EXTENDING EVM and
SCHEDULING BEST PRACTICE METRICS
for more confident predictions of future project performance

Project Governance and Control Symposium 2015

Canberra: 6 & 7 May 2015

Peter COLQUHOUN & Kym HENDERSON
PRESENTATION OUTLINE

1. INTRODUCTION
2. TRADITIONAL EVM - Overview
3. TRADITIONAL EVM – Performance Analysis
4. TRADITIONAL EVM – Deficiencies in Treatment of Schedule
5. EXTENDING EVM – to deliver early warning of future problems
6. SCHEDULE ADHERENCE
7. EXAMPLES OF EXTENDED EVM APPLICATIONS
8. IMPLEMENTING EARNED SCHEDULE
9. SUMMARY
10. CONCLUSION
11. QUESTIONS
INTRODUCTION
DMO IS THE LARGEST PROJECT ORGANISATION IN AUSTRALIA

- **Present:**
  - 2013/14 budget: $9.7 billion,
  - over 180 major capital equipment projects
  - over 70 minor projects,
  - sustains and upgrades over 100 existing fleets of equipment.

- **Future:**
  - 2014 to 2017: Managing $43 billion acquisition and sustainment (approx 55% to be spent in Australia).
  - Latest Defence Capability Plan:
    - 111 projects, or phases of projects
    - Value approx $153 billion.
COMPLEXITY OF DEFENCE PROJECTS

Defence Projects are a level more complex than those in other Australian organisations.
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Fast Frigate Upgrade Project
Airborne Early Warning and Control Project

Refer to Project website & Janes for description
A Bright New Shiny Project All Ready to Roll

Heading Down the Interstate on a Journey of Delivery

A straight run from Conceptville through to Productville  !!!

Conceptville  -----------------------------------------------  Productville
And We’ve Ended Up Here
How the Heck Does This Happen ???

Drugs, Alcohol, Impatience, **Overload**, Inattention, Poor Skills, Mechanical Failure—
What If We Had

Reliable Lane Departure Warning???
Traditional EVM –
The foundation for meaningful project performance metrics
PROJECT BADNESS VERSIONS:

• PRODUCT = NOT TO SPEC (OR IS ?)

• COST = OVER BUDGET (OR NOT ?)

• SCHEDULE = GONE WEST (OR NOT ?)
Origins of EVM:

- Management by feeling, anecdote and experience, → became scientific management

- Project Management by anecdote and experience, morphed through Gantt Chart and Critical Path Management → to arrive at Earned Value Management
Traditional EVM –
Brief overview of cost and
schedule performance analysis
HOW TRADITIONAL EV IDENTIFIES PROJECT BADNESS

(Source: Lipke W., Earned Value Basics 2003, p.2)
WHY ???

This behaviour is explained by looking at the Schedule Variance (SV) and the Schedule Performance Index (SPI) formulas.

These metrics consist of two parameters: EV and PV, and .....  

...... at the end of the project, EV always equals the budget at completion (and thus equals the PV), it follows that the SPI always returns to one and the SV becomes zero !!!!  

(Source: Lipke W., 2003, p.3)

Schedule Variance = Earned Value – Planned Value  

(= zero at completion)

Schedule Performance Index (SPI) = \[
\frac{\text{Earned Value}}{\text{Planned Value}}
\]  

(= 1.000 at completion)

(Source: Def Sup AS 4817-2006)
DEFICIENCIES IN TRADITIONAL EVM SCHEDULE TREATMENT

(Source: Lipke W., 2003, p.3)
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SCHEDULE UNDER TRADITIONAL EVM:

THE METRICS DANGER ZONE
BEST SCHEDULE RELATED QUOTE:

“THE SCHEDULE IS VALID AND ROBUST, HOWEVER WE DO ACKNOWLEDGE IT’S RUNNING AN ELEVATED LEVEL OF COMPLETION RISK.”

(Source: not MontyPython or Black Adder)
AND ABOUT THE PRODUCT:

“IT IS WHAT IT IS.”

(Source: neither MontyPython or Black Adder)

“WE’RE HERE TO DELIVER A PRODUCT, NOT RUN A COLLECTION OF SCIENCE EXPERIMENTS FOR YOU”
AND ABOUT THE PRODUCT:

“IT IS WHAT IT IS.”

(Source: not MontyPython or Black Adder)

“WE’RE HERE TO DELIVER A PRODUCT, NOT RUN A COLLECTION OF SCIENCE EXPERIMENTS FOR YOU”

(Source: Acceptance Test Failure Review Meeting)
Extending Traditional EVM – to deliver early warning of future performance problems
# Earned Schedule Speak

(a near common language with traditional EVM)

<table>
<thead>
<tr>
<th>Status</th>
<th>EVM</th>
<th>Earned Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earned Value (EV)</td>
<td>Earned Schedule (ES)</td>
<td></td>
</tr>
<tr>
<td>Actual Costs (AC)</td>
<td>Actual Time (AT)</td>
<td></td>
</tr>
<tr>
<td>SV</td>
<td>SV(t)</td>
<td></td>
</tr>
<tr>
<td>SPI</td>
<td>SPI(t)</td>
<td></td>
</tr>
<tr>
<td>Future Work</td>
<td>Budgeted Cost for Work Remaining (BCWR)</td>
<td>Planned Duration for Work Remaining (PDWR)</td>
</tr>
<tr>
<td>Estimate to Complete (ETC)</td>
<td>Estimate to Complete (time) ETC(t)</td>
<td></td>
</tr>
<tr>
<td>Prediction</td>
<td>Variance at Completion (VAC)</td>
<td>Variance at Completion (time) VAC(t)</td>
</tr>
<tr>
<td>Estimate at Completion (EAC) (supplier)</td>
<td>Estimate at Completion (time) EAC(t) (supplier)</td>
<td></td>
</tr>
<tr>
<td>Independent EAC (IEAC) (customer)</td>
<td>Independent EAC (time) IEAC(t) (customer)</td>
<td></td>
</tr>
<tr>
<td>To Complete Performance Index (TCPI)</td>
<td>To Complete Schedule Performance Index (TSPI)</td>
<td></td>
</tr>
</tbody>
</table>
# Earned Schedule Formulae

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Earned Schedule</th>
<th>ES&lt;sub&gt;cum&lt;/sub&gt;</th>
<th>AT&lt;sub&gt;cum&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ES = C + l, l = number of complete periods (C) plus an incomplete portion</td>
<td>AT = number of periods executed</td>
</tr>
<tr>
<td>Actual Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule Variance</td>
<td>SV(t)</td>
<td>SV(t) = ES – AT</td>
<td></td>
</tr>
<tr>
<td>Schedule Performance Index</td>
<td>SPI(t)</td>
<td>SPI(t) = ES / AT</td>
<td></td>
</tr>
<tr>
<td>To Complete Schedule Performance Index</td>
<td>TSPI</td>
<td>TSPI = (PD – ES) / (PD – AT)</td>
<td>TSPI = (PD – ES) / (ED – AT)</td>
</tr>
<tr>
<td>Predictors</td>
<td>IEAC(t)</td>
<td>IEAC(t) = PD / SPI(t)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VAC(t)</td>
<td>VAC(t) = PD - IEAC(t) or ED</td>
<td></td>
</tr>
</tbody>
</table>

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Earned Schedule Concept

(more Walt Lipke)

Schedule Variance (time) $SV(t) = \text{Earned Schedule} - \text{Actual Time}$

$SPI(t) = \frac{\text{Earned Schedule}}{\text{Actual Time}}$

Statistically Predicted Project Duration $= \frac{PD}{SPI(t)}$

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 EXPLAINED

SPI = \frac{EV}{PV}

SV = EV - PV

SPI(t) = \frac{ES}{AT}

SV(t) = ES - AT

Projection of EV onto PV

ES = \text{Jan thru May} + \text{Portion of June}

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

AT = 7

PERIODS: 1 2 3 4 5 6 7 8 9
EARNED SCHEDULE
PREDICTIVE ABILITY COMPARED

Un-named US Federal Govt Agency Program Data

Comparison of projected completion dates

Schedule status indicates 5-month delay
Earned Schedule identified a delay before the critical path

USA IPMC Conference 2009: Michelle Jones et. al.
(Booze Allen Hamilton data)
"CRITICAL PATH IS ONLY THE CRITICAL PATH WHILE EVERYTHING ELSE PLAYS NICELY"
Schedule Adherence – Lipke’s P Factor
Reliable Lane Departure Warning

EARNED SCHEDULE + LIPKE’S “P” FACTOR
LIPKE’S “P” FACTOR
“P” FACTOR MEASURES SCHEDULE ADHERENCE
“P” FACTOR MEASURES SCHEDULE ADHERENCE

“A”

“Out of Sequence” Earned Schedule

“B”
P Factor Metric – Schedule Adherence

Schedule Adherence: P Factor = 1.000 across project duration

“Houston, we have a problem”
Schedule Adherence: significantly below 1.000
P Factor Metric – Schedule Adherence

Full Recovery – 100% Adherence

Recovery towards full schedule adherence

Schedule Adherence Issues

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“P” FACTOR MEASURES

SCHEDULE ADHERENCE

“Out of Sequence” Risk

“Blockage” Risk
OUT OF SEQUENCE RISK

• Gaming the system or preserving schedule ??
  (How have you structured your milestones?)
• Schedule preservation / progress at what risk
  • Will it conform ?
  • Have preceding events changed the requirement
  • ????

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BLOCKAGE RISK

• Gaming the system or genuine issue ??
• Underlying Technical Issue (Scientific Resolvability ??)
• Underlying shortage of technical resources (specialists ??)
• Underlying Materiel Delay – Why
  • Contract dispute
  • Delivery Delay (Transport, availability obsolete spec ?)
  • Sourcing Issue
  • Other ????
IMPLEMENTING EARNED SCHEDULE

Public Domain Resources – and where / how to begin
• Read articles …to begin
  – “Performance analysis of Earned Value Management in the construction industry”
  – “Schedule is Different”
  – “Further Developments in Earned Schedule”

• Explore the Earned Schedule website
  – www.earnedschedule.com
  – Papers, Presentations, Calculators, Terminology

• Scan the Calculators …and experiment with them
  – ES Calculator v1a
  – P-Factor Calculator
  – Statistical Prediction Calculator
  – SA Index & Rework Calculator
IMPLEMENTATION: Hard Documentation

PMI EVM Practice Standard

- Inclusion of *Earned Schedule* into PMI EVM Practice Standard, 2nd Edition (2011)

- Appendix D, “Schedule Analysis Using EVM Data,” provides ES theory and practical application to example project.
IMPLEMENTATION: Available Resources

- Earned Schedule Website
  http://www.earnedschedule.com/

- Wikipedia references Earned Schedule
  http://en.wikipedia.org/wiki/Earned_Schedule

- *Earned Schedule* book (English, Japanese, Spanish)
  - Print
  - ePub (Nook & iPad)
  - Kindle
  - PDF
If you’re already using EVM
... take the next step to ES

Try it on archived project data
... check the ES analysis against what occurred
... gain confidence

Prototype ES on a few projects
... get comfortable with the analysis

Train others in ES and expand the application in the organization
... discuss with analysts and managers
... work out the problems

Integrate into organization’s EVM application policy
INITIALLY, augment the EVM tool in use
  – ES calculators
  – Henderson’s spreadsheet set

Research the available tools - request a trial period
  – Project Flight Deck
    • MS Project add-on, inexpensive yet includes advanced features
  – OR-AS
    • Sophisticated, research oriented, expensive
  – SuperTech – EV Engine
    • Basic EVM & ES …includes more financial analysis
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CONCLUSIONS

1. SCHEDULE MANAGEMENT IS CRITICAL
   ...... SO WE NEED TO METRIC IT BETTER

2. ES IS EASY TO EXPLAIN AND IMPLEMENT
   ...... BECAUSE THE DATA IS ALREADY THERE

3. ES & P FACTOR HAVE MUCH TO OFFER
   ...... BECAUSE THEY’RE INTELLECTUALLY ROBUST
   (AND DON’T SKEW)

4. ALL ES NEEDS IS TO BECOME KNOWN
   ...... BECAUSE IT’S SO USEFUL IT WILL SELL ITSELF
QUESTIONS

???
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