# A Neat Solution for the EVM Schedule Problem 

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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 ${ }^{1}$
- 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

[^0]
## 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)



## Performance Measurement Baseline (PMB)



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

PMBOK ${ }^{\text {5th }}$ Edition:
6.0 Project Time Management 7.0 Project Cost Management

## Earned Value Management (EVM) - basics



PV: budget for work to be performed
EV: budget for work completed
AC: cost of work completed

PMBOK ${ }^{\text {5th Edition: 7.4.2 Control Costs: Tools and Techniques }}$

## EVM - cost performance metrics


$C V=E V-A C$

- Program is overrun!
- EVM cost metrics work well
- Metrics indicate inefficient spending
- Ending metrics indicate "poor" cost performance
- Can predict an estimate at completion from metrics
- $\mathrm{EAC}=\mathrm{BAC} / \mathrm{CPI}_{\text {cum }}$

$\mathrm{CPI}=\mathrm{EV} / \mathrm{AC}$


## EVM - schedule performance metrics


$S V=E V-P V$

- Program is late!
- EVM schedule metrics are misleading
- Indicate improving schedule after $1 / 2$ point
- Indicate "perfect" schedule performance at end
- $\quad$ SV $\$=$ how much time?
- When will the project end?
- Cannot predict program end with metrics

SPI = EV / PV

## Cost EVM metrics OK! Schedule metrics problematic!

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

## Schedule performance - earned schedule (ES)



## Calculate earned schedule (ES)

- $P V_{(\text {Week 7) }}<E V<P V_{\text {(Week 8) }}$
- 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 | 71 |



$$
\mathrm{ES}=7+\frac{\mathrm{EV}-\mathrm{PV}_{7}}{\mathrm{PV}_{8}-\mathrm{PV}_{7}}=7+\frac{48-46}{52-46}=7+\frac{2}{6}=7.33
$$

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

```
\(E S=n+\frac{E V-P V_{n}}{P V_{n+1}-P V_{n}}\) where \(n\) is the period when \(P V_{n}<E V<P V_{n+1}\)
\(\mathrm{PD}=\) original planned duration of project
AT \(=\) actual time \(=\) time now
Cumulative \(\mathrm{SV}(\mathrm{t})=\mathrm{ES}-\mathrm{AT}\)
Cumulative \(\operatorname{SPI}(\mathrm{t})=\frac{\mathrm{ES}}{\mathrm{AT}}\)
Monthly \(\mathrm{SV}(\mathrm{t})=\left(\mathrm{ES}(\mathrm{cum})_{\mathrm{AT}}-\mathrm{ES}(\mathrm{cum})_{\mathrm{AT}-1}\right)-\left(\mathrm{AT}(\mathrm{cum})_{\text {AT }}-\mathrm{AT}(\mathrm{cum})_{\mathrm{AT}-1}\right)\)
Monthly SPI(t) \(=\frac{\mathrm{ES}(\text { cum })_{A T}-\mathrm{ES}(\text { cum })_{A T-1}}{\mathrm{AT}(\text { cum })_{A T}-\mathrm{AT}(\mathrm{cum})_{A T-1}}\)
```


## PMI NOT-ṔPOTY schedule metrics



Target Completion Date $=$

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

| Week | 1 | 7 | 8 | 10 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Cumulative EV | \$5 | \$38 | \$43 | \$48 | \$98 |
| Cumulative PV | \$6 | \$46 | \$52 | \$71 | \$98 |
| 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(t) | -0.17 | -0.47 | 0.05 | -0.17 | 0.17 |
| Monthly SPI(t) | 0.83 | 0.53 | 1.05 | 0.83 | 1.17 |
| Cumulative SV(t) | -0.17 | -1.80 | -1.75 | -2.67 | -4.00 |
| Cumulative SPI( $t$ ) | 0.83 | 0.74 | 0.78 | 0.73 | 0.78 |

Traditional dollar-based schedule metrics - we're 4 weeks late and at Week 18 it's perfect ??!!

WHAT DO THESE MEAN?

Time-based earned-schedule-based schedule metrics we're 4 weeks late and at Week 18 these metrics indicate this.
THESE ARE COMMUNICATIVE AND TRANSPARENT!

## PMI NOT-POTY Schedule Metrics (continued)



Target
Completion
Date $=$

## Earned Schedule (ES) as a predictor

- When will the project end?

$$
\text { Projected Project Length }=\frac{\text { Planned duration }}{\text { Schedule efficiency }}=\frac{\mathrm{PD}}{\mathrm{SPI}(\mathrm{t})}=\frac{14}{0.733}=19.1 \text { weeks }
$$

## ES fixes the EVM schedule metric problem

|  | CV(\$) | CPI(\$) | SV(\$) | SPI(\$) | SV(t) | SPI(t) |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Based on EVM data | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ |
| Accurate through entire project | $\checkmark$ | $\checkmark$ | $\times$ | $\times$ | $\checkmark$ | $\checkmark$ |
| Meaningful measure / information | $\checkmark$ | $\checkmark$ | $\times$ | $\times$ | $\checkmark$ | $\checkmark$ |
| Can make forecasts | $\checkmark$ | $\checkmark$ | $\times$ | $\times$ | $\checkmark$ | $\checkmark$ |

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

Scenario - 1 task remaining, PV $=\$ 12 \mathrm{~K}$, 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


Target

## Earned schedule (ES) - analysis

- $\mathrm{SV}(\mathrm{t})=-2.67$ 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 !!!???

- Practice Standard for Earned Value Management Second Edition; 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
- http://www.earnedschedule.com/

- Practice Standard for Earned Value Management Second Edition; PMI; 2011


[^0]:    ${ }^{1}$ Christensen, David S. 1993. "An Analysis of Cost Overruns on Defense Acquisition Contracts."
    Project Management Journal $3: 43-48$ (September)

