Using Earned Value to Track Progress

The PB&J Project
Using Earned Value to Track Progress

What can you tell me about this project?

Is it... on schedule, ahead schedule, or behind schedule?

Is it... on budget, over budget, or under budget?

Will the project finish on time?

THE XYZ PROJECT

Costs (M) vs. Time (Months ARO)

- Actuals 3.2M
- Budget Plan 3.8M
- Budget at Completion 4.9M

Project Current Status Point

Client Project Success™

On Target | On Time | On Budget

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Using Earned Value to Track Progress

- We know the original budget (the plan)
- We know what we spent to date --BUT--
- Without additional information to show the project status -- we DON’T know what progress we have made (if any)

Earned value metrics can give us the whole picture
Using Earned Value to Track Progress

What is Earned Value

An earned value management system (EVMS) integrates the project work scope with the schedule and cost elements of the project to optimize status and control.
Using Earned Value to Track Progress

What is Earned Value - A Brief Synopsis

EVMS is based upon breaking the project into manageable pieces called “Work Packages”

- Each work package defines a piece of the work to be performed. It can define several activities or tasks and the resources required to perform them.
- Each activity (task) will have one to several resources assigned.
  - Therefore the activity’s “Work” may be greater than the duration.
- Work packages may also have “Other Direct Costs” (ODC) assigned such as materials, subcontractors, vehicles, etc.
- WP Budget = (work assigned to each resource) x (resource’s rate) + (ODCs)
- The work package will also describe how this “Budget” will be expended across time - i.e.; The Work Schedule.
- Each work package must have an evaluation criteria for determining the percent completion of the activity (task) – “what means done”
Using Earned Value to Track Progress

What is Earned Value - A Brief Synopsis

The work packages are then added together across time to create a “Plan” for the project.

As the work packages are completed and the performance evaluated (against the WP evaluation criteria), value is “Earned” against the planned cost (the “WP Budget”) of the work package.

- The value “Earned” against work packages is NOT linked to the actual cost to perform or complete the work.

**Status** -- I have spent 50% of the budget so therefore I am 50% complete -- **Status**
An Earned Value Example

Project: Building a Peanut Butter and Jelly Sandwich (PB&J)

Primary Resource: Mom (Rate: $0.02)

But Wait a Minute!

- that’s $0.02/sec and…
- $0.02/sec = $1.20/min
- $1.20/min = $72.00/hr
- $72.00/hr = $150,000/year

Is that better??
An Earned Value Example

Project: Building a Peanut Butter and Jelly Sandwich (PB&J)

Materials and Tools:

- Bread; Peanut Butter; Jelly;
- Knife; Cutting Board

Tasks:

- Lay out Bread onto the Cutting Board
- Obtain and Open Peanut Butter Jar
- Spread Peanut Butter on Each Slice of Bread
- Obtain and Open the Jelly Jar
- Spread the Jelly onto One Slice of Bread
- Place 2 Slices of Bread together and Cut the Sandwich in Half
- Deliver the Sandwich
## An Earned Value Example

### Our Project Task Estimates:

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Description</th>
<th>Estimated Work (Seconds)</th>
<th>Estimated Cost (Work x Rate)</th>
<th>Cumulative Planned Project Costs Planned Value (PV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>$1.20</td>
<td>$1.20</td>
</tr>
<tr>
<td>2</td>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$1.80</td>
</tr>
<tr>
<td>3</td>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>$0.80</td>
<td>$2.60</td>
</tr>
<tr>
<td>4</td>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$3.20</td>
</tr>
<tr>
<td>5</td>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>$0.40</td>
<td>$3.60</td>
</tr>
<tr>
<td>6</td>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$4.20</td>
</tr>
<tr>
<td>7</td>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>$1.20</td>
<td>$5.40</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td><strong>270 sec.</strong></td>
<td></td>
<td><strong>$5.40</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Task Sequence:**

1. Task 1
2. Task 2
3. Task 3
4. Task 4
5. Task 5
6. Task 6
7. Task 7
An Earned Value Example

Plot the Cumulative Planned Project Costs (PV):

Our Project Budget Planning is Now Complete

We are Ready to Start our Project
An Earned Value Example

The Project is now Underway

180 seconds has elapsed and we are requested to provide status on our project

- According to our original plan, at 180s we should have completed Tasks 1 through 5

- We should be ready to start task 6, “Place 2 Slices of Bread together and Cut in Half”

- Unfortunately, we ran into a problem!

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Description</th>
<th>Estimated Work</th>
<th>Planned Elapsed Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>60 sec.</td>
</tr>
<tr>
<td>2</td>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>90 sec.</td>
</tr>
<tr>
<td>3</td>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>130 sec.</td>
</tr>
<tr>
<td>4</td>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>160 sec.</td>
</tr>
<tr>
<td>5</td>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>180 sec.</td>
</tr>
<tr>
<td>6</td>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>210 sec.</td>
</tr>
<tr>
<td>7</td>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>270 sec.</td>
</tr>
</tbody>
</table>
**An Earned Value Example**

**The Problem and Solution**

The problem:

- When Mom opened the jar of jelly, she discovered it to be moldy and could not use it.

The solution:

- Fortunately, Mom had an extra jar of jelly in the closet and sent Dad to get it. Dad retrieved the new jar and placed it on the counter next to Mom.
- However -- It took an extra 20s to retrieve the second jelly jar by Dad and the jar is still not opened.
- Therefore:
  - Task 4, “Obtain and Open the Jelly Jar” is only 50% completed;
  - It has taken 50s to complete half (50%) of Task 4;
  - And, Dad (an unplanned resource) has worked 20s on the project.
    - Dad’s Rate is also $0.02/Sec.
**An Earned Value Example**

**Lets summarize our current status**

Clearly we are now behind schedule and we still have to perform the 2nd half of Task 4, “Opening the Jelly Jar”

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Description</th>
<th>Estimated Work</th>
<th>Planned Elapsed Time</th>
<th>Status (% Completion)</th>
<th>Actual Time Spent</th>
<th>Actual Time Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>60 sec.</td>
<td>100%</td>
<td>60 sec.</td>
<td>60 sec.</td>
</tr>
<tr>
<td>2</td>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>90 sec.</td>
<td>100%</td>
<td>30 sec.</td>
<td>90 sec.</td>
</tr>
<tr>
<td>3</td>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>130 sec.</td>
<td>100%</td>
<td>40 sec.</td>
<td>130 sec.</td>
</tr>
<tr>
<td>4</td>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>160 sec.</td>
<td>50%</td>
<td>50 sec.</td>
<td>180 sec.</td>
</tr>
<tr>
<td>5</td>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>180 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>210 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>270 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
An Earned Value Example

Let's determine our actual costs to date for the project (AC)

We know Mom has charged full-time since the beginning of the project and has worked on ALL the tasks (180s x $0.02 = $3.60)

Dad got involved on the 4th task and spent 20s obtaining the extra jelly jar (20s x $0.02 = $0.40).

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Description</th>
<th>Estimated Work</th>
<th>Actual Time (Mom)</th>
<th>Actual Time (Dad)</th>
<th>Cumulative Actual Costs Actual Costs (AC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>60 sec.</td>
<td>0 sec.</td>
<td>$1.20</td>
</tr>
<tr>
<td>2</td>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>30 sec.</td>
<td>0 sec.</td>
<td>$1.80</td>
</tr>
<tr>
<td>3</td>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>40 sec.</td>
<td>0 sec.</td>
<td>$2.60</td>
</tr>
<tr>
<td>4</td>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>50 sec.</td>
<td>20 sec.</td>
<td>$4.00</td>
</tr>
<tr>
<td>5</td>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td></td>
<td><strong>270 sec.</strong></td>
<td></td>
<td></td>
<td><strong>Total Actual Costs: $9.60</strong></td>
</tr>
</tbody>
</table>
An Earned Value Example

Plot the actual costs (AC) incurred on the project-to-date:

The Actual Costs (AC) incurred on this project to date are $4.00 versus the $3.60 that was planned.

Thus we have spent more than we planned to this point.

Total Estimated Project Costs (BAC): $5.40
An Earned Value Example

Now let's determine our earned performance value (EV)

The Earned Performance Value or Earned Value (EV) for the project is based on the percent completion for each task in the project – times – the original budget established for that task.

(Task Earned Value = Task % Completion x Original Estimated Task Cost)

<table>
<thead>
<tr>
<th>Task No.</th>
<th>Task Description</th>
<th>Estimated Work</th>
<th>Planned Cost</th>
<th>Cumulative Planned Cost</th>
<th>Cumulative Actual Time Spent</th>
<th>Status (% Completion)</th>
<th>Status Value Earned</th>
<th>Cumulative Earned Performance Earned Value (EV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>$1.20</td>
<td>$1.20</td>
<td>60 sec.</td>
<td>100%</td>
<td>$1.20</td>
<td>$1.20</td>
</tr>
<tr>
<td>2</td>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$1.80</td>
<td>90 sec.</td>
<td>100%</td>
<td>$0.60</td>
<td>$1.80</td>
</tr>
<tr>
<td>3</td>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>$0.80</td>
<td>$2.60</td>
<td>130 sec.</td>
<td>100%</td>
<td>$0.80</td>
<td>$2.60</td>
</tr>
<tr>
<td>4</td>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$3.20</td>
<td>180 sec.</td>
<td>50%</td>
<td>$0.30</td>
<td>$2.90</td>
</tr>
<tr>
<td>5</td>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>$0.40</td>
<td>$3.60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>$0.60</td>
<td>$4.20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>$1.20</td>
<td>$5.40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Totals:</td>
<td></td>
<td>270 sec.</td>
<td>$5.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**An Earned Value Example**

*Plot the status value earned (EV) to date:*

The total value earned in status to date is $2.90
This is less than what was planned, $3.60;

*We did not finish as much as we planned. Thus, we are behind schedule.*
Finally, let determine what it will take to finish our project, the estimate to complete (ETC)

Since Task 4 was only 50% complete, it will require another 15s to complete by Mom.

Mom believes the other remaining individual tasks can be completed as originally planned and budgeted.

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Estimated Work</th>
<th>Cumulative Actual Time Spent</th>
<th>Cumulative Actual Costs to Date</th>
<th>Status (% Completion)</th>
<th>Estimated Work to Finish</th>
<th>Cumulative Time to Finish</th>
<th>Estimated Cost to Finish</th>
<th>Cumulative Cost to Finish (ETC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lay out Bread onto the Cutting Board</td>
<td>60 sec.</td>
<td>60 sec.</td>
<td>$1.20</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Obtain and Open Peanut Butter Jar</td>
<td>30 sec.</td>
<td>90 sec.</td>
<td>$1.80</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spread Peanut Butter on Each Slice of Bread</td>
<td>40 sec.</td>
<td>130 sec.</td>
<td>$2.60</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Obtain and Open the Jelly Jar</td>
<td>30 sec.</td>
<td>180 sec.</td>
<td>$4.00</td>
<td>50%</td>
<td>15 sec.</td>
<td>195 sec.</td>
<td>$0.30</td>
<td>$4.30</td>
</tr>
<tr>
<td>Spread the Jelly onto One Slice of Bread</td>
<td>20 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20 sec.</td>
<td>215 sec.</td>
<td>$0.40</td>
<td>$4.70</td>
</tr>
<tr>
<td>Place 2 Slices of Bread together and Cut in Half</td>
<td>30 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30 sec.</td>
<td>245 sec.</td>
<td>$0.60</td>
<td>$5.30</td>
</tr>
<tr>
<td>Deliver the Sandwich</td>
<td>60 sec.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>60 sec.</td>
<td>305 sec.</td>
<td>$1.20</td>
<td>$6.50</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td><strong>270 sec.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An Earned Value Example

Plot the Estimate to Complete the Project (EAC):

We now see that due to the problem encountered...

It is expected that our sandwich will now cost more and will be delivered late.
An Earned Value Example

Now – Let's look at some Key Measurement points

“A” - This distance reflects the amount the project is behind schedule at the current status time (180 seconds).

“B” - This reflects the amount of time the project will finish late as compared to the original plan.

“C” - This reflects the schedule variance (SV) in dollars (SV=EV-PV).

“D” - This reflects the cost variance (CV) in dollars (CV=EV-AC).

“E” - This reflects the cost variance at the completion of the project (VAC=BAC-EAC)
An Earned Value Example

Conclusions from our Earned Value exercise:

At the present time (180s into the project) we are approximately 30-40 seconds behind schedule

- (Time at Present EV) - (Time when current EV was *Scheduled*)
- Point “A” on the Chart

We will finish our sandwich 35 seconds late

- (Time at EAC) - (Time at BAC)
- Point “B” on the Chart

It will cost an addition $1.10 to complete our sandwich for a total cost of $6.50 (verses a planned cost of $5.40)

- (BAC) - (EAC)
- Point “E” on the Chart
Using Earned Value to Track Progress

Let's take another look at our XYZ Project

This time with earned value status information included

Now we see THE REAL STORY!

THE XYZ PROJECT

- Actuals 3.2M (AC)
- Budget Plan 3.8M (PV)
- Budget at Completion 4.9M (BAC)
- Progress Value Earned 2.7M (EV)

Project Current Status Point
Using Earned Value to Track Progress

The XYZ Project – The Real Story

Project is behind schedule (7-months late at this point)
Project is over budget ($500K over-spent at this point)
Earned Value Analysis Tools

Formulas helpful in Earned Value Analysis

Variance Measurements

- Cost Variance (CV) = EV - AC
- Schedule Variance (SV) = EV - PV
- Variance at Completion (VAC) = BAC - EAC
- Cost Variance Percentage (CV %) = \( \frac{CV}{EV} \)
- Schedule Variance Percentage (SV %) = \( \frac{SV}{PV} \)
**Earned Value Analysis Tools**

**Formulas helpful in Earned Value Analysis**

**Performance Indices**

- **Cost Performance Index (CPI)** = \( \frac{EV}{AC} \)

- **Schedule Performance Index (SPI)** = \( \frac{EV}{PV} \)

- **To Complete Performance Index (TCPI)** = \( \frac{(BAC - EV)}{(EAC - AC)} \)
**Earned Value Analysis Tools**

*Formulas helpful in Earned Value Analysis (cont.)*

**Overall Status**

- **Project Percent Complete** (% Complete) = \( EV \times 100\% \div BAC \)

- **Percent of Project Budget Spent** (% Spent) = \( AC \div BAC \times 100\% \)

**Estimate at Completion**

- **Mathematical EAC** = \( BAC - EV + AC = EAC_{(math)} \)

- **Cost Performance EAC** = \( \frac{BAC}{CPI} = EAC_{(CPI)} \)

- **Composite EAC** = \( \frac{(BAC - EV) + AC}{CPI \times SPI} = EAC_{(comp)} \)
## Earned Value Analysis Tools

### Indicators to Look for in Earned Value Analysis

<table>
<thead>
<tr>
<th>Measurement</th>
<th>A Good Thing</th>
<th>A Bad Thing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Variance (CV)</td>
<td>0 or +</td>
<td>-</td>
</tr>
<tr>
<td>Schedule Variance (SV)</td>
<td>0 or +</td>
<td>-</td>
</tr>
<tr>
<td>CPI</td>
<td>≥1.0</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>SPI</td>
<td>≥1.0</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>VAC</td>
<td>0 or +</td>
<td>-</td>
</tr>
<tr>
<td>TCPI</td>
<td>≤1.0</td>
<td>&gt;1.0</td>
</tr>
</tbody>
</table>
Some Good EVM Practices

Following good EVMS practices will yield good results

- Develop detailed work breakdown (WBS)
  - Develop tasks with specific/defined deliverables and labor assigned to complete those deliverables
  - Create a WBS dictionary for all the elements of the WBS
  - Develop defendable (BOE) estimates for each task (activity) in the WBS
  - Develop detailed schedule that “connects” to the WBS
- Map contract requirements (CLINS) and deliverables (CDRLs) to tasks/subtasks
- Enter information into scheduling/tracking tool and establish a project baseline to measure performance against
  - EVM cannot be calculated without a baseline
- Map/Track labor hours expended against the project baseline
- Conduct regular (weekly -to- monthly) reviews to determine schedule and overall project status
- Perform periodic Estimates to Complete
EIA EVMS Guidelines

The American National Standards Institute (ANSI) and the Electronic Industries Alliance (EIA) has adopted standard guidelines for Earned Value Management Systems (EVMS) with standard ANSI/EIA-748-A

Guidelines for EVMS are available for a fee from Global Engineering Documents

- Website: http://global.ihs.com/
- Phone: (800) 854-7179

Guidelines are high level and goal oriented purposely

- Intended to state the qualities and operational considerations of an integrated management system using earned value analysis methods without mandating detail system characteristics
- Gives organizations the flexibility to establish and apply a management system that suits their management style and business environment
Thank you for your time!

For more information on how we can provide your organization with comprehensive full-life cycle project management support services, training and enterprise-level solutions, please contact:

EDWARDS PROJECT SOLUTIONS
7250 Parkway Drive • Suite 200 • Hanover, MD 21076
Office: (800) 556-2506 • (443) 561-0180
Fax: (443) 561-0199
Email: info@EdwPS.com

Also Visit our website at: Website: www.EdwPS.com