**Earned Value System**

- Pioneered by U.S. Department of Defence to track schedule and cost in large projects in 1960s.
- Widely used by private sector around the world.
  - NCR, Levi Strauss, Disney etc.
- System depends on a well-developed plan and schedule.
- System is based on an accounting system called "earned value".

**Consider the following example:**
- R&D project planned to last 10 months and cost $200,000 per month.
- After 5 months, top management assesses the status of the project
  - Actual cost for the 5 month period: $1.3 million
  - Would it be accurate to conclude that the project has $300,000 cost overrun?

**Earned Value System**

- Earned value system is an integrated cost/schedule system. System overview:
  - Develop a project plan and schedule as discussed earlier in this course.
  - Develop a time-phased budget. The cumulative values of these budgets will be the baseline and called budgeted cost of the work scheduled (BCWS).
  - Collect actual costs for the work performed at the work package level. These costs will be called actual cost of work performed (ACWP).

**BAC: Budgeted cost at completion**

\[
\text{CPI (Cost Performance Index)} = \frac{\text{BCWP}}{\text{ACWP}}
\]

\[
\text{SPI (Schedule Performance Index)} = \frac{\text{BCWP}}{\text{BCWS}}
\]

- Prepare hierarchical status reports for each level of management.

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**Earned Value System**

<table>
<thead>
<tr>
<th>WBS Element</th>
<th>BCWS</th>
<th>BCWP</th>
<th>ACWP</th>
<th>Cost Variance BCWP - ACWP</th>
<th>Schedule Variance BCWP - BCWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>-10</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>56</td>
<td>50</td>
<td>48</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>28</td>
<td>20</td>
<td>30</td>
<td>-10</td>
<td>58</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BAC: Budgeted cost at completion</th>
</tr>
</thead>
</table>

\[
\text{CPI (Cost Performance Index)} = \frac{\text{BCWP}}{\text{ACWP}} = \frac{170}{188} = 0.904
\]

\[
\text{SPI (Schedule Performance Index)} = \frac{\text{BCWP}}{\text{BCWS}} = \frac{170}{184} = 0.924
\]

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**Earned Value System**

- Collect the budgeted values of work actually performed. These will be called budgeted cost of work performed (BCWP).
- Compute schedule variance as
  - \( \text{SV} = \text{BCWP} - \text{BCWS} \)
- Compute cost variance as
  - \( \text{CV} = \text{BCWP} - \text{ACWP} \)
- Prepare hierarchical status reports for each level of management.

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**Earned Value System**

- Compute schedule variance as
  - \( \text{SV} = \text{BCWP} - \text{BCWS} \)
- Compute cost variance as
  - \( \text{CV} = \text{BCWP} - \text{ACWP} \)
- Prepare hierarchical status reports for each level of management.
Earned Value System

- The main reason for creating a baseline is to monitor and report progress. Hence it is absolutely necessary that costs are time-phased in the baseline exactly as managers expect them to be “earned”.
- Three common rules
  - 0/100 percent rule: 100% of the budget is earned when the work package is complete.
- During monitoring the measure percent complete, it is common practice to limit amount earned by 80% until the work package is 100% complete.

Earned Value System

- After the current status of the project is determined, one would want to revise the project’s total cost. This is referred to as EAC (Estimated cost at completion).
  - EAC: is equal to actual cost to-date plus revised estimated cost of the remaining work).
- EAC = ETC + ACWP
  - ETC: Estimated cost to complete
  - Typically ETC is determined by making use of the CPI.

Earned Value System

- 50/50 percent rule: 50% of the value earned when the work package is started and 50% is earned when the work package is completed.
- Percent complete rule: Establish frequent checkpoints over the duration of the work package and assign completion percentages in terms of dollars.
  - This is the method used most frequently.
  - During monitoring the measure percent complete, it is common practice to limit amount earned by 80% until the work package is 100% complete.

Earned Value System

- ETC = (BAC - BCWP)/CPI
  = (370 - 170) / 0.904 = 221.24
  EAC = ETC + ACWP = 221.24 + 188 = 409.24
- VAC (Variance at Completion) = EAC - BAC
  VAC = 409.24 - 370 = 39.24
- TCPI (To Complete Performance Index) = (BAC - BCWP) / (EAC - ACWP)
  - Performance index of the remaining work for a given EAC.
  - Let’s say we want EAC = 370, then
  TCPI = (370 - 170) / (370 - 188) = 1.099

Earned Value System - Example

- Some simplifying examples
  - Each cost account has only one work package and each cost account is represented by a single activity.
  - Project network early start times will serve as the basis for assigning the baseline values.
  - Except when the 0/100 rule or 50/50 rule is used, baseline values will be assigned linearly, unless stated differently.
  - From the moment work on an activity begins, some actual costs will be incurred each period until the activity is completed.
Earned Value System - Example

Project baseline budget

<table>
<thead>
<tr>
<th>Period</th>
<th>Baseline</th>
<th>Actual</th>
<th>Earned</th>
<th>BCWP</th>
<th>ACWP</th>
<th>EAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>1</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>4</td>
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<td>20</td>
<td>4</td>
<td>18</td>
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<tr>
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<td>30</td>
<td>6</td>
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<td>4</td>
<td>4</td>
<td>24</td>
<td>12</td>
<td>30</td>
</tr>
</tbody>
</table>

Earned Value System - Example

Status report at the end of period 4

<table>
<thead>
<tr>
<th>Period</th>
<th>Baseline</th>
<th>Actual</th>
<th>Earned</th>
<th>BCWP</th>
<th>ACWP</th>
<th>EAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>4</td>
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<td>4</td>
<td>4</td>
<td>4</td>
<td>24</td>
<td>12</td>
<td>30</td>
</tr>
</tbody>
</table>

EV Rules:
1) 100 percent of budget when completed
2) 50/50 percent when started and finished
3) observed percent complete