INTRODUCTION TO EARNED SCHEDULE

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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.
Overview

• Description
• Capabilities
• Affirmation
• Resources
• Computation
• Summary

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

- **CPI** = $\frac{EV}{AC}$
- **SPI** = $\frac{EV}{PV}$

- $PV = \text{Planned Value}$
- $EV = \text{Earned Value}$
- $AC = \text{Actual Cost}$
- $BAC = \text{Budget at Completion}$
- $PD = \text{Planned Duration}$

Something’s wrong!!

$SV = EV - PV$

- $SV = \text{Schedule Variance}$
- $CV = \text{Cost Variance}$
The idea is to determine the time at which the EV accrued should have occurred.

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: $SPI(t) = ES / AT$
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

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<tr>
<th>Indicator</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<td>xxx</td>
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<td><strong>IEAC(t)</strong></td>
<td>xxx</td>
<td>xxx</td>
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<td>13.13</td>
<td>11.11</td>
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<td>12.07</td>
<td>12.31</td>
<td>12.95</td>
<td>11.24</td>
<td>11.70</td>
<td>12.00</td>
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| **Performance Period** || 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12   |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| CPIp                  |     |     |     |     |     |     |     |     |     |     |     |     |      |
| CPIc                  |     |     |     |     |     |     |     |     |     |     |     |     |      |
| SPI(t)p               |     |     |     |     |     |     |     |     |     |     |     |     |      |
| SPI(t)c               |     |     |     |     |     |     |     |     |     |     |     |     |      |
| SPIp                  |     |     |     |     |     |     |     |     |     |     |     |     |      |
| SPIc                  |     |     |     |     |     |     |     |     |     |     |     |     |      |
| **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 - $EV_R$ & rework forecast, $EV_{eff}$
Capabilities

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

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

• Simple theory
• Initial prototype
• Independent confirmation
  • Trials
  • Testing
  • Usage
• EVM Tools
• Educators/Researchers
• 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.”


Educators/Researchers

• Awards
Affirmation

• Simple theory
  Initial prototype
  “The results reveal that the earned schedule method outperforms, on the average, all other forecasting methods.”
  - Vanhoucke & Vandevoorde (2007)

• Testing
  “This research finds Earned Schedule to be a more timely and accurate predictor than Earned Value Management.”
  - Capt. Kevin Crumrine (2013)

• Educators/Researchers
  • Awards
## Affirmation

### Evidence of Earned Schedule Usage

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

- Earned Schedule Website
  
  - Papers, Presentations, Calculators, Terminology


- *Earned Schedule* book (English, Japanese, Portuguese)
  - Print
  - ePub (Nook & iPad)
  - Kindle
  - PDF

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Resources

• Read two articles …to begin
  • “Schedule is Different”
  • “Further Developments in Earned Schedule”

• Scan the Calculators …experiment with them
  • ES Calculator (v1b & vs1b)
  • ES-LP Calculator
  • P-Factor Calculator
  • Statistical Forecasting Calculator
  • SA Index & Rework Calculator
  • Prediction Analysis Calculator
## Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walt Lipke</td>
<td>USA</td>
<td><a href="mailto:waltlipke@cox.net">waltlipke@cox.net</a></td>
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</tr>
<tr>
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<td>Belgium</td>
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</tr>
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<td>Alex Davis</td>
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</tr>
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<td>Japan</td>
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</tr>
</tbody>
</table>
ES COMPUTATION
ES Computation Example

\[
\text{SPI}($) = \frac{EV}{PV}
\]

\[
\text{SV}($) = EV - PV
\]

\[
\text{SPI}(t) = \frac{ES}{AT}
\]

\[
\text{SV}(t) = ES - AT
\]

ES = All of May + Portion of June

\[
ES = 5 + \frac{EV - PV(\text{May})}{PV(\text{June}) - PV(\text{May})} \quad \text{AT} = 7
\]
**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.

$C = 5 \text{ (months)}$.

The projection of EV onto PV is found by:

$$ES = \frac{EV - PV(May)}{PV(June) - PV(May)} + 5$$

$AT = 7$
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) PV₅ (May) = 90
3) PV₆ (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 Terminology

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

*Note: IEAC(t) and VAC(t) can be used as predictors to estimate future performance.*
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 prediction is better than any other EVM method presently used
  - $\text{SPI}(t) & \text{SV}(t)$ behave similarly to $\text{CPI} & \text{CV}$
  - $\text{IEAC}(t) = \text{PD} / \text{SPI}(t)$ behaves similarly to $\text{IEAC} = \text{BAC} / \text{CPI}$
Summary

• Schedule performance analysis – much easier and possibly better than “bottom-up” methods
• Application is growing in both small and large projects
• Practice recognized by PMI in EVM Practice Standard
• 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!!