PROJECT COST MANAGEMENT

CONTROL COSTS

PROCESSES BY PROCESS GROUP

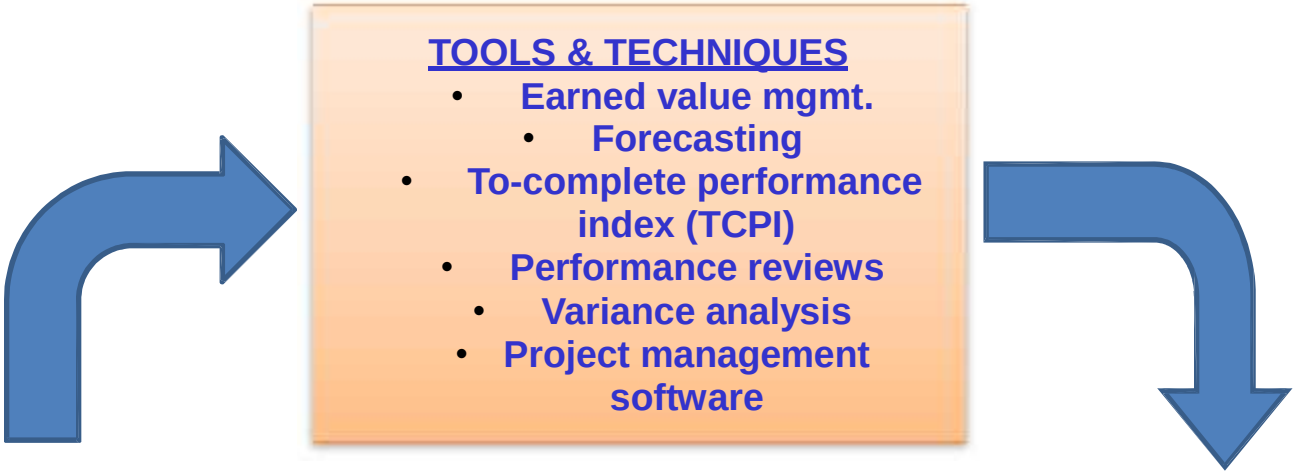
Planning	Monitoring and Controlling
7.1 Plan Costs Management	7.4 Control Costs
7.2 Estimate Costs	
7.3 Determine Budget	

CONTROL COSTS

WHAT SHOULD YOU DO IN CONTROL COSTS?

- Influencing the factors that create changes to the cost baseline,
- Ensure that all change requests are acted on in a timely manner,
- Manage the actual changes when and as they occur,
- Make sure that cost expenditures don't exceed authorized funding (by period & in total) for the project,
- Monitor cost performance to isolate and understand variances from approved cost baselines,
- Monitor work performance against funds expended,
- Prevent unapproved changes from being included in the reported cost or resource usage,
- Inform appropriate stakeholders of approved changes and associated cost, and
- Act to bring expected cost overruns within acceptable limits

CONTROL COSTS



TOOLS & TECHNIQUES

- Earned value mgmt.
- Forecasting
- To-complete performance index (TCPI)
- Performance reviews
- Variance analysis
- Project management software

INPUTS

- Project management plan
- Project funding requirements
- Work performance information
- Organizational process assets

OUTPUTS

- Work performance measurements
- Budget forecasts
- Organizational process assets updates
- Change requests
- Project management plan updates
- Project document updates

CONTROL COSTS - INPUTS

INPUTS

- Project Management Plan
  - Cost Performance Baseline
  - Cost Mgmt. Plan
- Project Funding Requirements
- Work Performance Information
- Organizational Process Assets

CONTROL COSTS - T&T

TOOLS & TECHNIQUES

Cost Change Control System

Performance Measurement Analysis

- An important part of cost control is to determine:
  - Cause of variance
  - Magnitude of a variance
  - Decide if variance requires corrective action
- Performance measurement techniques (called EVT) help to assess the magnitude of any variances that will invariably occur.
- Earned Value Technique (EVT) compares the value of the budgeted cost of work performed (earned) at the original allocated budget amount to both
  - the budgeted cost of work scheduled (planned)
  - to the actual cost of work performed (actual)

This technique is especially useful for cost control, resource management & production.

CONTROL COSTS - T&T

Earned Value Management

- Earned value mgmt. (EVM) in its various forms is a commonly used method of performance measurements.
- It integrates project scope, cost, and schedule measures to help the project mgmt. team assess and measure project performance and progress.
- It is a project mgmt. technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project.
- The principles of EVM can be applied to all projects, in any industry.

CONTROL COSTS - T&T

Earned Value Management (Contd.)

- EVM) develops and monitors three key dimensions for each work package and control account:

  - Planned Value (PV): budgeted cost for the work scheduled (in planned time) to be completed

  - Earned Value (EV): budgeted amount for work actually completed

  - Actual Cost (AC): actual money spent in finishing the work (actual cost)

CONTROL COSTS - T&T

For example,

You've hired a man to paint your house. It should take 3 months & you'll pay him $2,700 ($900/mo.). Paint is estimated at $3,600. After, one month, he's completed 20% of the work, but used 40% of the paint, therefore the:

PV = {($2,700 + $3,600) / 3 } = $2,100
EV = 20% of $6,300 = $1,260
AC = $900 + 40% of $3,600 = $ 900 + $1,440 = $2,340

CONTROL COSTS - T&T

EV= 1,260 PV= 2,100 AC=2,340
(See Figure 7-9, p.183)

Cost Variance (CV) (sometimes called burn rate)
= EV - AC
= $1,260 -$2,340 = -$1,080 (over budget)
CV%=CV/EV (many a time asked in exam)

Schedule Variance (SV) = EV-PV
=$1,260 -$2,100 = -$840 (behind schedule)
SV%=SV/PV (many a time asked in exam)

CONTROL COSTS - T&T

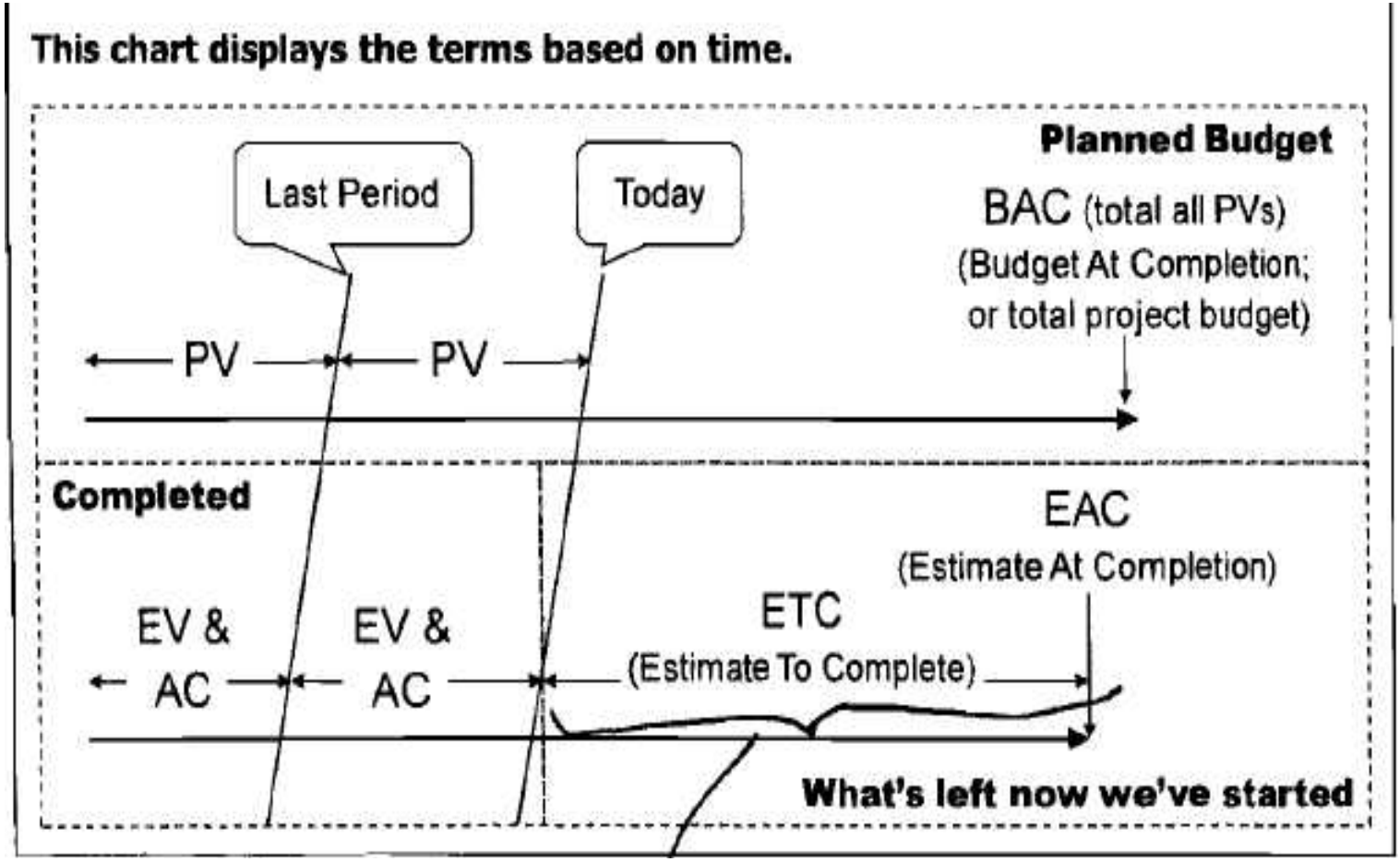
EV= 1,260 PV= 2,100 AC=2,340

Cost Performance Index (CPI) -Cost efficiency ratio (cost trend analysis)
CPI = EV / AC = $1,260/ $2,340 = 0.54
CPI < 1 -over budget
CPI> 1 -under budget

This is the ratio of what you expected to spend for the work you've earned (done) to what you really spent for it.

Schedule Performance Index (SPI) -Schedule efficiency ratio (schedule trend)
SPI = EV / PV = $1,260/ $2,100 = 0.6
SPI < 1 -behind schedule
SPI > 1 ahead of schedule. This is the ratio of what you planned on doing to what you really did.

CONTROL COSTS - T&T



CONTROL COSTS - T&T

Forecasting: Predicts or estimates future values of *Estimate to Complete (ETC)* and *Estimate at Completion (EAC)*

The earned value technique parameters are:

Budget At Completion (BAC) : total of all PV's (project's total cost baseline) = PV^c (also called Cumulative Planned Value)

Project Cost Variance (CV) - After project is complete, difference between budget at completion (total project budget) & actual amount spent

CV = BAC- AC

Variance at Completion (VAC) - Before project is complete, difference between budget at completion (total project budget) & estimate at completion (now that project is underway)

VAC = BAC –EAC

CONTROL COSTS - T&T

Estimate to Complete (ETC) - Expected cost to finish all the remaining work

ETC based on new estimate – Revised (New) estimate for the work remaining (uses standard estimating techniques) because original estimate was flawed, e.g. in a project installing the latest version of Primavera on 500 computers, the team though initially had expected current hardware would be okay, found that 20% of the computers require upgrading; thus a revised new estimate.

ETC based on *atypical* variances –PM team expectations are that similar variances will **not** occur in future.

ETC = BAC-EV

ETC based on typical variances – This approach is used when current variances **are seen as typical of future variances** (is expected to occur in future as well).

ETC = (BAC -EV)/ CPI (factors in CPI for trend)

CONTROL COSTS - T&T

Estimate at Completion (EAC) - Most likely total cost of the project (or activity) based on performance to date (often called latest revised estimate)

EAC using a new estimate - Actual costs to date plus new estimate for the remaining work. Used when original estimate was flawed or no longer relevant.

EAC = AC + ETC (doesn't rely on original budget BAC)

EAC using remaining budget - Similar variances **not** expected to occur in future (atypical)

EAC =AC + BAC -EV

EAC using CPI - Similar variances **are** expected to occur (is typical)

EAC =AC + (BAC-EV)/CPI

CONTROL COSTS - T&T

To-complete Performance Index (TCPI)

The to-complete performance index (TCPI) is the calculated projection of cost performance that must be achieved on the remaining work to meet a specified management goal, such as the BAC or the EAC. If it becomes obvious that the BAC is no longer viable, the project manager develops a forecasted estimate at completion (EAC). Once approved, the EAC effectively supersedes the BAC as the cost performance goal.
Equation for the TCPI based on the BAC:

$$TCPI = (BAC-EV) / (BAC-AC)$$

The TCPI is conceptually displayed in Fig 7-10. The equation for the TCPI is shown in the lower left as the work remaining (defined as the BAC minus EV) divided by the funds remaining (which can be either the BAC minus the AC, or the EAC minus AC).

CONTROL COSTS - T&T

To-complete Performance Index(TCPI) – Contd.

If the cumulative CPI falls below the baseline plan (as shown in Fig.7-6), all future work of the project will need to immediately be performed in the range of the TCPI (BAC) (as reflected in the top line of Fig.7-6) to stay within the authorized BAC. Whether this level of performance is achievable is a judgment call based on a number of considerations, including risks, schedule, and technical performance.

Once the mgmt. acknowledges that the BAC is no longer attainable, the project manager will prepare a new estimate at completion (EAC) for the work, and once approved, the project will work to the new EAC value. This level of performance is displayed as the TCPI (EAC) line. The equation for the TCPI based on the EAC:

$$TCPI = (BAC - EV) / (EAC - AC)$$

CONTROL COSTS - T&T

Performance Reviews

Compare cost performance over time**,** schedule activities or work packages overrunning & under running budget (planned value), and estimated funds needed to complete work in progress.
If EVM is being used, the following information is determined:

- **Variance analysis** -Compares actual to planned or expected cost and schedule variances are the most frequently analyzed.

- **Trend analysis** - Examines performance over time to determine if performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals in the form of BAC versus EAC and completion dates.

- **Earned value performance** – EVM compares the baseline plan to actual schedule and cost performance.

CONTROL COSTS - T&T

Variance Analysis

- Cost performance measurements (CV, CPI) are used to assess the magnitude of variation to the original cost baseline.
- Important aspects of project cost control include determining the cause and degree of variance relative to the cost performance baseline (section 7.2.3.1) and deciding whether corrective or preventive action is required.
- The % range of acceptable variances will tend to decrease as more work is accomplished. The larger % variances allowed at the start of the project can decrease as the project nears completion.
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Project Management Software

PMS is often used to monitor the three EVM dimensions (PV, EV, and AC), to display graphical trends, and to forecast a range of possible final results.

CONTROL COSTS - OUTPUTS

OUTPUTS

- Work Performance Measurements
- Budget Forecasts
- Organizational Process Assets Updates -
- Change Requests –

- Project Management Plan Updates -
  - Cost performance baseline

- Project document Updates
  - Cost estimates
  - Basis of estimates

DEPRECIATION

Straight Line Depreciation (SLD)

- Equal amount of depreciation is taken out each period (year)

Example below shows depreciation for 5 years where:

Depreciable value is $140,000 (purchase price) - $40,000 (salvage Value) = $100,000

Depreciation each year is $100,000 / 5 years = $20,000/year

Purchase Price	Salvage Value	Year	Depreciation	Depreciated Balance
$ 140,000	$40,000	0	0	$100,000
		1	$20,000	$80,000
		2	$20,000	$60,000
		3	$20,000	$40,000
		4	$20,000	$20,000
		5	$20,000	0
		Total	**$100,000**	

DEPRECIATION

Double Declining Balance (DDB)

- Depreciation taken out each period (year) by double straight line depreciation
- Usually, applied on the initial purchase price (don't subtract salvage value)

Example below shows depreciation for 5 years where:

Depreciation for 1st year is $140,000 / 5 years x 2 = $56,000 (or 40% of $140,000)
Depreciation for 2nd year is $84,000 / 5 years x 2 = $33,600 (or 40% of $84,000)

Purchase Price	Depreciation %	Year	Depreciation	Depreciated Balance
$ 140,000		0	0	$140,000
	40%	1	$56,000	$84,000
	40%	2	$33,600	$50,400
	40%	3	$20,160	$30,240
	40%	4	$12,096	$18,144
	40%	5	$7,257	$10,886 (Salvage)
		Total	**$100,000**	

DEPRECIATION

Sum of Years Digits Depreciation (SYD)

- Accelerated depreciation amount taken out each period (year) based on year's digits

Example below shows depreciation for 5 years where sum of years' digits = 1+2+3+4+5 = 15

Depreciation factor for 1st year is 5 (reverse order of years) / 15 (sum of years)

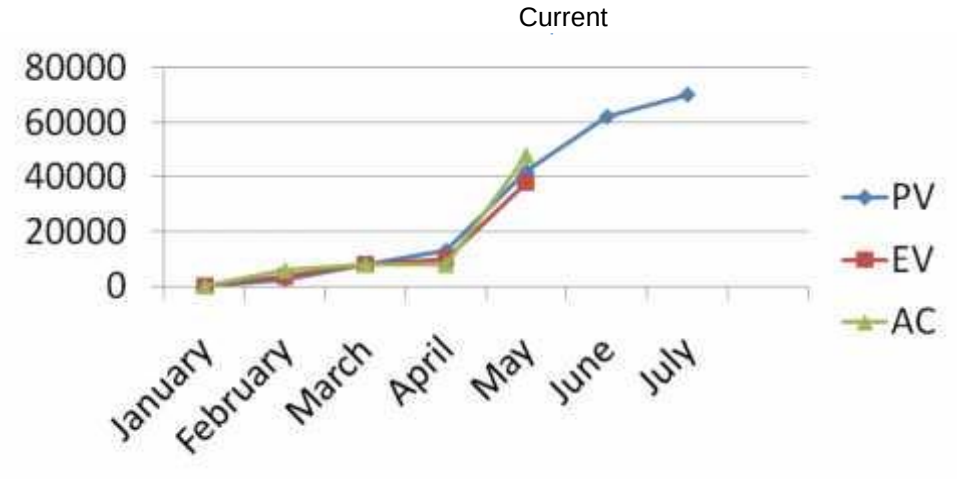
Multiply factor by original balance to get depreciation for that year

Depreciation for 1st year is 5/15 x $100,000 = $33,333, 2nd year is 4/15 x $100,000 = $26,667

Purchase Price	Salvage Value	Depreciation Factor	Year	Depreciation	Depreciated Balance
$140,000	$40,000		0	0	$100,000
		5/15	1	$33,333	$66,667
		4/15	2	$26,667	$40,000
		3/15	3	$20,000	$20,000
		2/15	4	$13,000	$6,667
		1/15	5	$6,667	0
			Total	$100,000	

CONTROL COSTS - EARNED VALUE

Performance Measurement Baseline



	PV	EV	AC
January	0	0	0
February	2500	3600	6000
March	8000	8000	8000
April	13000	10000	8000
May	**42000**	38000	48000
June	62000		
July	70000		

CONTROL COSTS - COST VARIANCE

From the last chart, we have these values and can make these calculations:
PV = $42,000 EV = $38,000 AC = $48,000

Comparing original amount budgeted for work that's done (EV) to the amount spent to produce that work (AC), we can get cost variance (CV) as follows:
CV (= EV -AC) = $38,000 -$48,000 = -$10,000 (> spent than planned)

Comparing original amount budgeted for work that's done (EV) to the amount budgeted for that work In the plan (PV), we can get schedule variance (SV) as follows:
SV (= EV -PV) = $38,000 -$42,000 = -$4,000 «work than planned)

CONTROL COSTS - OTHER CALCULATIONS

CPI (= EV / AC) = $38,000/ $48,000 = 0.79
$0.79 worth of work was done for each $1.00 spent

SPI (= EV/PV) =$38,000/ $42,000 =0.90
$0.90 worth of work was done for each $1.00 worth of work planned
ETC (= BAC -EV) = $70,700 -$38,000 = $32,700
EAC (= AC+BAC-EV) = $48,000 + $70,700 -$38,000 = $80,700

VAC (= BAC -EAC) = $70,700-$80,700 =-$10,000
Project will exceed planned budget by $10,000

CONTROL COSTS - SAMPLE COST PROBLEM

More Calculations (slight possibility that these will be on the exam)

Given BAC
= $40K EV =
$20K PV =
$28K AC =
$26K

Calculate
% of work Scheduled
% of Budget Spent
% of Work Accomplished
To Complete Performance Index (TCPI)
CV%
SV%

CONTROL COSTS - SAMPLE SOLUTION

More Calculations

Answers

% of Work Scheduled → PV/ BAC = $28K/ $40K = 0.7 or 70%

% of Budget Spent → AC/ BAC = $26K / $40K = 0.65 or 65%

% of Work Accomplished → EV / BAC =$20K / $40K = 0.5 or 50%

TCPI → (BAC-EV)/(BAC - AC) = ($40K -$20K) / ($40K -$26K) = 1.43

CV% → CV / EV =($20K -$26K) / $20K =0.3 or 30%

SV% → SV/ PV =($20-$28)/$28K =0.28 or 28%

CONTROL COSTS - EARNED VALUE EXAMPLES

FOR BUDGET		
If CPI < 1	EV < AC	Over Budget
If CPI > 1	EV > AC	Under Budget
FOR SCHEDULE		
IF SPI < 1	EV < PV	Behind Schedule
IF SPI > 1	EV > PV	Ahead of Schedule

CONTROL COSTS - CASE 1

PV = $1,860
EV = $1,860
AC = $1,860

CONTROL COSTS - CASE 2 SCHEDULE

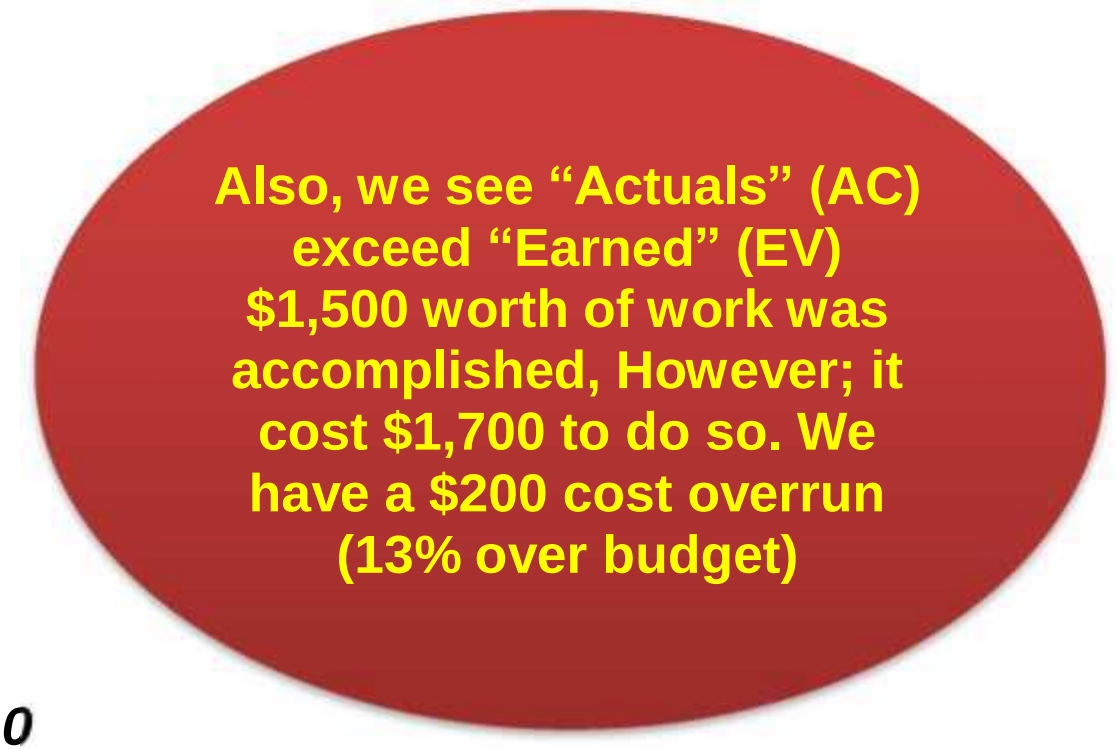
CASE 2 SCHEDULE

PV = $1,900
EV = $1,500
AC = $1,700

SV = EV-PV = -$400
SV% = SV/ PV = -0.21 or -21%

CONTROL COSTS - CASE 2 COST

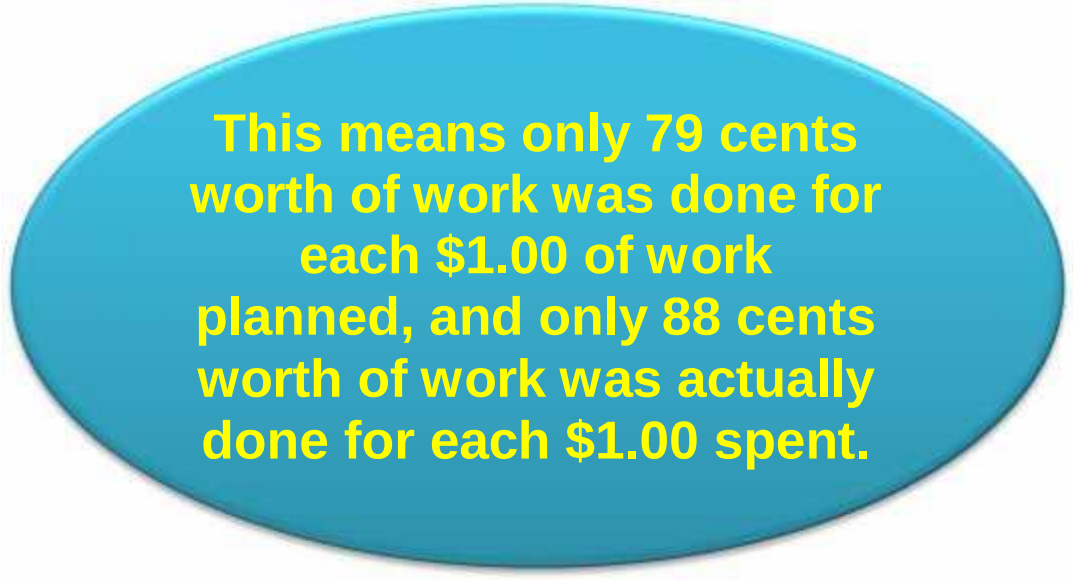
PV= $1,900
EV= $1,500
AC= $1,700



CV = EV-AC = *-$200*
CV% = CV *I EV* = -0.13 or -13%

CONTROL COSTS - CASE 2 INDICES

PV = $1,900
EV = $1,500
AC = $1,700



SPI = EV / PV = *$0.79*
CPI= EV / AC = $0.88

Case 2 is the worst case where all Performance indicators are negative.

CONTROL COSTS - CASE 3 INDICES

PV= $2,600
EV= $2,400
AC= *$2,200*

SV= -$200
SV% = - 8%
SPI= *0.92*

This is bad news. Our work efficiency is a bit low. We are getting only 92 cents of work done per dollar. We are behind schedule.

CONTROL COSTS – CASE 3 INDICES

***PV* = $2,600**
***EV* = $2,400**
AC = $2,200

CV = $200
CV% = 8%
CPI = 1.09

This is good news as we are under budget. We are getting $1.09 worth of work done for each $1.00 spent.

00 = 0.92

SPI = EV/PV = 2400/26

Case 3 is under budget, <u>but behind schedule.</u>