Earned Schedule …application to Project Management

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The ES idea is to determine the time at which the EV accrued should have occurred.
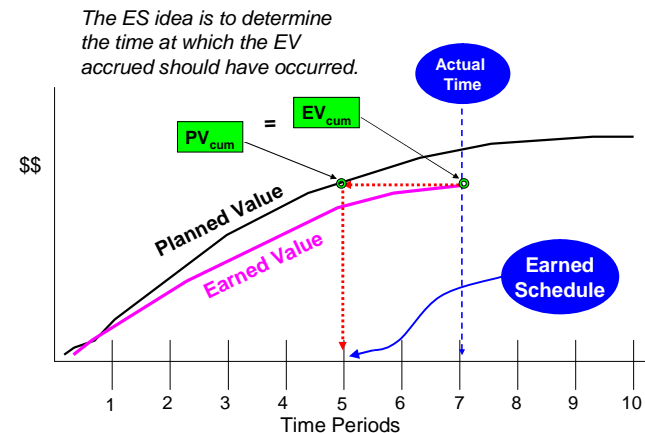
Abstract

A review of Earned Schedule, focusing on project management control areas for which the methodology provides an advance in practice.
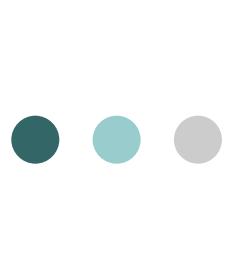
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Overview

- Background
- Review of ES Metric
- Indicators & Terminology
- Forecasting & Prediction
- Project Control
- Schedule Adherence
- Rework
- Application Aids
- Supplemental Remarks
- Summary

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Background

"We need to maintain our attention on schedule delivery. Data tells us that since July 2003, real cost increase in projects accounted for less than 3 percent of the total cost growth. …*Therefore, our problem is not cost, it is SCHEDULE*."
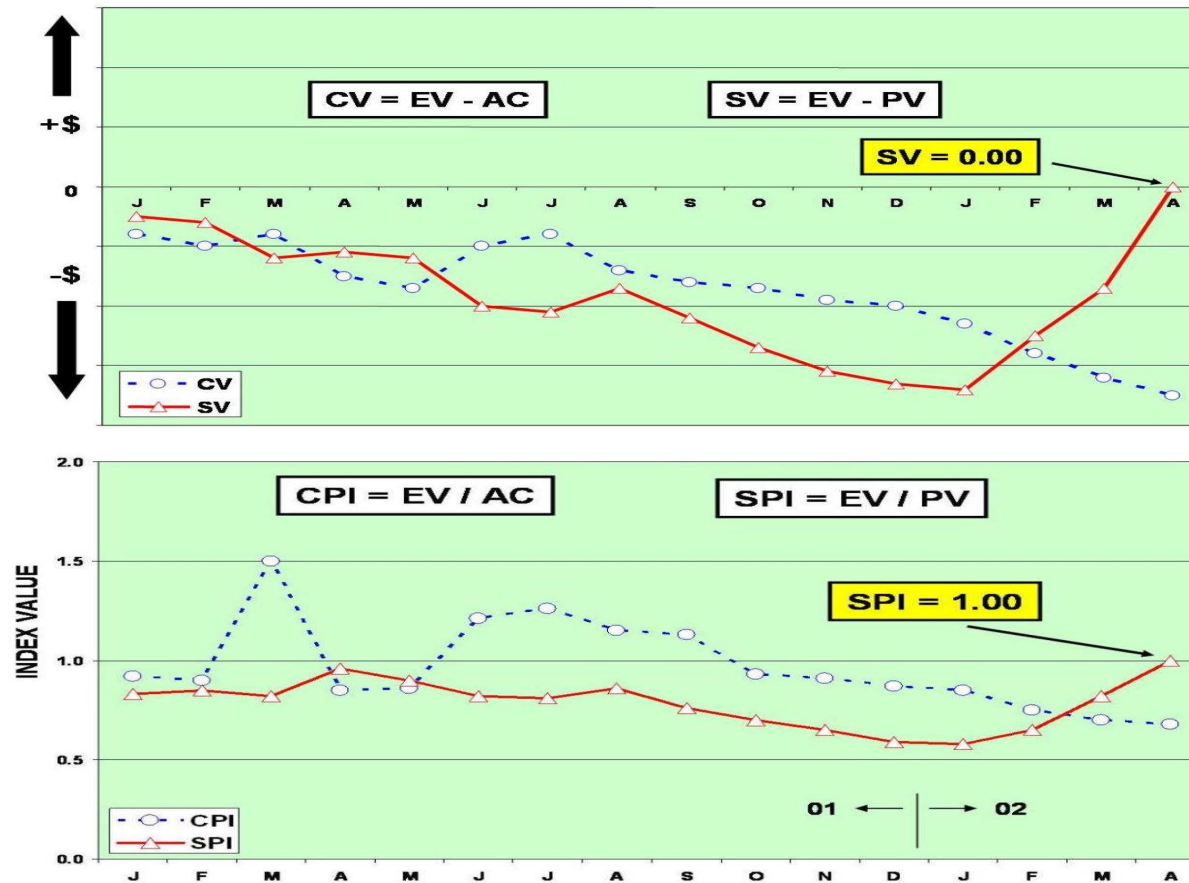
- Dr. Steve Gumley, CEO

Defence Materiel Organization (Australia)

Quote taken from DMO Bulletin, July 2006, Issue 61, page

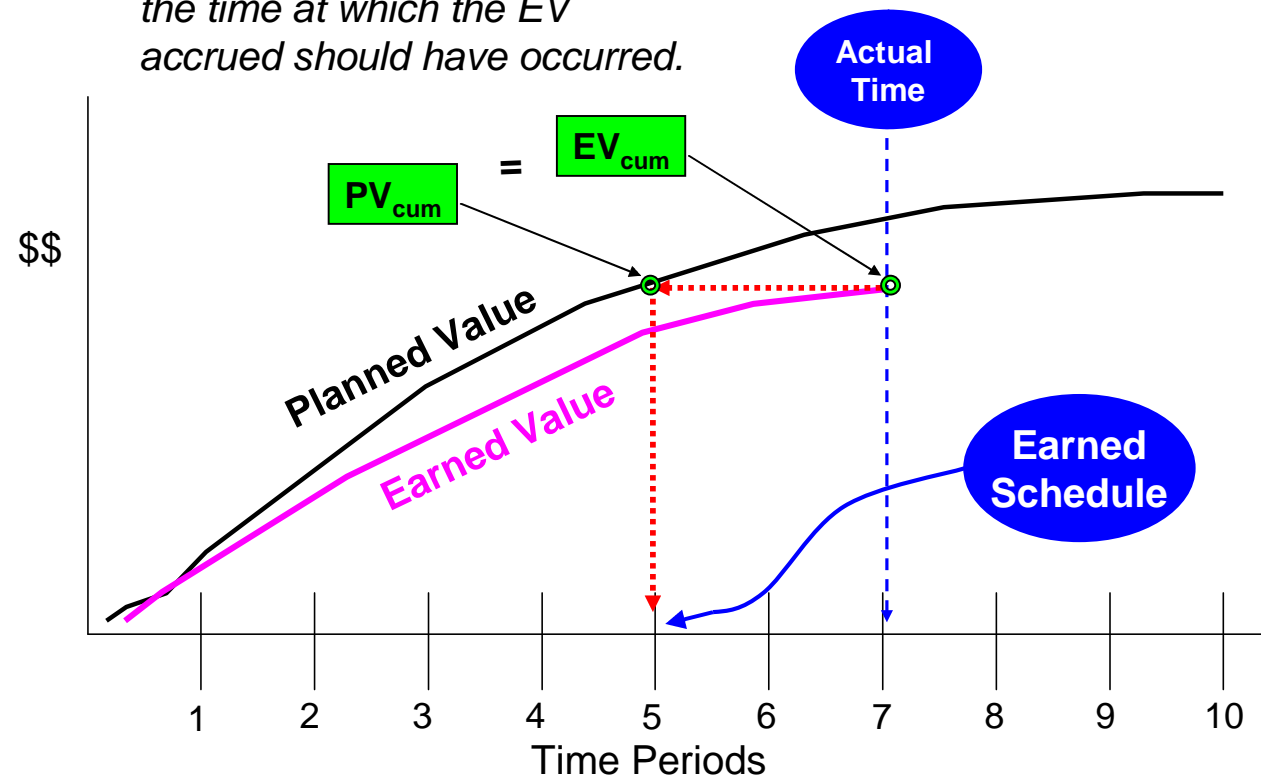EVM Europe 2011

Background

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ES Metric

The ES idea is to determine the time at which the EV accrued should have occurred.

$$PV_{cum} = EV_{cum}$$

Actual Time

$$ Planned\ Value $$

$$ Earned\ Value $$

Earned Schedule

$$ Time\ Periods $$

1 2 3 4 5 6 7 8 9 10
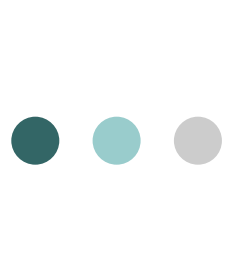
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ES Metric

- ES measure requires the PMB and EV accrued
- Determined from formula, ES = C + I

  where C is number of periodic time units of the PMB for which $EV \geq PV_C$

  and I = $[(EV - PV_C) / (PV_{C+1} - PV_C)] * 1$ period

- At completion, just as EV = BAC, ES = PD where PD = Planned Duration

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ES Indicators

○ The ES measure leads to reliable indicators for the entire duration of the project

$$SV(t) = ES - AT$$
$$SPI(t) = ES / AT$$

cumulative

$$SV(t)_n = (ES_n - ES_{n-1}) - 1$$
$$SPI(t)_n = (ES_n - ES_{n-1}) / 1$$

periodic

where AT is the number of status periods

Metrics	Earned Schedule	ES_{cum}	$ES = C + I$ number of complete periods (C) plus an incomplete portion (I)
	Actual Time	AT_{cum}	AT = number of periods executed
Indicators	Schedule Variance	SV(t)	$SV(t) = ES - AT$
		SV(t)%	$SV(t)\% = (ES - AT) / ES$
	Schedule Performance Index	SPI(t)	$SPI(t) = ES / AT$
	To Complete Schedule Performance Index	TSPI	$TSPI = (PD - ES) / (PD - AT)$
			$TSPI = (PD - ES) / (ED - AT)$
Predictors	Independent Estimate at Completion (time)	IEAC(t)	$IEAC(t) = PD / SPI(t)$
			$IEAC(t) = AT + (PD - ES) / PF(t)$
	Variance at Completion	VAC(t)	$VAC(t) = PD - IEAC(t)$ or EFD

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Forecasting

- EVM forecast of final cost: IEAC = BAC / CPI

- ES forecast of project duration:

  $$IEAC(t) = PD / SPI(t)$$

- Goodness of forecast has been verified by

  - Application

  - Statistical testing

  - Simulation

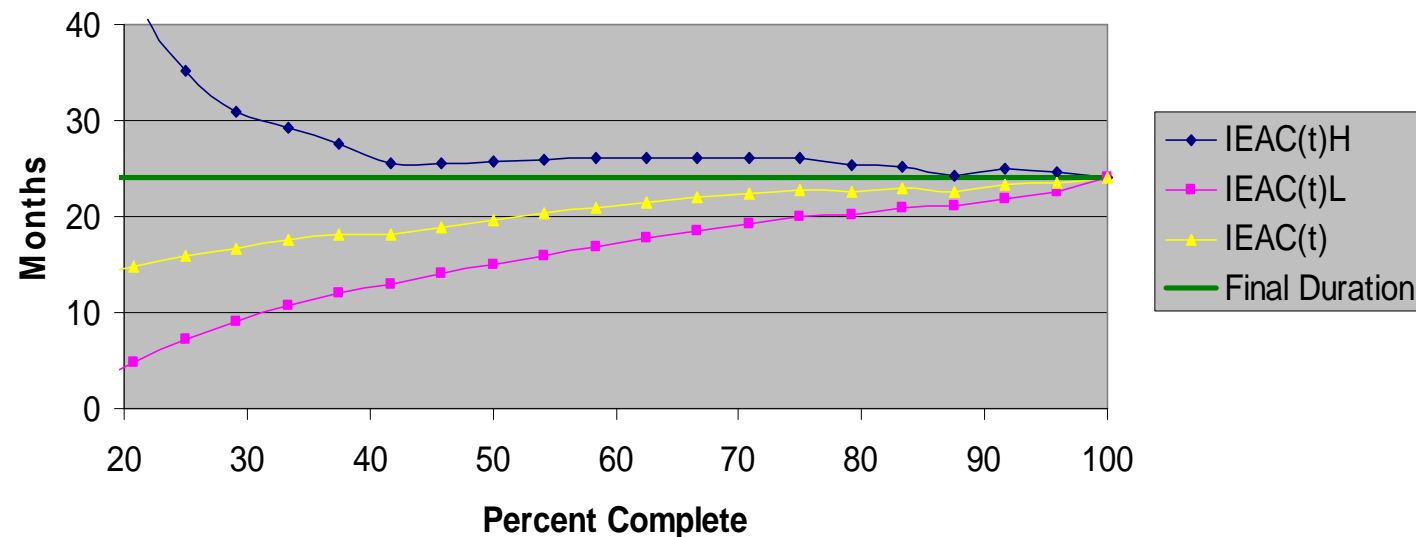- Useful to compare forecast from Critical Path EV data to project forecast

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Forecasting

○ Range of possible outcomes – confidence limits

Project #1 - Schedule

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Prediction

○ Calculation of TSPI provides information concerning whether to attempt corrective action or negotiate a change with the customer

TSPI Value	Predicted Outcome
≤ 1.00	Achievable
> 1.10	Not Achievable

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Project Control

- Using EVM & ES leads to general strategies

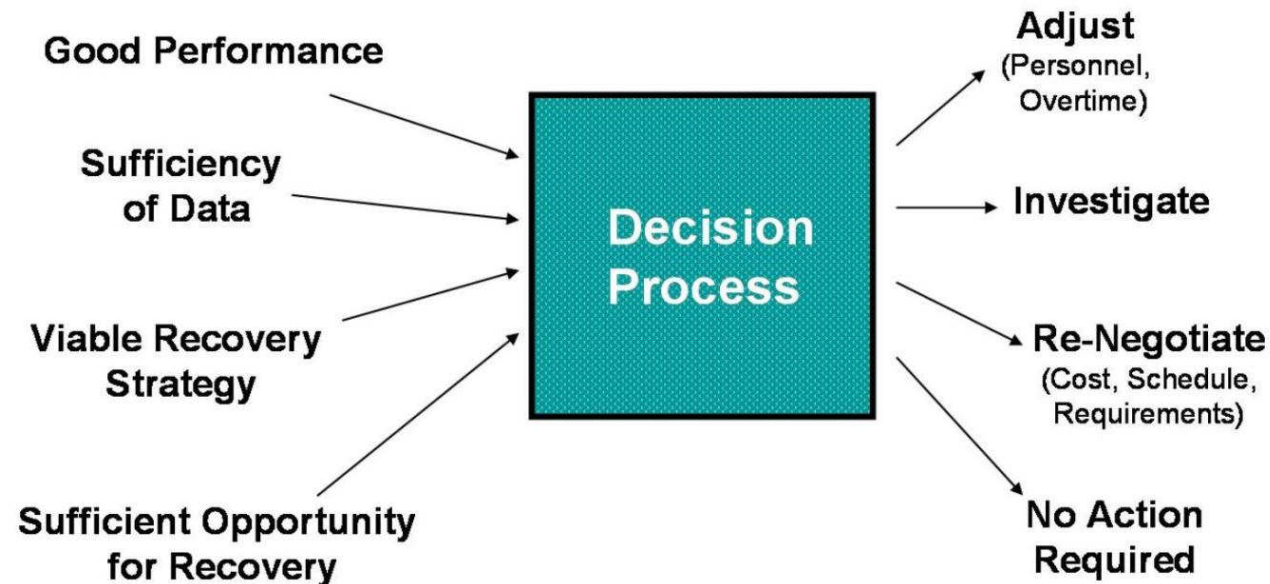| CPI^{-1}	SPI(t)$^{-1}$	Recommended Action
Green	Green	Reward Employees
Green	Yellow	Increase Overtime
Green	Red	Increase Overtime or People
Yellow	Green	Decrease Overtime
Yellow	Yellow	Review & Adjust Assignments
Yellow	Red	Adjust Assignments; Consider Negotiation (Schedule)
Red	Green	Decrease Overtime or People
Red	Yellow	Adjust Assignments; Consider Negotiation (Funding)
Red	Red	Negotiation (Funding/Schedule/Rqmts); Causal Analysis

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Project Control

o Improved project recovery tactics

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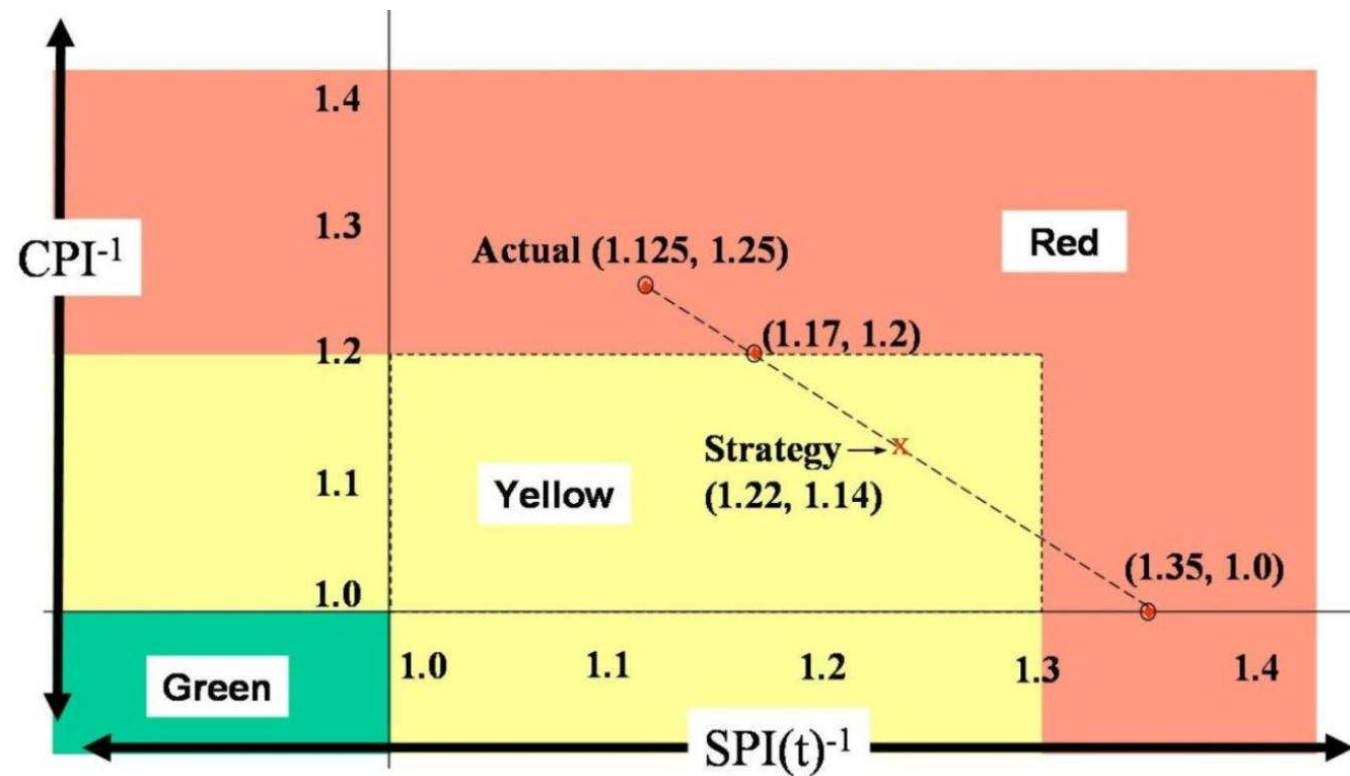
Project Control

○ Better project management decisions

Good Performance →

Sufficiency of Data →

Viable Recovery Strategy →

Sufficient Opportunity for Recovery →

Decision Process

→ Adjust (Personnel, Overtime)

→ Investigate

→ Re-Negotiate (Cost, Schedule, Requirements)

→ No Action Required

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Schedule Adherence

- ES facilitates measuring how well project execution follows the plan


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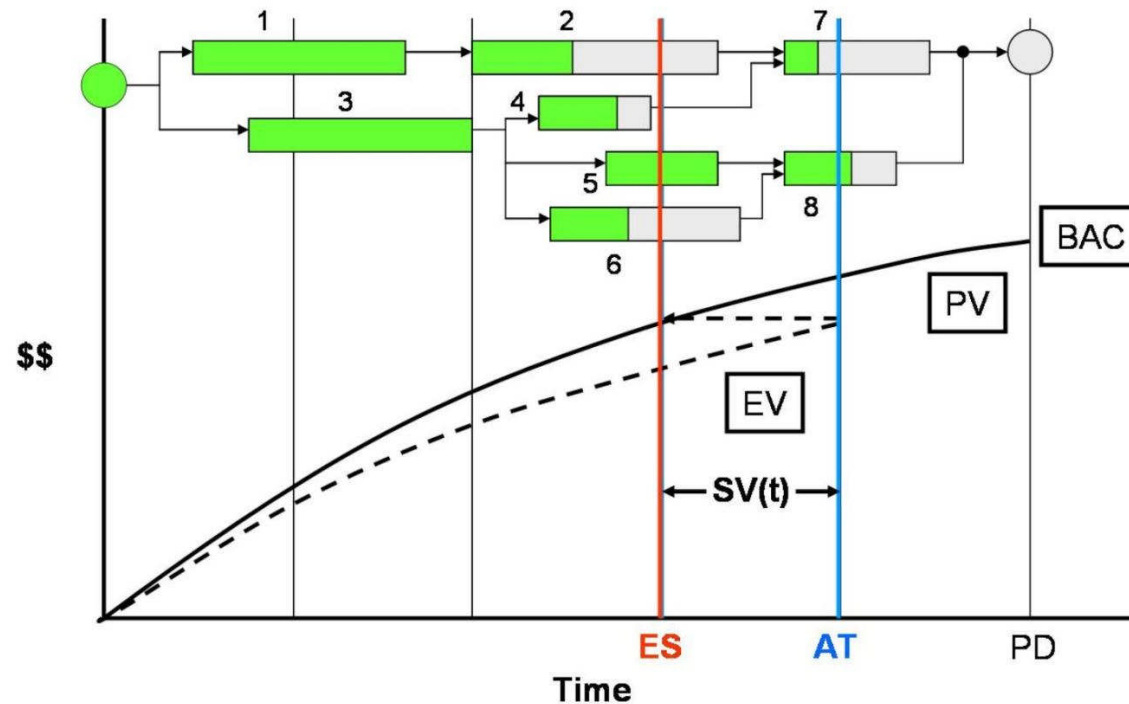
Schedule Adherence

- Independent from schedule efficiency (SPI(t))
- Measured as ratio of EV conforming to the PV which should have been earned (P-Factor)
- Allows analysis which identifies tasks having impediments or constraints
- Identifies tasks which are likely to have future rework and enhances forecasting
- Leads to Schedule Adherence Index and improved control
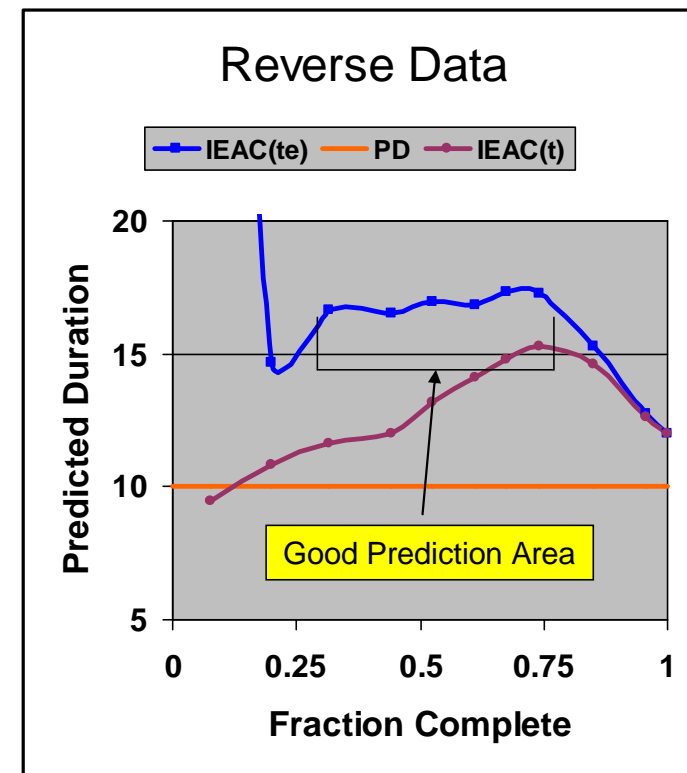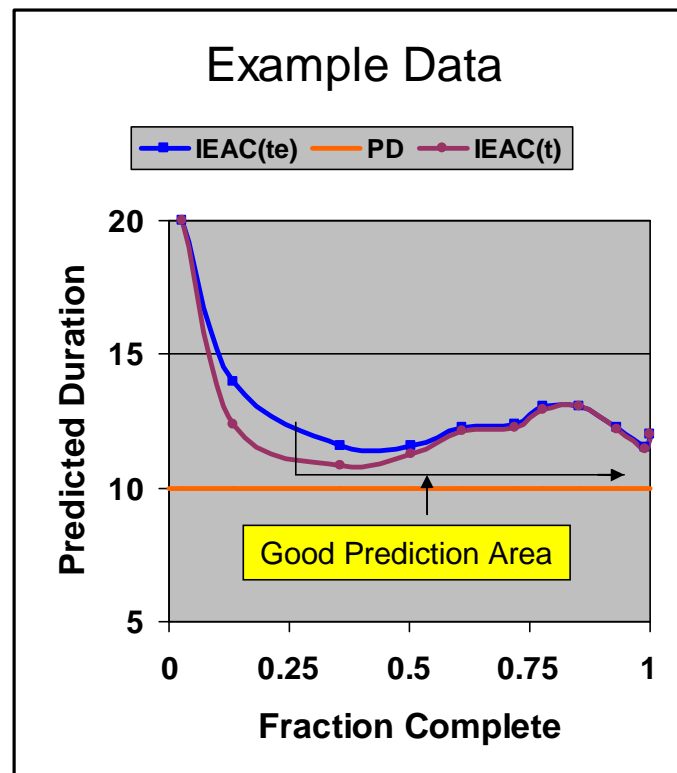- Facilitates calculation of induced rework

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SA - Analysis Example
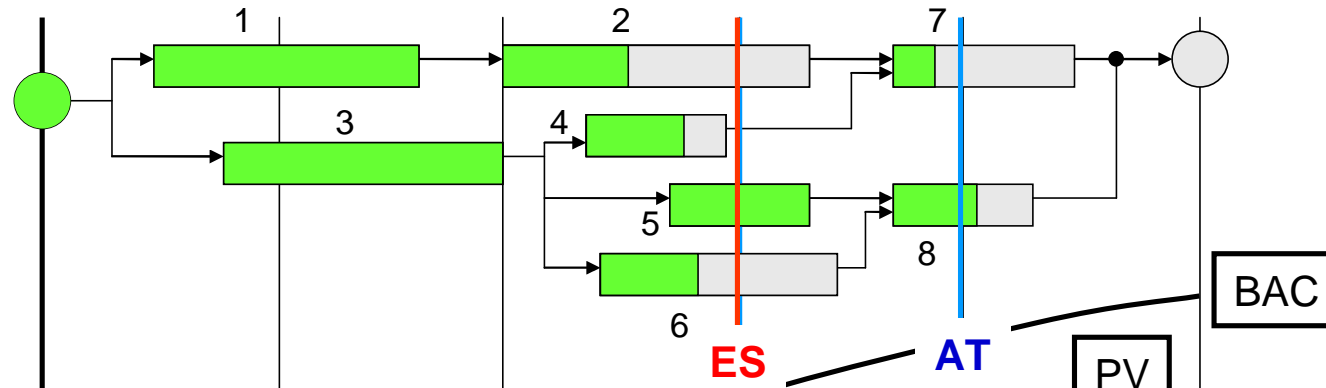
Task	PV	PV@ES	EV@AT	EV - PV	I/C or R
1	10	10	10	0	
2	12	9	5	-4	I/C
3	10	10	10	0	
4	5	5	3	-2	I/C
5	5	2	5	+3	R
6	8	4	3	-1	I/C
7	7	0	1	+1	R
8	5	0	3	+3	R
Total	62	40	40	0	

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SA - Enhanced Forecasting

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Rework

○ Schedule Adherence Index

SAI = R / (BAC – EV)

where R = f(P, EV, BAC)

○ SAI is useful for detecting trends …thus a management tool for gauging actions taken

● SAI increasing with EV $\Rightarrow$ SA worsening

● SAI decreasing with EV $\Rightarrow$ SA improving

○ Allows for calculation of out of sequence EV

○ Facilitates forecast of project rework cost

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Rework

- Ability to determine amount of out of sequence EV and forecast rework cost heightens management attention to schedule execution

- Increases ability of oversight functions to identify EV "gaming"

- Improved schedule adherence hypothesized to improve both cost and schedule performance efficiencies

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Rework - Real Example
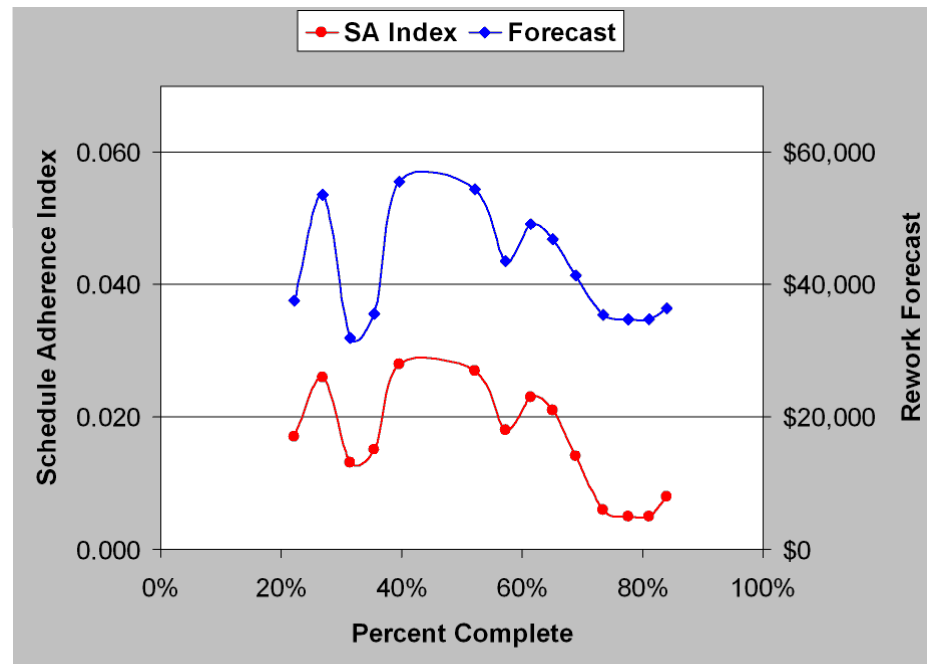
- BAC $\cong$ \$2.5 million, P = 0.930 $\Rightarrow$ 0.995
- CPI $\cong$ 1.05, SPI(t) $\cong$ 0.98
- EV(r) $\cong$ \$80K, Rework Forecast $<$ \$40K

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Application Aids

- Calculation of ES, indicators, and forecast – *available from ES website (es calculator page) and several EVM tools*

- Small Projects (Down Time & Stop Work) – *ES website*

- Range of possible outcomes (confidence limits) – *ES website*

- Schedule Adherence (P-Factor) – *ES website, Project Flight Deck, and ProTrack*

- Out of Sequence EV & Rework – *ES website*

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Summary

- Managing schedule may be more difficult than cost and has more repercussions
- ES is derived from the PMB and EV accrued
- ES makes possible – reliable schedule performance indicators, forecasting, prediction
- Amplifies ability to control project using EVM & ES
- Facilitates identifying process logjams and assess & minimize rework
- Application aids are available and coming

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Supplemental Remarks

- Data for analysis comes from EVM …no new data is required

- Provides top down approach to assessing schedule performance

- Equally usable for re-planned projects, and small projects having stop work and down-time conditions

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Supplemental Remarks

- ES methodology is growing
  - ES website is receiving $\cong$ 40K hits per month
  - Project management and EVM books now include ES
  - Included in university coursework & research
  - Evidence of use is global
  - Usage is occurring in several industries
  - Included in PMI$_®$ EVM Practice Standard (Oct 2011)

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Supplemental Remarks

- ES has had its share of detractors …and proponents, as well
- British philosopher, John Stuart Mill, once made this observation that new ideas pass through three phases of denial:

First – *They are wrong*

Second – *They are against religion*

Third – *They are old news, trivial, common sense, and we all would have thought of them if we had had the time, money, and interest*

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References

- "Earned Schedule Application to Small Projects," *PM World Today*, April 2011 (Vol. XIII, Issue IV)
- "Schedule Adherence and Rework," <u>*The Measurable News*</u>, 2011 Issue 1: 9-14
- *Earned Schedule,* Rayleigh, NC, Lulu Publishing 2009
- Earned Schedule Website: www.earnedschedule.com

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