Project Cost Management
Objective

- To understand the Project cost Management
- To understand tools and techniques that are unique to Project cost Management
- To understand processes of estimation, budgeting, and control costs
Key Terms

- **Cost**
  The monetary value of an activity or component

- **Budget**
  Approved estimate of cost for the Project or a WBS component or any schedule activity

- **Reserve**
  A provision in the Project Management plan to mitigate risk

- **Cost Management Plan**
  Setouts a format and establishes activities and criteria for planning, structuring and controlling the Project cost

- **Cost Performance Baseline**
  A specific version of time based budget used to compare actual expenditure to the planned expenditure
Key Terms

- **Management Reserve**
  For mitigating risk arising out of unplanned changes to Project Scope and cost

- **Contingency Reserve**
  To handle unplanned but potentially required changes arising out of identified risk in the risk register

- **‘S’ curve**
  ‘S’ curve is a graphic display of cumulative cost of the Project
**Key Terms**

- **Earned Value Management**
  For integrating Scope, schedule and cost for objectively measuring the Project performance and progress

- **Actual Cost**
  Total cost actually incurred in accomplishing a work or schedule activity

- **Earned Value**
  EV is the value of the work performed expressed in terms of approved budget assigned to that work or schedule activity or WBS component

- **Cost Variance (CV)**
  A measure of cost performance. It is the algebraic difference between the earned value (EV) and the actual cost (AC): $CV = EV - AC$

- **Cost Performance Index (CPI)**
  The ratio of earned value (EV) to the actual cost (AC): $CPI = EV/AC$
PM role in Cost Management?

- In cost Management process, the Project Manager:

Estimates Costs at ACTIVITY level

Determines Project Budget and Baseline

Monitors, Controls, Forecasts Cost
Managing Project Cost

Cost Management commences with planning effort, consider:

- Creating a Cost Management Plan
- It is a subsidiary of Project Management Plan
- Created by Project Management Team
- Establishes criteria for Estimating, Budgeting, and Controlling Costs
Cost Management Processes

Project Cost Management

- Plan Cost Management
- Estimate Costs
- Control Costs
- Determine Budget
PLAN COST MANAGEMENT

Planning Process Group

Plan Cost Management
Estimate Costs
Determine Budget
Control Costs
Plan Cost Management

Process that establishes the policies, procedures and documentation for planning, managing, expending and controlling Project costs.
Plan Cost Management

**INPUTS**
- Project Management plan
- Project charter
- Enterprise environmental factor
- Organizational process assets

**TOOLS and TECHNIQUES**
- Expert judgment
- Analytical techniques
- Meetings

**OUTPUTS**
- Cost Management plan

Plan Cost Management – Inputs, Tools and Techniques and Outputs
Plan Cost Management

- **Inputs**

  - **Project Management Plan**
    - Documents how each step of the Project is executed, monitored, controlled and closed
    - Incorporates and consolidates all the subsidiary plans and baselines
  
  - **Project Charter**
    - Is the formal document authorizing the Project.
    - It will contain the high level Project and product requirements

- **Enterprise Environmental Factor**

- **Organizational Process Assets**
Plan Cost Management
Tools and techniques

• Expert Judgment
  – Getting the opinion of an expert on the particular field.

  ▪ Analytical Techniques
    - Choosing strategic options to fund the Project
    - Self-funding, funding with equity or funding with debt
    - Organizational policies and procedures may influence which financial techniques

  ▪ Meetings
Plan Cost Management

Cost Management Plan
–Cost Management plan can establish the following
  • Units of measure
  • Level of precision
  • Level of Accuracy
  • Organizational procedures links
  • Control Thresholds
  • Rules of performance measurement
  • Report formats
  • Process descriptions
  • Additional Details
ESTIMATE COSTS

Planning Process Group

Plan Cost Management
Estimate Costs
Determine Budget
Control Costs
The Project Management team performs:
• Calculation of approximate monetary resources required to execute all Project activities
• Estimations in view of:
  – Risk vs. Cost Tradeoffs
  – Make vs. buy analysis or buy vs. lease analysis
  – Optimal Resources Sharing
• Cost estimation for resources like:
  – Labor, material, machine, equipment, services and facilities
**Estimate Costs**

- **Project cost estimation range:**

<table>
<thead>
<tr>
<th>Project Status</th>
<th>Estimation Range</th>
<th>Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation</td>
<td>Rough Order of Magnitude</td>
<td>-25% to +75%</td>
</tr>
<tr>
<td>Planning</td>
<td>Definitive Estimate</td>
<td>-5% to +10%</td>
</tr>
</tbody>
</table>

- **Cost estimation may include:**
  - Only direct cost or with a combination of indirect cost
Estimate Costs

**INPUTS**
- Cost Management plan
- Human Resource Plan
- Scope Baseline
- Project Schedule
- Risk Register
- Enterprise Environmental Factor
- Organizational Process Assets

**TOOLS and TECHNIQUES**
- Expert Judgment
- Analogous Estimating
- Parametric Estimating
- Bottom-up Estimating
- Three-point Estimates
- Reserve Analysis
- Cost of Quality
- Project Management Software
- Vendor Bid Analysis
- Group decision-making techniques

**OUTPUTS**
- Activity Cost Estimates
- Basis of Estimates
- Project Document Updates
Estimate Costs

Inputs

- **Cost Management Plan**
  - Defines how Project cost will be managed and controlled

- **Human Resource Plan**
  - Project staffing requirements
  - Resource rates
  - Planned rewards and recognition program

- **Scope Baseline**
  - Scope Statement
  - Work Breakdown Structure
  - WBS Dictionary
- Project Schedule
  - Vital input for cost estimation
  - Details about when to perform each activity
- Risk Register
  - Impacts on Project cost and schedule
  - Risk mitigation costs
- Enterprise Environmental Factors influencing Estimate Costs process
  - Market Conditions
  - Published Commercial Information
- Organizational Process Assets
  - Policies, Procedures, Templates, etc.
  - Lessons Learned and Historical Information
Expert Judgment
- It is used with supporting historical information
- Costing Elements are determined:
  - Labor Rates, Material Costs, Inflation Factors, Risk Factors and Other Variables

Analogous Estimating
- Using the actual cost of previous, similar Projects as the basis for estimating the cost of the current Project
- Uses gross value estimating approach and adjustments to accommodate known differences in Project complexity
• **Parametric Estimating**
  – Statistical relationship between historical data and other variables to calculate a cost estimate for a schedule activity

  e.g. square footage in construction, lines of code in software, required labor hours

• **Bottom-up Estimating**
  – Produces high level of accuracy and determined based on size and complexity of activity / work package
  – Cost is estimated for individual activity or work packages with specific details
  – Costs are rolled up to determine estimated cost for higher level
• Three-point Estimates
  - Uncertainty and inaccuracy in a single point estimate is eliminated
  - Uses the following formula

\[ C_E = \frac{C_O + 4C_M + C_P}{6} \]

• Reserve Analysis
  – Contingency Reserve is used to handle risk uncertainty
  – Reserve is determined based on:
    • Percent of Estimated Cost; or
    • Fixed Amount; or
    • Determined based on Quantitative Analysis

\[ C_E = \frac{C_O + C_M + C_P}{3} \]

Beta Distribution
\[ C_E = \frac{C_O + 4C_M + C_P}{6} \]

Triangular Distribution
\[ C_E = \frac{C_O + C_M + C_P}{3} \]
Cost of Quality comprises of:

- Cost of Prevention
- Cost of Appraisal
- Cost of Failure

Project Management Software

- Cost Estimating Software Applications
- Computerized Spreadsheets
- Simulation and Statistical Tools
■ **Vendor Bid Analysis**
  - Cost estimated from Responsive Bids
  - Total Project Cost includes Project team’s costs of handling bid process

■ **Group Decision-Making Techniques**
  - Useful for engaging team members to improve estimate accuracy and commitment to the emerging estimates
Activity Cost Estimates
- Amount and type of additional details supporting the schedule activity cost estimate vary by application area
- Cost Items include:
  - Direct Labor, Materials, Equipment, etc.
  - Indirect Cost if not included at the Project level

Basis of Estimates
- Description of the schedule activity’s Project Scope of work
- Documentation of:
  - Basis for the estimate
  - Assumptions made
  - Constraints
- Indication of the range of possible estimates
  - e.g. ₹10,000 (-10%/+15%) to indicate that the item is expected to cost between ₹9,000 and ₹11,500
- Indication of confidence level of final estimate

Project Document Updates
- Risk Register
DETERMINE BUDGET

Planning Process Group

Plan Cost Management
Estimate Costs
**Determine Budget**
Control Costs
Determine Budget

- Project Management Team aggregates the estimated cost of individual activities or work packages
- Establishes Project’s Authorized Cost Baseline

Project Cost Baseline—Authorized funds to execute the Project and this does not include the Management Reserve
Determine Budget

**INPUTS**
- Cost Management Plan
- Scope Baseline
- Activity Cost Estimates
- Basis of Estimates
- Project Schedule
- Resource Calendar
- Risk Register
- Agreements
- Organizational Process Assets

**TOOLS and TECHNIQUES**
- Cost Aggregation
- Reserve Analysis
- Expert Judgment
- Historical Relationships
- Funding Limit Reconciliation

**OUTPUTS**
- Cost Baseline
- Project Funding Requirement
- Project Document Updates
Determine Budget

Inputs

- Cost Management Plan
- Scope Baseline
  - Scope Statement—Funding Constraints or Spending Limitation
  - WBS and WBS Dictionary
- Activity Cost Estimates
  - Basis of Estimates
  - Project Schedule
    - Vital input for cost estimation
    - Details about when to perform each work package
Determine Budget

**Inputs**

- **Resource Calendar**
  - Cost of the assigned resources including timeline

- **Risk Register**
  - Should be reviewed to consider how to aggregate the risk response costs

- **Agreement**
  - Cost information relating to Products, Services, or Results that are purchased or acquired

- **Organizational Process Assets**
  - Organizational Process, Guidelines, and Procedure for Budgeting
  - Cost Budgeting Tools and Reporting Methods
Cost Aggregation
- Activity cost estimates are aggregated by activity / work packages in accordance with the WBS

Reserve Analysis
- Contingency Reserve
- Management Reserve

Expert Judgment
- Opinion from experts related to:
  - Knowledge Area, Discipline, Industry
- Sources of Expert Judgment
  - Other Projects within organization
  - Consultants
  - Stakeholders, etc.
Determine Budget
Tools and Techniques

- **Historical Relationships**
  - Parametric or Analogous Estimation uses historical information, these are reliable when:
    • Model used is accurate
    • Parameters used in model used are quantifiable
    • Models are scalable (should work for small or large Projects or phases within Projects)

- **Funding Limit Reconciliation**
  - Large variations in the periodic expenditure of funds are usually undesirable
  - Activities are rescheduled to meet Funding Limitation
Cost Baseline
- Time-phased budget that is used as a basis against which to measure, monitor, and control overall cost performance on the Project
Determine Budget

**Outputs**

- **Project Funding Requirement**
  - Funding requirements, total and periodic (e.g., annual or quarterly), are derived from the cost baseline and can be established to exceed, usually by a margin, to allow for either early progress or cost overruns

- **Project Document Updates**
  - Risk Register, Project Schedule, Cost Estimates
Example of Cost Aggregation

8. Cost budget
   7. Management reserve
      6. Cost baseline
         5. Contingency reserve
            4. Project
               3. Control account
                  2. Work package
                     1. Activities

* Cost in INR

137000
  7000
  130000
       10000
          120000
             50000
                70000
                   20000
                      10000
                         10000
                            10000
CONTROL COSTS

Monitoring and Controlling Process Group

Plan Cost Management
Estimate Costs
Determine Budget
Control Costs
Control Costs

- Monitoring Project progress and expended cost on completed activities
- Comparing Actual Cost with Baseline
- Managing Changes to Cost Baseline
- Analyzing the relationship between Actual Cost and Earned Value
- Cost Control explores causes of positive and negative variance
• Monitoring Changes
  – Performing in timely manner, preventing unapproved changes
  – Communicating Changes to Appropriate Stakeholders and its Impacts of Costs

• Monitoring Performance
  – Ensuring positive variance (avoiding negative)
  – To isolate and understand variances with respect to the approved baseline
  – The work accomplished against the funds expended
  – Keep expected cost overruns within the acceptable limit
Control Costs

**INPUTS**
- Project Management Plan
- Project Funding Requirements
- Work Performance data
- Organizational Process Assets

**TOOLS and TECHNIQUES**
- Earned Value Management
- Forecasting
- To-Compete Performance Index
- Performance Reviews
- Project Management Software
- Reserve Analysis

**OUTPUTS**
- Work Performance Information
- Cost Forecasts
- Change Requests
- Project Management Plan Updates
- Project Document Updates
- Organizational Process Assets Updates
Control Costs

Inputs

- Project Management Plan
  - Cost Management Plan
  - Cost Baseline
- Project Funding Requirements
- Work Performance data
  - Progress of Deliverables (activities that are started, activities that are yet to be started)
- Organizational Process Assets
  - Policies, Procedures, and Templates around Cost Control
  - Cost Control Tools
  - Methods that are used for monitoring and reporting
Control Costs
Tools and Techniques

- Earned Value Management
  - Performance Indices: SV; CV; SPI; CPI

- Forecasting
  - EAC through budgeted rate
  - EAC through present CPI
  - EAC through SPI and CPI

- To-Compete Performance Index
  - \((BAC-EV) / (BAC-AC)\)
# Control Costs

## Tools and Techniques

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Term</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV</td>
<td>Planned Value</td>
<td>As of today, what is the estimated value of the work planned to be done ?</td>
</tr>
<tr>
<td>EV</td>
<td>Earned Value</td>
<td>As of today, what is the estimated value of the work actually accomplished ?</td>
</tr>
<tr>
<td>AC</td>
<td>Actual Cost</td>
<td>As of today, what is the actual cost incurred for the work accomplished ?</td>
</tr>
<tr>
<td>BAC</td>
<td>Budget at completion</td>
<td>How much did we budget for the total Project effort ?</td>
</tr>
<tr>
<td>EAC</td>
<td>Estimate at Completion</td>
<td>What do we currently expect the total Project to cost ?</td>
</tr>
<tr>
<td>ETC</td>
<td>Estimate to complete</td>
<td>From this point onwards, how much MORE do we expect to cost to finish the Project ?</td>
</tr>
<tr>
<td>VAC</td>
<td>Variance at Completion</td>
<td>As of today, how much over or under budget do we expect to be at the end of the Project ?</td>
</tr>
</tbody>
</table>
## Control Costs

### Tools and Techniques

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Variance</td>
<td>CV = EV – AC</td>
<td>Negative if over budget, positive if under budget</td>
</tr>
<tr>
<td>Schedule Variance</td>
<td>SV = EV – PV</td>
<td>Negative if behind schedule, positive if ahead of schedule</td>
</tr>
<tr>
<td>Cost Performance Index</td>
<td>CPI = EV/AC</td>
<td>&gt; 1 is good for the Project, Less than 1 is bad.</td>
</tr>
<tr>
<td>Schedule Performance Index</td>
<td>SPI = EV / PV</td>
<td>&gt; 1 is good for the Project, Less than 1 is bad.</td>
</tr>
<tr>
<td>EAC</td>
<td>AC + (BAC-EV)</td>
<td>Actual cost to date plus remaining budget</td>
</tr>
<tr>
<td>ETC</td>
<td>EAC – AC</td>
<td>How much more will the Project cost ?</td>
</tr>
<tr>
<td>VAC</td>
<td>BAC – EAC</td>
<td>As of today, how much over or under budget do we expect to be at the end of the Project ?</td>
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</table>
Earned Value Management

Terms involved:

1. Planned Value (PV): Estimated value of the work planned to be done
2. Earned Value (EV): Estimated value of the work actually accomplished
3. Actual Cost (AC): Actual money spent for the work accomplished.
4. Budget at Completion (BAC): Budget for the total project work
Control Costs
Tools and Techniques

- Performance Reviews
  - Variance Analysis
  - Trend Analysis
  - Earned Value Performance

- Variance Analysis
  - CV; CPI

- Project Management Software
  - To monitor EVM dimensions (PV, EV, and AC)
Control Costs

Outputs

- **Work Performance Information**
  - Computed CV, SV, CPI, SPI values for WBS components

- **Cost Forecasts**
  - Stakeholders are communicated about EAC values

- **Change Requests**
  - Performed through Integrated Change Control
  - Issue Preventive / Corrective Actions
Control Costs
Outputs

- Project Management Plan Updates
  - Any required updates Cost Management Plan
  - Any approved changes to Cost Baseline

- Project Document Updates
  - Cost Estimates
  - Basis of Estimates

- Organizational Process Assets Updates
  - Causes of Variances
  - Corrective Action with reasons