Estimation and Earned Value Management for ICT Projects

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Agenda

01 Estimation Best Practices

02 Overview of the Work
   Breakdown Structure (WBS)

03 Earned Value Management
Estimation Best Practices
What is the difference between an estimate and a guess?
**Estimate**: Approximation, prediction, or projection of a quantity based on experience and/or information available at the time, with the recognition that other pertinent facts are unclear or unknown

**In other words**: An estimate is almost the same as an educated guess
Which estimation techniques have you used?

- Top-Down
- Parametric
- Bottom-Up
- PERT
- Analogous
- What-If
Common Estimating Practices

- Top-Down
- Analogous
- PERT
- Bottom-Up
- Parametric
- What-If
<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quickly Develop Estimate</td>
<td>Accuracy</td>
</tr>
<tr>
<td>Lower Cost to Implement</td>
<td>Overlooks Lower Levels of Input</td>
</tr>
<tr>
<td>Small Tasks Can Be Aggregated</td>
<td>Potential to Mislead</td>
</tr>
<tr>
<td>Pros</td>
<td>Cons</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Extremely Accurate</td>
<td>Estimate Inflation Is Aggregated</td>
</tr>
<tr>
<td>Controls Cost</td>
<td>Scope of Work Must Be Complete</td>
</tr>
<tr>
<td>Risks Can Be Identified</td>
<td>Time Consuming to Develop</td>
</tr>
</tbody>
</table>

Bottom-Up
### Analogous

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Fast</td>
<td>Requires Identical Projects</td>
</tr>
<tr>
<td>Easy to Implement</td>
<td>Adjustments Can Be Subjective</td>
</tr>
<tr>
<td>Great for Initial Estimates</td>
<td>Accuracy Can Suffer</td>
</tr>
<tr>
<td>Pros</td>
<td>Cons</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Versatility</td>
<td>Database Requirements</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>Currency</td>
</tr>
<tr>
<td>Statistical Output</td>
<td>Relevancy</td>
</tr>
<tr>
<td>Pros</td>
<td>Cons</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Easily Plan Large Projects</td>
<td>Can Be Complicated</td>
</tr>
<tr>
<td>Can Show Critical Path</td>
<td>Time Consuming</td>
</tr>
<tr>
<td>Accounts for Poor Outcomes</td>
<td>Estimation Inaccuracies</td>
</tr>
</tbody>
</table>

\[ o + 4m + p = 6 \]
## PERT Practice

<table>
<thead>
<tr>
<th>Task</th>
<th>Optimistic</th>
<th>Most Likely</th>
<th>Pessimistic</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trench Pathway</td>
<td>$15,000</td>
<td>$18,000</td>
<td>$22,000</td>
<td>$18,166.67</td>
</tr>
<tr>
<td>Install Conduit</td>
<td>$2,000</td>
<td>$3,400</td>
<td>$4,600</td>
<td>$3,366.67</td>
</tr>
<tr>
<td>Install Fiber</td>
<td>$8,000</td>
<td>$8,500</td>
<td>$8,750</td>
<td>$8,458.33</td>
</tr>
<tr>
<td>Test/Term Fiber</td>
<td>$1,000</td>
<td>$1,250</td>
<td>$2,000</td>
<td>$1,333.33</td>
</tr>
</tbody>
</table>

\[ t_e = \frac{o + 4m + p}{6} \]
<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate Different Outcomes</td>
<td>Garbage In/Garbage Out</td>
</tr>
<tr>
<td>More Informed Decisions/Outcomes</td>
<td>Information Overload</td>
</tr>
<tr>
<td>Improved Project Predictability</td>
<td>Decision Paralysis</td>
</tr>
</tbody>
</table>
Which should you use?

- Time
- Information
- Experience
- Money
You have been asked to estimate a small project.

You will have 48 Category 6A cables running from one patch panel to another.

The total distance between panels, including slack up and down, is 280 ft.

How many 1000-ft boxes of cable will be needed?
Steps to Better Estimates

- Documentation
- Understand the Scope
- Clarify Assumptions
- Understand Constraints
- Evaluate Risk
- Create a Checklist
- Review Peer/Delayed
- Management Buy-in

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What pieces of documentation should we have for proper estimating?
Documentation

- Lessons Learned
- Customer Intent
- Notes
- Specifications
- Blueprints/Drawings
- Safety Requirements
- Security Requirements
- Stakeholder List
- Start/End Date or Duration
Understand the Scope

1. Review Documentation
2. Issue Requests for Information
3. Define Objectives
4. Define Goals
5. Break into Sub-Parts
Clarify Assumptions

- Working Hours
- Labor Costs
- Material Availability
- Equipment
- Indirect Costs
- Site Access
- Pathways
- Furniture Placement
Create Checklist

- Organization
- Motivation
- Productivity
- Creativity
- Delegation
- Excellence
Evaluate Risk

- Technical
- Logistical
- Environmental
- Management
- Financial
- Socio-Political
When do you evaluate risk?

- At project estimation
- During project initiation
- I don’t currently evaluate risk
Understand Constraints

- Cost
- Time
- Quality
- Environment
- Resources
- Technology
- Safety
- Stakeholders
- Risk
No one but a fool is always right

""

- David Hare
Review Peer/Delayed

- Review the Estimate
- Verify Data
- Don’t Miss Decimals
- Phone a Peer
Management Buy-in
How do you define labor?

What is it?

How do you calculate it?
Labor Cost

\[
\text{Labor} = \text{Direct} + \text{Indirect}
\]
Direct vs Indirect Costs

**Direct**

- Wage paid to the employee

**Indirect**

- Examples?
Determine Base Compensation by multiplying the Hourly Base Pay by Hours Worked Per Week by Weeks Per Year.

| STEP ONE |
|-----------------|----------|
| Hourly Base Pay | $25.00   |
| Hours Worked per Week | 40 |
| Weeks per Year | 52       |
| **Base Compensation** | **$52,000.00** |
Determine the Hours of Total Paid Time Off

Determine the hours of **Total Paid Time Off** for which the employee is paid but does not work.

<table>
<thead>
<tr>
<th>STEP TWO</th>
<th>Total Paid Time Off 88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holidays</td>
<td>48 Days 6 Hours 8 Total 48</td>
</tr>
<tr>
<td>Vacation Time</td>
<td>40 Days 5 Hours 8 Total 40</td>
</tr>
<tr>
<td>Sick Time</td>
<td>0 Days 8 Hours 8 Total 0</td>
</tr>
<tr>
<td>Training Time</td>
<td>0 Days 8 Hours 8 Total 0</td>
</tr>
</tbody>
</table>
## Determine Admin Time

3. Determine the hours of **Admin Time** spent per year on tasks that are non-production related.

### STEP THREE

<table>
<thead>
<tr>
<th>Admin Time Per Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours</td>
<td>2</td>
</tr>
<tr>
<td>Total Available Weeks</td>
<td>49</td>
</tr>
<tr>
<td>Total Yearly Admin</td>
<td>98</td>
</tr>
</tbody>
</table>
## Calculate Available Working Hours

**STEP FOUR**

Calculate **Available Working Hours** by subtracting **Total Paid Time Off** from the **Total Hours per Year** (usually 2080).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Hours Per Year</strong></td>
<td>2080</td>
</tr>
<tr>
<td><strong>Total Paid Time Off</strong></td>
<td>88</td>
</tr>
<tr>
<td><strong>Available Working Hours</strong></td>
<td>1992</td>
</tr>
</tbody>
</table>
Determine the Total Production Hours

Determine the **Total Production Hours** the employee can work by subtracting the **Admin Time** from the **Available Working Hours**.

### STEP FIVE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Available Working Hours</td>
<td>1992</td>
</tr>
<tr>
<td>Admin Time</td>
<td>98</td>
</tr>
<tr>
<td><strong>Total Production Hours</strong></td>
<td><strong>1894</strong></td>
</tr>
</tbody>
</table>
## Calculate the Indirect Costs for the Employee

### STEP SIX

<table>
<thead>
<tr>
<th>Indirect Costs</th>
<th>%</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payroll Tax Rate</td>
<td>10%</td>
<td>$5,200.00</td>
</tr>
<tr>
<td>Workers Compensation Rate</td>
<td>10%</td>
<td>$5,200.00</td>
</tr>
<tr>
<td>Uniforms</td>
<td>1%</td>
<td>$520.00</td>
</tr>
<tr>
<td>Tool Allowance</td>
<td>0%</td>
<td>$0.00</td>
</tr>
<tr>
<td>Company Events</td>
<td>0%</td>
<td>$0.00</td>
</tr>
<tr>
<td>Bonus</td>
<td>1%</td>
<td>$520.00</td>
</tr>
<tr>
<td>Cost Of Living Increase</td>
<td>1%</td>
<td>$520.00</td>
</tr>
<tr>
<td>Raises</td>
<td>1%</td>
<td>$520.00</td>
</tr>
<tr>
<td>Health Insurance</td>
<td>3%</td>
<td>$1,560.00</td>
</tr>
<tr>
<td><strong>Total Indirect Costs</strong></td>
<td></td>
<td><strong>$14,040.00</strong></td>
</tr>
</tbody>
</table>
Determine the Total Burden Labor

**STEP SEVEN**

Base Compensation $52,000.00
Total Indirect Costs $14,040.00

**Total Burden Labor** $66,040.00

**Total Burden Labor** is equal to the **Base Compensation** plus the **Total Indirect Costs**.
Find the Actual Cost per Hour

To find the **Actual Cost Per Hour**, divide the **Total Burden Labor** by the **Total Production Hours**.

<table>
<thead>
<tr>
<th>STEP EIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Burdened Labor</td>
</tr>
<tr>
<td>Total Production Hours</td>
</tr>
<tr>
<td><strong>Actual Cost Per Hour</strong></td>
</tr>
</tbody>
</table>
### Determine Labor Burden

**Labor Burden** can be determined taking **Actual Cost Per Hour** and dividing by **Hourly Base Pay**.

<table>
<thead>
<tr>
<th>STEP NINE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Cost Per Hour</td>
<td>$34.87</td>
</tr>
<tr>
<td>Hourly Base Pay</td>
<td>$25.00</td>
</tr>
<tr>
<td><strong>Labor Burden</strong></td>
<td>1.40</td>
</tr>
</tbody>
</table>
Determine the Labor Sale Price

Multiply the determined **Markup on Labor** by the **Actual Cost per Hour** to determine the **Labor Sale Price**.

<table>
<thead>
<tr>
<th>STEP TEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markup on labor</td>
</tr>
<tr>
<td>Actual Cost Per Hour</td>
</tr>
<tr>
<td>Labor Sale Price</td>
</tr>
</tbody>
</table>
### Labor Calculator Workbook

#### Labor Calculator

**Step One**
- **Hourly Base Pay**: $25.00
- **Total Time Off**: 88 Admin
- **Weeks Per Year**: 52
- **Base Compensation**: $52,000.00

**Step Two**
- **Total Paid Time Off**: 88 Holidays
- **Total Available Weeks**: 49
- **Total Yearly Admin**: 98

**Step Three**
- **Admin Time Per Year**: 2 Hours
- **Total Yearly Admin**: 98

**Step Four**
- **Total Hours Per Year**: 2080
- **Total Time Off**: 88
- **Available Working Hours**: 1992

**Step Five**
- **Available Working Hours**: 1992
- **Admin Time**: 98
- **Total Production Hours**: 1894

**Step Six**
- **Indirect Costs**
  - Payroll Tax Rate: 10% $5,200.00
  - Workers Compensation Rate: 10% $5,200.00
  - Uniforms: 1% $520.00
  - Tool Allowance: 0% $0.00
  - Company Events: 0% $0.00
  - Bonus: 1% $520.00
  - Cost Of Living Increase: 1% $520.00
  - Health Insurance: 3% $1,560.00

**Step Seven**
- **Base Compensation**: $52,000.00
- **Total Indirect Costs**: $14,040.00
- **Total Burdened Labor**: $66,040.00

**Step Eight**
- **Total Burdened Labor**: $66,040.00
- **Total Production Hours**: 1894

**Step Nine**
- **Actual Cost Per Hour**: $34.87
- **Markup on labor**: 25%

**Step Ten**
- **Actual Cost Per Hour**: $34.87
- **Actual Total Hourly Pay**: $43.59
Weighted Man-Hour Cost

\[ W = \frac{Ac_1 + Bc_2 +Cc_3}{t} \]

- \( W \) = Weighted Cost per Man-Hour
- \( A, B, C \) = Number of Personnel per Cost Center
- \( c_1, c_2, c_3 \) = Labor Cost Center per Man-Hour
- \( t \) = Total Number Labor Cost Centers
# Weighted Man-Hour Cost Scenario

<table>
<thead>
<tr>
<th>Labor Cost Center</th>
<th>Quantity</th>
<th>Cost/Man Hour</th>
<th>Total Man Hour Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apprentice</td>
<td>6</td>
<td>$25.00</td>
<td>$150.00</td>
</tr>
<tr>
<td>Journeyman</td>
<td>3</td>
<td>$35.00</td>
<td>$105.00</td>
</tr>
<tr>
<td>Foreman</td>
<td>1</td>
<td>$45.00</td>
<td>$ 45.00</td>
</tr>
</tbody>
</table>
"Lots of Math"

\[ W = \frac{A c_1 + B c_2 + C c_3}{t} \]

\[ W = \frac{6 \times $25 + 3 \times $35 + 1 \times $45}{3} \]

\[ W = \frac{$150 + $105 + $45}{3} = \frac{$300}{3} \]

\[ W = $100 \]
## Scenario Check

<table>
<thead>
<tr>
<th>Labor Cost Center</th>
<th>Cost/Man Hour</th>
<th>Quantity</th>
<th>Total Per Man Hour</th>
<th>Man Hours</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apprentice</td>
<td>$25.00</td>
<td>6</td>
<td>$150.00</td>
<td>40</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>Journeyman</td>
<td>$35.00</td>
<td>3</td>
<td>$105.00</td>
<td>40</td>
<td>$4,200.00</td>
</tr>
<tr>
<td>Foreman</td>
<td>$45.00</td>
<td>1</td>
<td>$45.00</td>
<td>40</td>
<td>$1,800.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Totals:</strong> $12,000.00</td>
</tr>
</tbody>
</table>

\[ W \times \text{Total Man Hours} = \text{Total Cost} \]

\[ $100 \times 120 = $12,000 \]
### Overtime

<table>
<thead>
<tr>
<th>Week of Extended OT</th>
<th>50 hrs/wk</th>
<th>60 hrs/wk</th>
<th>70-72 hrs/wk</th>
<th>84 hrs/wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.95</td>
<td>0.91</td>
<td>0.86</td>
<td>0.75</td>
</tr>
<tr>
<td>2</td>
<td>0.93</td>
<td>0.88</td>
<td>0.80</td>
<td>0.70</td>
</tr>
<tr>
<td>3</td>
<td>0.92</td>
<td>0.85</td>
<td>0.73</td>
<td>0.65</td>
</tr>
<tr>
<td>4</td>
<td>0.91</td>
<td>0.81</td>
<td>0.68</td>
<td>0.60</td>
</tr>
<tr>
<td>5</td>
<td>0.85</td>
<td>0.76</td>
<td>0.63</td>
<td>0.55</td>
</tr>
<tr>
<td>6</td>
<td>0.86</td>
<td>0.72</td>
<td>0.58</td>
<td>0.50</td>
</tr>
<tr>
<td>7</td>
<td>0.76</td>
<td>0.67</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>8</td>
<td>0.77</td>
<td>0.64</td>
<td>0.51</td>
<td>0.44</td>
</tr>
<tr>
<td>9</td>
<td>0.74</td>
<td>0.62</td>
<td>0.50</td>
<td>0.43</td>
</tr>
<tr>
<td>10</td>
<td>0.72</td>
<td>0.61</td>
<td>0.49</td>
<td>0.42</td>
</tr>
<tr>
<td>11</td>
<td>0.72</td>
<td>0.60</td>
<td>0.48</td>
<td>0.41</td>
</tr>
<tr>
<td>12</td>
<td>0.71</td>
<td>0.59</td>
<td>0.47</td>
<td>0.40</td>
</tr>
<tr>
<td>13</td>
<td>0.69</td>
<td>0.56</td>
<td>0.46</td>
<td>0.39</td>
</tr>
<tr>
<td>14</td>
<td>0.68</td>
<td>0.55</td>
<td>0.45</td>
<td>0.38</td>
</tr>
<tr>
<td>15</td>
<td>0.67</td>
<td>0.54</td>
<td>0.44</td>
<td>0.37</td>
</tr>
<tr>
<td>16</td>
<td>0.66</td>
<td>0.53</td>
<td>0.43</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Exercise

Create labor rates for your sample project using the template provided (Materials):

- Assign at least four labor categories with a different number of personnel for each category.
- Compute the Weighted Man-Hour Cost.
## Recap and Review

### Weighted Labor Calculator

**Weighted Labor Rate** $ $67.16$

<table>
<thead>
<tr>
<th>Labor Cost Center</th>
<th>Number of Personnel</th>
<th>Cost/Man Hour</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apprentice</td>
<td>4</td>
<td>$31.38</td>
<td>$125.52</td>
</tr>
<tr>
<td>Journeyman</td>
<td>2</td>
<td>$43.59</td>
<td>$87.18</td>
</tr>
<tr>
<td>Foreman</td>
<td>1</td>
<td>$61.02</td>
<td>$61.02</td>
</tr>
<tr>
<td>Site Safety</td>
<td>1</td>
<td>$39.05</td>
<td>$39.05</td>
</tr>
<tr>
<td>Project Coordinator</td>
<td>1</td>
<td>$23.01</td>
<td>$23.01</td>
</tr>
</tbody>
</table>
The Work Breakdown Structure (WBS)
Which project would you choose?

- Photoshoot for Great White Sharks
- Study of Polar Bear Migration Patterns
- Study of Anacondas in Captivity
Do you create a project charter for every project?

- Yes
- Sometimes
- No
- What’s a project charter?
First, have a definite, clear practical ideal; a goal, an objective. Second, have the necessary means to achieve your ends; wisdom, money, materials, and methods. Third, adjust all your means to that end.

- Aristotle
Project Charter

**Defines**
- Scope
- Objectives
- Overall Approach

**Critical Element**
- Initiating
- Planning
- Executing
- Controlling
- Assessing

**Single Point of Reference**
- Project goals
- Scope
- Organization
- Estimates
- Work Breakdown Structure
- Budget

**Contract**
- Budget
- Time
- Risks
- Resources
- Standards
Scope of Work

- Goals and Objectives
- Statements of Work (SOW)
- Organizational Impacts
- Project Deliverables
- Project Estimated Costs & Duration
Recall: Documentation

- Lessons Learned
- Customer Intent
- Notes
- Specifications
- Blueprints/Drawings
- Safety Requirements
- Security Requirements
- Stakeholder List
- Start/End Date or Duration
Recall: Evaluate Risk

- Technical
- Logistical
- Environmental
- Management
- Financial
- Socio-Political
### Recall: Understand Constraints

<table>
<thead>
<tr>
<th>Cost</th>
<th>Time</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Resources</td>
<td>Technology</td>
</tr>
<tr>
<td>Safety</td>
<td>Stakeholders</td>
<td>Risk</td>
</tr>
</tbody>
</table>
What is a Work Breakdown Structure?
Work Breakdown Structure

- Project Scope Defined
- Outcome Oriented
Why Is It Important?

- The total program can be described as a summation of subdivided elements
- Planning can be performed
- Costs and budgets can be established
- Time, cost, and performance can be tracked
- Objectives can be linked to company resources in a logical manner
- Schedules and status-reporting procedures can be established
- Network construction and control planning can be initiated
- The responsibility assignments for each element can be established
Two Basic Types of Work Breakdown Structure Design

Outline

1. University ICT Upgrade
   1.1. Business Building
      1.1.1. First Floor TR
         1.1.1.1. Ladder Rack Construction
            1.1.1.1.1. Install Supports
            1.1.1.1.1.1. Install Anchors
            1.1.1.1.1.2. Install Threaded Rod
      1.2. Science Building
         1.2.1. First Floor TR
How Detailed Does It Need to Be?

Do not attempt to subdivide work to the lowest possible level.

DO WHAT MAKES SENSE!
## Rules for Work Breakdown Structures

1. The WBS and work description should be easy to understand.
What do you think about having the list build over the slides? If it is too much, I can rethink.
Rules for Work Breakdown Structures

1. The WBS and work description should be easy to understand.

2. Since scope of effort can change during a program, every effort should be made to maintain flexibility in the WBS.
Rules for Work Breakdown Structures

1. The WBS and work description should be easy to understand.

2. Since scope of effort can change during a program, every effort should be made to maintain flexibility in the WBS.

3. Most WBS elements (at the lowest control level) range from 0.5 to 2.5 percent of the total project budget.
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5. All schedules should follow the WBS.
Level One—Define the Major Deliverables

1. University Project

- University ICT Upgrade
- Total Program

Level 1
Level Two — Sub Deliverables / Project Level

1. University Project
   - Level 1 Total Program
     - University ICT Upgrade
     - Level 2 Project
       - Business Building
       - Science Building

1.1. Business Building
Level Three — Task

1. University Project
   1.1. Business Building
      1.1.1 First Floor TR
Level Four—Subtask

Level 1 Total Program
- 1. University Project
  - 1.1. Business Building
    - 1.1.1 First Floor TR
      - 1.1.1.1 Ladder Rack Construction

Level 2 Project
- 1. University Project
  - 1.1. Business Building
    - 1.1.1 First Floor TR
      - 1.1.1.1 Ladder Rack Construction

Level 3 Task
- 1. University Project
  - 1.1. Business Building
    - 1.1.1 First Floor TR
      - 1.1.1.1 Ladder Rack Construction

Level 4 Subtask
- 1. University Project
  - 1.1. Business Building
    - 1.1.1 First Floor TR
      - 1.1.1.1 Ladder Rack Construction

University ICT Upgrade
- Business Building
  - First Floor TR
  - Second Floor TR
- Science Building
  - First Floor TR

Ladder Rack Construction
Level Five — Work Package

- Level 1 Total Program
  - 1. University Project
    - Level 2 Project
      - 1.1. Business Building
        - Level 3 Task
          - 1.1.1 First Floor TR
            - Level 4 Subtask
              - 1.1.1.1. Ladder Rack Construction
                - Level 5 Work Package
                  - 1.1.1.1.1. Install Supports
Change Orders

1. University ICT Upgrade
   1.1. Business Building
   1.1.1. First Floor TR
   1.1.1.1. Ladder Rack Construction
   1.1.1.1.1. Install Supports
   1.1.1.1.1.1. Install Anchors
   1.1.1.1.1.2. Install Threaded Rod
   1.2. Science Building
   1.2.1. First Floor TR
   1.3. Change Orders
   1.3.1. First Floor Cable Additions
   1.3.1.1. Add Two Cables to Room 214
Work Breakdown Structure Checklist

- ✅ Develop WBS
- ✅ Check for Completeness
- ✅ Check for Continuity
- ✅ Verify Requirements
- ✅ Check Logic
- ✅ Assign Responsibilities
## BICSI Example — Work Breakdown Structure

<table>
<thead>
<tr>
<th>WBS</th>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
<th>Successor</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>106</td>
<td>Sales</td>
<td>1 day</td>
<td>Wed 2/1/17</td>
<td>Wed 2/1/17</td>
<td></td>
<td></td>
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<tr>
<td>107</td>
<td>Course Pricing determined</td>
<td>2 days</td>
<td>Thu 2/1/18</td>
<td>Mon 2/5/18</td>
<td>136SF-60 d</td>
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<td>100%</td>
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<tr>
<td>108</td>
<td>Publications</td>
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<td>Wed 1/24/18</td>
<td>Wed 1/24/18</td>
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<tr>
<td>109</td>
<td>OSPDRM Release</td>
<td>1 day</td>
<td>Wed 1/24/18</td>
<td>Wed 1/24/18</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>110</td>
<td>TD&amp;O</td>
<td>Wed 2/1/17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>111</td>
<td>Pre-Release</td>
<td>Wed 2/1/17</td>
<td></td>
<td></td>
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<td></td>
<td>100%</td>
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<tr>
<td>112</td>
<td>Set Requirements for Certified Trainers</td>
<td>3 days</td>
<td>Mon 12/25/17</td>
<td>Wed 12/27/17</td>
<td>115</td>
<td>117FS+60 d</td>
<td>100%</td>
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<tr>
<td>113</td>
<td>Add Event Codes to CV for Pilot classes</td>
<td>1 day</td>
<td>Fri 2/9/18</td>
<td>Fri 2/9/18</td>
<td>39</td>
<td></td>
<td>100%</td>
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<tr>
<td>114</td>
<td>Add Event Codes to CV for all Webinars &amp; CTU Sessions</td>
<td>1 day</td>
<td>Fri 2/9/18</td>
<td>Fri 2/9/18</td>
<td>39</td>
<td></td>
<td>100%</td>
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<tr>
<td>115</td>
<td>Certified Trainer (CT) Announcement of new Program Requirements (CTU/Pilot)</td>
<td>1 day</td>
<td>Fri 12/22/17</td>
<td>Mon 12/25/17</td>
<td>136SF-90 days</td>
<td>112</td>
<td>100%</td>
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<tr>
<td>116</td>
<td>Notify ATF/ADTP of new Program Requirements</td>
<td>1 day</td>
<td>Fri 12/22/17</td>
<td>Mon 12/25/17</td>
<td>136SF-90 d</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>117</td>
<td>Announce Webinars &amp; CTU Session to CTs</td>
<td>1 day</td>
<td>Thu 3/22/18</td>
<td>Thu 3/22/18</td>
<td>112FS+60 d</td>
<td></td>
<td>100%</td>
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<tr>
<td>118</td>
<td>Prepare for Pilot Class</td>
<td>2 days</td>
<td>Mon 3/26/18</td>
<td>Tue 3/27/18</td>
<td>445S</td>
<td>120</td>
<td>100%</td>
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<tr>
<td>119</td>
<td>Create CT Comp Product Codes</td>
<td>3 days</td>
<td>Fri 3/23/18</td>
<td>Wed 3/28/18</td>
<td>120SF</td>
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<tr>
<td>120</td>
<td>CTU/Webinars</td>
<td>5 days</td>
<td>Wed 3/28/18</td>
<td>Tue 4/3/18</td>
<td>118</td>
<td>119SF</td>
<td>100%</td>
</tr>
</tbody>
</table>
Simple Scope of Work

Project Scope and Notes
The following notes are based on information about the BICSI University ICT Upgrade Project gathered during the pre-bid phase and while developing the estimate. This information should be incorporated into your creation of your work breakdown structure.

The BICSI University is upgrading existing Category 6 cable plant to Category 6A cable plant to support 10Gig to the desktop. All existing horizontal cable infrastructure will be removed and replaced with Category 6A components. Outside Plant and intra-building backbone infrastructures are not part of this scope of work.

The ICT contractor (your team) will provide and install the new jacks and faceplates for the floor monuments. Horizontal cabling will be placed in existing cable tray through common areas and supported by non-continuous open-top supports within spaces (e.g., open offices, offices, classrooms, labs, and so on) after old infrastructure has been removed. Average horizontal cable runs for the second floor are 165ft (50m). All existing Category 6 cable plant is to be recycled with proof to be shown as part of the final documentation. Firestopping will be restored by the ICT contractor as required. All cable certification testing will be performed to ensure both TIA and ISO standards are met for the Category 6A installation.

The existing racks in the Telecommunications room (TR) will remain in place and be reutilized with the new Category 6 cable distribution equipment. An Operations & Maintenance Manual shall be included with Recycling Documentation, As-Built Documentation, As-built Drawings, Test results, including all required manufacturer submissions to assure execution of extended warranties.
Create a Work Breakdown Structure
1. Building Two Second Floor
   1.1. Upgrade Activities
      1.1.1. Telecommunications room (TR)
         1.1.1.1. Room preparation
         1.1.1.2. Remove existing Category 6 cable distribution equipment
         1.1.1.3. Installation of Category 6A cable distribution equipment
         1.1.1.4. Bonding and Grounding verification
         1.1.1.5. Cleanup and restoration
      1.1.2. Firestop, cleanup, and restoration
      1.1.3. Horizontal cabling (including)
         1.1.3.1. Remove Existing Category 6 cable
         1.1.3.2. Pull new Category 6A cables
         1.1.3.3. Dress new Category 6A cables
         1.1.3.4. Terminate new Category 6A twisted-pair (TRs)
         1.1.3.5. Faceplate install/jacking
         1.1.3.6. Test new Category 6A cable
         1.1.3.7. Apply faceplate labels
         1.1.3.8. Inspection and acceptance
      1.1.4. Materials
         1.1.4.1. Material order
         1.1.4.2. Material delivery to site
         1.1.4.3. Material issuance
         1.1.4.4. Recycle existing Category 6 cable
      1.1.5. Operations & Maintenance Manual
         1.1.5.1. Recycling Documentation
         1.1.5.2. As-Built Documentation
         1.1.5.3. As-built Drawings
         1.1.5.4. Test results
Earned Value Management (EVM)
How do you feel about math?

I love it! It was my favorite class!

Math? There’s a reason I majored in history…
Elements of EVM

- **PV** Planned Value
- **BAC** Budget at Completion
- **AC** Actual Cost
- **EV** Earned Value
- **LOM** Lots O’ Math

Lots of Math

Elements of EVM
Planned Value (PV)
Work Breakdown Structure Planned Values

Outline

1. University ICT Upgrade
   1.1. Business Building
      1.1.1. First Floor TR
         1.1.1.1. Ladder Rack Construction
            1.1.1.1.1. Install Supports - $1,200
            1.1.1.1.1.1. Install Anchors - $800
            1.1.1.1.1.2. Install Threaded Rod - $400
      1.2. Science Building
         1.2.1. First Floor TR

Tree

- University ICT Upgrade
  - Business Building
    - First Floor TR
      - Ladder Rack Construction
        - Install Supports $1,200
        - Install Anchors $800
        - Install Threaded Rod $400
  - Science Building
    - First Floor TR
Budget at Completion (BAC)
Actual Cost (AC)
Earned Value (EV)
## Earned Value Defined

<table>
<thead>
<tr>
<th>WBS</th>
<th>ITEM</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1.1.1.1</td>
<td>Install Supports</td>
<td></td>
</tr>
<tr>
<td>1.1.1.1.1.1</td>
<td>Install Anchors</td>
<td>120</td>
</tr>
<tr>
<td>1.1.1.1.1.2</td>
<td>Install Threaded Rod</td>
<td>120</td>
</tr>
</tbody>
</table>
Earned Value Management Relationships

EV
PV
AC
Pure mathematics is, in its way, the poetry of logical ideas.

- Albert Einstein
# Lots O’ Math

<table>
<thead>
<tr>
<th>NAME</th>
<th>ACRONYM</th>
<th>FORMULA</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Variance</td>
<td>CV</td>
<td>EV-AC</td>
<td>Cost baseline comparison</td>
</tr>
<tr>
<td>Schedule Variance</td>
<td>SV</td>
<td>EV-PV</td>
<td>Schedule baseline comparison</td>
</tr>
<tr>
<td>Cost Performance Index</td>
<td>CPI</td>
<td>EV/AC</td>
<td>Project budget efficiency</td>
</tr>
<tr>
<td>Schedule Performance Index</td>
<td>SPI</td>
<td>EV/PV</td>
<td>Project schedule efficiency</td>
</tr>
<tr>
<td>Cost Schedule Index</td>
<td>CSI</td>
<td>CPI x SPI</td>
<td>Likelihood of project recover</td>
</tr>
<tr>
<td>Work in Progress</td>
<td>WIP</td>
<td>(CPI x SPI)/2</td>
<td>Cash flow and billing</td>
</tr>
<tr>
<td>Estimate At Completion</td>
<td>EAC</td>
<td>BAC/CPI</td>
<td>Project cost at completion</td>
</tr>
<tr>
<td>Estimate To Completion</td>
<td>ETC</td>
<td>EAC-AC</td>
<td>Budget to spend to complete project</td>
</tr>
<tr>
<td>Variance At Completion</td>
<td>VAC</td>
<td>BAC-EAC</td>
<td>Amount over/under original budget</td>
</tr>
<tr>
<td>To Complete Performance Index – BAC</td>
<td>TCPI&lt;sub&gt;BAC&lt;/sub&gt;</td>
<td>(BAC-EV)/(BAC-AC)</td>
<td>CPI needed to meet original budget</td>
</tr>
<tr>
<td>To Complete Performance Index – EAC</td>
<td>TCPI&lt;sub&gt;EAC&lt;/sub&gt;</td>
<td>(BAC-EV)/(EAC-AC)</td>
<td>CPI needed to meet Estimate at Completion</td>
</tr>
</tbody>
</table>
Cost Variance (CV)

- Cost Performance
- Budget Status
- Positive = Below Budget
- Negative = Over Budget

\[ CV = EV - AC \]

\[ CV = \$69,000 - \$67,000 \]

\[ CV = \$2,000 \]

Example Problem

PV = $68,000
AC = $67,000
EV = $69,000
BAC = $134,000
Cost Variance (CV) – Student Problem One

\[ CV = EV - AC \]

\[ CV = \$33,000 - \$41,000 \]

\[ CV = \$ - 8,000 \]
Schedule Variance (SV)

- Schedule Performance
- Schedule Status
- Positive = Ahead of Schedule
- Negative = Behind Schedule

\[ SV = EV - PV \]

\[ SV = \$69,000 - \$68,000 \]

\[ SV = \$1,000 \]

Example Problem

- PV = $68,000
- AC = $67,000
- EV = $69,000
- BAC = $134,000
Schedule Variance (SV) – Man Hours

\[ SV = EV - PV \]

\[ SV = \$69,000 - \$68,000 \]

\[ SV = \$1,000 \]

\[ M_c = \$25.00 \]

\[ M_h = \frac{SV}{M_c} \]

\[ M_h = \frac{\$1,000}{\$25.00} \]

\[ M_h = 40 \text{ man hours} \]
Schedule Variance (SV) – Student Problem Two

\[
SV = EV - PV
\]

\[
SV = \$33,000 - \$35,000
\]

\[
SV = \$ - 2,000
\]

**Student Problem**
- PV = \$35,000
- AC = \$41,000
- EV = \$33,000
- BAC = \$94,000
Cost Performance Index (CPI)

- Cost Performance
- Investment Payback
- $1 = On Target
- $> 1 = Positive Payback
- $< 1 = Negative Payback

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

Example Problem

\[
PV = $68,000
AC = $67,000
EV = $69,000
BAC = $134,000
\]

\[
CPI = \frac{$69,000}{$67,000} = 1.03
\]
Cost Performance Index (CPI) – Student Problem Three

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

\[
CPI = \frac{\$33,000}{\$41,000}
\]

\[
CPI = .81
\]

**Student Problem**
- PV = $35,000
- AC = $41,000
- EV = $33,000
- BAC = $94,000
Schedule Performance Index (SPI)

- Schedule Performance
- 1 = On Target
- > 1 = Ahead of Schedule
- < 1 = Behind Schedule

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

Example Problem:
- PV = $68,000
- AC = $67,000
- EV = $69,000
- BAC = $134,000

\[ SPI = \frac{$69,000}{$68,000} = 1.02 \]
Schedule Performance Index (SPI) – Student Problem Four

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

\[ SPI = \frac{\$33,000}{\$35,000} \]

\[ SPI = .94 \]
Control Charts

SPI and CPI Control Chart

- Upper Control Limit
- SPI
- CPI
- Lower Control Limit
Cost Schedule Index (CSI)

- Shows likelihood of project recovery
- \(< 1\) poor likelihood
- \(> 1\) greater likelihood

\[
CSI = CPI \times SPI
\]

\[
CSI = 1.03 \times 1.02
\]

\[
CSI = 1.05
\]

Example Problem

\[
PV = \$68,000
\]

\[
AC = \$67,000
\]

\[
EV = \$69,000
\]

\[
BAC = \$134,000
\]

\[
CPI = 1.03
\]

\[
SPI = 1.02
\]
Cost Schedule Index (CSI) – Student Problem Five

\[
CSI = CPI \times SPI
\]

\[
CSI = .81 \times .94
\]

\[
CSI = .76
\]
Work in Progress (WIP)

\[
WIP = \frac{CPI + SPI}{2}
\]

\[
WIP = \frac{1.03 + 1.02}{2}
\]

\[
WIP = 1.03
\]

Example Problem

- PV = $68,000
- AC = $67,000
- EV = $69,000
- BAC = $134,000
- CPI = 1.03
- SPI = 1.02
Work in Progress (WIP) – Student Problem Six

\[
WIP = \frac{CPI + SPI}{2}
\]

\[
WIP = \frac{.81 + .94}{2}
\]

\[
WIP = 0.88
\]

Student Problem

- PV = $35,000
- AC = $41,000
- EV = $33,000
- BAC = $94,000
- CPI = .81
- SPI = .94
Estimate at Completion (EAC)

- Estimated total cost of project if CPI remains constant

\[
EAC = \frac{BAC}{CPI}
\]

\[
EAC = \frac{\$134,000}{1.03}
\]

\[
EAC = 130,097
\]

Example Problem

- PV = $68,000
- AC = $67,000
- EV = $69,000
- BAC = $134,000
- CPI = 1.03
- SPI = 1.02
Estimate at Completion (EAC) – Student Problem Seven

\[ EAC = \frac{BAC}{CPI} \]

\[ EAC = \frac{94,000}{.81} \]

\[ EAC = 116,049 \]

Student Problem

PV = $35,000
AC = $41,000
EV = $33,000
BAC = $94,000
CPI = .81
SPI = .94
Independent Estimate at Completion Calculation - One

- Cost will be performed at original budgeted rate

\[ EAC = AC + (BAC - EV) \]

\[ EAC = $67,000 + ($134,000 - $69,000) \]

\[ EAC = $67,000 + $65,000 \]

\[ EAC = $132,000 \]
Independent Estimate at Completion Calculation – Student Problem Eight

- Cost will be performed at original budgeted rate

\[ EAC = AC + (BAC - EV) \]

\[ EAC = $41,000 + ($94,000 - $33,000) \]

\[ EAC = $41,000 + $61,000 \]

\[ EAC = $102,000 \]
Independent Estimate at Completion Calculation - Two

• Future cost will be the same as the last three reporting periods.

\[
EAC = AC + \frac{(BAC - EV)/(EV_a + EV_b + EV_c)}{(AC_a + AC_b + AC_c)}
\]
Future performance will be affected by past schedule performance

\[
EAC = AC + \frac{BAC - EV}{CPI \times SPI}
\]

\[
EAC = \$67,000 + \frac{\$134,000 - \$69,000}{1.03 \times 1.02}
\]

\[
EAC = \$67,000 + \frac{\$65,000}{1.05}
\]

Example Problem
PV = $68,000
AC = $67,000
EV = $69,000
BAC = $134,000
CPI = 1.03
SPI = 1.02
Independent Estimate at Completion Calculation - Three

\[ EAC = \$67,000 + \$61,905 \]

\[ EAC = \$128,905 \]
Independent Estimate at Completion Calculation – Student Problem Nine

\[ EAC = AC + \frac{BAC - EV}{CPI \times SPI} \]

\[ EAC = $41,000 + \frac{$94,000 - $33,000}{.81 \times .94} \]

\[ EAC = $41,000 + \frac{$61,000}{.76} \]

\[ EAC = $41,000 + $80,263 \]

\[ EAC = $121,263 \]

**Student Problem**

PV = $35,000
AC = $41,000
EV = $33,000
BAC = $94,000
CPI = .81
SPI = .94
Independent Estimate at Completion Calculation - Four

- Future performance will be affected by a proportion of the current cost and schedule performance

\[ EAC = AC + \frac{BAC - EV}{0.8 \times CPI + 0.2 \times SPI} \]

Example Problem

<table>
<thead>
<tr>
<th>PV</th>
<th>$68,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>$67,000</td>
</tr>
<tr>
<td>EV</td>
<td>$69,000</td>
</tr>
<tr>
<td>BAC</td>
<td>$134,000</td>
</tr>
<tr>
<td>CPI</td>
<td>1.03</td>
</tr>
<tr>
<td>SPI</td>
<td>1.02</td>
</tr>
</tbody>
</table>

\[ EAC = $67,000 + \frac{\$134,000 - \$69,000}{0.8 \times 1.03 + 0.2 \times 1.02} \]

\[ EAC = $67,000 + \frac{\$65,000}{0.824 + .204} \]
Independent Estimate at Completion Calculation - Three

\[
EAC = \$67,000 + \frac{\$65,000}{1.028}
\]

\[
EAC = \$67,000 + \$63,230
\]

\[
EAC = \$130,230
\]
Independent EAC Calculation – Student Problem Ten

\[ EAC = AC + \frac{BAC - EV}{0.8 \cdot CPI + 0.2 \cdot SPI} \]

\[ EAC = \$41,000 + \frac{\$94,000 - \$33,000}{0.8 \cdot 0.81 + 0.2 \cdot 0.94} \]

\[ EAC = \$41,000 + \frac{\$61,000}{0.648 + 0.188} \]

\[ EAC = \$41,000 + \frac{\$61,000}{0.836} \]

\[ EAC = \$41,000 + \$72,967 \]

\[ EAC = \$113,967 \]
## EAC Comparison

<table>
<thead>
<tr>
<th>EAC Method</th>
<th>Example Value</th>
<th>Student Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$EAC = \frac{BAC}{CPI}$</td>
<td>$130,097$</td>
<td>$116,049$</td>
</tr>
<tr>
<td>$EAC = AC + (BAC - EV)$</td>
<td>$132,000$</td>
<td>$102,000$</td>
</tr>
<tr>
<td>$EAC = AC + \frac{BAC - EV}{CPI \times SPI}$</td>
<td>$128,905$</td>
<td>$121,000$</td>
</tr>
<tr>
<td>$EAC = AC + \frac{BAC - EV}{0.8 \times CPI + 0.2 \times SPI}$</td>
<td>$130,230$</td>
<td>$113,967$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Example</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BAC</strong></td>
<td>134,000</td>
<td>94,000</td>
</tr>
</tbody>
</table>
Estimate to Complete (ETC) – Statistical

- Remaining amount to be spent on project with no change to CPI

\[
ETC = \frac{BAC - EV}{CPI}
\]

\[
ETC = \frac{134,000 - 69,000}{1.03}
\]

\[
ETC = \frac{65,000}{1.03}
\]

Example Problem

PV = $68,000
AC = $67,000
EV = $69,000
BAC = $134,000
CPI = 1.03
SPI = 1.02
EAC = $130,097

\[
ETC = 63,107.00
\]
Estimate to Complete (ETC) – Estimate at Completion

• Remaining amount to be spent on project using revised EAC

\[ ETC = EAC - AC \]

\[ ETC = $130,097 - $67,000 \]

\[ ETC = $70,097 \]

Example Problem

\[ PV = \$68,000 \]
\[ AC = \$67,000 \]
\[ EV = \$69,000 \]
\[ BAC = \$134,000 \]
\[ CPI = 1.03 \]
\[ SPI = 1.02 \]
\[ EAC = \$130,097 \]
Estimate to Complete (ETC) – Student Problem Ten

\[ ETC = EAC - AC \]

\[ ETC = $116,049 - $41,000 \]

\[ ETC = $75,049 \]

<table>
<thead>
<tr>
<th>Student Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV = $35,000</td>
</tr>
<tr>
<td>AC = $41,000</td>
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<tr>
<td>EV = $33,000</td>
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<tr>
<td>BAC = $94,000</td>
</tr>
<tr>
<td>CPI = .81</td>
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<tr>
<td>SPI = .94</td>
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</table>
Variance at Completion (VAC)

- How much more or less than was budgeted
- Positive value is under the original budget
- Negative value is over the original budget

\[ VAC = BAC - EAC \]

\[ VAC = 134,000 - 130,097 \]

\[ VAC = 3,903 \]

Example Problem

<table>
<thead>
<tr>
<th>PV</th>
<th>AC</th>
<th>EV</th>
<th>BAC</th>
<th>CPI</th>
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<td>1.02</td>
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Variance at Completion (VAC) – Student Problem Eleven

\[ VAC = BAC - EAC \]

\[ VAC = $94,000 - $116,049 \]

\[ VAC = -$22,049 \]

**Student Problem**

- PV = $35,000
- AC = $41,000
- EV = $33,000
- BAC = $94,000
- CPI = .81
- SPI = .94
- EAC = $116,049
To Complete Performance Index ($TCPI_{BAC}$) - Baseline

- **Target CPI to Complete project at original budget**
- **$TCPI_{BAC} < 1$** = Project likely to be at or under budget
- **$TCPI_{BAC} > 1$** = Project NOT likely to be at or under budget

\[
TCPI_{BAC} = \frac{BAC - EV}{BAC - AC}
\]

**Example Problem**
- $PV = $68,000
- $AC = $67,000
- $EV = $69,000
- $BAC = $134,000
- $EAC = $130,097

\[
TCPI_{BAC} = \frac{$65,000}{BAC - AC}
\]

\[
TCPI_{BAC} = \frac{$134,000 - $69,000}{BAC - AC}
\]

\[
TCPI_{BAC} = \frac{$65,000}{$67,000}
\]

$TCPI_{BAC} = .97$
To Complete Performance Index (TCPI$_{BAC}$) – Student Problem 12

\[ TCPI_{BAC} = \frac{BAC - EV}{BAC - AC} \]

\[ TCPI_{BAC} = \frac{\$94,000 - \$33,000}{\$94,000 - \$41,000} \]

\[ TCPI_{BAC} = \frac{\$61,000}{\$53,000} \]

\[ TCPI_{BAC} = 1.15 \]

**Student Problem**

<table>
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<tr>
<th>PV</th>
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<td>AC</td>
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<td>SPI</td>
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<tr>
<td>EAC</td>
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</table>
To Complete Performance Index (TCPI\textsubscript{EAC}) - Estimate

- Target CPI to Complete project at revised budget
- TPCI < 1 = Project likely to be at or under budget
- TPCI > 1 = Project NOT likely to be at or under budget

\[
TCPI\textsubscript{EAC} = \frac{BAC - EV}{EAC - AC}
\]

\[
TCPI\textsubscript{EAC} = \frac{$134,000 - $69,000}{$132,000 - $67,000}
\]

Example Problem

- PV = $68,000
- AC = $67,000
- EV = $69,000
- BAC = $134,000
- EAC\textsuperscript{*} = $132,000

\[
TCPI\textsubscript{EAC} = \frac{$65,000}{$63,097}
\]

\[
TCPI\textsubscript{EAC} = 1.03
\]
To Complete Performance Index (TCPI_{EAC}) – Student Problem 13

\[
TCPI_{EAC} = \frac{BAC - EV}{EAC - AC}
\]

\[
TCPI_{EAC} = \frac{\$94,000 - \$33,000}{\$102,000 - \$41,000}
\]

\[
TCPI_{EAC} = \frac{\$61,000}{\$61,000}
\]

\[
TCPI_{EAC} = 1.00
\]

**Student Problem**

- PV = $35,000
- AC = $41,000
- EV = $33,000
- BAC = $94,000
- CPI = .81
- SPI = .94
- EAC* = $102,000
## TCPI Comparison

<table>
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<tr>
<th>TCPI Method</th>
<th>Example Value</th>
<th>Student Value</th>
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<tr>
<td>$TCPI_{BAC} = \frac{BAC - EV}{BAC - AC}$</td>
<td>.97</td>
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<td>$TCPI_{EAC} = \frac{BAC - EV}{EAC* - AC}$</td>
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<td>1.00</td>
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</table>

<table>
<thead>
<tr>
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<th>Student</th>
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<tr>
<td>Calculated CPI</td>
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<td>Difference $TCPI_{BAC}$</td>
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TCPI Control Chart
Earned Value Management Benefits

- Utilizing EVM allows us to manage by exception.
- Numbers don’t lie—usually.
- Creates data-based decision-making.
- Acts as tactical and strategic planning for projects and programs.
# EVM Workbook

## Earned Value Analysis Report

### Project Name

**Prepared By:** [Name]
**Date:** [Date]
**For Reporting Period:** [Period]

**Summary**

[Enter summary text here about the reporting period. This section should provide insights into the project's progress and any key changes or concerns.]

---

### Planned Value (PV)

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<th>Week</th>
<th>Total Cost</th>
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<th>Week 1</th>
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### Budget At Completion (BAC)

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</tbody>
</table>

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### Actual Cost and Earned Value

<table>
<thead>
<tr>
<th>Week</th>
<th>Actual Cost (AC)</th>
<th>Earned Value (EV)</th>
<th>Cost Variance (CV)</th>
<th>Schedule Variance (SV)</th>
<th>Cost Performance Index (CPI)</th>
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### Project Performance Metrics

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### Earned Value Methodology

- **Cost Variance (CV)**: Earned Value - Actual Cost
- **Schedule Variance (SV)**: Earned Value - Budgeted Cost
- **Cost Performance Index (CPI)**: Earned Value / Actual Cost
- **Schedule Performance Index (SPI)**: Earned Value / Budgeted Cost

---

### Key Performance Indicators (KPIs)

- **CV > 0**: Expenditures are less than planned
- **CV < 0**: Expenditures are more than planned
- **SV > 0**: Actual progress is ahead of planned
- **SV < 0**: Actual progress is behind planned

---

### Conclusion

The project is currently under budget and ahead of schedule, with a CV of $0 and an SPI of 1.00 as of the reporting period. However, close monitoring is advised to maintain this performance.
What is one thing you learned from the course?
Any Questions?
PM102: Applied Telecommunications Project Management
35 CECs

PM103: Advanced Tools for ICT Project Management
6 CECs

Resource Management
2 CECs
THANK YOU