Risk Leadership in Complex Project Management

Achieving Risk Leadership with Improved Schedule Analysis and Prediction Techniques

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Achieving Leadership in Complex Project Management

Risk = Sum \{Probability_i \times Impact_i (\$, \text{time})\}

- Does the management method selected, such as Earned Value Management, inject additional risk?
  - Inappropriate management action
  - Loss of time and money
Overview

• Breaking new ground with improved techniques and methodology
• Introducing *Earned Schedule* – a schedule analysis enhancement to Earned Value Management
• Advancement in predictive techniques made possible by Earned Schedule
• Planning for uncertainty and analysis of project performance with statistical methods
Breaking New Ground

- Shedding our traditional thinking that constrains us
- Change is a departure from our past …there is no such thing as a smooth transition
- Required is a recognition that something better is needed …by all involved
- Questions you’ve likely had from time to time
  - Why can’t we plan our projects better?
  - Why aren’t project reserves related to risks?
  - Why is schedule analysis separate from EVM analysis?
  - We do EVM analysis …so what?
  - Why can’t we do a better job of forecasting outcomes?
Breaking New Ground

- Earned Value Management (EVM) integrates cost, schedule, and requirements
  - Provides structure for planning
  - Requires project schedule
  - Accounts for project cost reserves
  - Indicators provide information about project performance
  - Provides facility to forecast project outcome

- Seemingly, EVM answers the questions
  - Those that govern the practice appear satisfied
  - Those that teach & consult prefer the status quo
  - Practitioners want more, but use what is available

EVM is in a rut
Breaking New Ground

- Compounding the rut, EVM has deficiencies and needs improvement
  - Schedule indicators are flawed for late projects
  - EVM is extremely limited for schedule performance analysis
  - EVM practitioners pay attention to Cost and ignore Schedule data
  - EVM has become focused in financial management
  - Indicators are not directly connected to deliverables
  - EV is not required to be earned synchronously with the schedule
  - Indicators do not explicitly lead to appropriate management action
  - EVM does not offer management guidance for project control

EVM can be better
Breaking New Ground

• Four actions will significantly improve EVM and diminish the deficiencies identified
  – Resolve the EVM schedule indicators flaw
  – Connect EVM to the network schedule
  – Connect project performance information with possible management actions
  – Make use of historical project data

*The Path to Improvement*
EVM Schedule Indicators

\[
\text{CPI} = \frac{EV}{AC}
\]

\[
\text{SPI} = \frac{EV}{PV}
\]

\[
\text{PV} \quad \text{BAC}
\]

\[
\text{AC} \quad \text{EV}
\]

\[
\text{SV} \quad \text{CV}
\]

Time

March 21-22, 2007
LNS Conference

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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**

  **Regardless of lateness !!**

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

• Why does this happen?
  – At planned completion, PV = BAC
  – At actual completion, EV = BAC
**Earned Schedule Concept**

- SPI = \(\frac{EV}{PV}\)
- SV = \(EV - PV\)
- SPI(t) = \(\frac{ES}{AT}\)
- SV(t) = \(ES - AT\)

Projection of EV onto PV

ES = Jan thru May + Portion of June

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

AT = 7
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 ≤ PD, while AT > PD
  – SV(t) will be negative (time behind schedule)
  – SPI(t) will be < 1.00

  Reliable Values from Start to Finish !!
Schedule Analysis with EVM?

- The general belief is EVM cannot be used to predict schedule duration
- Most practitioners analyze schedule from the bottom up using the network schedule ....“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)
- Prediction/forecasting using Earned Schedule provides macro-methods similar to those for estimating Cost
  - a significant advance in practice
Earned Schedule Predictors

• Can the project be completed as planned?
  – TSPI = Plan Remaining / Time Remaining
    = (PD – ES) / (PD – AT)
    where (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>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1.00</td>
<td>Achievable</td>
</tr>
<tr>
<td>&gt; 1.10</td>
<td>Not Achievable</td>
</tr>
</tbody>
</table>
Forecasting with Earned Schedule

- Long time desire of EVM practitioners…
  
  **Prediction of total project duration from EVM data**

- 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 predict final cost

- Independent Estimated Completion Date (IECD)
  - IECD = Start Date + IEAC(t)
Detailed Schedule Analysis

- Earned Schedule facilitates easier, simpler analysis of the network schedule
  - Total Project
  - Critical Path
  - Control Account
  - Individual Task
- ES analysis identifies potential process constraints and impediments and the likelihood of future rework
- ES couples EVM to the schedule & deliverables
  - Allows measuring “Schedule Adherence”
  - Facilitates concept of “Effective Earned Value”
- ES with EVM provides a more complete understanding of project performance, thereby improving outcome prediction for schedule and cost
Earned Schedule
Bridges EVM to Network Schedule
Graphs of CPI, CPI(e) & P - Factor (notional data)
Schedule & Cost Prediction
(notional data)

Cost Forecast Comparison

Schedule Forecast Comparison

BAC = $1,000,000
PD = 36 months

IEAC(e)
IEAC

IEAC(te)
IEAC(t)

PD = 36 months

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Connecting Performance to Action

• EVM does not provide managers with a description of how to use the cost and schedule indicators for project control
  • What is to be done when cost performance is good but schedule is not? …and vice versa
  • What are the manager’s strategies?
  • Is more information needed beyond the EVM indicators?
  • When should a manager take action?

Not acting appropriately …
Consumes Time & Budget
# Project Control Strategies

<table>
<thead>
<tr>
<th>Cost Performance</th>
<th>Schedule Performance</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Green</td>
<td>Reward Employees</td>
</tr>
<tr>
<td>Green</td>
<td>Yellow</td>
<td>Increase OT</td>
</tr>
<tr>
<td>Green</td>
<td>Red</td>
<td>Increase OT or People</td>
</tr>
<tr>
<td>Yellow</td>
<td>Green</td>
<td>Decrease OT</td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow</td>
<td>Review &amp; Adjust Assignments</td>
</tr>
<tr>
<td>Yellow</td>
<td>Red</td>
<td>Adjust Assignments; Consider Negotiation (Schedule)</td>
</tr>
<tr>
<td>Red</td>
<td>Green</td>
<td>Decrease OT or People</td>
</tr>
<tr>
<td>Red</td>
<td>Yellow</td>
<td>Adjust Assignments; Consider Negotiation (Funding)</td>
</tr>
<tr>
<td>Red</td>
<td>Red</td>
<td>Negotiation (Funding/Schedule/Rqmts); Examination</td>
</tr>
</tbody>
</table>
Management Action Process

- Poor Performance
- Sufficiency of Data
- Viable Recovery Strategy
- Sufficient Time for Recovery
- Adjust (Personnel, Overtime)
- Investigate
- Re-Negotiate (Cost, Schedule, Requirements)
- No Action Required
Current EVM Understanding

• Prediction expectation for final cost comes from one primary researcher
• Using US DoD project data
• Do the results apply to your projects?
• If they don’t should you base management decisions on these published results?
• What alternative is available?

Your Intuition
Application of Statistics

• Available pertinent project performance data facilitates the application of statistical methods

• Confidence Limits can be used for
  – Strategizing management reserves
  – Forecasting range of possible outcomes

• Knowledge of Probability
  – Increases management understanding of trade-off between reserves and competitiveness
  – Provides management information, especially for when re-negotiation is necessary

• Wide-spread application will require statistical tools tailored to EVM/ES data
My Future Vision

- EVM data is retained, classified, and available for retrieval
  - Within company division
  - Across company
  - Across like industries
  - Totally shared across all applications & organizations

- Benefits of having historical EVM data
  - Facilitates broad-based empirical studies
  - Improves planning & performance
  - Decrease in re-plans & re-negotiation
  - Better, more complete project records
  - Improves prediction & management
Wrap Up

- EVM has flaws that can inject risk to project control
- ES improves schedule indicators & facilitates duration prediction
- ES connects EVM to the schedule & project deliverables, yielding new schedule analysis methods and improved forecasting
- Management decisions require more than EVM data
- Use of Statistics improves project planning & control
- Historical project records are key to the future
References

• **CrossTalk**
  – “Project Recovery …It Can be Done,” January 2002  [Lipke]
  – “Connecting Earned Value to the Schedule,” June 2005  [Lipke]
References

• **The Measurable News**
  – “Schedule is Different,” March 2003  [Lipke]