#### A Neat Solution for the EVM Schedule Problem February 2013

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## Your customer might doubt your optimism

- Office of the Under Secretary of Defense for Acquisition (OUSD(A)) observed that once a contract is 15% complete it is highly unlikely to recover from a cost overrun<sup>1</sup>
- Observation insensitive to:
  - contract type (price, cost)
  - contract phase (development, production)
  - type of weapon system (air ground, sea)
  - armed force service (air force, army, navy) that managed the contract
- Despite this observation, contractor and governmental personnel often claim that their programs are different

<sup>1</sup>Christensen, David S. 1993. "An Analysis of Cost Overruns on Defense Acquisition Contracts." Project Management Journal 3 :43-48 (September)

## How do EVM metrics perform?

	CV(\$)	CPI(\$)	SV(\$)	SPI(\$)	
Based on EVM data					
Accurate through entire project					
Meaningful measure / information					
Can make forecasts					

# Work Breakdown Structure (WBS)



PMBOK<sup>5th Edition</sup>: 5.4 Create WBS

PMI Practice Standard for Work Breakdown Structures 2<sup>nd</sup> Edition

## Performance Measurement Baseline (PMB)



Planned Value (PV) is the authorized budget assigned to scheduled work

PMBOK<sup>5th Edition</sup>:

6.0 Project Time Management 7.0 Project Cost Management

# Earned Value Management (EVM) - basics



### EVM – cost performance metrics



CV = EV - AC

### EVM – schedule performance metrics



SPI = EV / PV

SV = EV - PV

# Cost EVM metrics OK! Schedule metrics problematic!

	CV(\$)	CPI(\$)	SV(\$)	SPI(\$)	
Based on EVM data	$\checkmark$	1	$\checkmark$	1	
Accurate through entire project	$\checkmark$	1	×	X	
Meaningful measure / information	$\checkmark$	1	X	×	
Can make forecasts	$\checkmark$	1	X	×	

### Schedule performance – earned schedule (ES)



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## Calculate earned schedule (ES)

- PV (Week 7) < EV < PV (Week 8)
- ES is into Week 8 of the project baseline
  - Calculate what fraction of Week 8 is earned

Week	1	7	8		10
AC	7	52	60		84
EV	5	38	43		48
PV	6	46	52	$\mathbf{>}$	71



$$\mathsf{ES} = 7 + \frac{\mathsf{EV} - \mathsf{PV}_7}{\mathsf{PV}_8 - \mathsf{PV}_7} = 7 + \frac{48 - 46}{52 - 46} = 7 + \frac{2}{6} = 7.33$$

### ES-based (time-based) schedule metrics formulas

$$\begin{split} & \text{ES} = \text{n} + \frac{\text{EV} - \text{PV}_{\text{n}}}{\text{PV}_{\text{n+1}} - \text{PV}_{\text{n}}} \text{ where n is the period when } \text{PV}_{\text{n}} < \text{EV} < \text{PV}_{\text{n+1}} \end{split}$$

$$\begin{aligned} & \text{PD} = \text{original planned duration of project} \\ & \text{AT} = \text{actual time} = \text{time now} \end{aligned}$$

$$\begin{aligned} & \text{Cumulative SV(t) = \text{ES} - \text{AT}} \\ & \text{Cumulative SPI(t) = \frac{\text{ES}}{\text{AT}}} \end{aligned}$$

$$\begin{aligned} & \text{Monthly SV(t) = (\text{ES}(\text{cum})_{\text{AT}} - \text{ES}(\text{cum})_{\text{AT-1}}) - (\text{AT}(\text{cum})_{\text{AT}} - \text{AT}(\text{cum})_{\text{AT-1}}) \end{aligned}$$

$$\begin{aligned} & \text{Monthly SPI(t) = \frac{\text{ES}(\text{cum})_{\text{AT}} - \text{ES}(\text{cum})_{\text{AT-1}}}{\text{AT}(\text{cum})_{\text{AT}} - \text{AT}(\text{cum})_{\text{AT-1}}} \end{aligned}$$

# Not Project of the Year PMI NOT-POTY schedule metrics

	\$-ba	sed	me	trics	;				/	E\ to	/MS d gene	ata is rate b	used oth ty	UNCI pes o	HANG f metr	ED ics				
n = weeks fr	om start	0	1	2	3	4	5	6	1	8	9	10	11	12	13	14	15	16	17	18
Week		-	W1	W2	W3	W4	W5	W6	y₩7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18
		0	\$7	\$14	\$22	\$30	\$39	\$48	▼ \$52	\$60	\$70	\$84	\$90	\$100	\$108	\$112	\$118	\$121	\$124	\$126
Cumulative I	EV	0	\$5	\$10	\$16	\$22	\$28	\$34	\$38	\$43	\$44	\$48	\$57	\$69	\$76	\$80	\$83	\$88	\$94	\$98
Cumulative I	PV	0	\$6	\$12	\$20	\$28	\$37	\$42	\$46	\$52	\$60	\$71	\$82	\$89	\$95	\$98	\$98	\$98	\$98	\$98
r																				
Monthly SV		0	-\$1	-\$1	-\$2	-\$2	-\$3	\$1	\$0	-\$1	-\$7	-\$7	-\$2	\$5	\$1	\$1	\$3	\$5	\$6	\$4
Monthly SPI			0.83	0.83	0.75	0.75	0.67	1.20	1.00	0.83	0.13	0.36	0.82	1.71	1.17	1.33	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Cumulative	SV		-\$1	-\$2	-\$4	-\$6	-\$9	-\$8	-\$8	-\$9	-\$16	-\$23	-\$25	-\$20	-\$19	-\$18	-\$15	-\$10	-\$4	\$0
Cumulative	SPI		0.83	0.83	0.80	0.79	0.76	0.81	0.83	0.83	0.73	0.68	0.70	0.78	0.80	0.82	0.85	0.90	0.96	1.00
Week			W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18
ES (weeks)		0	0.83	1.67	2.50	3.25	4.00	4.67	5.20	6.25	6.50	7.33	8.63	9.82	10.45	10.82	11.14	11.86	12.83	14.00
Monthly SV(	t)		-0.17	-0.17	-0.17	-0.25	-0.25	-0.33	-0.47	0.05	-0.75	-0.17	0.29	0.19	-0.36	-0.64	-0.68	-0.29	-0.02	0.17
Monthly SPI	(t)		0.83	0.83	0.83	0.75	0.75	0.67	0.53	1.05	0.25	0.83	1.29	1.19	0.64	0.36	0.32	0.71	0.98	1.17
Cumulative	SV <i>(t)</i>		-0.17	-0.33	-0.50	-0.75	-1.00	-1.33	-1.80	-1.75	-2.50	-2.67	-2.38	-2.18	-2.55	-3.18	-3.86	-4.14	-4.17	-4.00
Cumulative S	SPI(t)		0.83	0.83	0.83	0.81	0.80	0.78	0.74	0.78	0.72	0.73	0.78	0.82	0.80	0.77	0.74	0.74	0.75	0.78
-	••••••	-	-	-	-		•	-	-	-		-	-	-	-				-	

time-based metrics

Target Completion Date =

### PMI NOT-POTY schedule metrics side-by-side comparison

						schedule metrics – we're
Week	1	7	8	10	18	18 it's perfect 22!
Cumulative EV	\$5	\$38	\$43	\$48	\$98	
Cumulative PV	\$6	\$46	\$52	\$71	\$98	WHAT DO THESE
						MEAN?
Monthly SV	-\$1	\$0	-\$1	-\$7	\$4	
Monthly SPI	0.83	1.00	0.83	0.36	#DIV/0!	
Cumulative SV	-\$1	-\$8	-\$9	-\$23	\$0	
Cumulative SPI	0.83	0.83	0.83	0.68	1.00	)
ES (weeks)	0.83	5.20	6.25	7.33	14.00	
Monthly SV <i>(t)</i>	-0.17	-0.47	0.05	-0.17	0.17	
Monthly SPI(t)	0.83	0.53	1.05	0.83	1.17	$\geq$ — —
Cumulative SV <i>(t</i> )	-0.17	-1.80	-1.75	-2.67	-4.00	
Cumulative SPI(t)	0.83	0.74	0.78	0.73	0.78	
			••		·	-

Time-based earned-schedule-based schedule metrics – we're 4 weeks late and at Week 18 these metrics indicate this.

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THESE ARE COMMUNICATIVE AND TRANSPARENT!

## PMI NOT-POTY Schedule Metrics (continued)



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## Earned Schedule (ES) as a predictor

• When will the project end?

Projected Project Length =	Planned duration	_ PD _	14	- 10 1 wooks
	Schedule efficiency	SPI(t)	0.733	= 13.1 WCCK3

## ES fixes the EVM schedule metric problem

	CV(\$)	CPI(\$)	SV(\$)	SPI(\$)	SV(t)	SPI(t)
Based on EVM data	$\checkmark$	1	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
Accurate through entire project	$\checkmark$	1	×	X	$\checkmark$	1
Meaningful measure / information	$\checkmark$	1	X	X	$\checkmark$	1
Can make forecasts	$\checkmark$	1	X	×	$\checkmark$	$\checkmark$

## Earned schedule (ES) is NOT conversion of \$ to time

Scenario – 1 task remaining, PV = \$12K, planned duration = 1 month Week 15 SV = -\$12K; SV(t) = -1 month

Week 16

SV = -\$12K; SV(t) = -2 months

Week 17



SV = -\$12K; SV(t) = -3 months

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# Earned schedule (ES) – analysis

• SV(t) = -2.67 weeks





## Earned Schedule (ES) – takeaways

- ES-based schedule metrics
  - **Based on WHEN** the work was planned to be done
  - EVM data already available
    - Non-complex calculations
  - Behaves like EVM cost metrics throughout the project
    - No misleading metrics
    - Can project end date
- Material and travel can skew schedule statistics
  - Labor only might provide a better indicator of schedule status
- How does this jive with critical path analysis?
  - You know how many days slip you need to mitigate

## Earned Schedule (ES) – recommendations

- Use ES if:
  - Schedule performance on your project is critical
  - Schedule performance is significantly ahead or behind
  - You want to step up your level of communication regarding schedule performance
- Do not use ES if:
  - Schedule performance is stellar
    - ES requires customer education
    - Do not give customer something to shoot at

MAKE SURE YOUR MANAGEMENT TEAM IS ON-BOARD WITH ADDING ES TO A CONTRACT'S EV METRICS!

# Earned Schedule (ES) – politics !!!???

<u>Practice Standard for Earned Value Management Second Edition</u>; PMI; 2011

In the previous edition, the concept of earned schedule was treated as "an emerging EVM practice," and an example was developed in Chapter 3 to explain the basic metrics and concepts. In the past five years this "emerging practice" has had an interesting path of emergence. With some exceptions, the concept was not adapted on U.S. Government contracts. However, when the content and structure of the second edition of this practice standard was presented at PMI's Global Congress in Ireland in 2011, and at the European EVA Conference in Ghent Belgium, it was evident that earned schedule has gained strong support outside of the United States. Subject matter expert reviewers of the PS-EVM Second Edition from the U.S. insisted on exclusion of the topic with the same intensity that non-U.S. reviewers insisted on inclusion. A compromise was reached by giving a more complete coverage of earned schedule, but placing that coverage into an appendix where topics that are not necessarily core to the subject matter of practice standards are presented.

Appendix D

### References

- "Schedule is Different"; Walter Lipke; Software Division; Oklahoma City Air Logistics Center; March 2003
- "Not your Father's Earned Value"; Ray Stratton; February 2005
- <u>Practice Standard for Earned Value Management Second Edition</u>; PMI; 2011