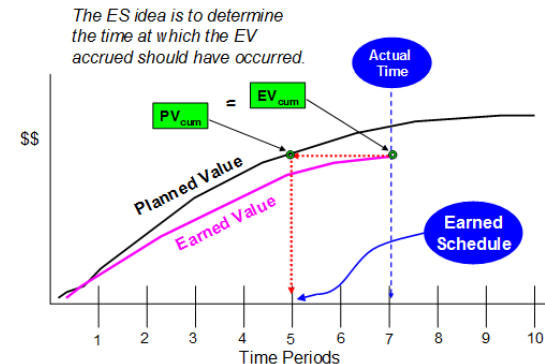




EARNED SCHEDULE

AN EVOLUTION OF EARNED VALUE MANAGEMENT

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Abstract

Earned Schedule is an extension to Earned Value Management. The method provides considerable capability to project managers for analysis of schedule performance. From the time of the public's first view of Earned Schedule, its propagation and uptake around the world has been extraordinary. This presentation will cover the capabilities, affirmation, and resources available supporting the practice.



Planning

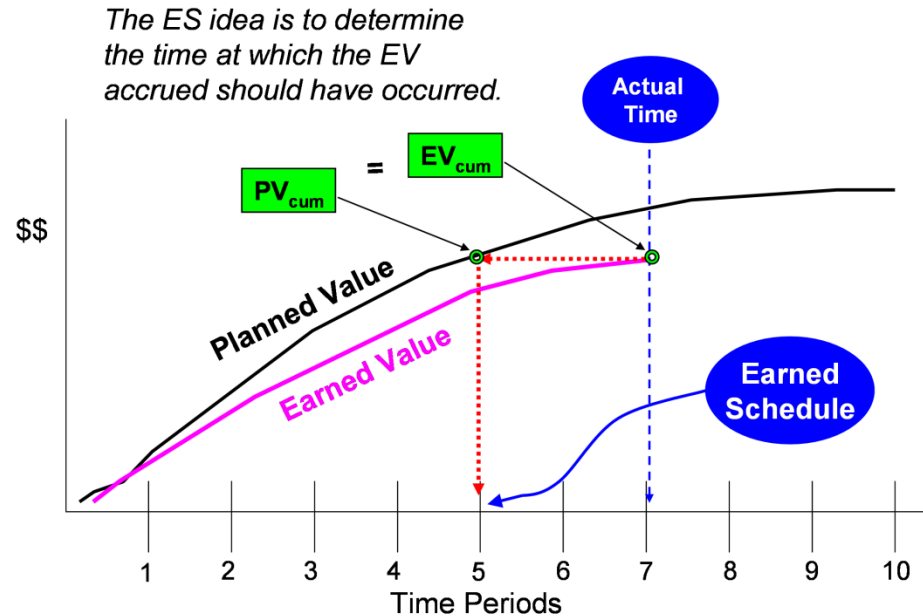
“Planning is an unnatural process; it is much more fun to do something. The nicest thing about not planning is that failure comes as a complete surprise, rather than being preceded by a period of worry and depression.”

-Sir John Harvey-Jones



Overview

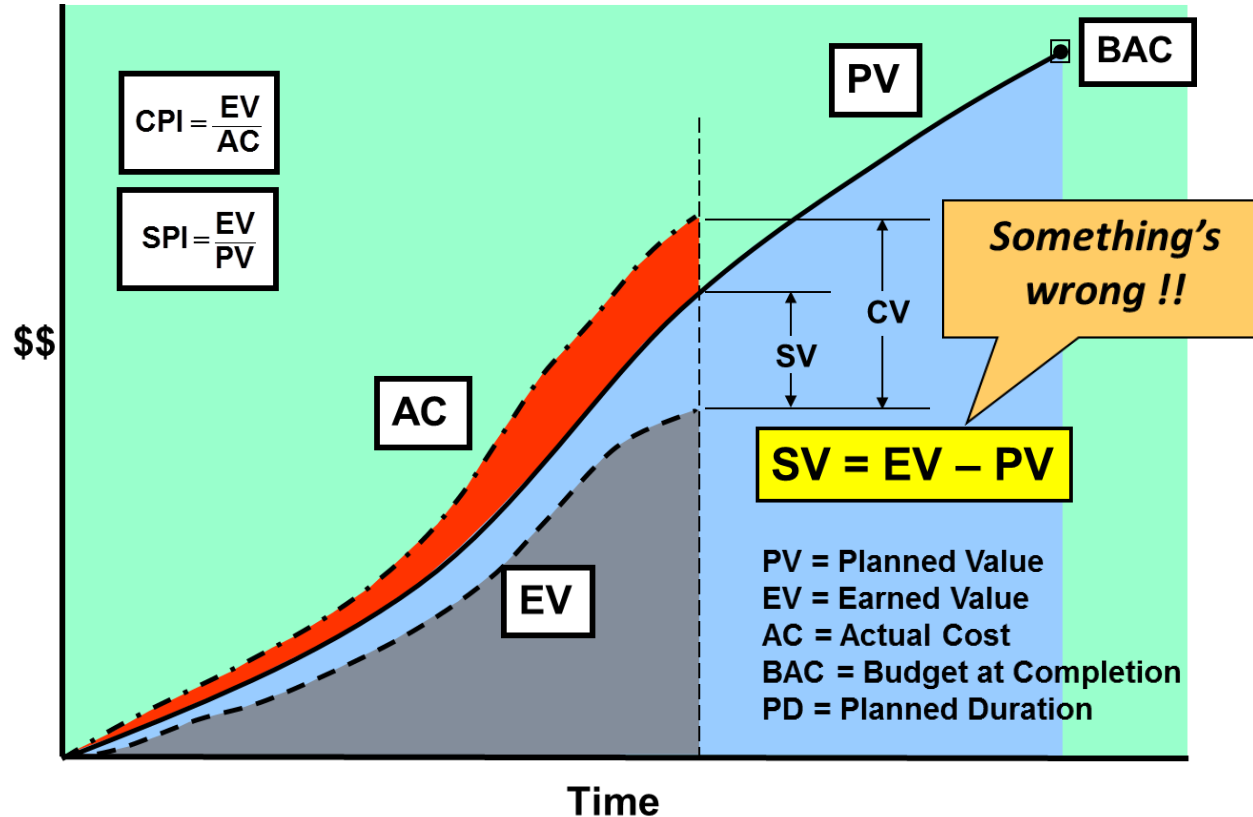
- Description
- Computation
- Capabilities
- Affirmation
- Resources
- Summary





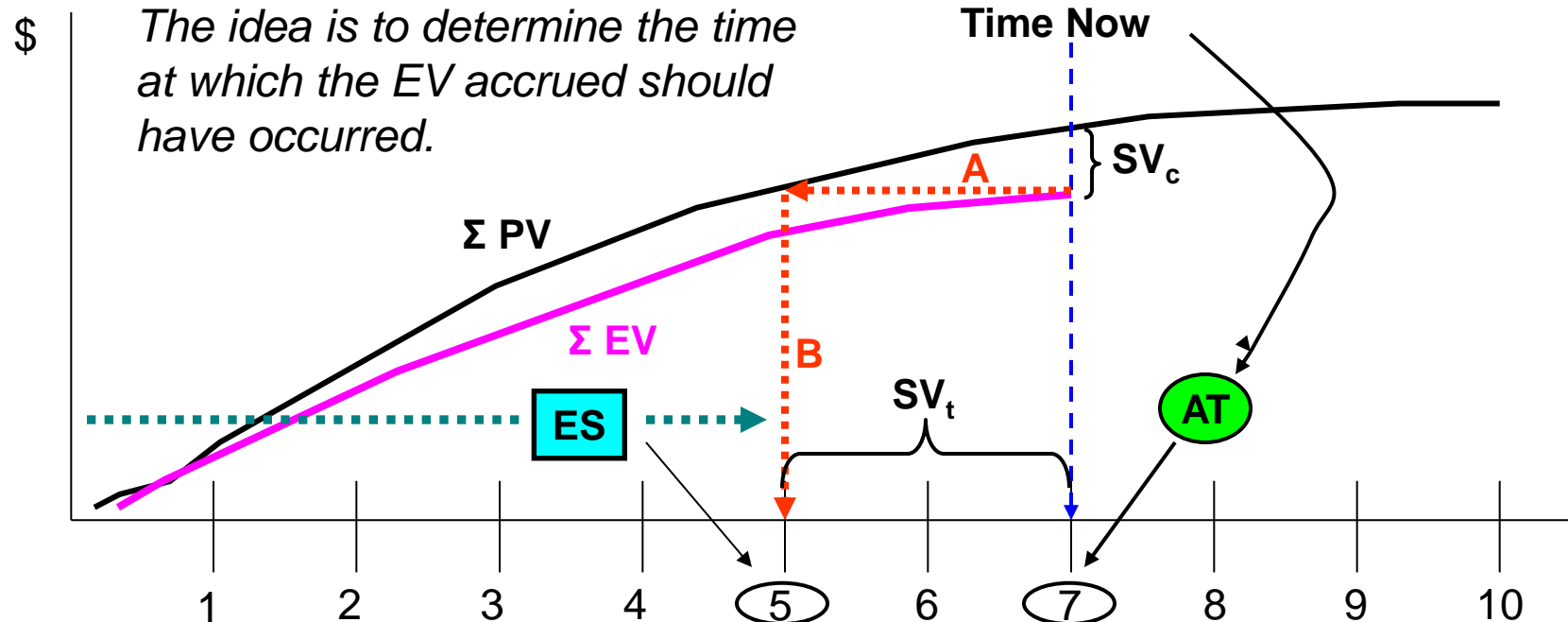
DESCRIPTION

EVM Schedule Indicators





Earned Schedule Concept



For the above example, ES = 5 months ...that is the time associated with the PMB at which PV equals the EV accrued at month 7.



Earned Schedule Concept

- Formula

- $ES = C + I$

where: C = number of time increments for $EV \geq PV$

$$I = (EV - PV_C) / (PV_{C+1} - PV_C)$$

- Indicators

- Schedule Variance: $SV(t) = ES - AT$

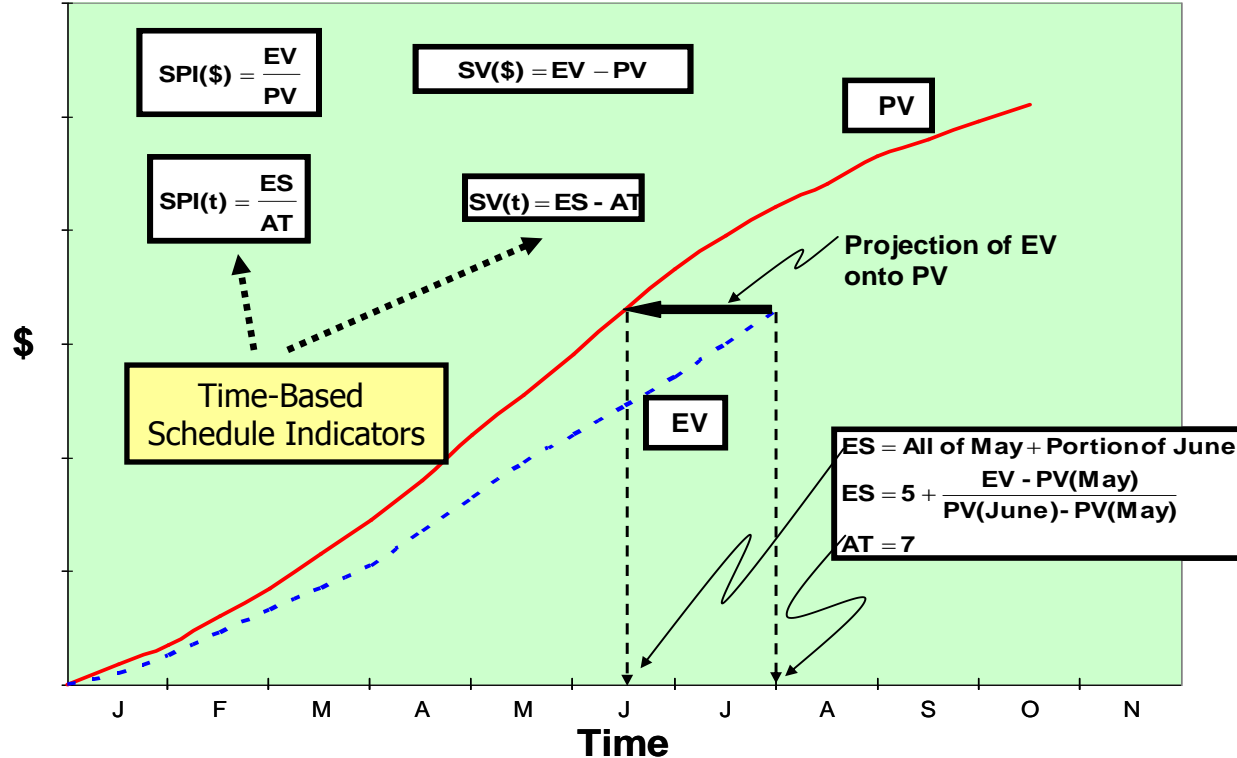
- Schedule Performance Index: $SPI(t) = ES / AT$



ES COMPUTATION



ES Computation Example





ES Computation Example

Earned Schedule requires the:

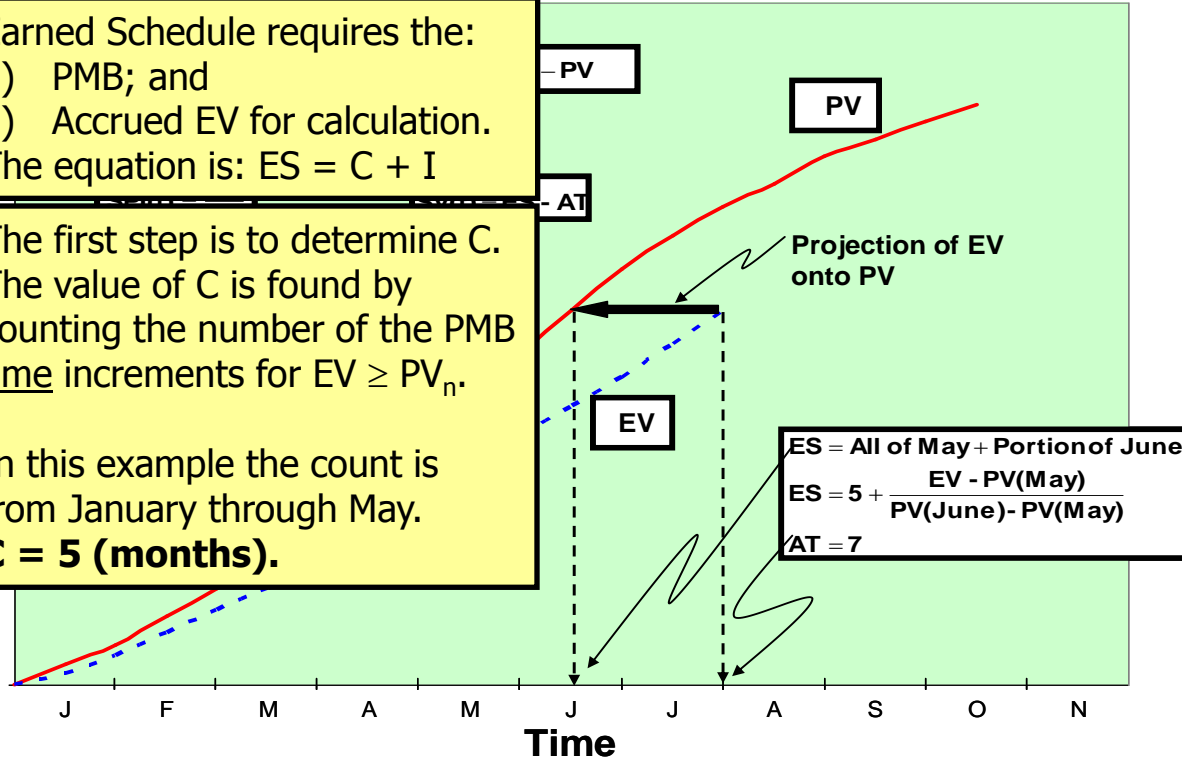
- 1) PMB; and
- 2) Accrued EV for calculation.

The equation is: $ES = C + I$

The first step is to determine C. The value of C is found by counting the number of the PMB time increments for $EV \geq PV_n$.

In this example the count is from January through May.

C = 5 (months).





ES Computation Example

Thus far, $ES = 5 + I$ (months).
 In the small box at the lower right,
 is the equation for calculating I .
 For the example, let

- 1) $EV = 100$
- 2) PV_5 (May) = 90
- 3) PV_6 (June) = 110.

Let's calculate I :
 $I = (100 - 90) / (110 - 90) = 0.5$

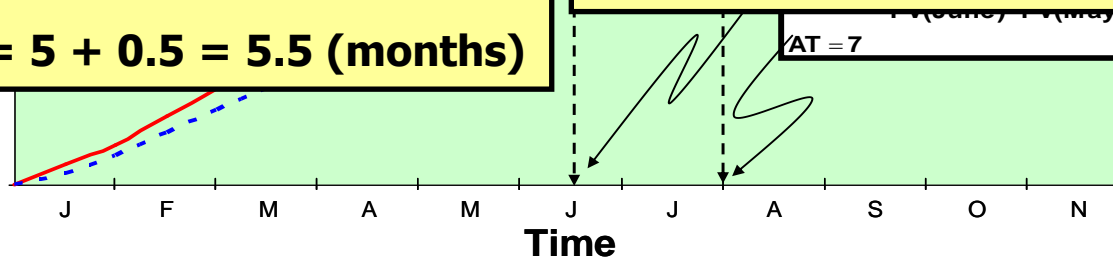
$ES = 5 + 0.5 = 5.5$ (months)

From ES (5.5 months) we can now
 calculate the ES indicators:
 $SV(t)$ and $SPI(t)$.

The EV is reported at Actual Time
 $AT = 7$, the end of July.

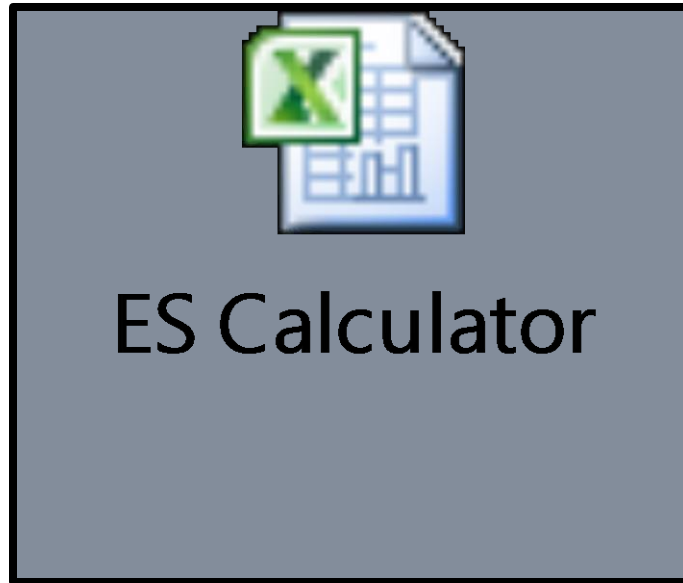
$SV(t) = 5.5 - 7 = -1.5$ months

$SPI(t) = 5.5 / 7 = 0.79$





Earned Schedule Calculator



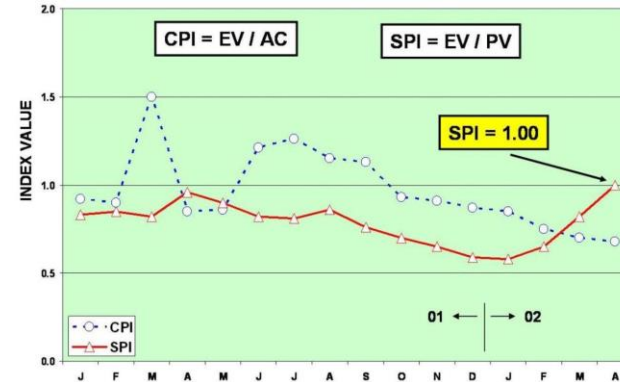
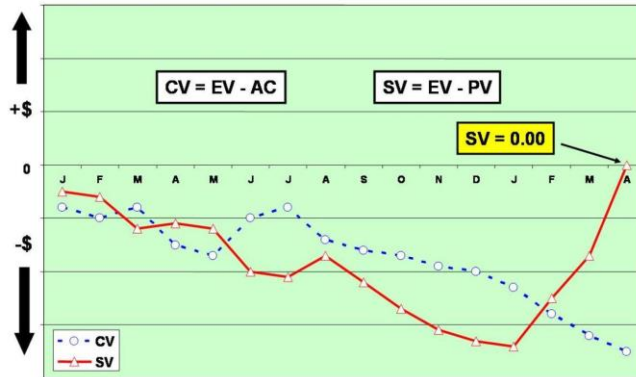


CAPABILITIES



Capabilities

- Reliable indicators – $SV(t)$ & $SPI(t)$
 - True performance at completion

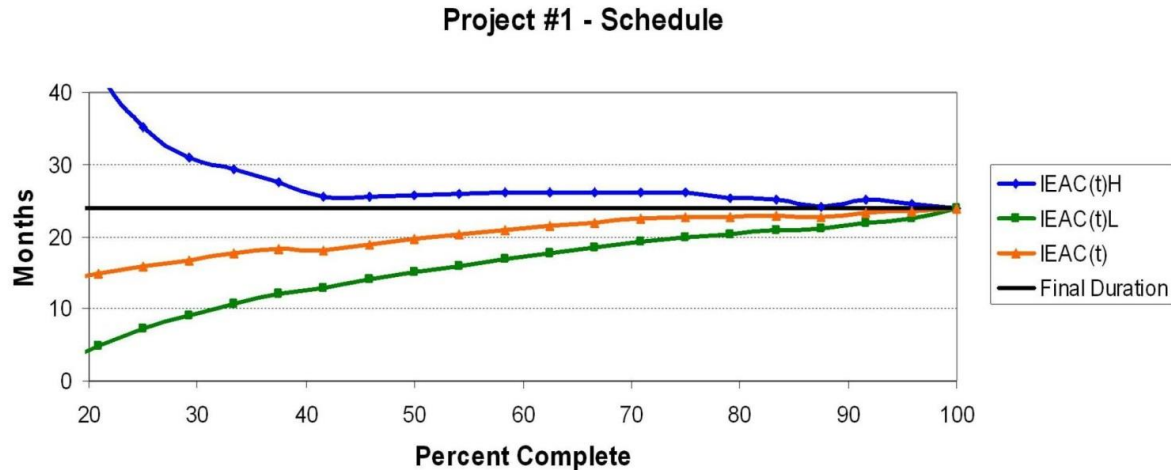


EVM schedule indicators fail for late performing projects



Capabilities

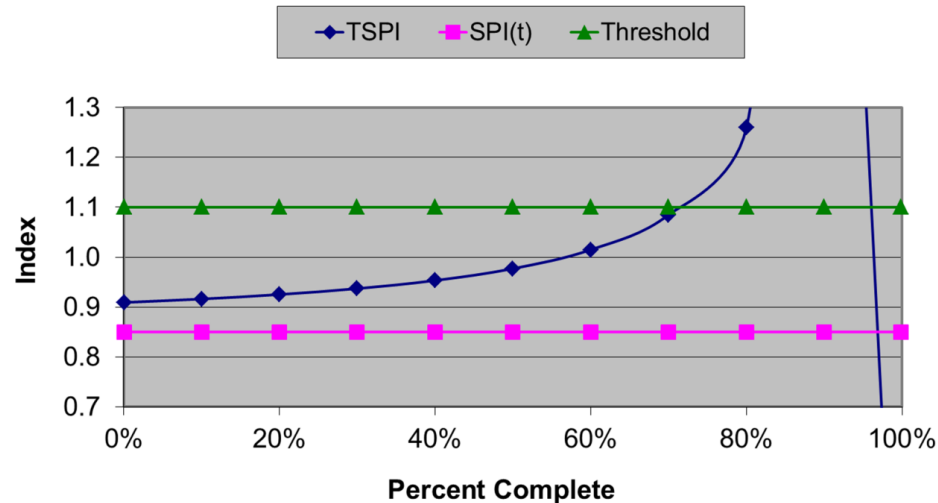
- Forecasting
 - Duration & completion date
 - Always converges to actual result





Capabilities

- Prediction
 - To Complete Schedule Performance Index (TSPI)
 - Answers question – “Is completion at (time) achievable?”





Capabilities

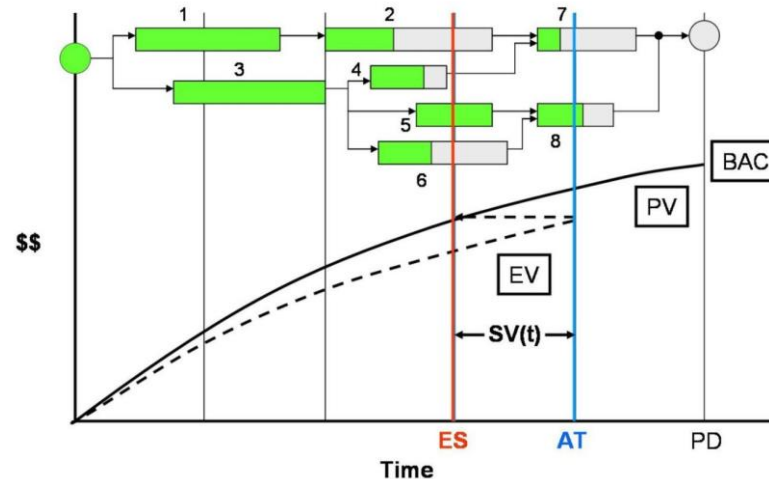
- Critical Path
 - Comparison of project and CP performance

		... Performance Period ...												
Indicator		0	1	2	3	4	5	6	7	8	9	10	11	12
Total Project	CPIp	xxx	xxx	0.800	0.800	0.827	0.771	0.900	0.838	0.727	0.900	0.750	0.600	1.000
	CPIc	xxx	xxx	0.800	0.800	0.818	0.804	0.818	0.822	0.812	0.816	0.810	0.805	0.808
	SPI(t)p	xxx	0.000	0.800	1.486	1.314	0.775	0.450	0.975	0.700	0.450	1.950	0.500	0.600
	SPI(t)c	xxx	0.000	0.400	0.762	0.900	0.875	0.804	0.829	0.813	0.772	0.890	0.855	0.833
	SPIp	xxx	0.000	0.800	0.457	1.433	0.675	0.600	1.550	3.200	0.900	3.000	xxx	xxx
	SPIc	xxx	0.000	0.400	0.444	0.840	0.783	0.745	0.842	0.912	0.911	0.968	0.984	1.000
	IEAC(t)	xxx	xxx	25.00	13.13	11.11	11.43	12.44	12.07	12.31	12.95	11.24	11.70	12.00
Critical Path 1-4-8-10	CPIp	xxx	xxx	0.800	0.800	0.833	0.600	xxx	0.800	0.667	xxx	0.714		
	CPIc	xxx	xxx	0.800	0.800	0.815	0.781	0.781	0.787	0.763	0.763	0.753		
	SPI(t)p	xxx	0.000	0.800	1.600	2.000	0.600	0.000	1.700	1.300	0.000	2.000		
	SPI(t)c	xxx	0.000	0.400	0.800	1.100	1.000	0.833	0.957	1.000	0.889	1.000		
	SPIp	xxx	0.000	0.800	1.600	2.000	0.600	0.000	1.200	1.600	0.000	2.000		
	SPIc	xxx	0.000	0.400	0.800	1.100	1.000	0.833	0.925	1.000	0.900	1.000		
	IEAC(t)	xxx	xxx	25.00	12.50	9.09	10.00	12.00	10.45	10.00	11.25	10.00	xxx	xxx



Capabilities

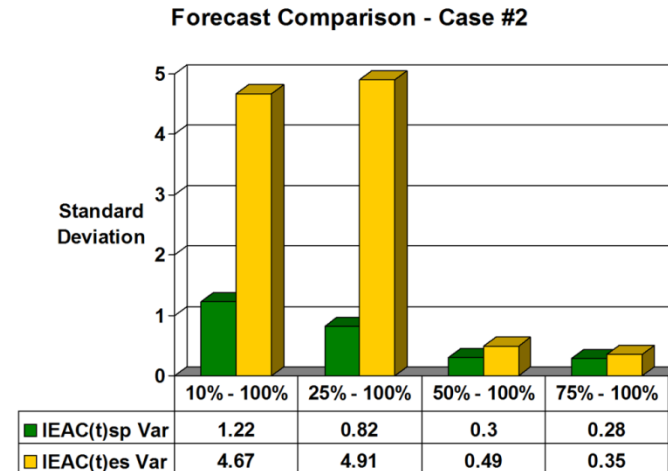
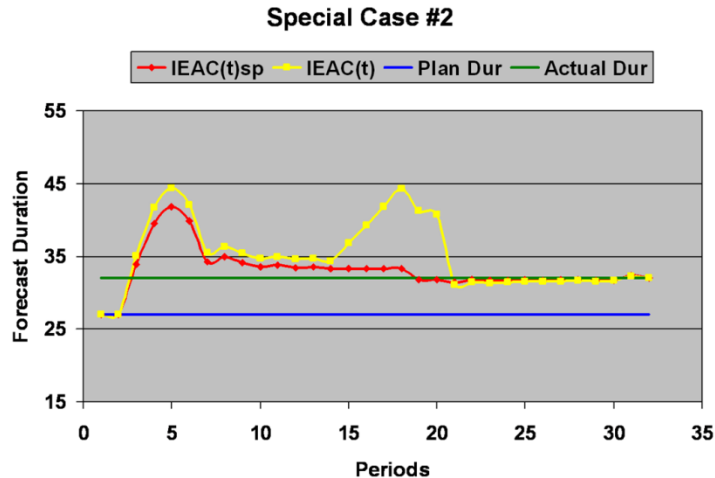
- Detail Analysis – Schedule Adherence
 - Identifies out of sequence performance
 - Isolates tasks - constraints/impediments & rework
 - Facilitates calculations - SA metric & rework forecast





Capabilities

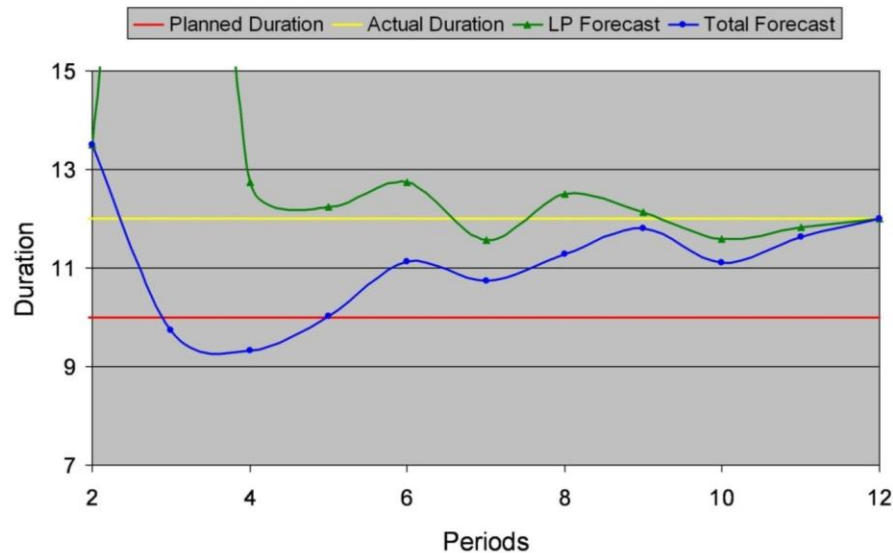
- Discontinuous performance – stop work & downtime
 - Accommodates and improves forecasting





Capabilities

- Schedule Topology
 - Longest path concept improves forecasts for parallel networks





Earned Schedule Terminology

Metrics	Earned Schedule	ES_{cum}	ES = C + I number of periods (C), EV ≥ PV _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
Predictor	To Complete Schedule Performance Index	TSPI	TSPI = (PD – ES) / (PD – AT)
			TSPI = (PD – ES) / (ED – AT)
Forecasts	Independent Estimate at Completion (time)	IEAC(t)	IEAC(t) = PD / SPI(t)
			IEAC(t) = AT + (PD – ES) / PF(t)
	Variance at Completion (time)	VAC(t)	VAC(t) = PD – IEAC(t) or ED



AFFIRMATION



Affirmation

- Simple theory
- Initial prototype
- Independent confirmation
 - Trials
 - Testing
 - Usage
- EVM Tools
- Educators/Researchers
- Standards & Guides
- Awards



Affirmation

- Simple theory
- Initial prototype
- Independent confirmation
 - Trials

“The retrospective analysis of ES using my own EVM projects’ data, ... has confirmed with remarkable precision the accuracy of the ES concept and ES metrics ...when compared to their historic EVM counterparts.”

- Henderson (2003)

- Awards



Affirmation

- Simple theory

“The results reveal that the earned schedule method outperforms, on the average, all other forecasting methods.”

- Vanhoucke & Vandevorde (2007)

- Testing

“This research finds Earned Schedule to be a more timely and accurate predictor than Earned Value Management.”

- Capt. Kevin Crumrine (2013)

- Standards & Guides

- Awards



Affirmation

Evidence of Earned Schedule Usage				
Application	USA	Lockheed-Martin Boeing Booze-Allen-Hamilton Government & Defense	Projects are generally extremely large, running for a decade or more and costing in excess of \$1 Billion.	
	Australia UK Belgium Kazakhstan India	Private & Defense Network Rail & Defense Fabricom (GDF-SUEZ) Petroleum Development Building Construction		
University Coursework	USA	George Washington University, Drexel, University of Houston, University of Nevada (Reno), West Virginia University, Pennsylvania State University		
	non-USA	University of Ghent (Belgium), Australian National University		
Books	USA	<i>Earned Schedule</i> by Walter H. Lipke <i>Project Management Theory and Practice</i> by Dr. Gary L. Richardson <i>The Earned Value Maturity Model</i> by Ray W. Stratton <i>A Practical Guide to Earned Value Management, 2nd Edition</i> by Charles & Charlene Budd <i>Project Management Achieving Competitive Advantage</i> by Jeffrey K. Pinto <i>Practice Standard for Earned Value Management</i> by Project Management Institute		
	non-USA	<i>Measuring Time: Improving Project Performance Using Earned Value Management</i> by Dr. Mario Vanhoucke <i>Earned Schedule - an emerging Earned Value technique</i> issued by UK APM EVM SIG		



Affirmation

- Simple theory

- ❖ PMI Practice Standard for EVM
- ❖ PMI Project Management Body of Knowledge
- ❖ PMI Practice Standard for Scheduling (pending)
- ❖ NDIA Predictive Measures Guide
- ❖ NDIA Planning and Scheduling Excellence Guide
- ❖ ISO Standard for EVM
- ❖ Australian Standard for EVM (in work)

- Standards & Guides
- Awards





RESOURCES



Resources

- Earned Schedule Website

<http://www.earnedschedule.com/>

- Papers, Presentations, Calculators, Terminology,
- Standards & Guides
- *Earned Schedule* book (English, Japanese, Portuguese, Spanish)
 - Print
 - ePub (Nook & iPad)
 - Kindle
 - PDF





Resources

- To Begin ...use the website
 - View the “Introduction Video”
 - Download and read two articles
 - “Schedule is Different”
 - “Further Developments in Earned Schedule”
- Scan the Calculators ...experiment with them
 - ES Calculator (v1b)
 - P-Factor Calculator
 - Statistical Forecasting Calculator
 - SA Index & Rework Calculator
 - Prediction Analysis Calculator



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SUMMARY



Summary

- Derived from EVM data ... only
- Provides time-based schedule indicators
- Indicators do not fail for late finish projects
- Application is scalable up/down, just as is EVM
- Schedule forecasting & analysis is better than any other EVM method presently used
 - $SPI(t)$ & $SV(t)$ behave similarly to CPI & CV
 - $IEAC(t) = PD / SPI(t)$ behaves similarly to $IEAC = BAC / CPI$



Summary

- Schedule performance analysis – much easier and possibly better than “bottom-up” methods
- Application is growing in both small and large projects
- Practice recognized in Standards & Guides
- Resource availability enhanced with ES website and Wikipedia
- Research indicates ES superior to other methods

Hopefully you are encouraged to – Give ES a try!



Thank You!!

TM