Earned Schedule
an emerging enhancement to
Earned Value Management

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Importance of Schedule

“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)

Overview

- Introduce the Earned Schedule Concept
- Develop the Schedule Indicators
- Apply to Project Duration Prediction
- Apply to Schedule Analysis
Earned Value Basics

$$
\text{CPI} = \frac{\text{EV}}{\text{AC}}
$$

$$
\text{SPI} = \frac{\text{EV}}{\text{PV}}
$$

PV = Planned Value
EV = Earned Value
AC = Actual Cost
BAC = Budget at Completion
PD = Planned Duration

SV = EV – PV

Something’s wrong!!
EVM Schedule Indicators

• SV & SPI behave erratically for projects behind schedule
  – **SPI improves and equals 1.00 at end of project**
  – **SV improves and concludes at $0 variance**

• Schedule indicators lose predictive ability over the last third of the project

• Why does this happen?
  – SV = EV – PV
  – SPI = EV / PV

At planned completion PV = BAC
At actual completion EV = BAC
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 Metric

• Required measures
  – Performance Measurement Baseline (PMB) – the time phased planned values (PV) from project start to completion
  – Earned Value (EV) – the planned value which has been “earned”
  – Actual Time (AT) - the actual time duration from the project beginning to the time at which project status is assessed

• All measures available from EVM
Earned Schedule Calculation

- **ES (cumulative)** is the:
  Number of complete PV time increments EV equals or exceeds + the fraction of the incomplete PV increment

- **ES = C + I** where:
  
  \[ C = \text{number of time increments for } EV \geq PV \]
  
  \[ I = \frac{EV - PV_C}{PV_{C+1} - PV_C} \]
Earned Schedule Indicators

- Schedule Variance:
  \[ SV(t) = ES - AT \]

- Schedule Performance Index:
  \[ SPI(t) = ES / AT \]

where AT is “Actual Time” – the duration from start to time now

- SV(t) and SPI(t) are time-based (months, weeks …)
Earned Schedule Indicators

• What happens to the ES indicators, SV(t) & SPI(t), when the planned project duration (PD) is exceeded (PV = BAC)?
  
  They Still Work …Correctly!!

• ES will be \( \leq PD \), while AT > PD
  – SV(t) will be negative (time behind schedule)
  – SPI(t) will be < 1.00

  Reliable Values from Start to Finish !!
Late Finish Project

Commercial IT Infrastructure Expansion Project Phase 1
Cost and Schedule Variances
at Project Projection: Week Starting 15th July xx

Stop wk 19
Sched wk 20
Re-start wk 26
Schedule Prediction

• Can the project be completed as planned?
  – TSPI = Plan Remaining / Time Remaining
    = (PD – ES) / (PD – AT)
    where PD is the planned duration (time at BAC)
    (PD – ES) = PDWR
    PDWR = Planned Duration for Work Remaining

• …completed as estimated?
  – TSPI = (PD – ES) / (ED – AT)
    where ED = Estimated Duration

<table>
<thead>
<tr>
<th>TSPI Value</th>
<th>Predicted Outcome</th>
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<tbody>
<tr>
<td>≤ 1.00</td>
<td>Achievable</td>
</tr>
<tr>
<td>&gt; 1.10</td>
<td>Not Achievable</td>
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Schedule Forecasting

• Long time goal of EVM …*Prediction of total project duration from present schedule status*

• Independent Estimate at Completion (time)
  – IEAC(t) = PD / SPI(t)
  – IEAC(t) = AT + (PD – ES) / PF(t)
    where PF(t) is the Performance Factor (time)
  – Analogous to IEAC used to forecast final cost

• Independent Estimated Completion Date (IECD)
  – IECD = Start Date + IEAC(t)
Schedule Analysis with EVM?

• Most practitioners analyze schedule from the bottom up using the network schedule, independent from EVM
  ….“It is the only way possible.”
  – Analysis of the Schedule is overwhelming
  – Critical Path is used to shorten analysis
    (CP is longest path of the schedule)
• Duration forecasting using Earned Schedule provides a macro-method similar to the method for estimating Cost
  – A significant advance in practice
• But, there’s more that ES facilitates ….
Facilitates Drill-Down Analysis

- ES can be applied to any level of the WBS, to include task groupings such as the Critical Path
  - Requires creating PMB for the area of interest
  - EV for the area of interest is used to determine its ES
- Enables comparison of forecasts, total project (TP) to Critical Path (CP)
  - Desired result: forecasts are equal
  - When TP forecast > CP forecast, CP has changed
  - When CP > TP, possibility of future problems
ES Bridges EVM to the Schedule
How Can This Be Used?

- **Tasks behind** – possibility of impediments or constraints can be identified
- **Tasks ahead** – a likelihood of future rework can be identified
- The identification is independent from schedule efficiency
- The identification can be automated

PMs can now have a schedule analysis tool connected to the EVM Data!!
Leads to …

• Concept of *Schedule Adherence*
  – Most efficient project execution follows the plan
  – ES provides a way to measure how closely execution is to the plan

• *Schedule Adherence* provides a means to refine predictions and forecasts
  – Research underway
  – Application has begun
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
• Facilitates bridging EVM analysis to include the Schedule
• Provides capability to understand source of rework and refine forecasts & predictions
Available Resources

  - Repository for ES Papers and Presentations

- **Earned Schedule Website**  [http://www.earnschedule.com/](http://www.earnschedule.com/)
  - Established February 2006
  - Contains News, Papers, Presentations, ES Terminology, ES Calculators
  - Identifies Contacts to assist with application

# Contact Information

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