08 - Project Monitoring & Control

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Project Monitoring & Control - Outline

Measuring the actual progress of work

Earned Value Analysis

Earned Schedule

Estimating the final cost and schedule at completion

Project reporting practices

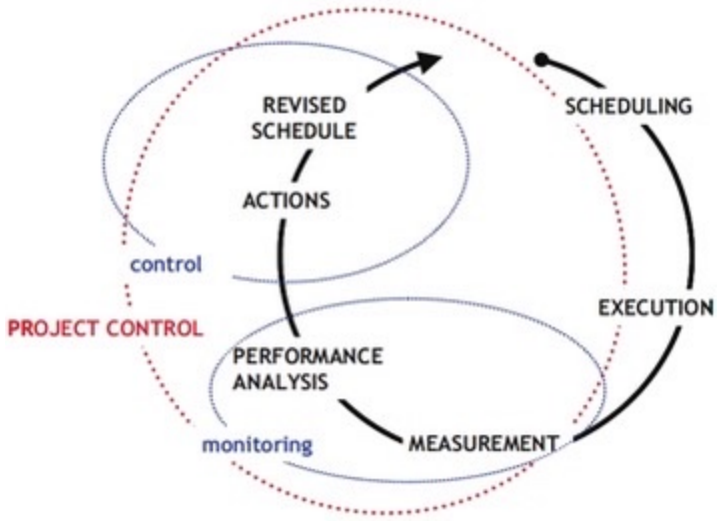
Possible control actions to bring the project back on track

Project Monitoring & Control - Introduction

As engineering and construction activities unfold, the project actual status may diverge from the planned one, with *discrepancies in expenditures, productivity and work pace*.

Accurate cost and schedule performance monitoring and control.

Project Monitoring & Control - Project Monitoring



Monitoring and Control ***(Project Control)*** are two parts of a feedback system

(1) Detection is made through monitoring,

(2) Correction is the objective of control actions.

Project Monitoring & Control - Project Control

Monitoring

Set of procedures and management practices to collect ***performance metrics*** and to determine performance variances regarding forecasted performance.

Control

Adjusts the project to meet its initial goals by

- ***analyzing the causes*** of performance problems
- ***designing changes***

to ***address problems and implement changes*** through control actions

Project Monitoring & Control - Measurement of Project Progress

Requires

- a detailed WBS/CBS and
- schedule

Steps:

1. measurement of actual cost ***(AC) and schedule progress***,
2. calculation of the ***discrepancy*** between actual status versus scheduled progress
3. ***Estimation of cost and time*** at completion of the project (based on trend).

Measurement of Project Progress

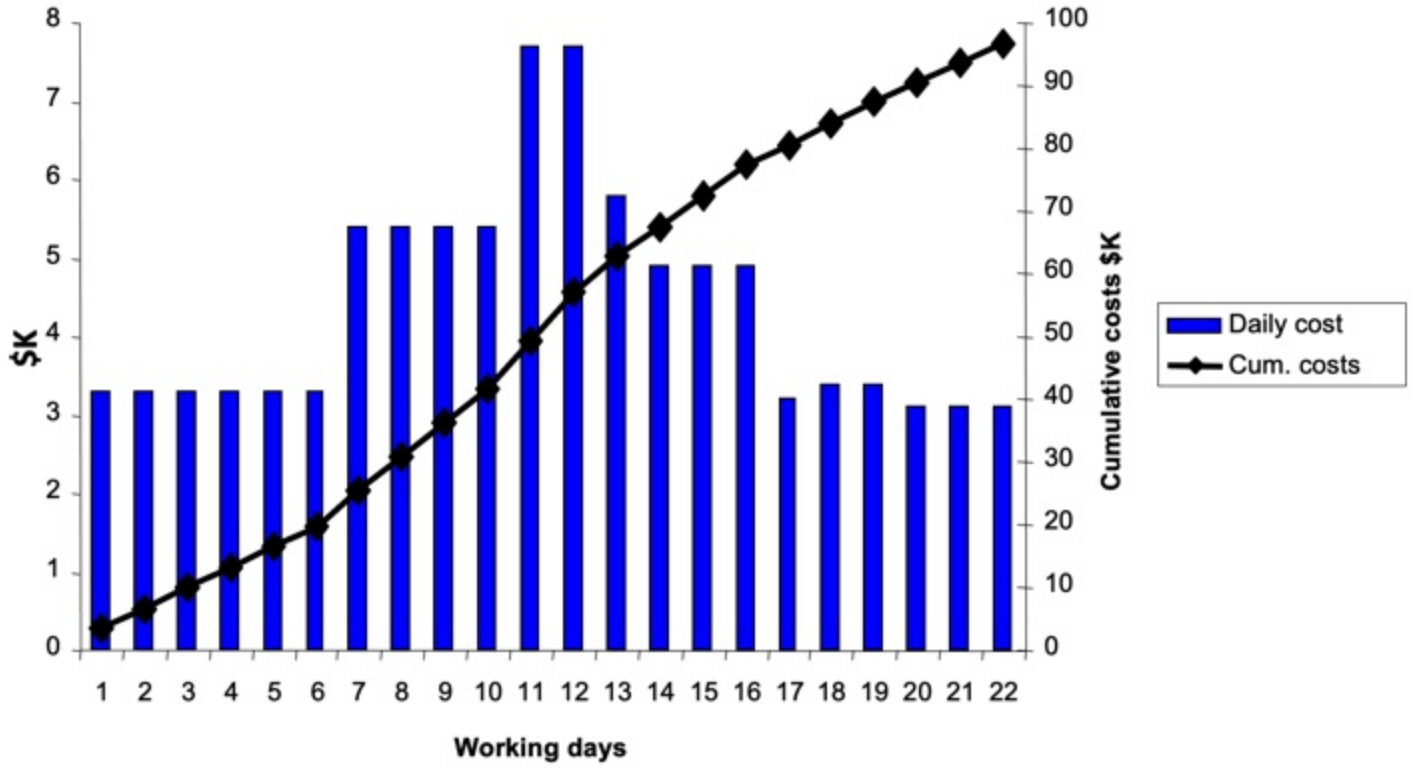
Example

- Schedule:
  Project duration: ***18 months*** / Scheduled Cost: ***1,100,000 $***
- After completion:
  Finish: 20 months
  Actual cost: 1,240,000 $
- Final overruns:
  Time: 2 months (+11%)
  Cost: 140,000 $ (+13%)

A way to predict over/underruns is needed based on ***discrepancy-trend*** analysis between actual situation and schedule

Project Monitoring & Control - Measurement of Project Progress

S-Curve Cost



Project Monitoring & Control - Earned Value

Earned value management ***(EVM)*** provides a ***performance measurement system*** for review of past and forecasted performance of a project

- Measuring and forecasting project using ***COST information***
- Problem of traditional actual vs. scheduled cost: ***Doesn't take into account progress***
- Availability of ***data for project management decisions***
- Providing a ***system to monitor*** the project

Earned Value - Definitions

EVM integrates cost, schedule, and work performed by ascribing monetary values to each

BCWS (Budgeted Cost of Work Scheduled): the value of work scheduled to be accomplished in a given period of time.
ACWP (Actual Cost of Work Performed): the costs actually incurred in accomplishing the work performed within the control time.
EV:BCWP (Budgeted Cost of Work Performed): the monetary value of the work actually performed within the control time.
BAC (Budget at Completion): usual cost objectives analysed should be the project approved BAC

Project Monitoring & Control - Earned Value - Example

Analytic:

W.B.S.	m.u.	actual quantity	Unit cost Budget [$]	Earned Value 10 months [$]
Structures				**621.297**
Footings				*154,050*
Procurement	n.	79.00	1,400.00	110,600
Shipping	n.	79.00	200.00	15,800
Erection	n.	79.00	350.00	27,650
Columns				*467,247*
Procurement	ml	108.00	2,800.00	302,400
Shipping	ml	108.00	326.37	35,247
Erection	ml	108.00	1,200.00	129,600

Synthetic:

EV = BCxWP = 1,100,000 x 56.48% = 621,280$

Project Monitoring & Control - Earned Value - Example

Cost variance

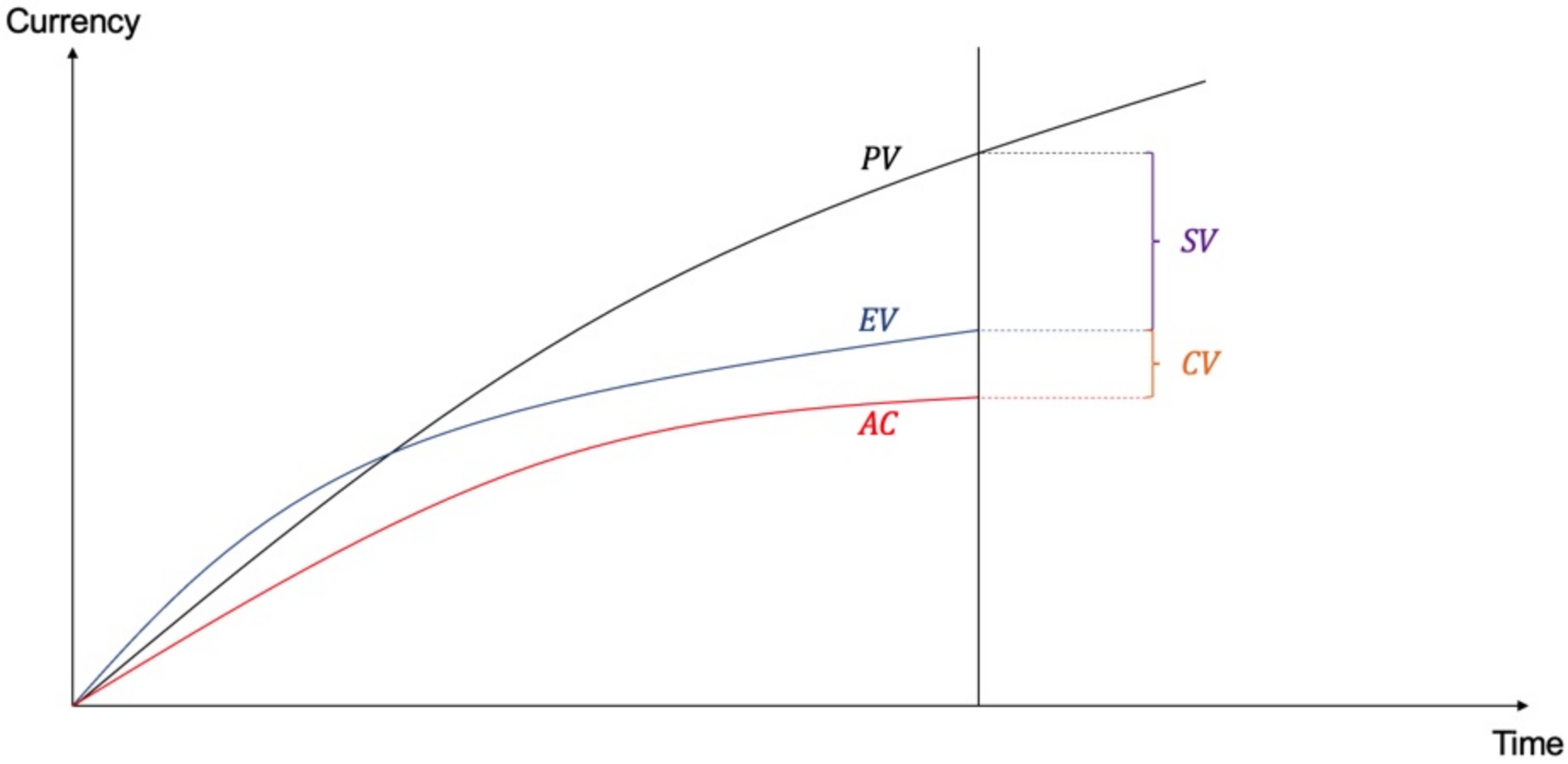
CV=EV-AC

Schedule variance

SV=EV-PV

WBS	WS	BCWS	WP	ACWP	BCWP	BV-AV	EV-AV
Structures	**60%**	**660,000**	**56%**	**700,000**	**621,297**	**-40,000**	**-78,703**
Footings	*13%*	*148,200*	*14%*	*162,209*	*154,050*	*-14,009*	*-8,159*
Procurement	100%	106,400	104%	118,500	110,600	-12,100	-7,900
Shipping	100%	15,200	104%	16,059	15,800	-859	-259
Construction	100%	26,600	104%	27,650	27,650	-1,050	0
Columns	*47%*	*511,800*	*42%*	*537,791*	*467,247*	*-25,991*	*-70,544*
Procurement	65%	400,400	49%	345,600	302,400	54,800	-43,200
Shipping	45%	32,310	49%	43,200	35,247	-10,890	-7,953
Construction	30%	79,090	49%	148,991	129,600	-69,901	-19,391

Earned Value - Indicators and Predictors



CV=EV-AC ..... SV=EV-PV

Earned Value - Indicators and Predictors

Schedule Variance

SV = EV – PV (Earned value – Planed Value)

=+ ahead of schedule

=- behind schedule condition

=0 (On Target)

Cost Variance

CV = BCWP – ACWP (Earned value – Actual Value)

=+ (Underrun) gain of value

=- (Overrun) loss of value

=0 (On Budget)

Earned Value - Indicators and Predictors

Schedule performance index

SPI=EV/PV

SPI<1 behind schedule condition

SPI>1 ahead of schedule condition

=0 (On Target)

Cost performance index

CPI=EV/AC

CPI<1 over-budget condition

CPI>1 under-spend condition

Earned Value - Indicators and Predictors

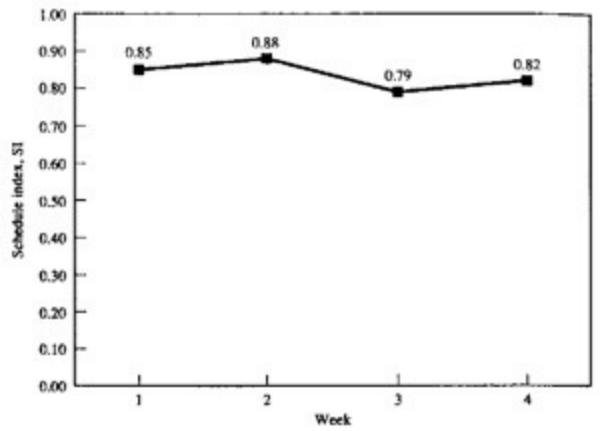


Figure 11-8 Schedule index for the project.

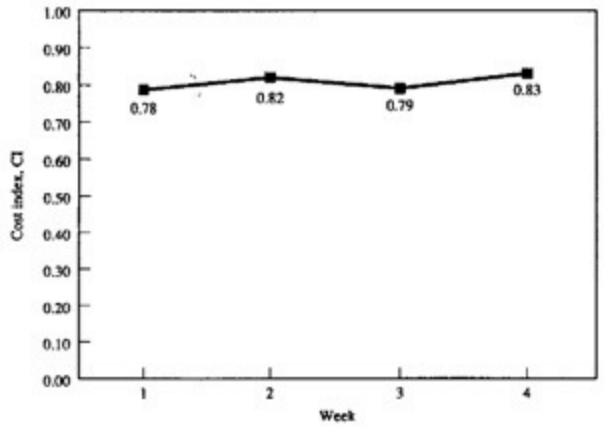
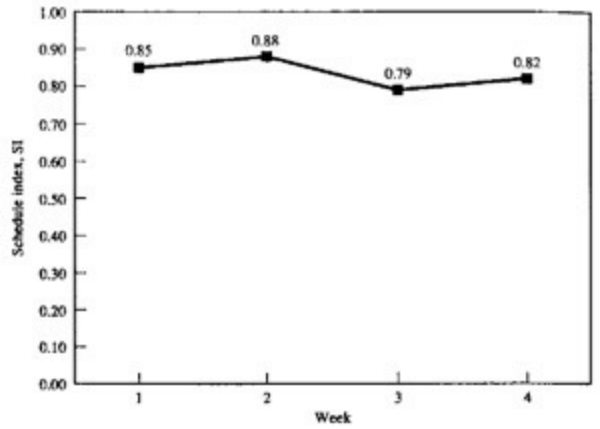


Figure 11-9 Cost index for the project.

If CPI<<1 or CPI>>1

- determine the causes
- implement corrective actions to further ***prevent deterioration or enable possible cost recovery***

Earned Value - Indicators and Predictors



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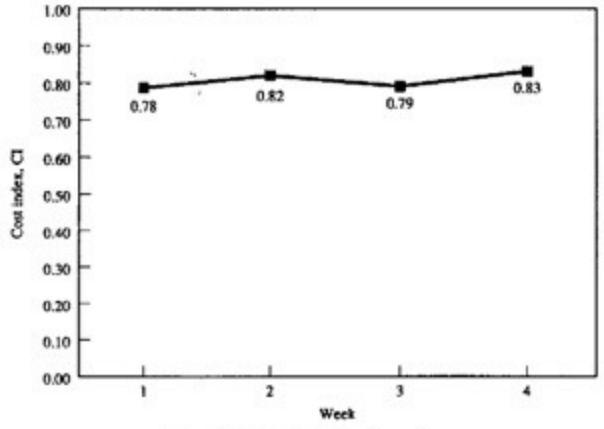


Figure 11-9 Cost index for the project.

If SPI<<1 or SPI>>1

- understand the causes
- implement corrective and preventive actions

The critical path impact of negative earned value SVs should be analysed in conjunction with the network schedule

Earned Schedule - Indicators and Predictors

EV-based SV is denoted SV($)=EV-PV

ES-based SV is SV(t)=ES-AT (Earned Schedule – Actual Time)

-> 0 (Ahead of schedule)

< 0 (Behind schedule)

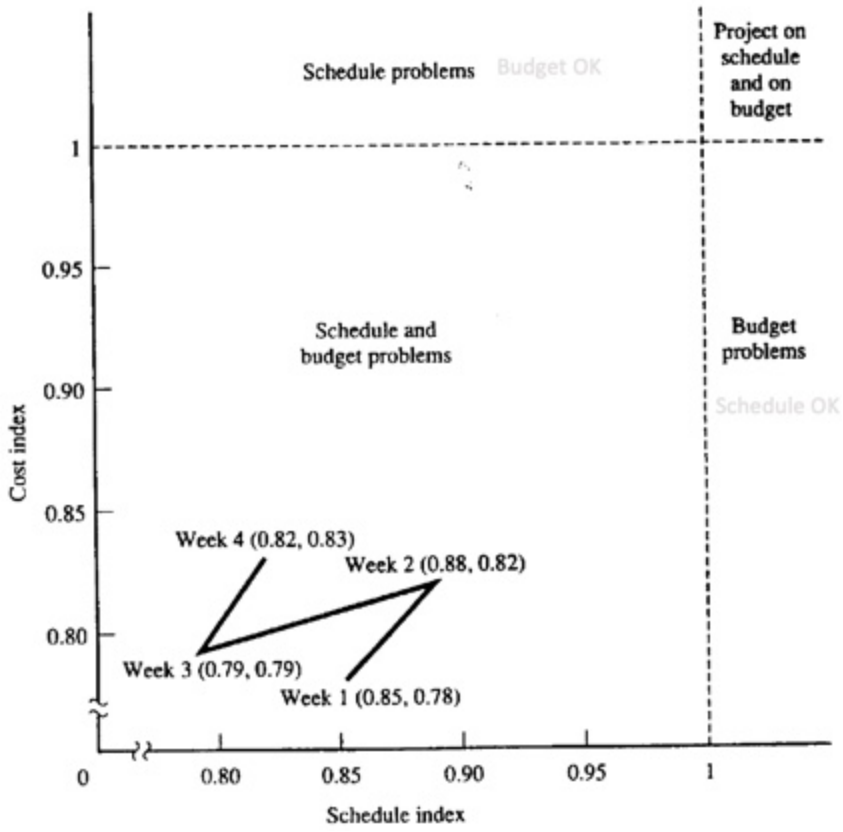
= 0 (On schedule)

EV-based SPI is as SPI($)=EV/PV

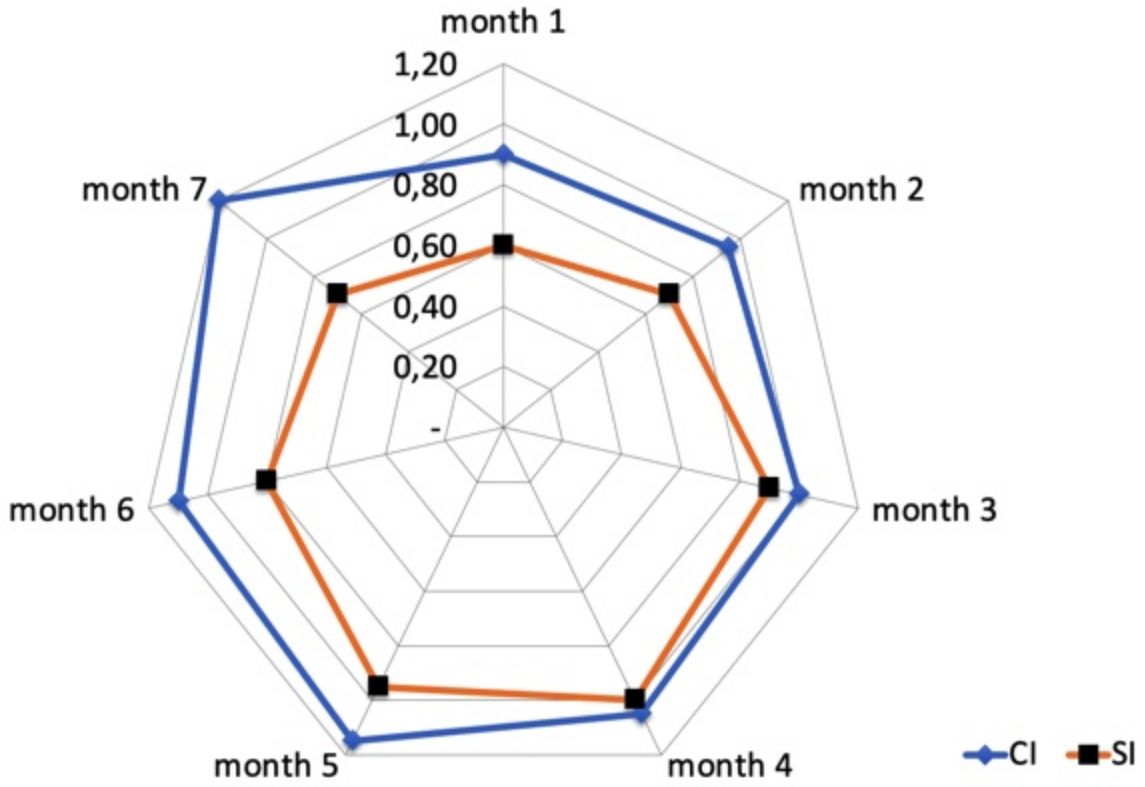
ES-based SPI(t)=ES/AT

> 1 (Ahead of schedule)
> < 1 (Behind schedule)
> = 1 (On schedule)

Earned Value - Integrating CI and SI



Earned Value - Integrating CI and SI



Earned Value - Forecasting Performance

The CV/CPI and SV/SPI are factors of past behavior ***to use as trends for predicting future targets, if no corrective actions are undertaken***

The ***cost estimate at completion*** and the ***time estimate at completion*** can be calculated by extrapolating the actual performance to the end of the project

Attempts to ***predict*** the conditions at a later time or the end of the project

Earned Value - Forecasting Performance - CEAC

It is possible to calculate Cost Estimate at Completion (CEAC) in a couple of ways.

(1) original approach ***(optimistic)*** states that future remaining cost will be in line with the budget

CEAC = AC + (BAC – EV)
= BAC - CV

Assumes that cost overruns will not incur in the future.

Earned Value - Forecasting Performance - CEAC

(2) A better way for calculating CEAC is a revised estimate approach:

CEAC = AC + (BAC – EV) / CPI

= BAC / CPI

Assumes that the project future will, at least, ***reflect the past performance***, if no corrective actions are undertaken.

Earned Value - Forecasting Performance - CEAC - Example

Original estimate approach:

CEAC = BAC – CV = 1,100,000 – (621,000 – 700,000) = $1,179,000

resulting in a Variance at Completion (VAC) = –79,000

Revised estimate approach:

CEAC = BAC/CI = BAC (ACWP/BCWP) = 1,100,000 (700,000/621,000) = $1,240,000

VAC = 1,100,000 – 1,240,000 = –140,000

Earned Value - Forecasting Performance - TEAC

It is possible to calculate the Time Estimate at Completion (TEAC) according to either an original or a revised approach.

(1)original approach (optimisitc)

Assumes that time overruns are past history and will not incur in the future

TEAC = AT + (PD - ES)

(2)Revised estimate approach

TEAC = AT + (PD - ES)/SPI(t)

Project future will, at least, reflect past behavior if no corrections!!!

Earned Value - Forecasting Performance - TEAC - Example

Original estimate approach

TEAC = AT + (PD - ES)

= 10 months + (18 – 9.61) = 18.39 months

Expected Schedule delay = 0.39 months

Revise estimate approach

TEAC = AT + (PD - ES)/SPI(t) = BC / SPI(t) =

= 10 months + (18 – 9.61)/ 0.96 = 18/ 0.96 = = 18.74 months

Expected Schedule delay = 0.74 months