Assessing Schedule Performance with Earned Value

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Learning Objectives

• Acquire practical tools and tips for assessing schedule performance on your project
• Learn about Earned Schedule, a breakthrough approach for assessing schedule performance
• Review the benefits and shortfalls of traditional Earned Value Management
What’s in it for me?

Baseline Schedule vs. Earned Schedule

Cumulative Months


Early Warning

Objectivity

Ease of Use

Practicality
Introduction

• Quantitative assessment of schedule performance is critical to the success of time-driven projects
• Earned Value Management has historically provided quantitative tools for project performance measurement
• Earned Value Management breaks down for schedule performance
• A recent innovation, Earned Schedule, corrects the problem
• This Track Session is divided into three parts:
  • Background: Earned Value Management
  • Theory: Earned Schedule Breakthrough
  • Practice: How to apply Earned Schedule to your projects
Earned Value Management Basics

- Earned Value Management is a technique for quantitatively assessing project performance
  - **Planned Value (PV)**: value for work that is planned
  - **Earned Value (EV)**: value for work that has been completed
- Cost Performance: compare Earned Value and Actual Cost
  - **Cost Variance (CV)**: Earned Value minus Actual Cost—EV - AC
  - **Cost Performance Index (CPI)**: Earned Value divided by Actual Cost—EV / AC
- Schedule Performance: compare Earned Value and Planned Value
  - **Schedule Variance (SV)**: Earned Value minus Planned Value—EV - PV
  - **Schedule Performance Index (SPI)**: Earned Value divided by Planned Value—EV / PV

**Budgeted Cost of Work**

- Earned Value
  - **Budgeted Cost of Work**
    * % Complete

**Cost Performance**

- Overrun: CV < 0, CPI < 1
- Under: CV > 0, CPI > 1

**Schedule Performance**

- Behind: SV < 0, SPI < 1
- Ahead: SV > 0, SPI > 1
Common Assessment of Project Performance

- A common method for assessing cost performance is to compare budgeted cost and actual cost

The chart appears to show that the project cost is tracking slightly below plan.
- A reasonable conclusion is that the project’s cost performance is acceptable.
Earned Value Management and Project Performance

• The following Earned Value Management chart is based on the same underlying data, but it tells a different story

![Planned Value vs. Earned Value](image)

- The Earned Value is tracking below plan, and the gap is widening
- The common view lacks information about how much should have been delivered for the cost expended
- Earned Value Management shows relationship between value and time, plan and result
Limits of Earned Value Management

• The technique’s accuracy in assessing cost performance is proven
• It is less successful for assessing schedule performance
  • Schedule performance is all about *time*
  • But, Earned Value Management is expressed in terms of *cost*—
    *Planned Value (PV) and Earned Value (EV)*

• At the end of the project, what is the relationship between EV and PV?
  
  \[ \text{Variance} = EV - PV = ? \]

  \[ \text{Schedule Performance Index} = EV/PV = ? \]

• What if the project’s completion date was supposed to be Dec?
Earned Schedule

- Breakthrough research by Walt Lipke on schedule performance analysis
- Relates Planned Value and Earned Value directly to time

At the Actual Time (AT), value has been earned
At the Target Time (TT), that same value *should* have been earned
The time from the project start to TT is the *Earned Schedule*
Earned Schedule Calculation

- Find the Earned Value at the Actual Time (AT)
- Map that Earned Value onto the Planned Value curve (EV = PV)
- Drop a line from the intersection point to the timeline (TT)

Earned Schedule = the sum of the time segments
  - Count the number of full periods
  - Calculate the amount of time earned in the partial period
Partial Period Calculation

• The partial period is represented by a fraction:
  \[ \frac{\text{the time between A and B}}{\text{the time between A and C}} \]

• Calculate the amount of time earned by using either:
  • Interpolation from the values on the Planned Value curve, or
  • Computation based on the daily totals for Planned Value and Earned Value

• Details of the partial period calculations are covered in the Appendix

• The Earned Schedule equals the number of full periods plus the earned time in the partial period
Earned Schedule Formulas

- Earned Schedule supports a wide range of formulas
- To distinguish them from the traditional Earned Value Management assessment formulas, the suffix “(t)” is appended
  - **Schedule Variance (t)**: Earned Schedule minus Actual Time
  - **Schedule Performance Index (t)**: Earned Schedule divided by Actual Time
- The variance and index values act in the same way as traditional Earned Value Management
- Unlike traditional Earned Value Management, Earned Schedule supports prediction of project duration and end date
  - **Estimated Duration (t)**: Planned Duration divided by Schedule Performance Index (t)
  - **Projected End Date**: Project Start Date plus Estimated Duration (t)
Implementing Earned Schedule

• The pre-requisites for implementing Earned Schedule do not vary significantly from standard project management practices
• The challenge for Project Managers is to consistently exercise the practices
• There are two sets of pre-requisites:
  • One for generating the data
  • The other for performing the calculations
• Once the pre-requisites are met, the results require interpretation—some tips and techniques are provided for doing this
• Manual calculation of Earned Schedule is possible, but onerous
  • For most projects, tool support is required
  • Common tools such as Microsoft Excel™ and Microsoft Project™ are used here for illustration purposes
Generating the Data

• Maintain the Schedule
  • Do you ensure that new tasks are incorporated into your schedule in a timely way?
  • Are you rigorous in tracking work that is done and that remains?
  • Do you regularly re-vamp your schedule so that it reflects reality?

• Set a Baseline
  • The system needs a basis for measurement—the baseline provides it
  • Overcoming the psychological hurdle of setting the baseline
    • Baseline selected tasks
    • Use a private baseline
    • Re-set the baseline (note: affects Earned Schedule)

• Enter Resources and Rates
  • Tools use resources and their costs to calculate Planned Value and Earned Value
  • Rates do not have to be exact—even nominal rates generate meaningful results
Manually Performing the Calculations

- Scheduling tools generally provide a function for extracting time-phased data (e.g., the “Analyze Timescaled Data in Excel” wizard)
- The data can then be put into the spreadsheet accompanying this presentation to perform the Earned Schedule calculations

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<th>Planned Value</th>
<th>Earned Value</th>
<th>Period Count</th>
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- Extract the Period name, Planned Value, and Earned Value for each time period
- Paste them into the respective columns
- Execute the macro
Automatically Performing the Calculations

- Commercial plug-ins are available for standard scheduling tools like Microsoft Project™
- The plug-in performs the following functions:
  - Extracts the required data from MS Project
  - Calculates the Earned Schedule values
  - Analyzes the results
  - Dynamically creates an Excel file to hold the output
- The charts make it easy to identify trends
- The numerical results support detailed analysis
- The warning message high-lights risks
Interpreting the Results

- Rule of Thumb #1: Mind the Gap
  - The gap between the baseline schedule and the earned schedule indicates whether there is an issue
  - The variance and index analysis portray the trend
  - Experienced users focus on the numbers, in particular, on the Schedule Performance Index, i.e., the SPI(t)
  - The estimated end date is a conservative forecast

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<th>Earned Value</th>
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Processing warning. Late finish detected. Increase number of periods.
Interpreting the Results

- Rule of Thumb #2: Three in a Row
  - For many projects, monthly resolution is insufficient; weekly time increments are required
  - In such cases, three successive SPI(t) values below expectation signal a trend
  - Expectations vary with projects, but, generally, SPI(t) < .8 are cause for concern
  - An end date that exceeds the target by more than two weeks is worrisome

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31-Mar-08 | 36    | $880,000.00     |               |               | Processing warning. Late finish detected. Increase number of periods. |
Interpreting the Results

• Rule of Thumb #3: Impact of Re-baselining
  • Re-baselining the whole schedule has significant impact on metrics
  • Best practice is to selectively re-baseline tasks, e.g., re-baseline new tasks as they are added, rather than re-baselining all tasks in the project

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<th>Period</th>
<th>Count</th>
<th>Earned Schedule</th>
<th>Earned Value</th>
<th>Planned Value</th>
<th>Schedule Variance</th>
<th>SPI(t)</th>
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Observations

• Earned Schedule makes a material difference in the management of project schedules
  • Quantitative assessment
  • Solid theoretical basis
  • Easy to use
• Virtually no incremental effort required for Project Managers already exercising disciplined project management practices
  • Take schedule seriously
  • Set the baseline
  • Enter resources and rates
• Tool support is required in practice
  • Scheduling tool must generate Planned Value and Earned Value
  • Scheduling tool should support export to a file
  • Full automation increases efficiency
Future Direction

• Task Level Analysis
  • Earned Schedule provides early warning of overall schedule performance problems
  • Project Manager must investigate schedule to identify the specific tasks that are at risk
  • “P-Factor analysis” takes the technique to the next level
    • Builds on theoretical foundation of Earned Schedule
    • Supports systematic identification of tasks at risk
    • Identifies tasks that are impeded and tasks that require re-work
  • Practical application to schedule management requires automated support
  • Methodology extensions and supporting tools are currently available
Learning Objectives

• Acquire practical tools and tips for assessing schedule performance on your project
• Learn about Earned Schedule, a breakthrough approach for assessing schedule performance
• Review the benefits and shortfalls of traditional Earned Value Management
Concluding Comments
Partial Period Calculation

- The only part of the technique that requires elaboration
- The partial period is represented by a fraction: \( \frac{B - A}{C - A} \)
- The values on the curves are cumulative
  - The denominator is the cumulative value at C minus the cumulative value at A
  - The numerator is the cumulative value at B minus the cumulative value at A
- The start of the partial period is known
- The end of the partial period is known
- The Target Time is not known and cannot be directly calculated
Interpolation

• The value of the partial period is estimated (interpolated) using known values from the Planned Value curve
• The equation is
\[ PV_B - PV_A / PV_C - PV_A \]
• The denominator is the Planned Value at the period end minus Planned Value at the period start
• The numerator is the Planned Value at the Target Time minus the Planned Value at the period start
• The Planned Value at the Target Time is the same as the Earned Value at the Actual Time; so,
\[ EV_{AT} - PV_A / PV_C - PV_A \]
Computational Method

• An alternative method for calculating the partial period has evolved from the computational implementation of the technique
• Some scheduling tools calculate and store Planned Value and Earned Value for each task for each time period (e.g., by day)
• The values can be used to determine the fractional amount

![Diagram showing EV and PV values for different months and days]

• Get the Earned Value (X) for the Target Time
• Compare it to the Planned Value for each day
• Determine the exact day when the Planned Value hits X (dotted line)
• Count the number of days in the partial period to get to X
• Count the total days in the partial period (solid line)
• The former over the latter is the fractional amount of Earned Schedule