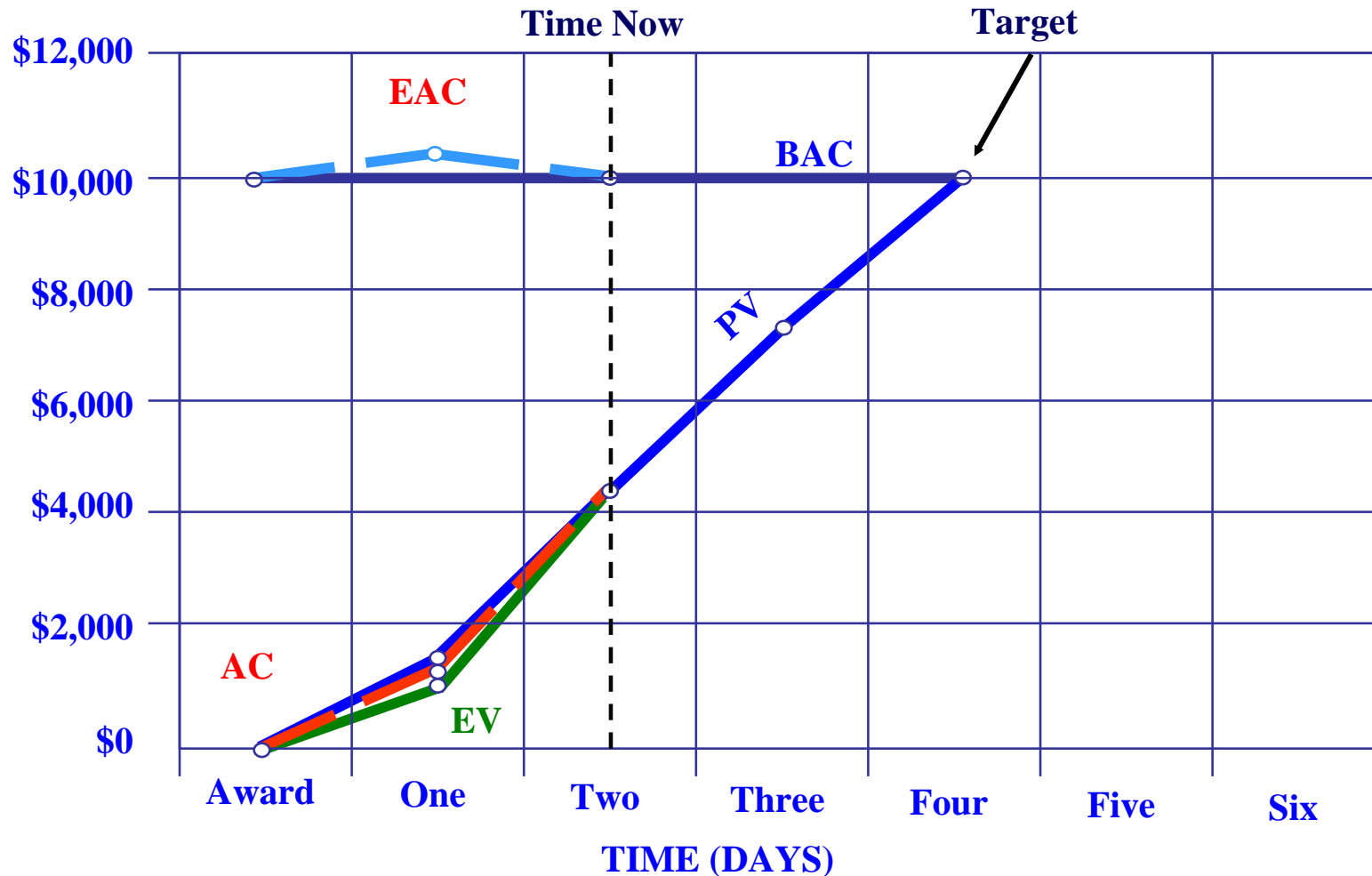
Actual



Planned Value (PV)	\$4,500	>	(\$0) SV
Earned Value (EV)	\$4,500	>	(\$0) CV
Actual cost (AC)	\$4,500	>	

Earned Value

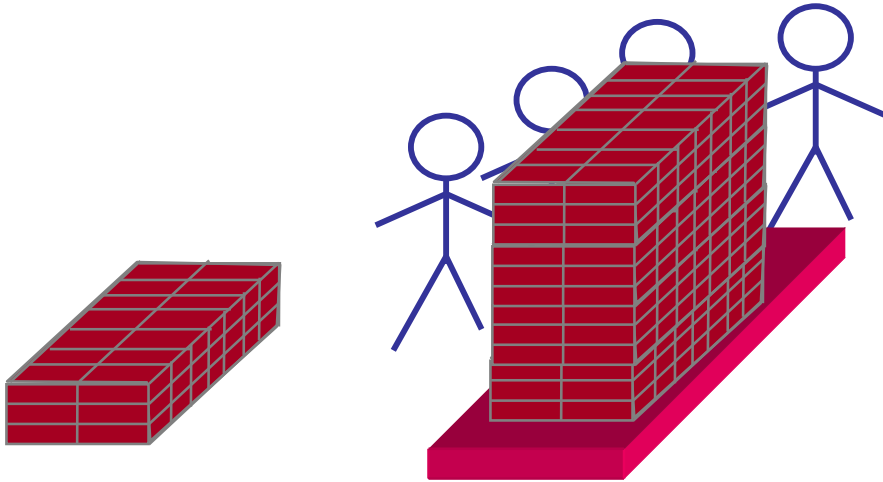
Day 2 Graphics



Earned Value

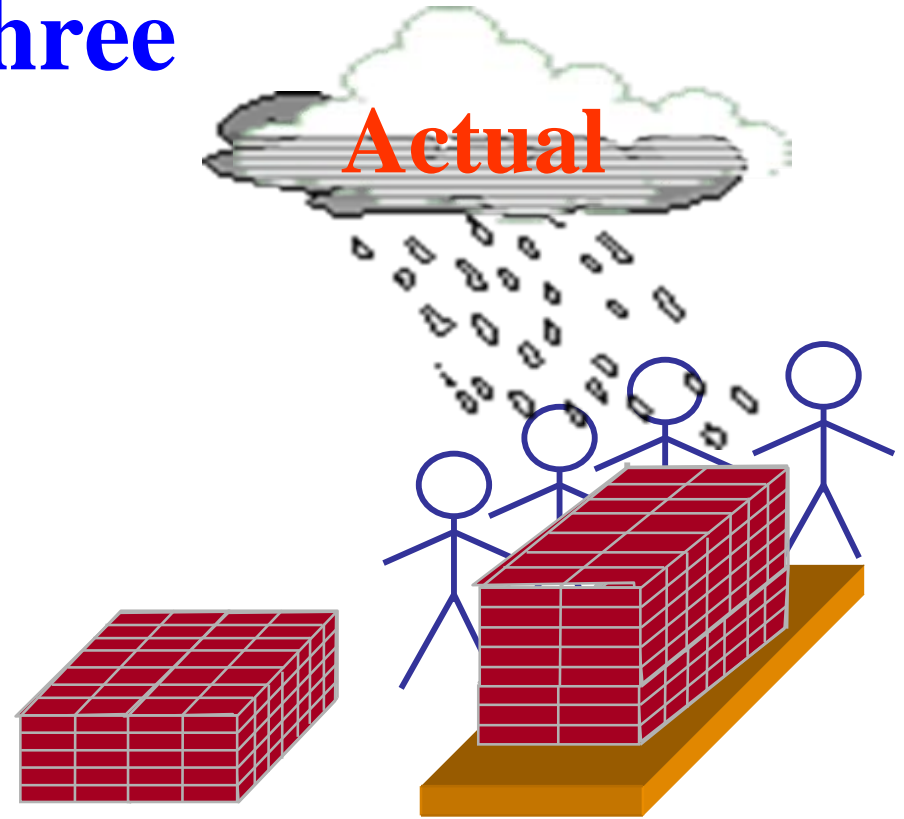
Day Three

Plan



Planned Value \$7,500

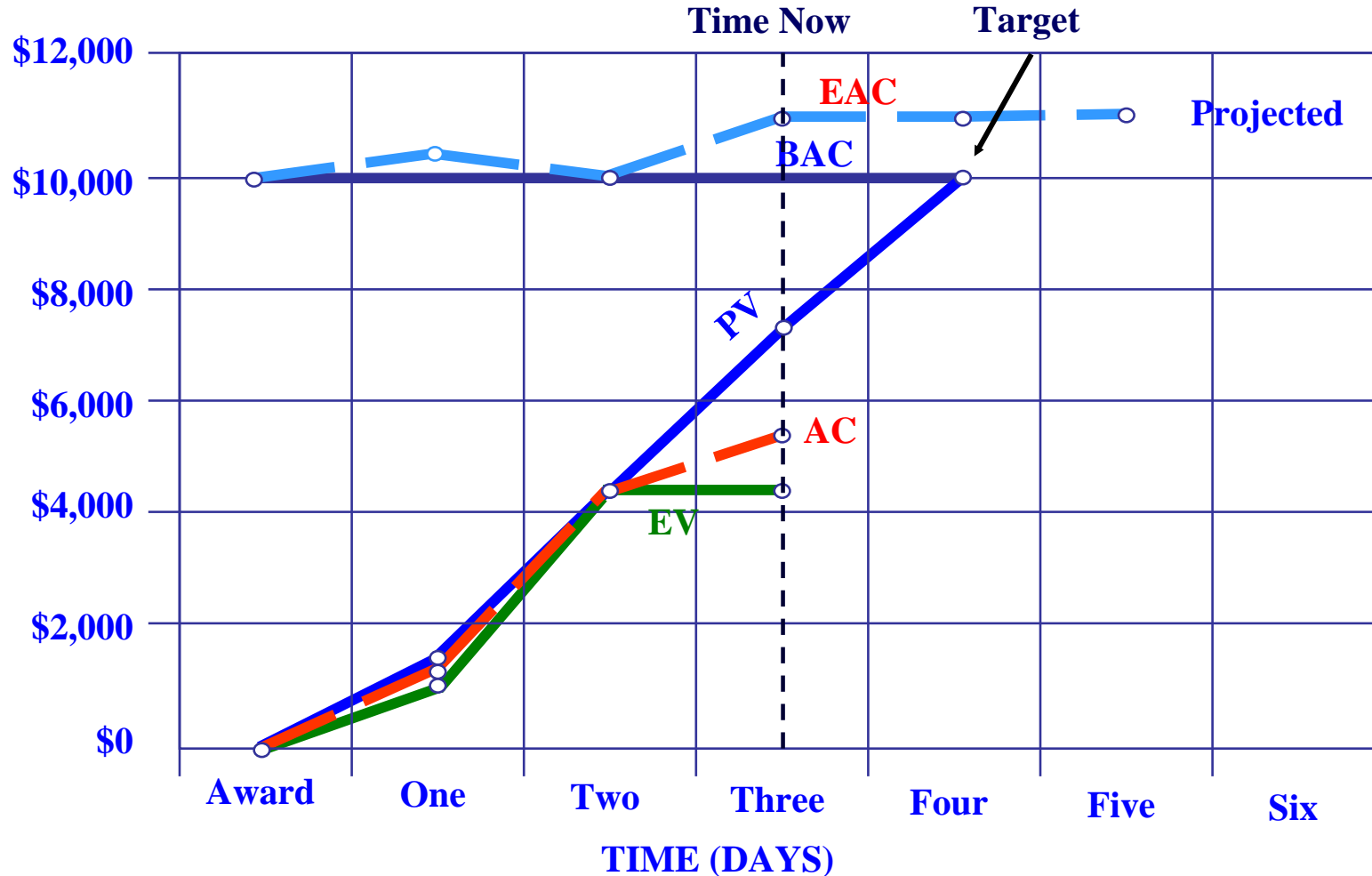
Actual



Planned Value (PV)	\$7,500	>	(\$3,000) SV
Earned Value (EV)	\$4,500	>	
Actual cost (AC)	\$5,500	>	(\$1,000) CV

Earned Value

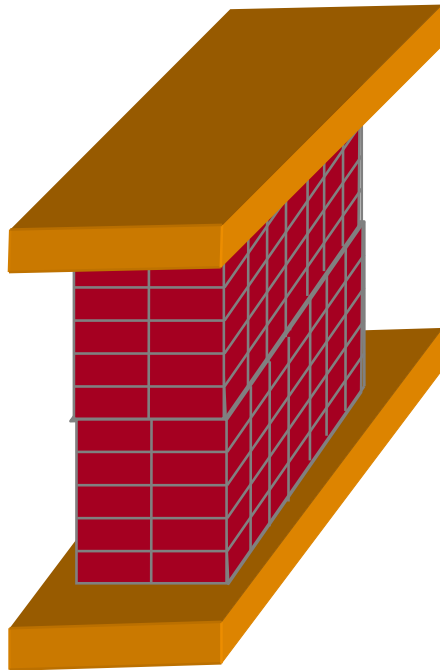
Day 3 Graphics



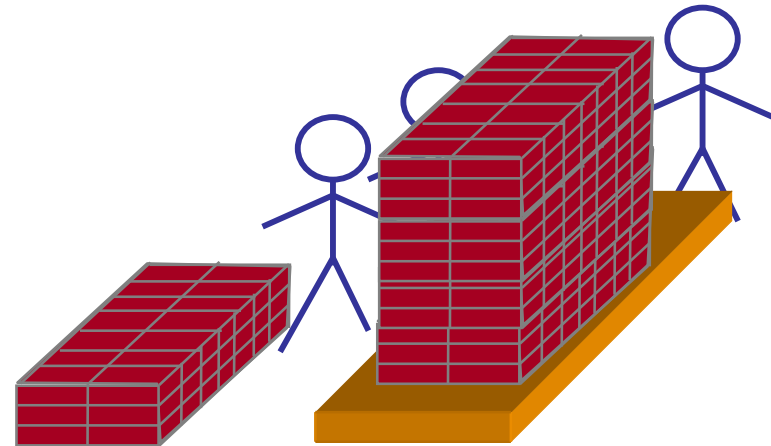
Earned Value

Day Four

Plan



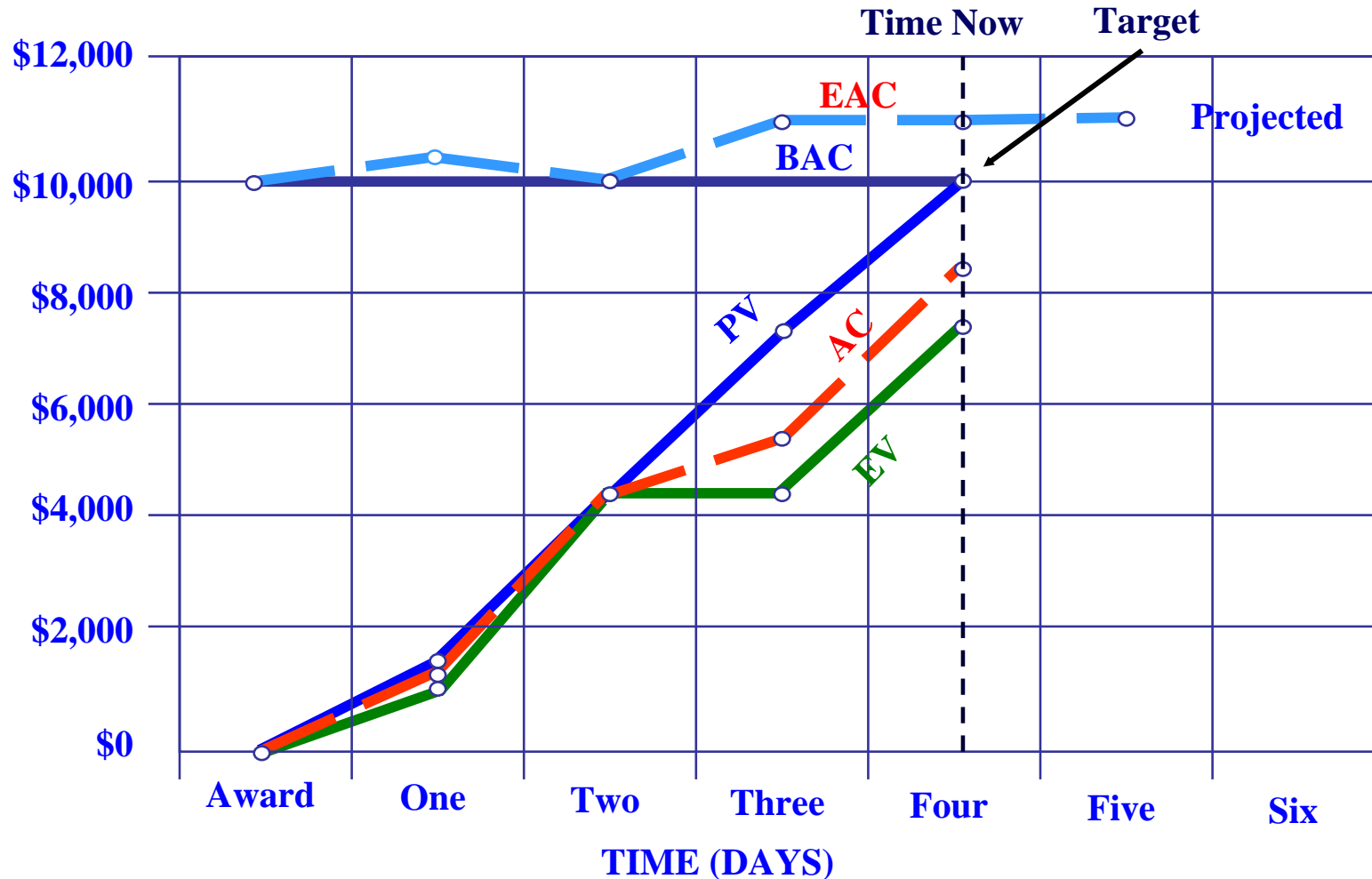
Actual



Planned Value (PV)	\$10,000	>	(\$2,500) SV
Earned Value (EV)	\$ 7,500	>	
Actual cost (AC)	\$ 8,500	>	(\$1,000) CV

Earned Value

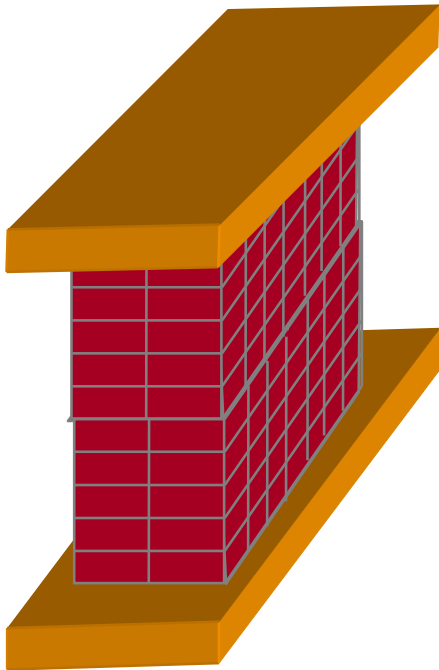
Day 4 Graphics



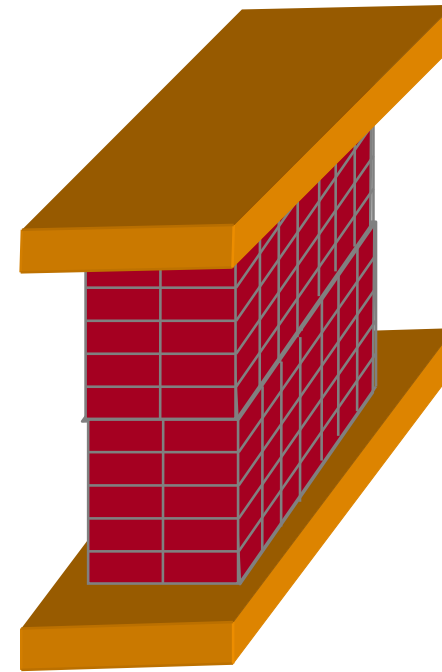
Earned Value

Day Five

Planned \$10,000



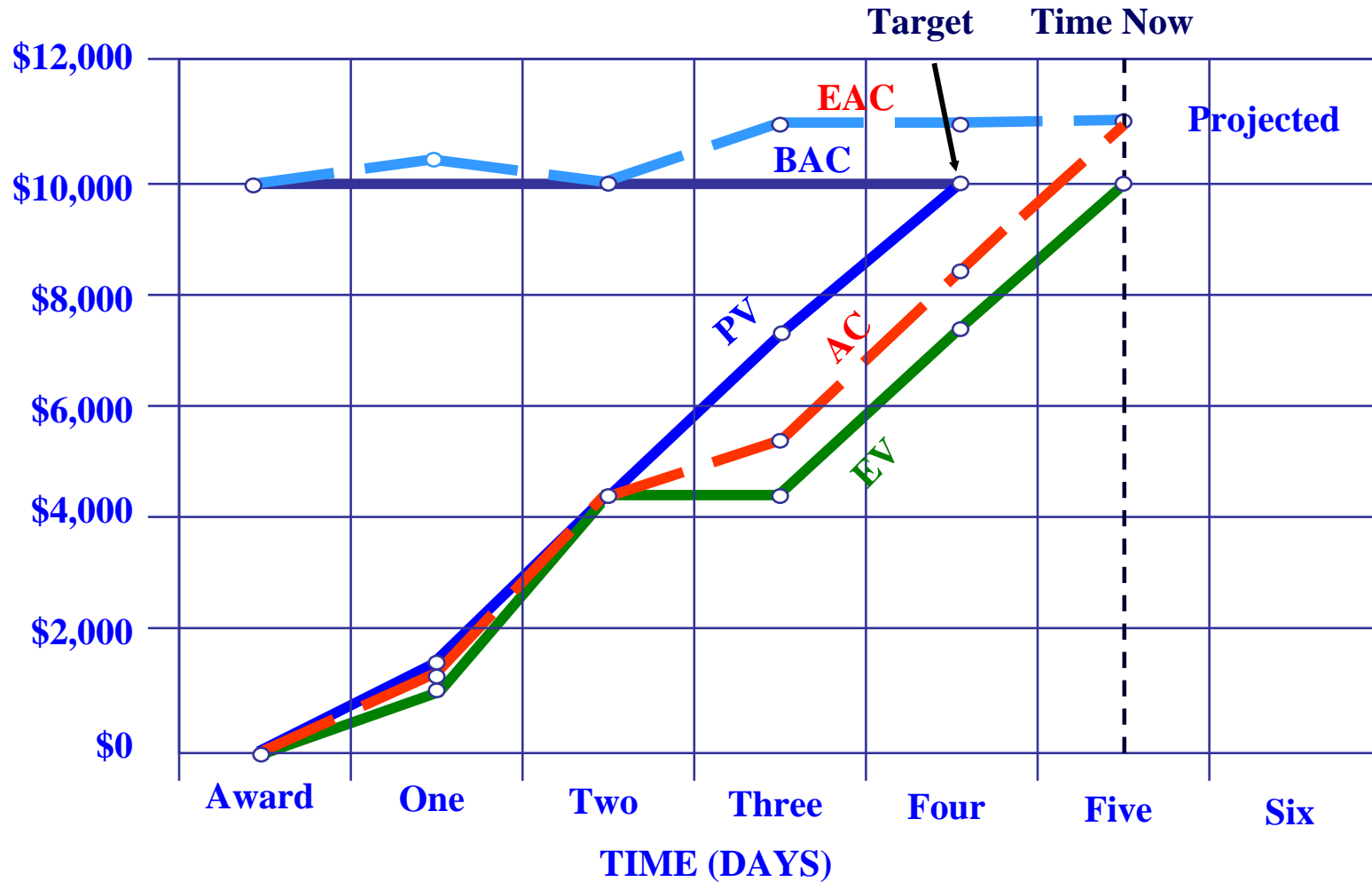
Actual \$11,000



Planned Value (PV)	\$10,000	>	(\$0) SV
Earned Value (EV)	\$10,000	>	(\$1,000) CV
Actual cost (AC)	\$11,000	>	

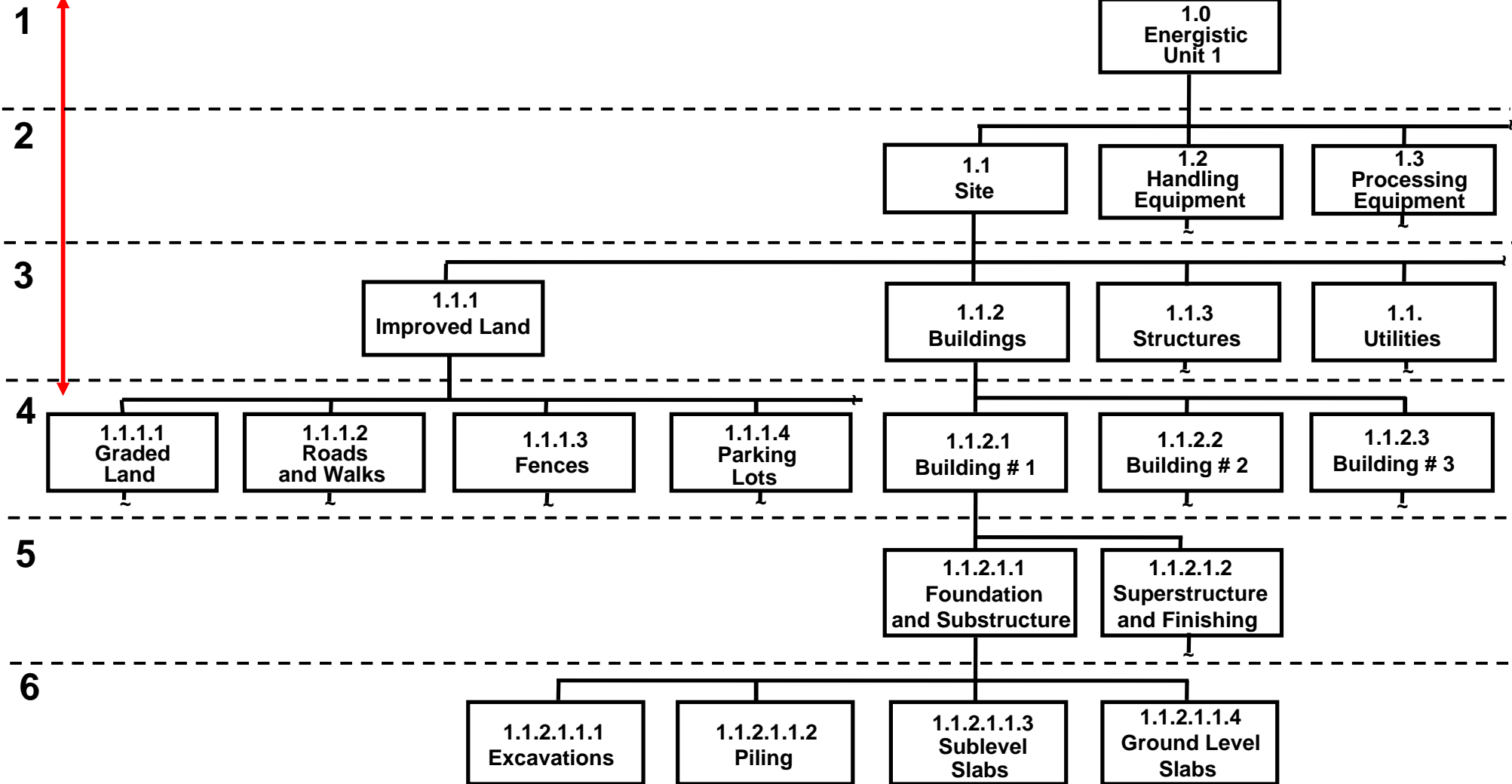
Earned Value

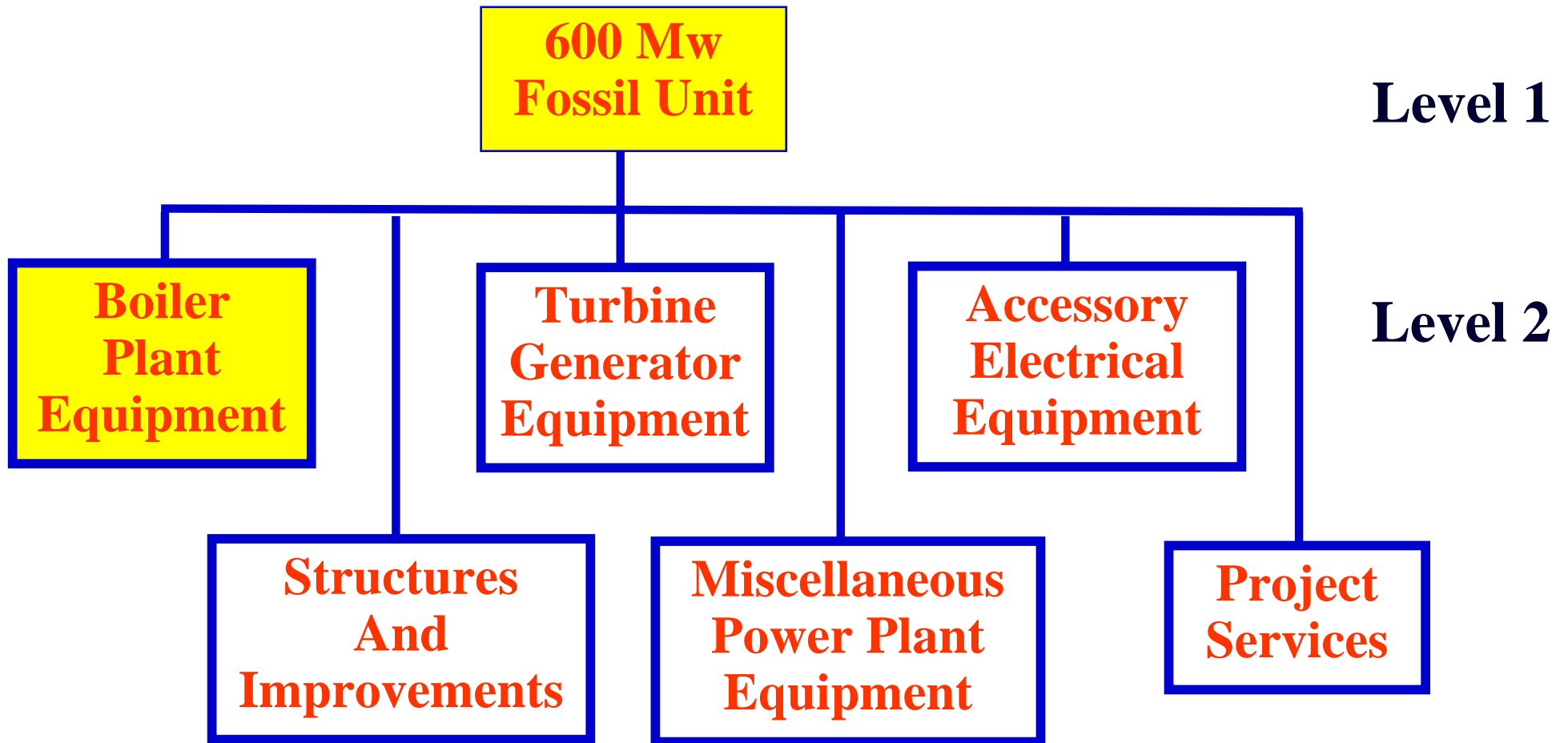
Day 5 Graphics

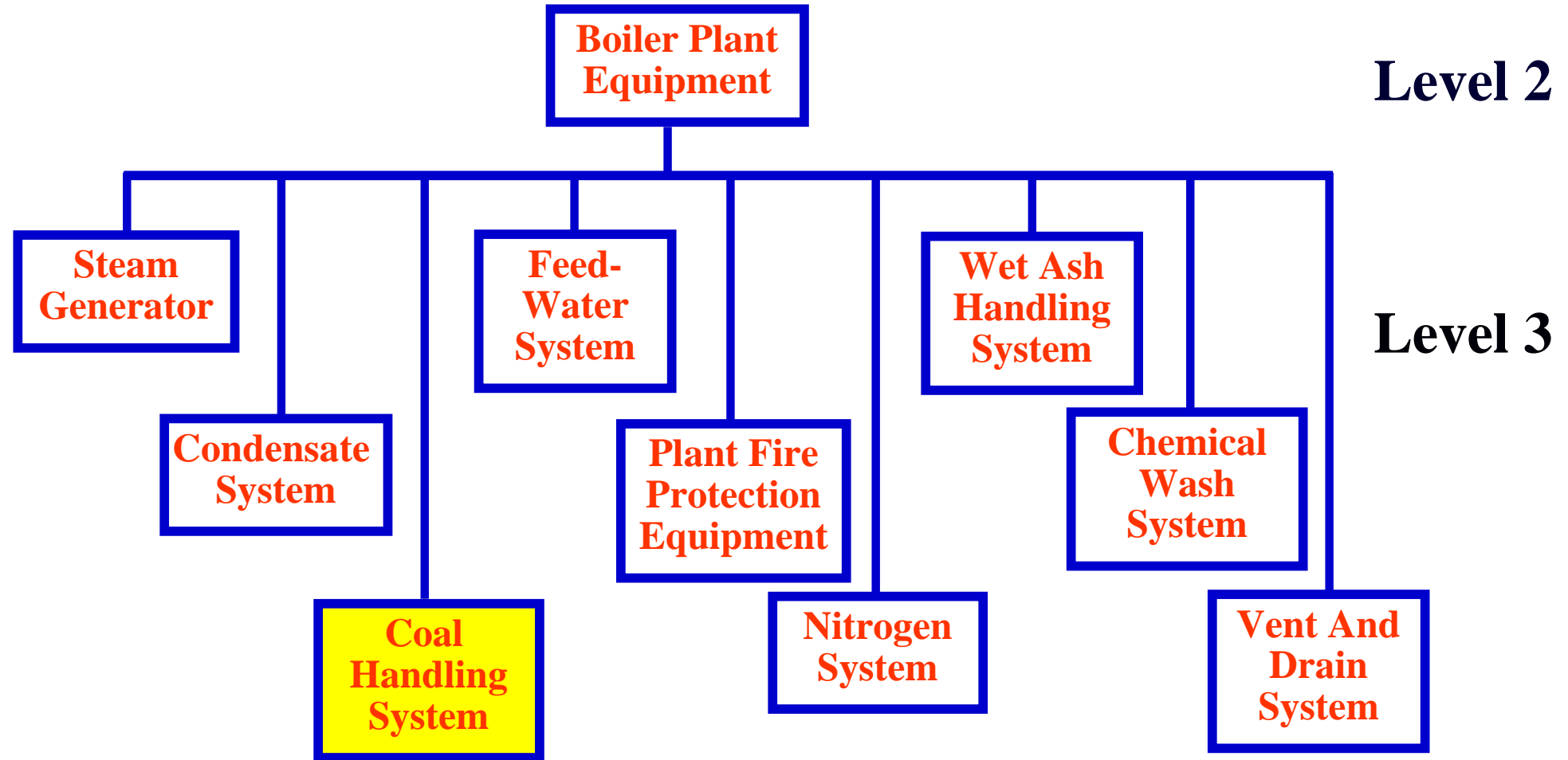


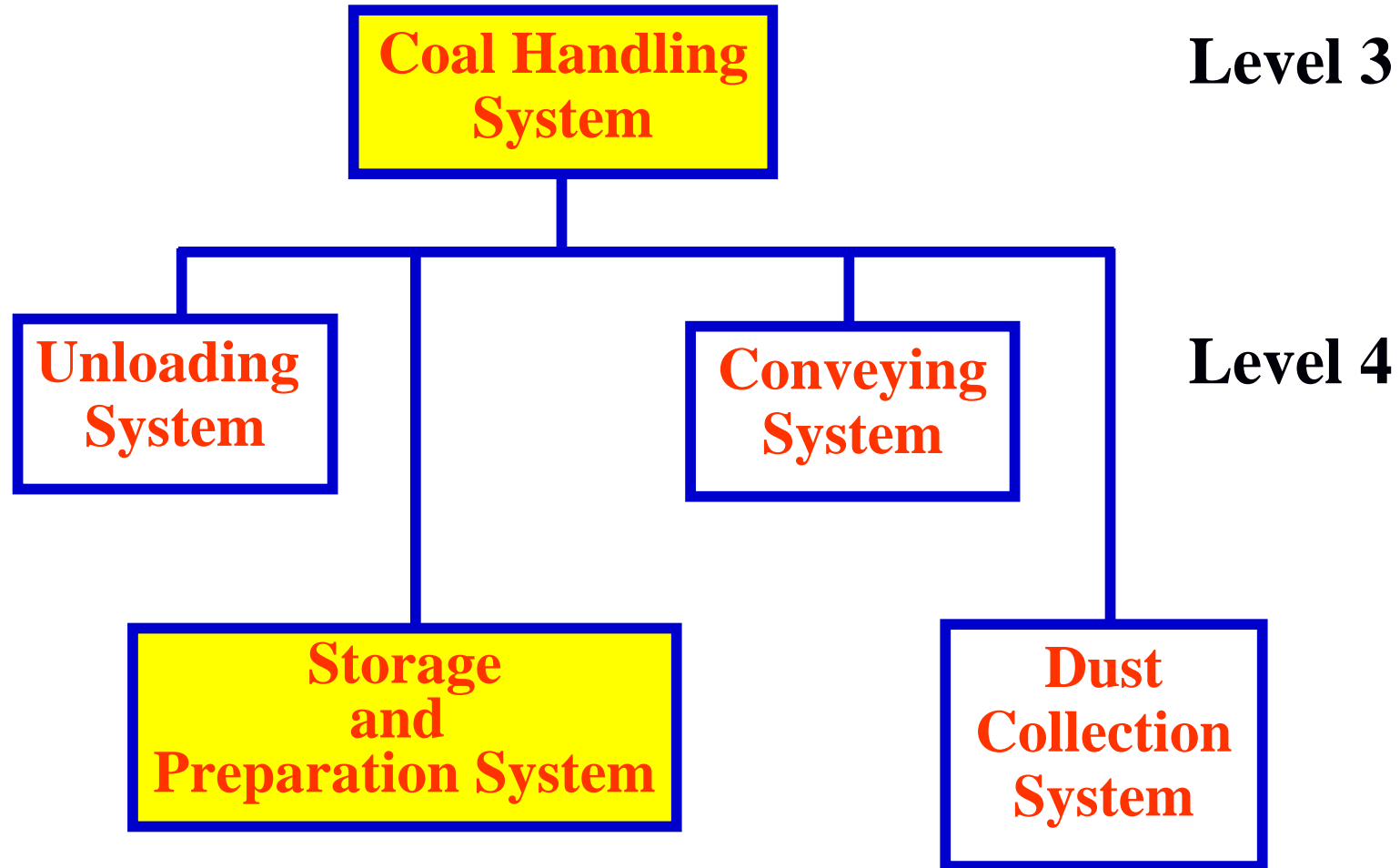
DOE project summary Work Breakdown Structure with contract WBS(s)

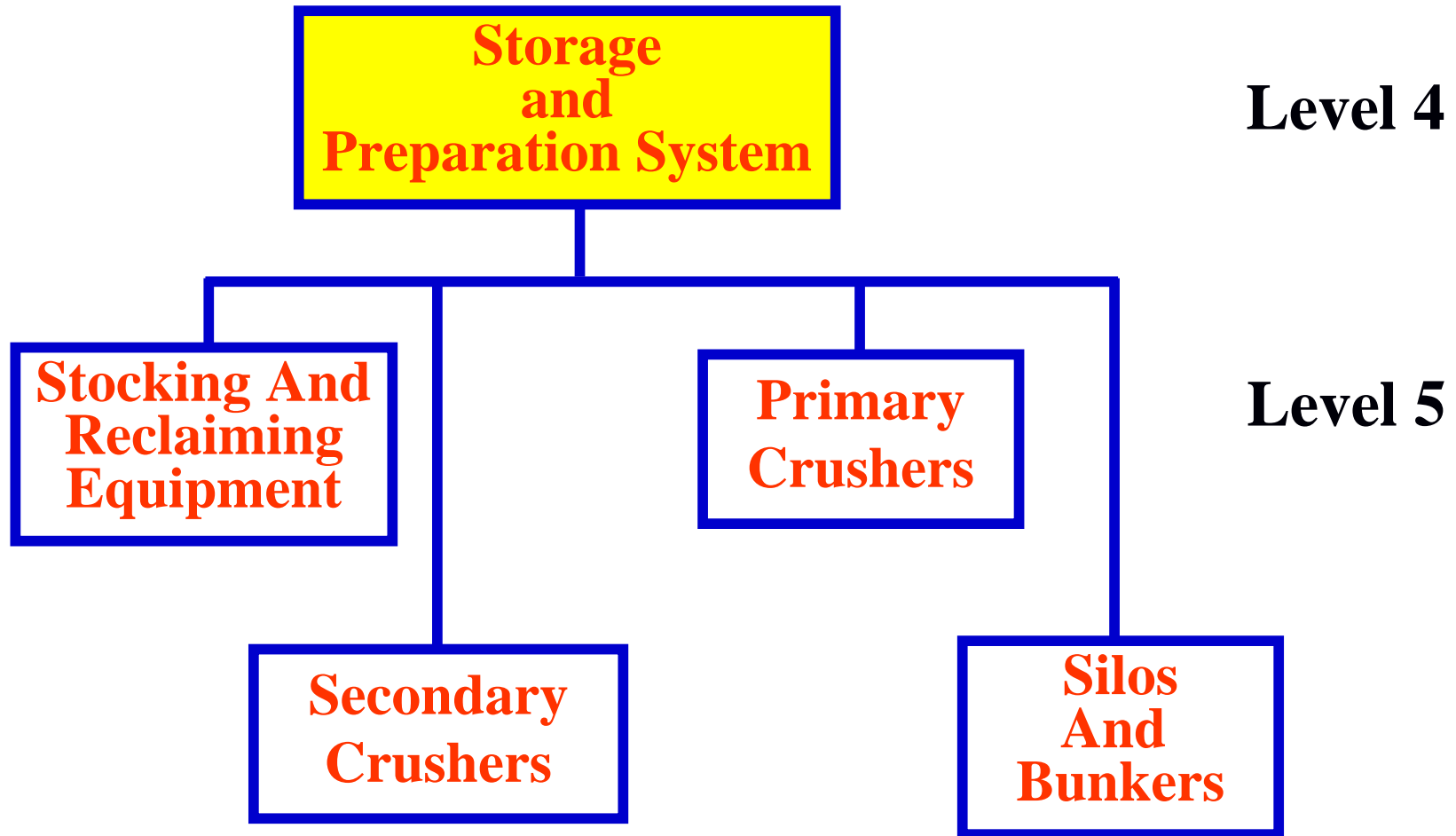
WBS Element





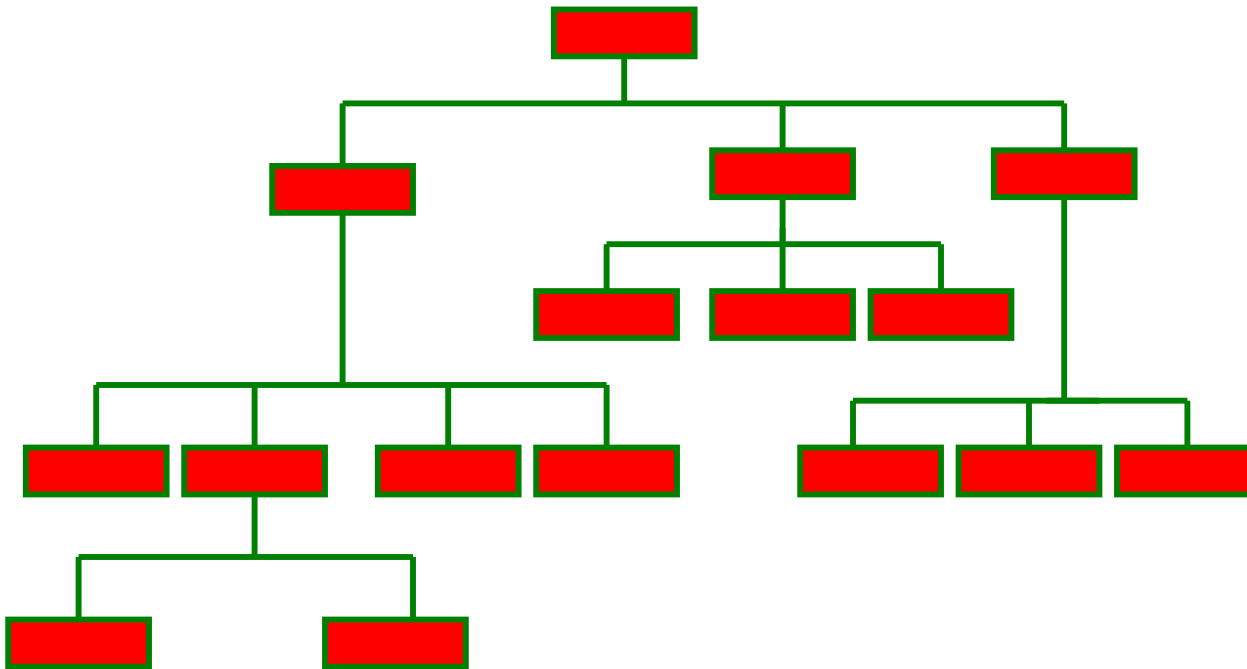






Work Definition

Work Breakdown Structure



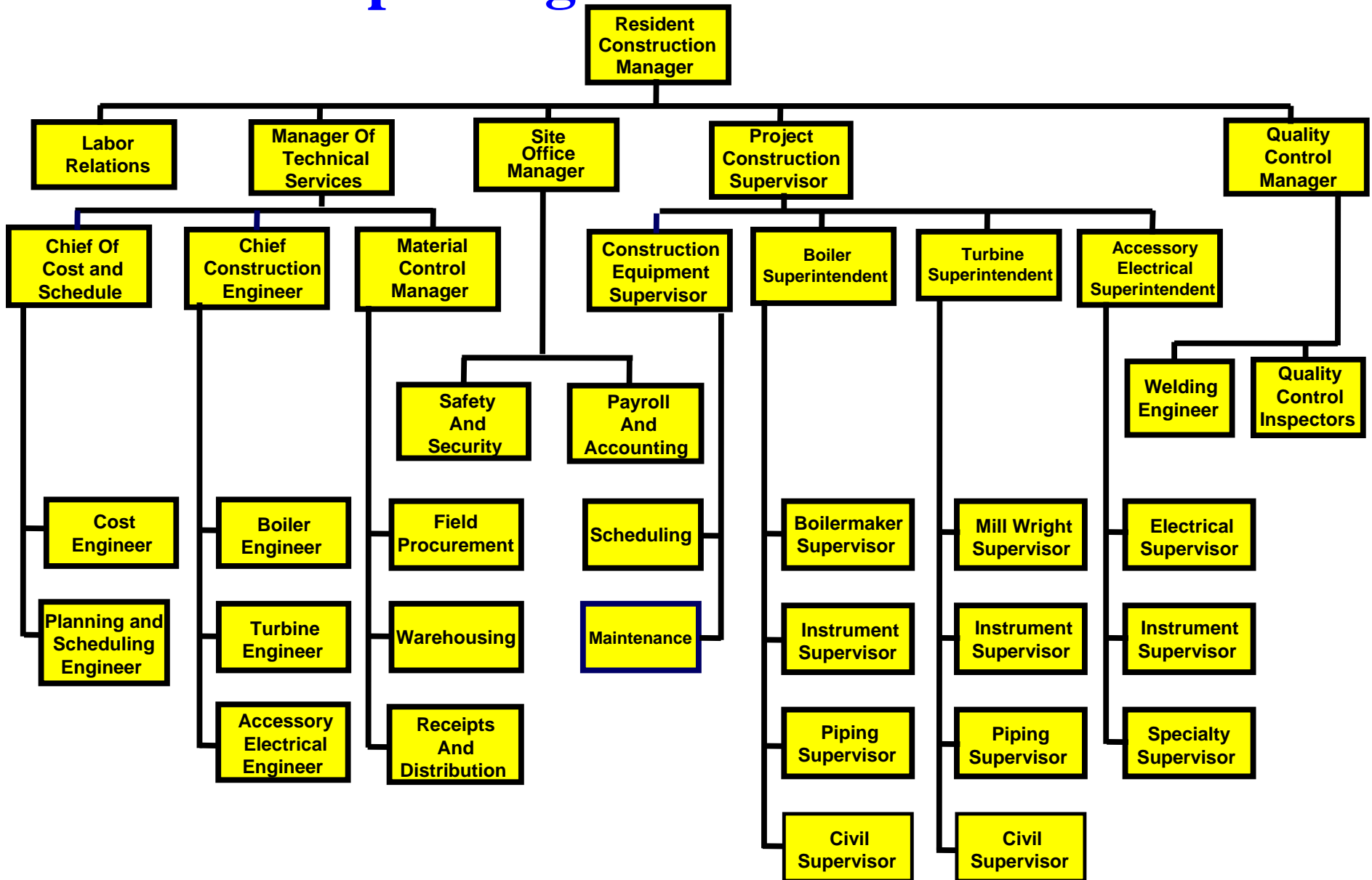
WBS DICTIONARY

A vertical list of ten horizontal white lines on a textured, light-brown background, intended for defining the tasks and sub-tasks associated with the WBS nodes.

WBS Dictionary

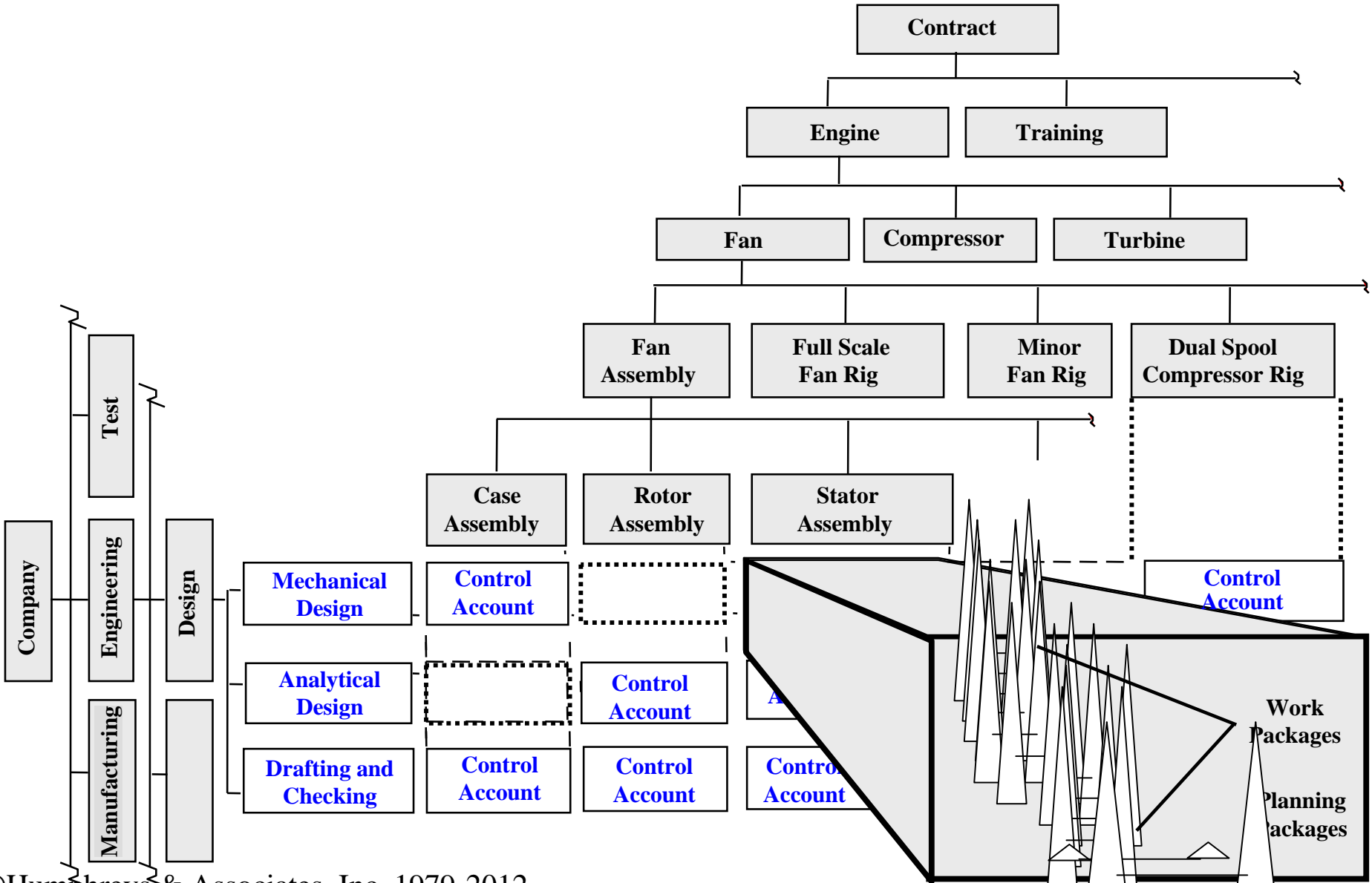
CWBS CODE	Contract Work Breakdown Structure Index	Program:	RFP NO:	Contract Plan No.
			Contract No.:	
			DATE:	
	<u>CWBS ELEMENT NAME</u>	<u>CWBS DEFINITION</u>		

Sample Organization Structure



Responsibility Assignment Matrix and Control Account Structure

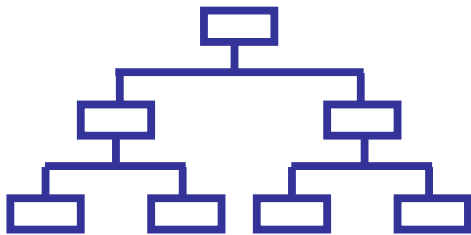
Contract Work Breakdown Structure



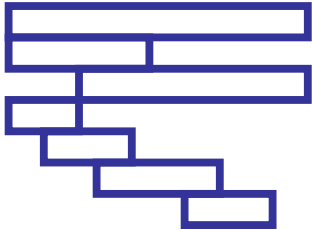
Planning & Budgeting

Establish the baseline - an iterative 3 - step process

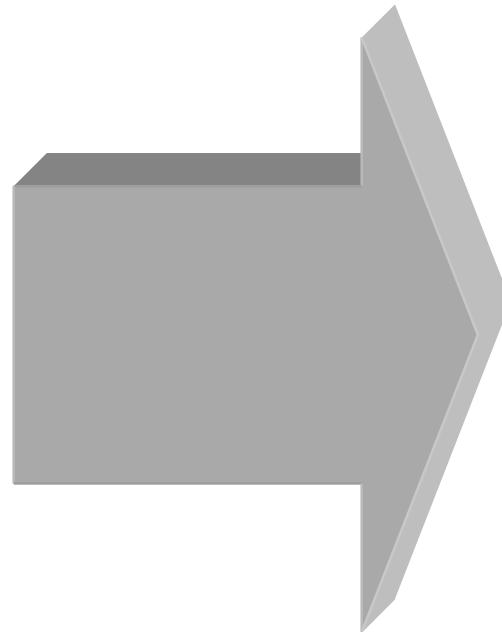
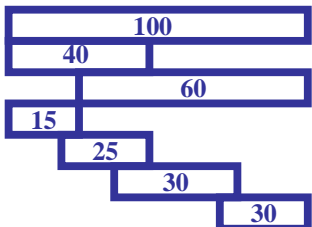
1. Define the Work



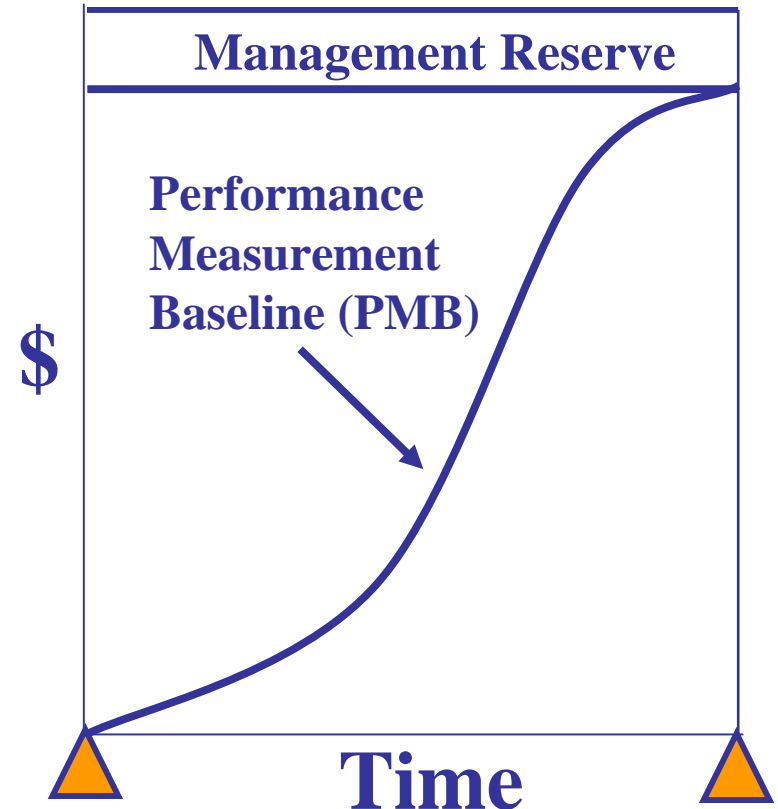
2. Schedule the work



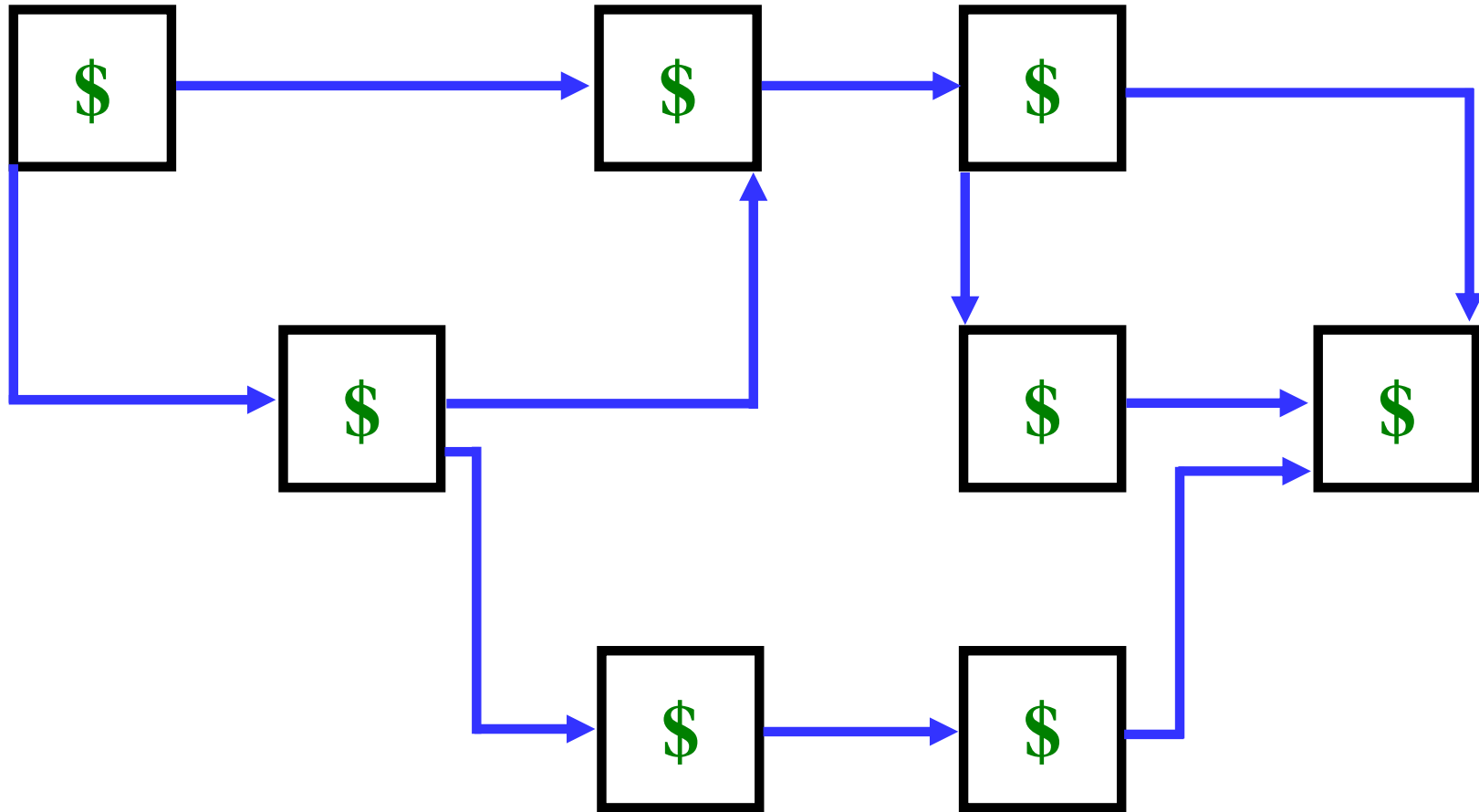
3. Allocate budgets



Contract Budget Base



Estimating Is Tied To Scheduling



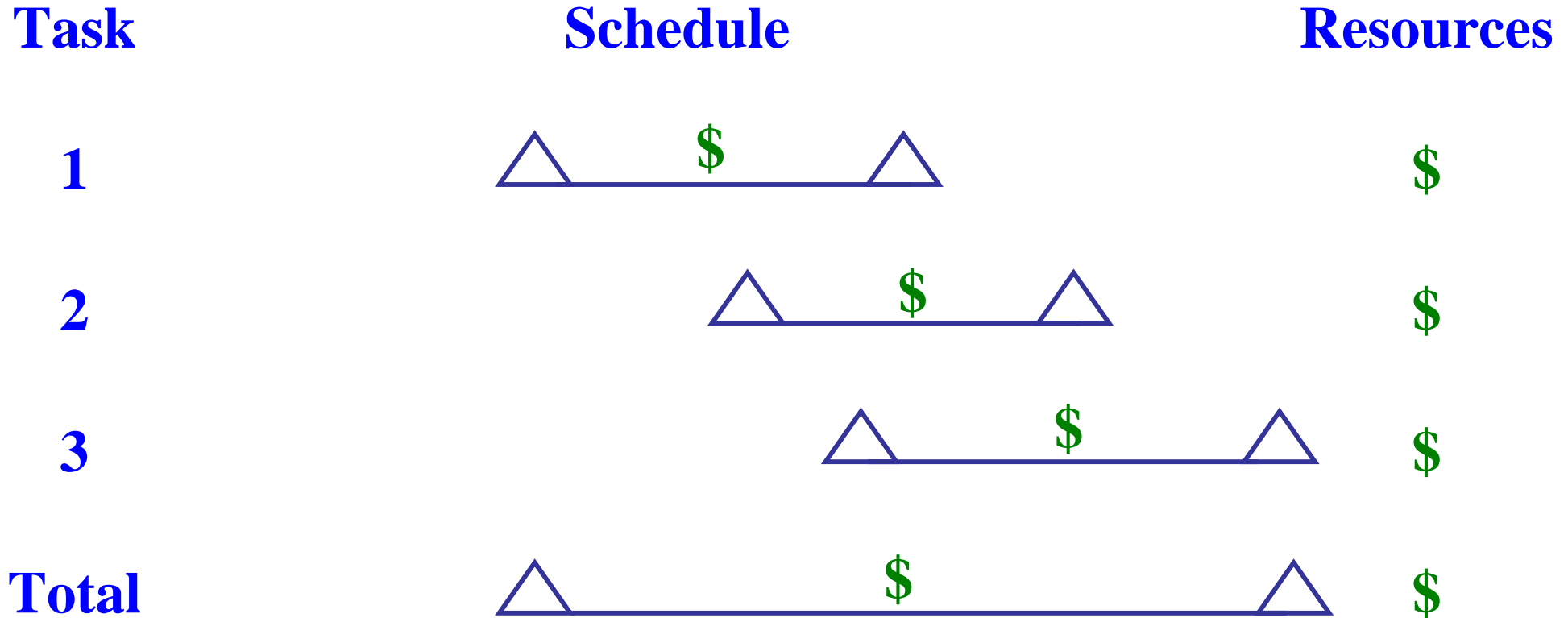
Budget Summary

Functional Organizations

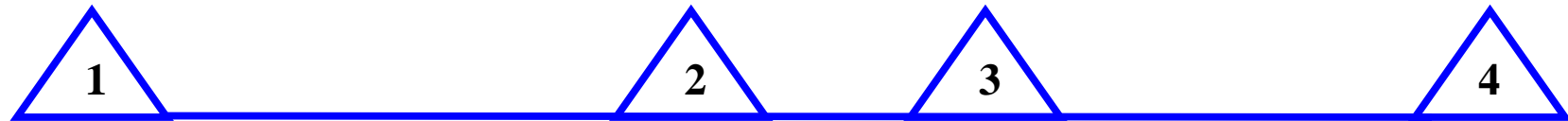
Work Breakdown Structure Functional Organizations			1.0 Total Program							Organization Budgets	
			1.1			1.2			1.3		
			1.1.1	1.1.2	1.1.3	1.2.1	1.2.2	1.2.3	1.3.1		1.3.2
Top Level Organization	Org. A	Organization A1	1			5			14		20
		Organization A2			12			7		14	33
		Organization A3		4							4
	Org. B	Organization B1				3	12				15
		Organization B2	4		2			3			9
	Org. C	Organization C1	3							1	4
WBS Element Budgets			8	4	14	8	12	10	14	15	85
Undistributed Budget (UB)											5
Performance Measurement Baseline (PMB)											90
Management Reserve (MR)											10
Contract Budget Base (CBB)											100

By Providing A Time-Phased Budget for Each Control Account

Control Account



Incremental Milestone---Planning



Milestone

Planned Value

1

300

2

1,200

3

1,200

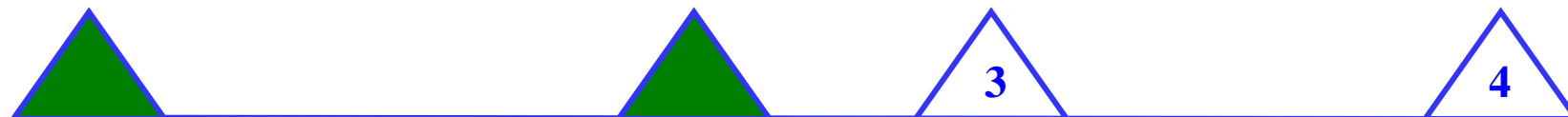
4

600

Totals

3,300

Incremental Milestone---Status



Milestone

Planned Value

Earned Value

1	300	300
2	1,200	1,200
3	1,200	0
4	600	0
Totals	<u>3,300</u>	<u>1,500</u>

Units Complete---Planning

Month	January	February	March	April	Total
Budget Feet	1,500	2,000	2,200	1,000	6,700
Budget @ \$100 per foot	\$150,000	\$200,000	\$220,000	\$100,000	\$670,000

Units Complete---Status

Month	January	February	March	April	Total
Budget Feet	1,500	2,000	2,200	1,000	6,700
Budget @ \$100 per foot	\$150,000	\$200,000	\$220,000	\$100,000	\$670,000
Quantity Installed	1,000	2,000	2,000	1,700	6,700
Earned @ \$100 per foot	\$100,000	\$200,000	\$200,000	\$170,000	\$670,000

Percent Complete

Month	January	February	March	April	BAC
PV	150	185	250	200	785

Date



**Status of work depends upon individual evaluation
of work accomplished**

Example Of Apportioned Effort

*Inspection estimated as 10% of related
production Control Account*

	<u>Planned Value</u>		<u>Earned Value</u>	
	<u>Production Control Account</u>	<u>Inspection Control Account</u>	<u>Production Control Account</u>	<u>Inspection Control Account</u>
June	200	20	150	15
July	500	50	450	45
Aug	100	10	150	15
	<hr/>	<hr/>	<hr/>	<hr/>
Total	800	80	750	75

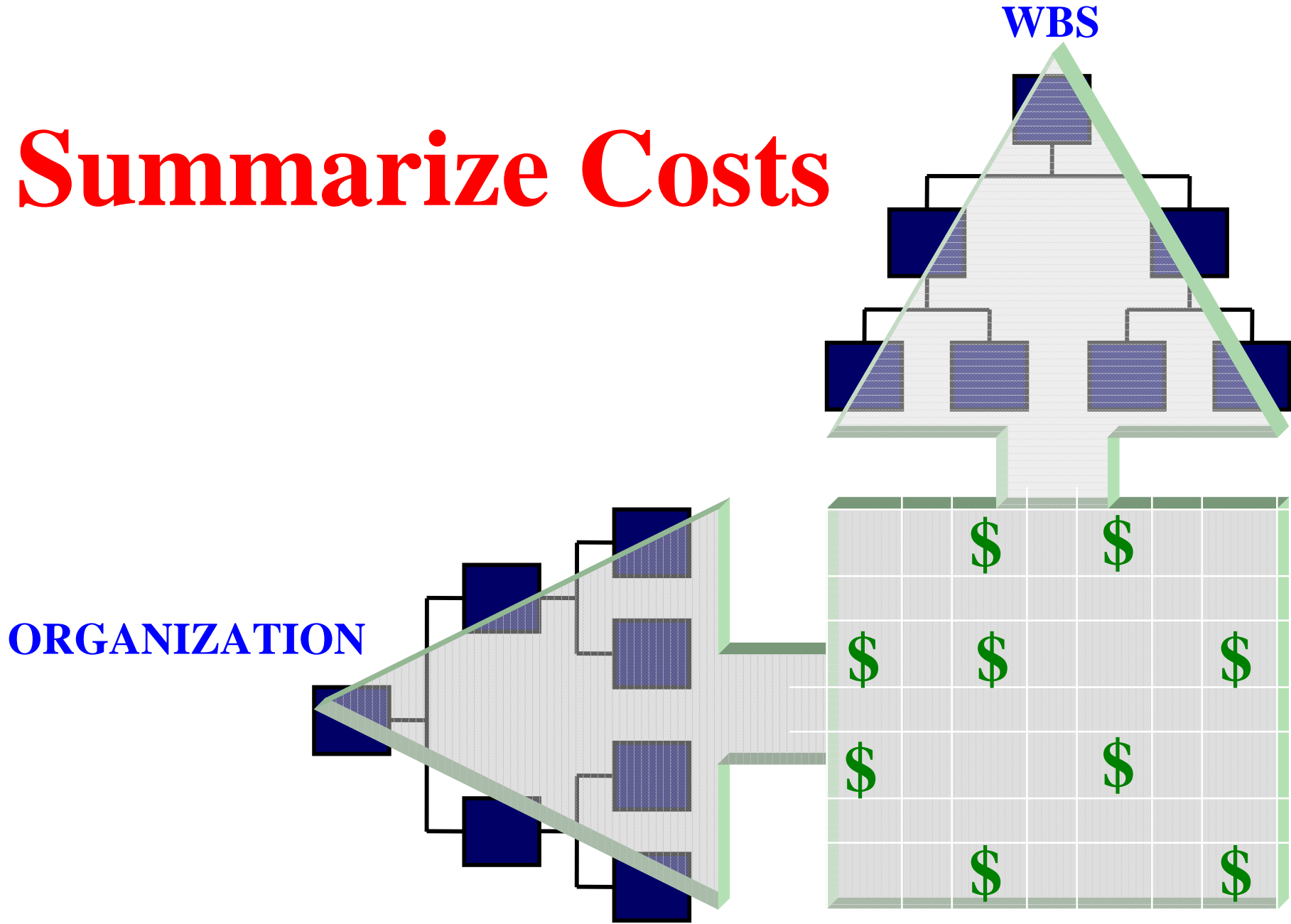
Level Of Effort (LOE)---Planning

Month	Jan	Feb	Mar	April	May	Jun	Jul	BAC
PV	100	100	150	200	200	200	200	1150

Date



Summarize Costs



Performance Measurement Approach

Earned Value - **Planned Value** = **Schedule Variance**

\$70,000 - **\$76,000** = **(\$6,000)**

Earned Value - **Actual Costs** = **Cost Variance**

\$70,000 - **\$80,000** = **(\$10,000)**

Variance Analysis Traceability

Work Breakdown Structure Total Contract WBS Level 1

Functional Organization Total Division

WBS Level 2 Element Detail

Element variance	
21	(1.2)
22	0.5
23	(10.0)
24	1.6

Contracts variance	
X	(12.0)
Y	3.2
Z	6.3

Contract
Summary

WBS Level 3 Element 23 Detail

Element variance	
31	(8.0)
32	(0.2)
33	(1.2)
34	(0.6)

Functions Variance	
MFG	2.1
ENG	(14.0)
Tool	0.9
QA	(1.0)

Contract X
Functional
Responsibility
Detail

WBS Level 4 Element 31

Element variance	
45	0
46	(10.0)
47	0.8
48	1.2

Engineering Variance	
Systems	(1.9)
Design	(0.1)
Test	(9.0)
Research	(3.0)

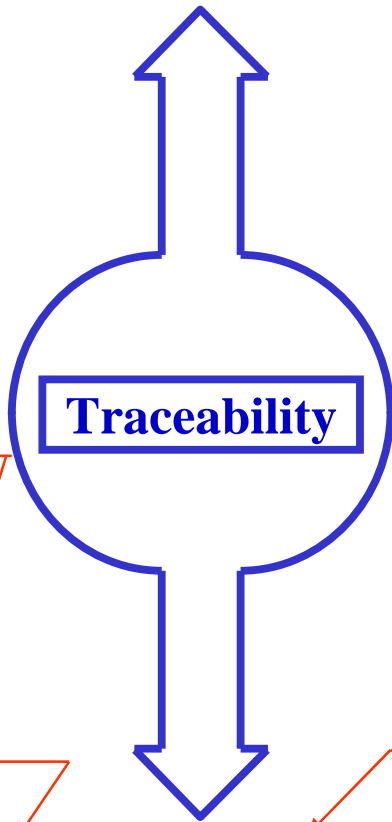
Contract X
Engineering
Departments
Detail

Control Accounts Element 46 Detail

Engineering Control Acct	Test Var.
C/A 302	(0.5)
C/A 306	(1.5)
C/A 308	(6.0)
C/A 315	(0.6)

Control Accounts Engineering Test Detail

To work package detail



Variance Analysis Report

Title: Condensing System

Number: 62-091-1-82-6

Report Period: July

	Planned Value	Earned Value	Actual Cost	Schedule Variance	VAR %	Cost Variance	VAR %
(\$000)							
Current	30	20	22	(10)	(33)	(2)	(10)
Cumulative	380	300	330	(80)	(21)	(30)	(10)
	1,200			1,300			(100)
	Budget At Complete			Estimate At Complete			Variance At Complete

Problem Analysis

Impact

Corrective Action Plan

Estimate At Completion Justification

Control Account Manager

Approvals

Signature

Date

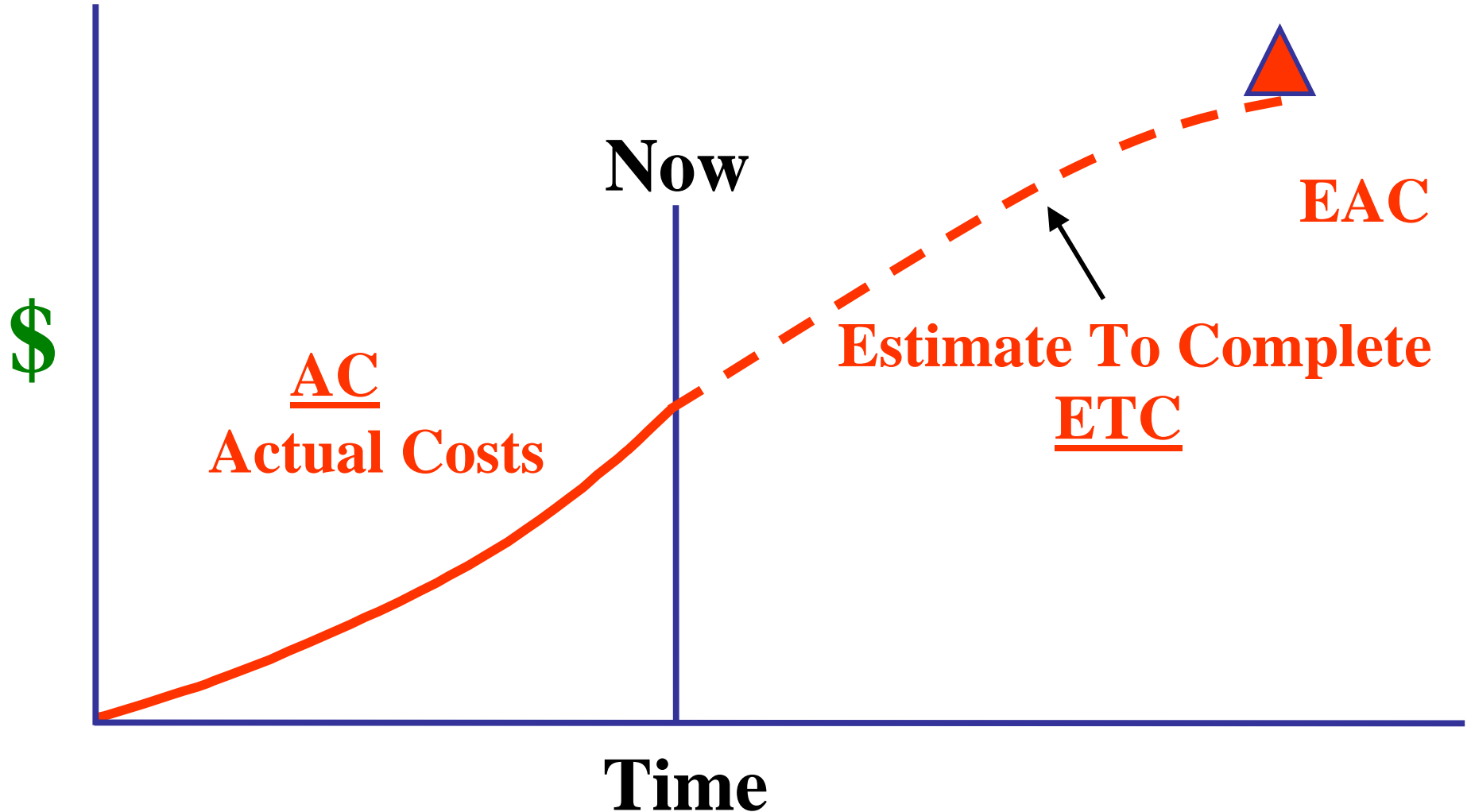
Signature

Date

Title

Title

Estimate At Completion



Cost Performance Index (CPI)

$$\text{CPI}_e = \frac{\text{Earned Value}}{\text{Actual Cost}} = \frac{70,000}{80,000} = 0.875$$

OR

$$\text{CPI}_p = \frac{\text{Actual Cost}}{\text{Earned Value}} = \frac{80,000}{70,000} = 1.142$$

“To Complete” Performance Index (TCPI)

$$\text{TCPI} = \frac{\text{Planned Value for remaining work}}{\text{Estimate for remaining work}} = \frac{\text{BAC} - \text{EV}_{\text{Cum}}}{\text{EAC} - \text{AC}_{\text{Cum}}}$$

$$\text{TCPI} = \frac{210,000 - 70,000}{230,000 - 80,000} = \frac{140,000}{150,000} = .93$$

Performance Indices Comparison

CPI_E

TCPI

Performance to date

Projected performance

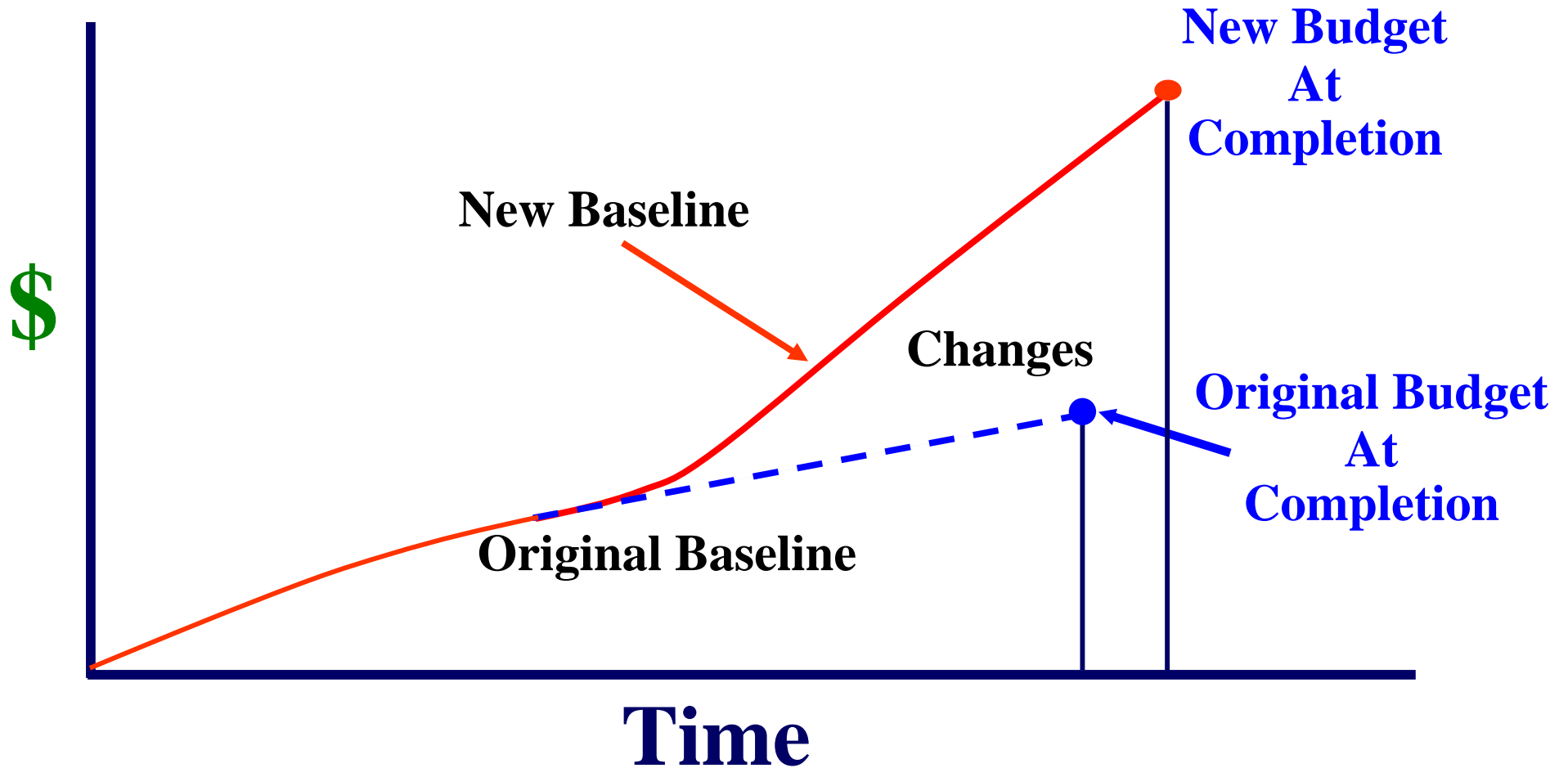
0.875

.93

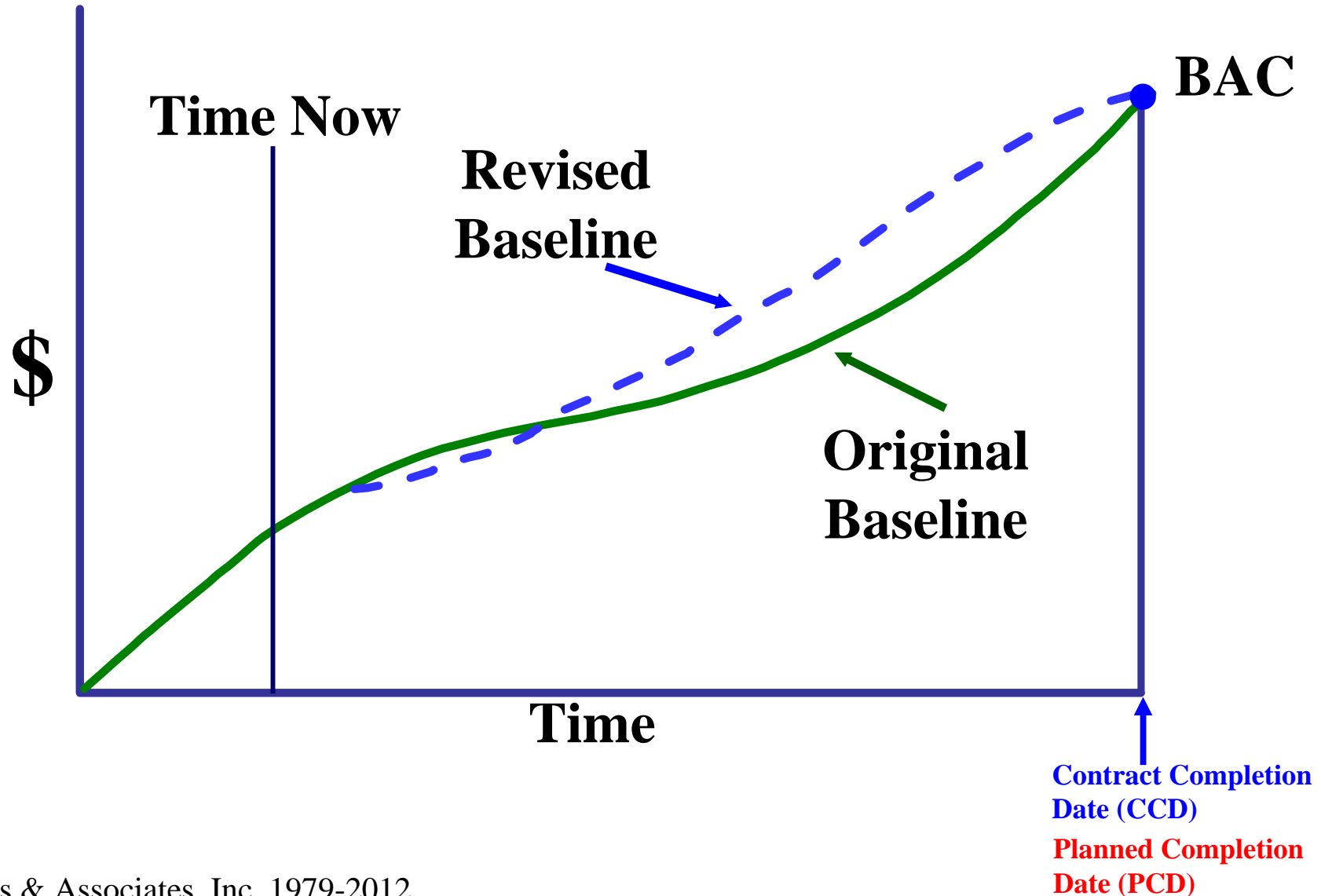
For every \$1.00 of actual cost we earned \$0.875 worth of work planned

For every \$1.00 of cost we estimate to earn \$.93 worth of work planned to finish on **EAC**

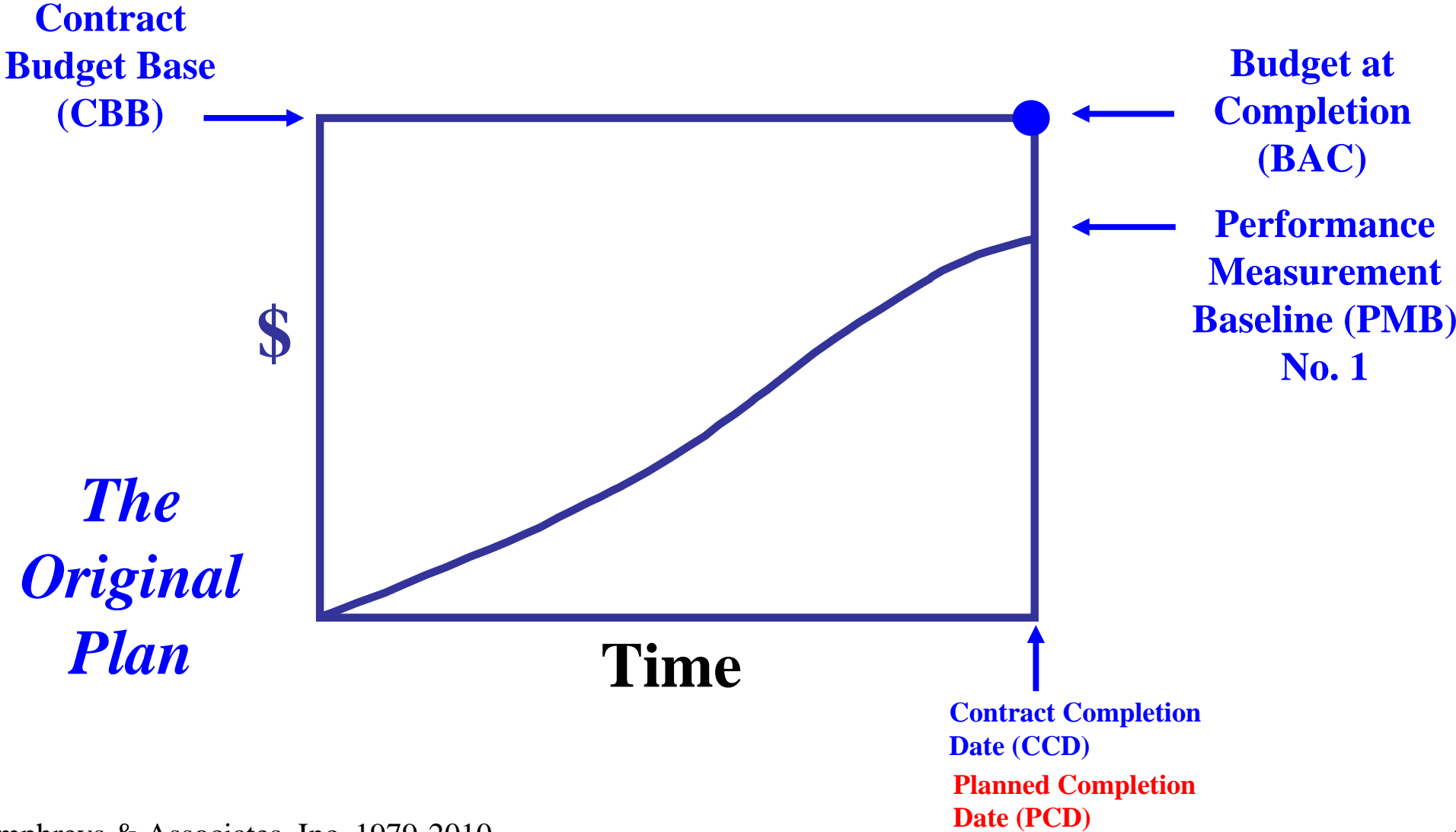
Effect Of Changes



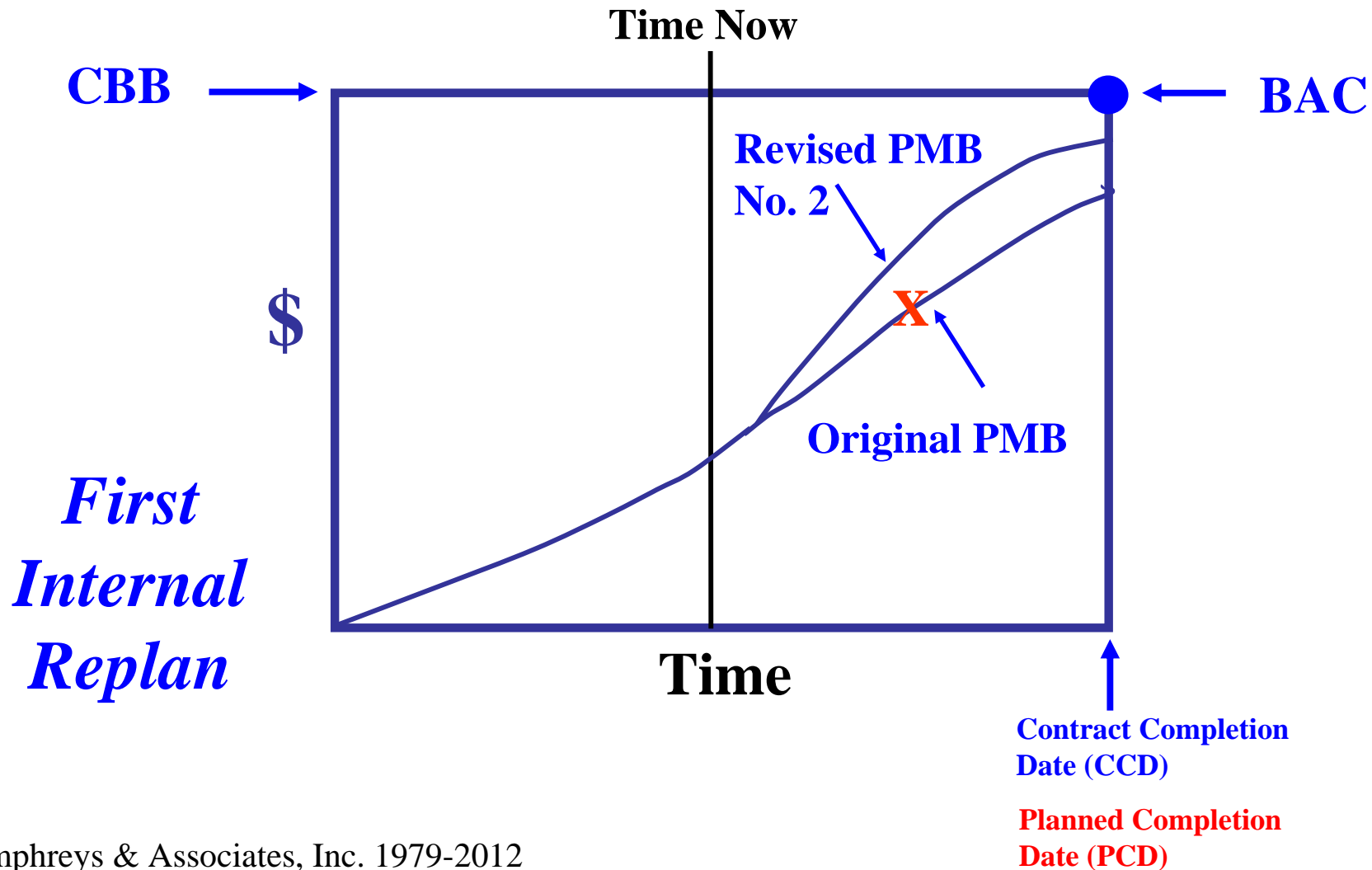
Internal Replanning



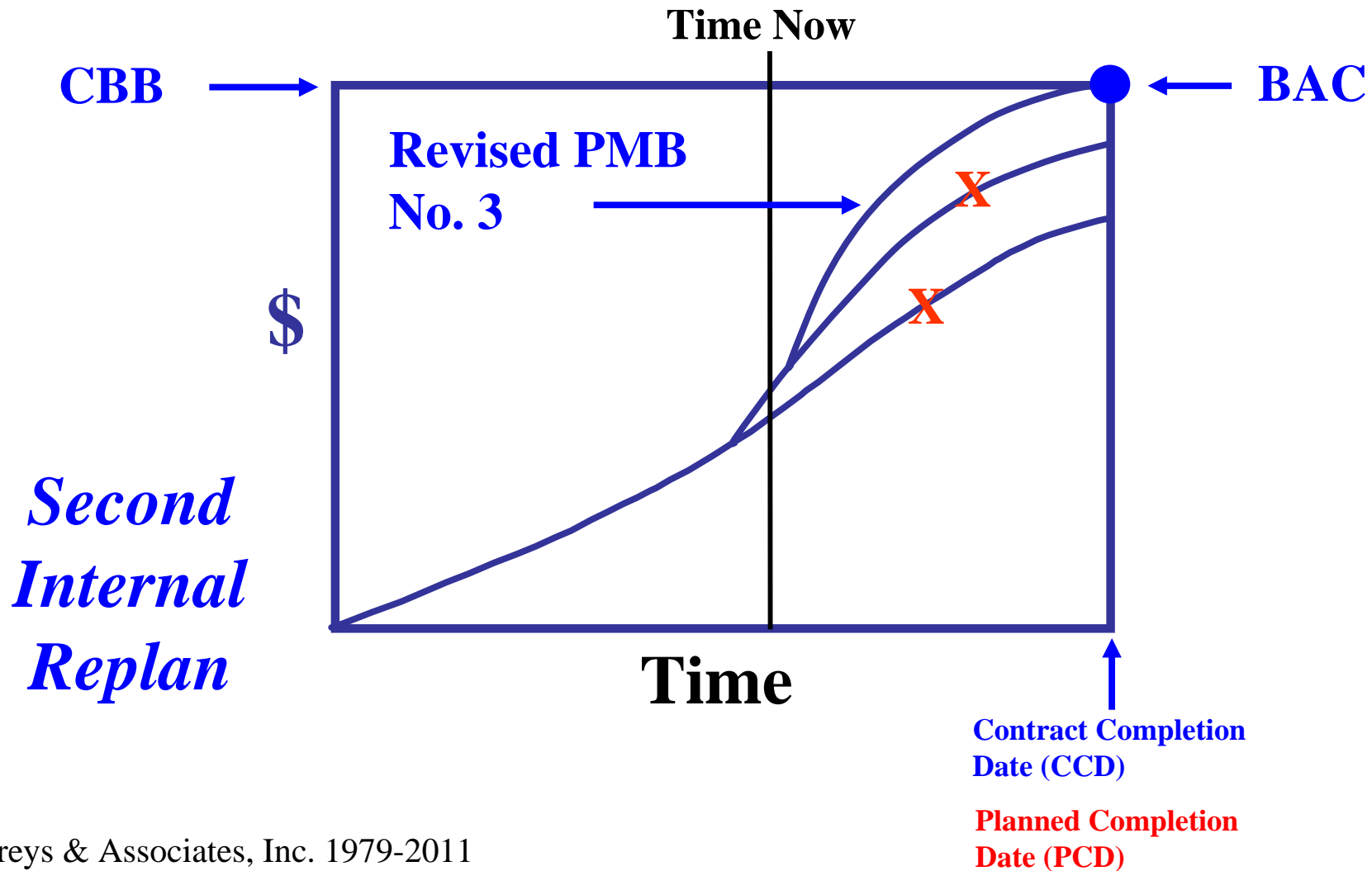
Revisions



Internal Replanning

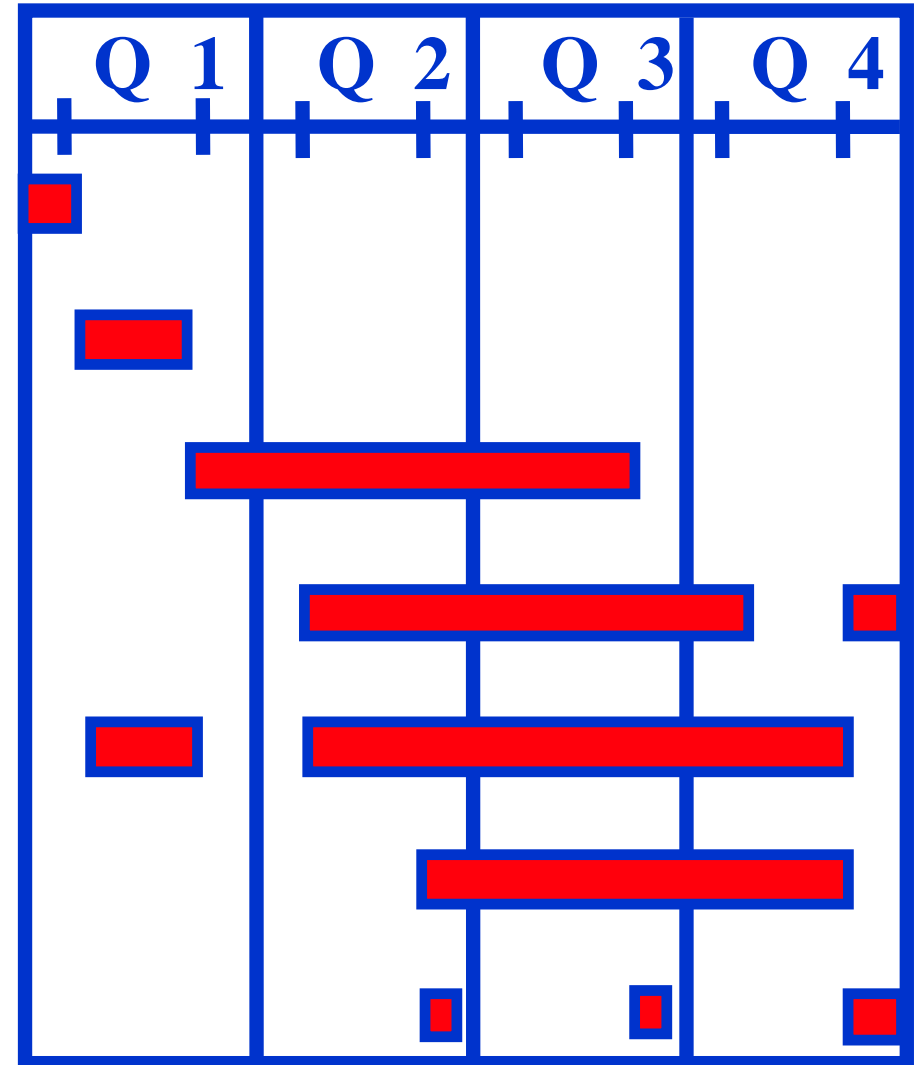


Internal Replanning



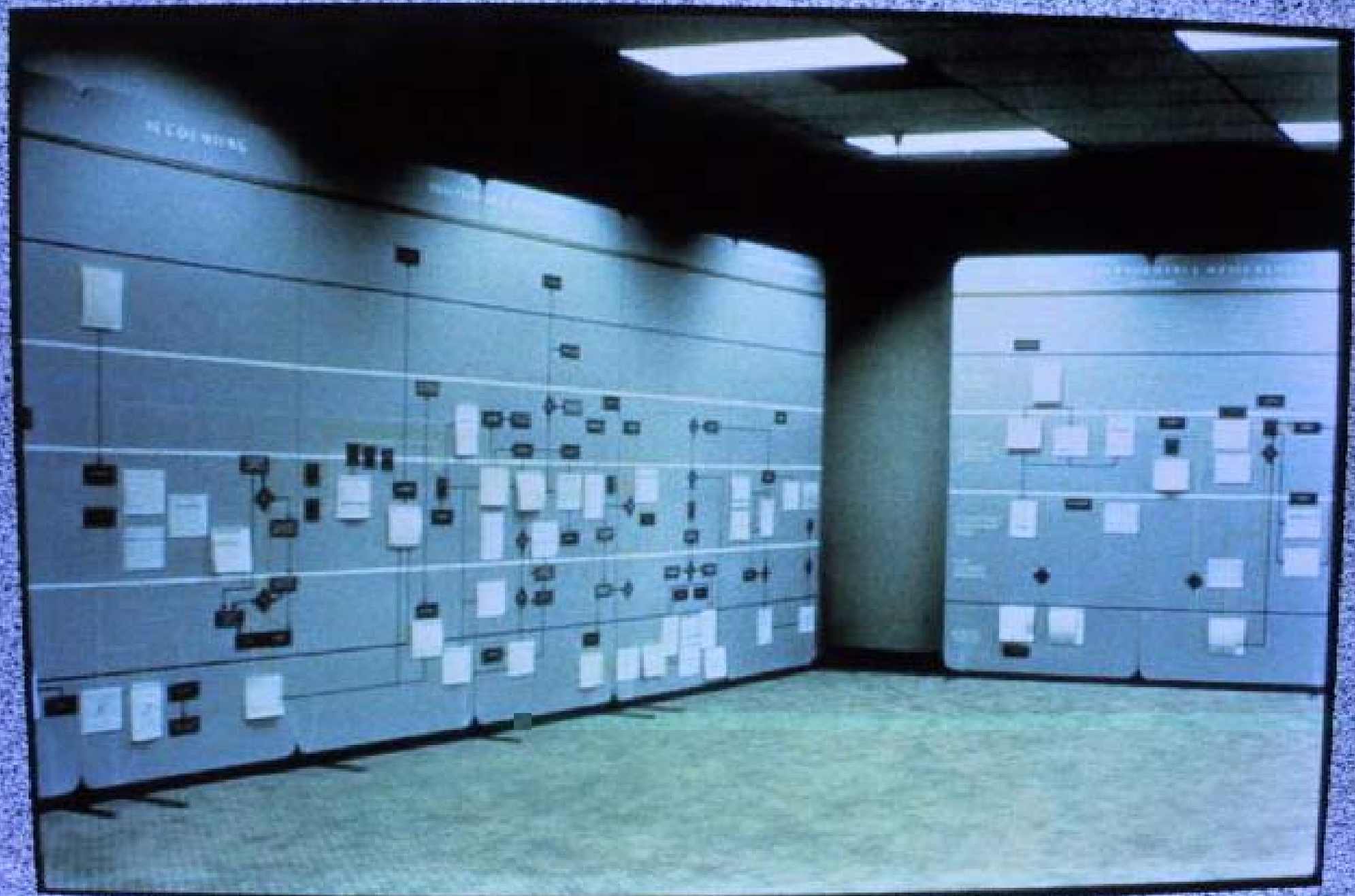
Implementation Schedule

1. Organization & Start up
2. Assessment
3. Design
4. Documentation
5. Training
6. Implementation
7. Review & Validation



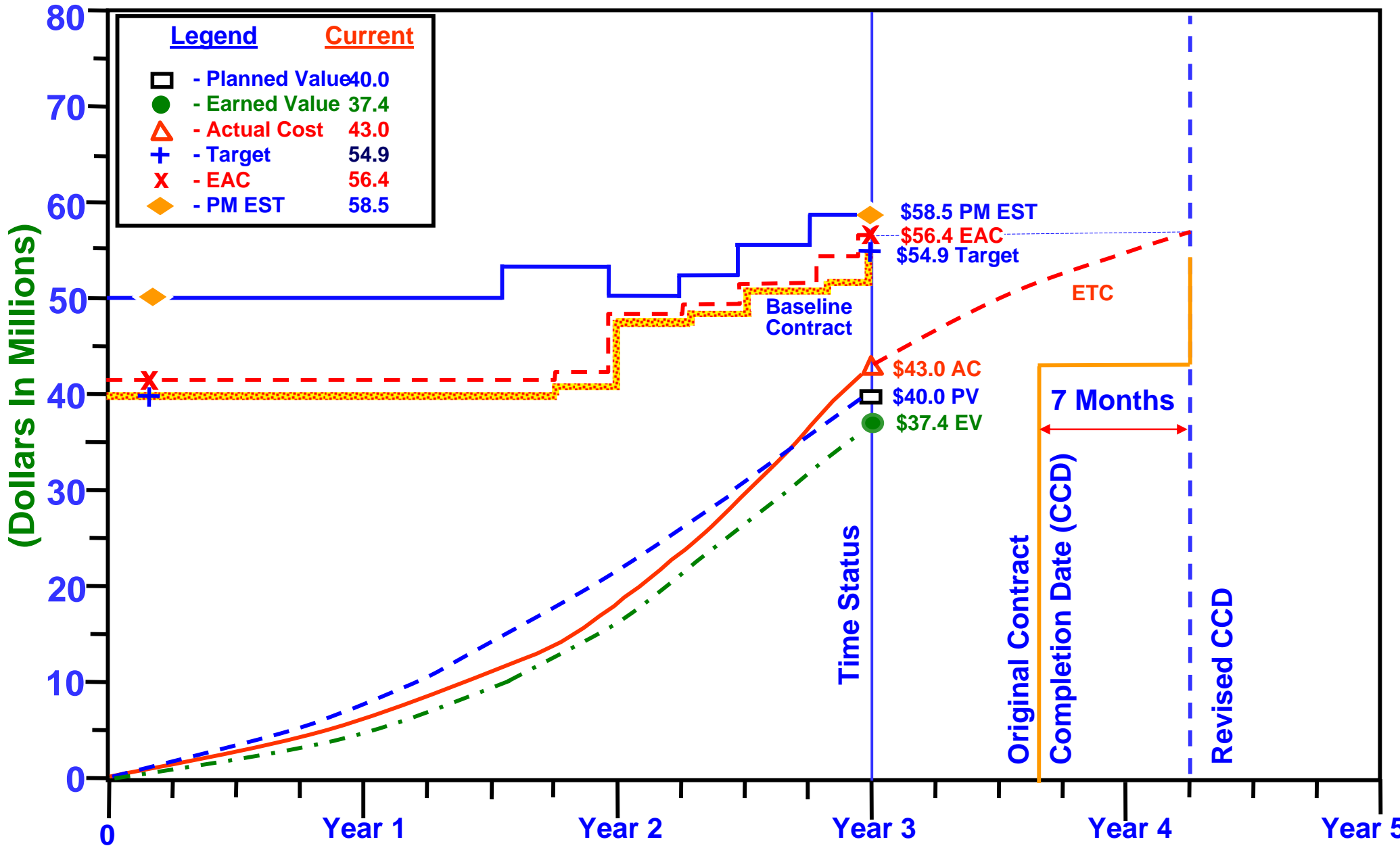


Sample Storyboard Slide

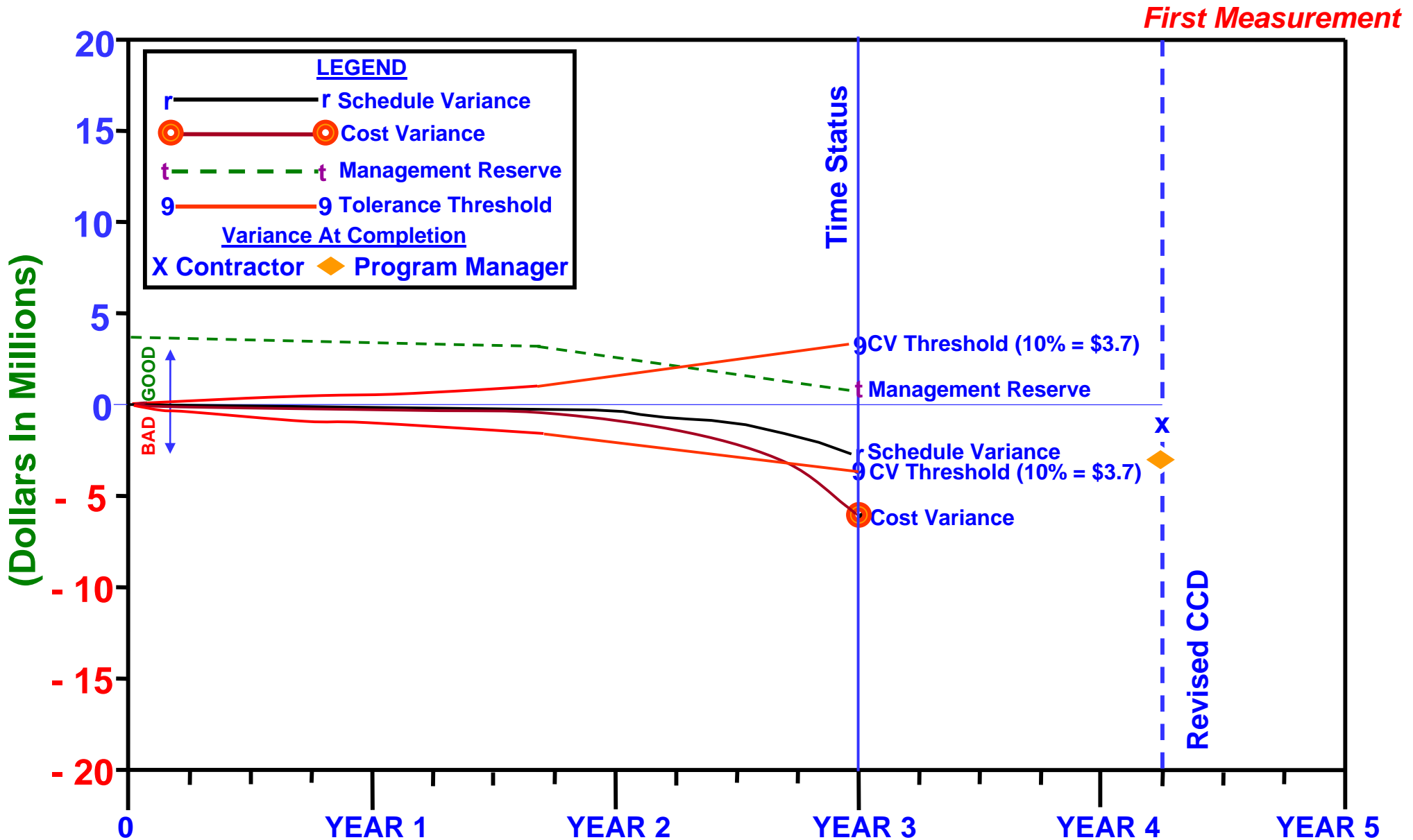


Contract Performance

First Measurement

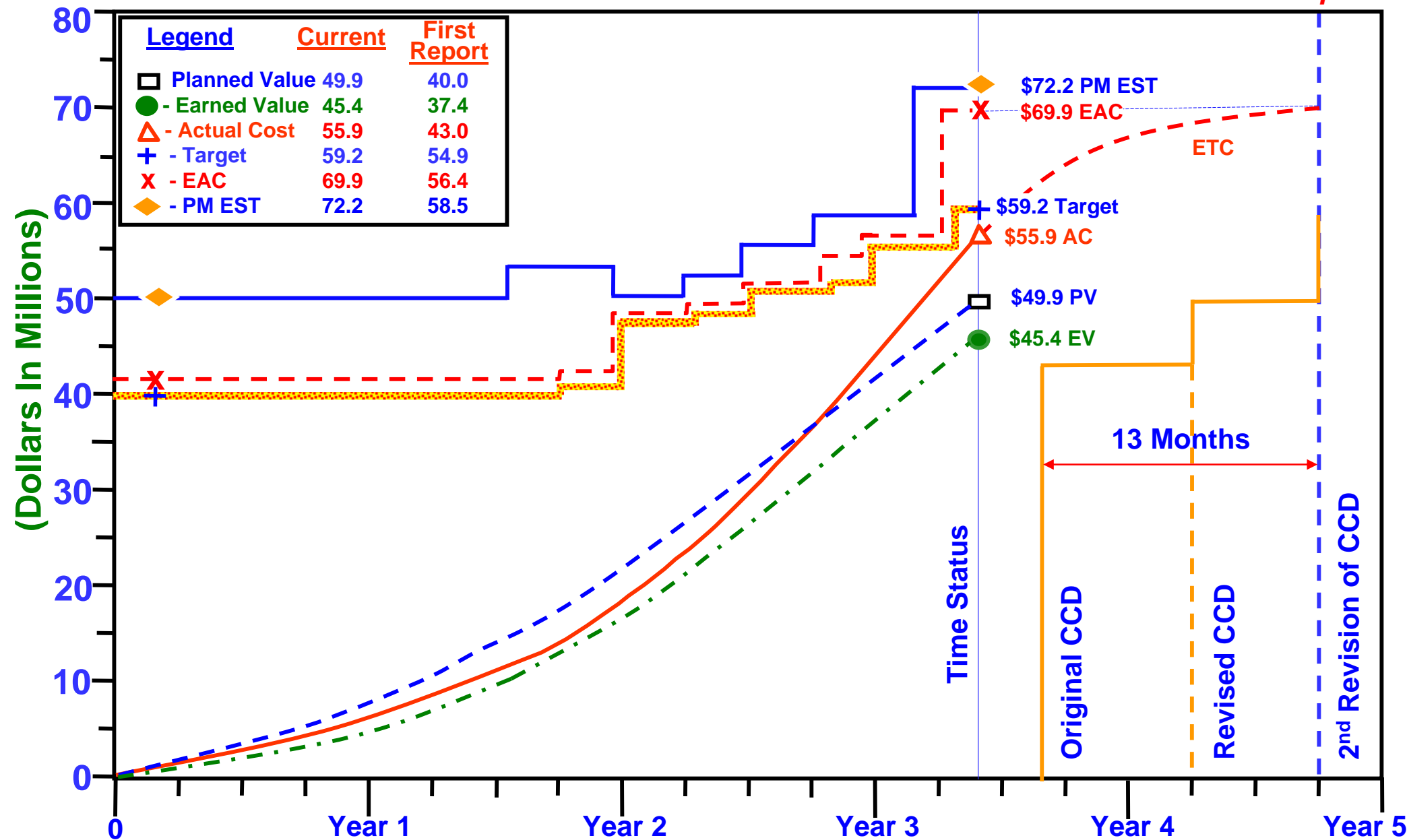


Cost/Schedule Variance Trends



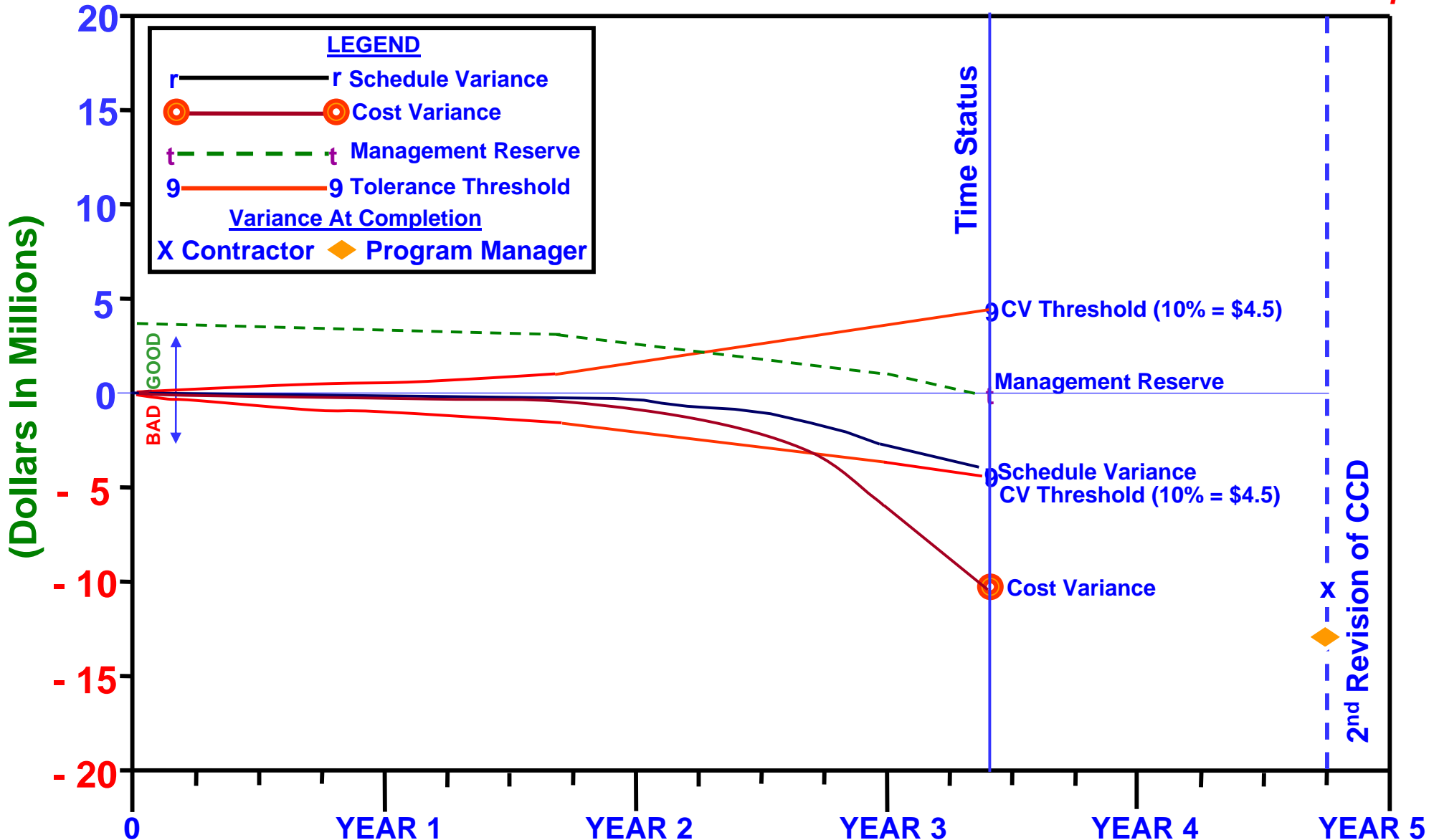
Contract Performance

*Second Measurement
5 months after 1st report*



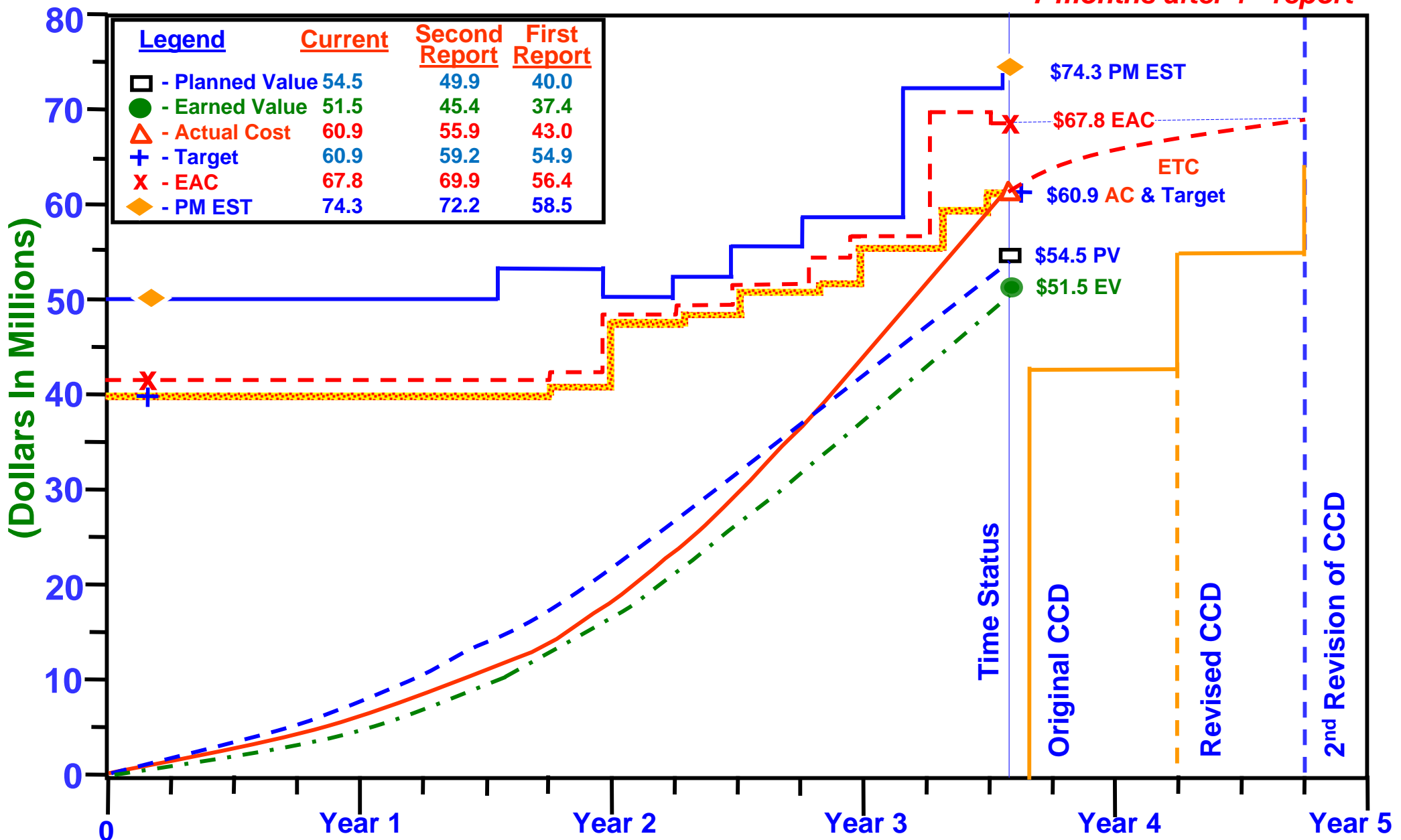
Cost/Schedule Variance Trends

*Second Measurement
5 months after 1st report*



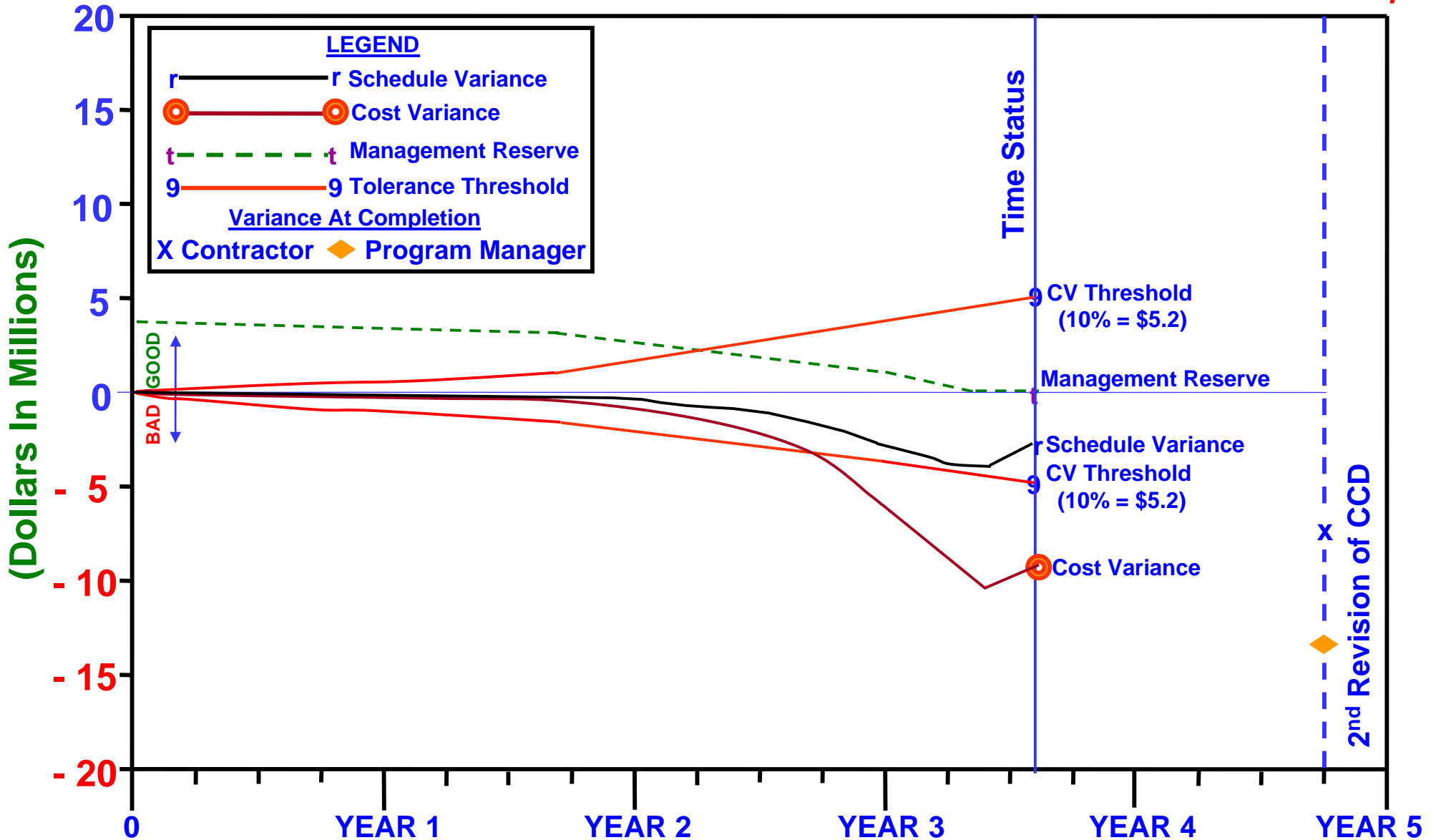
Contract Performance

*Third Measurement
7 months after 1st report*



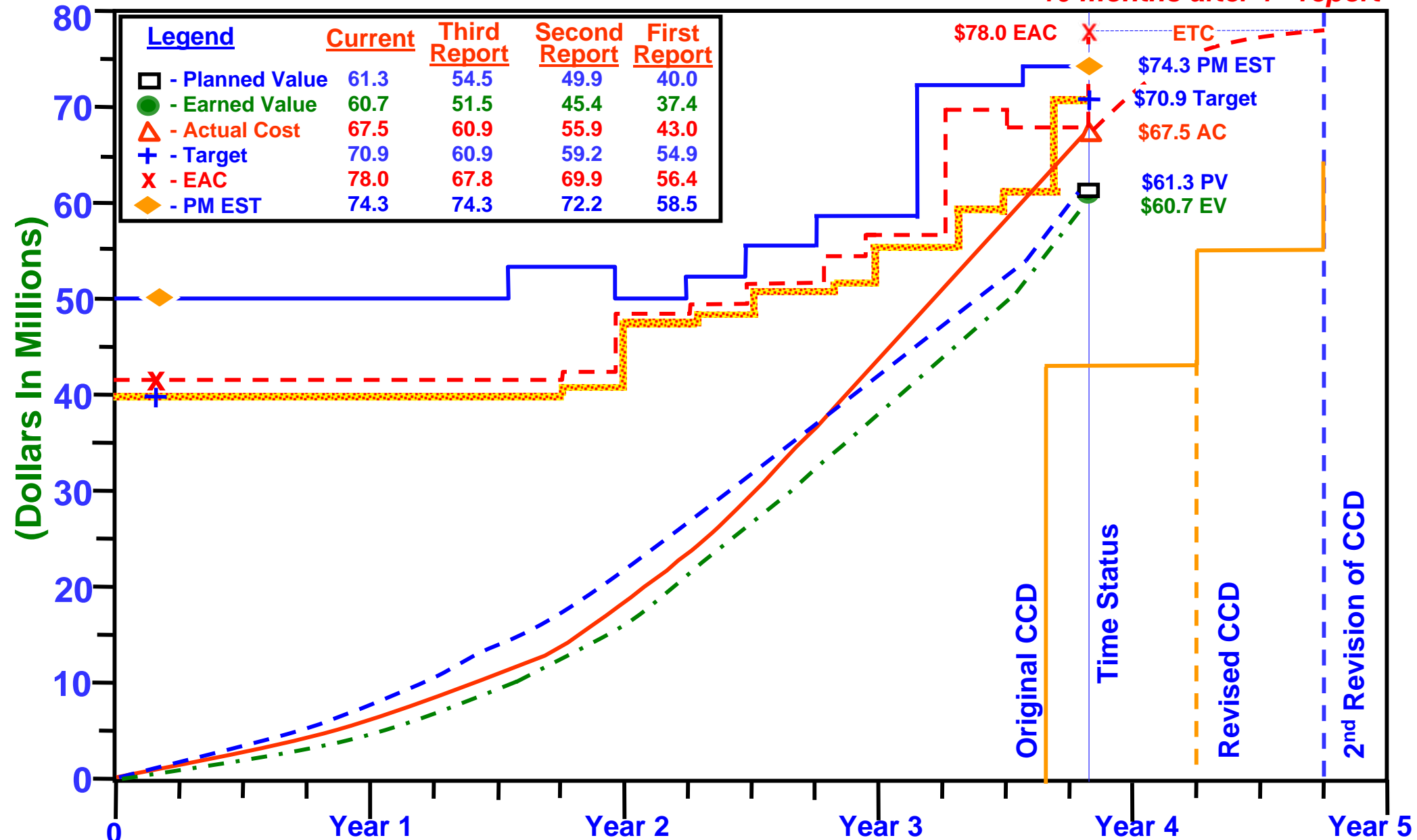
Cost/Schedule Variance Trends

*Third Measurement
7 months after 1st report*



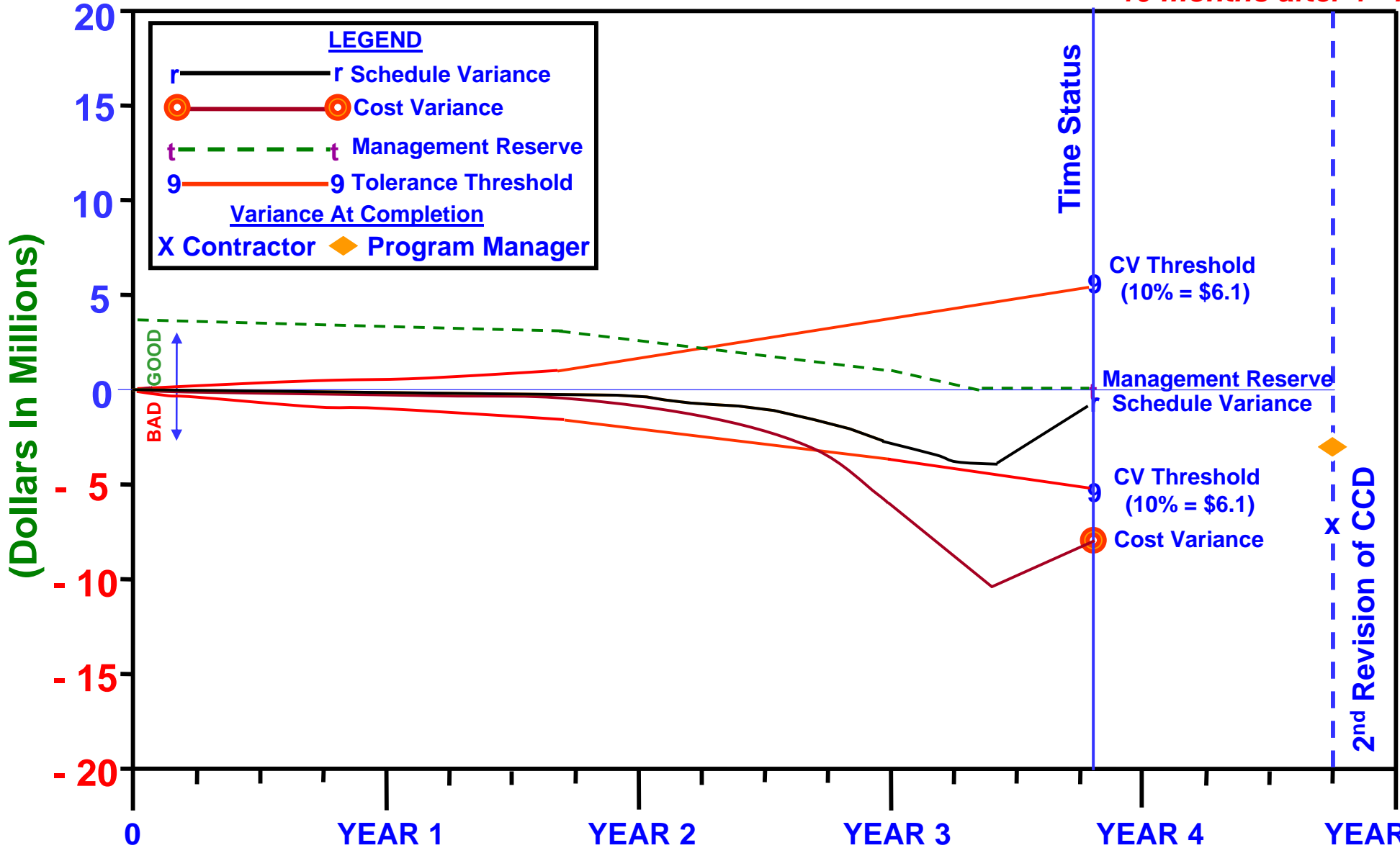
Contract Performance

*Fourth Measurement
10 months after 1st report*

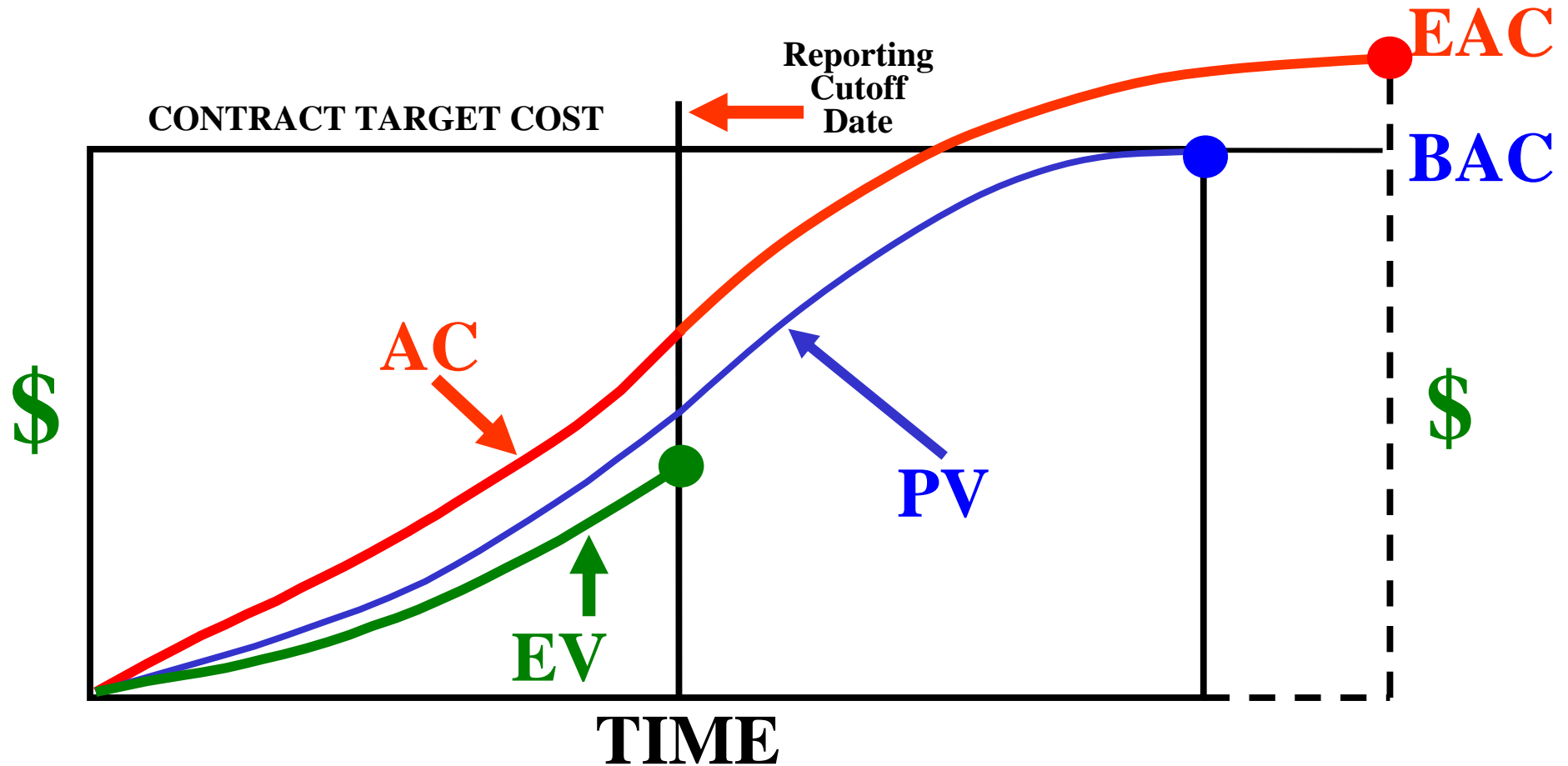


Cost/Schedule Variance Trends

*Fourth Measurement
10 months after 1st report*



The End of Instruction



Thank You for your participation