

Project Cost Management



Project Cost Management Processes

1. Estimate Costs
2. Determine Budget
3. Control Costs

In some projects, especially with smaller scope, cost estimation and cost budgeting are so tightly linked that they are viewed as a single process.

Quick Facts Cost Management

- Costing is different from Pricing. Costing includes the monetary resource required to complete the project and pricing normally include a profit margin.
- Costing is based on WBS and controlled by Control Accounts
- Costing shall be ideally done by a team who perform the work
- Schedule get affected by funding and project manager shall manage the link with organization
- Padding is not a good practice
- Final schedule can be done only after costing and final costing can only be done after risk since risk management involves budget for handling risk

Cost Management

- **Life Cycle Cost** - Project cost management is primarily concerned with cost needed to complete project activities however project cost management shall consider the effect of project decisions on the subsequent recurring cost of operation, maintenance and support of deliverables. Remember the product life cycle.
- Some decisions on project cost management have direct impact on future recurring cost. Example – Reduction in some features of project may reduce project cost but may make future operations more difficult and hence resulting overall more cost to organizations.
- Some project costing may involve predicting and analyzing the future financial performance of deliverables and may include techniques such as Return on Investments (ROI), Discounted Cash Flow and Investment Pay Back Analysis.

Project Cost Estimating

- **Types of Cost**

- **Cost can be Direct or Indirect**

- ❖ **Direct costs** These costs are attributed directly to the project work and cannot be shared among projects (Wages, Material, Equipment etc).

- ❖ **Indirect costs** Overhead costs that incurred for the benefit of more than one project (Taxes, Training, project management software license, and so on).

Cost can be Direct or Indirect

- ❖ **Variable costs** Costs that vary depending on the amount of work or production (Cost of materials, supplies, wages etc..).

- ❖ **Fixed costs** These costs remain constant throughout the project (Cost of office setup, rentals etc...).

7.1 Estimate Costs

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Enterprise environmental factors 2. Organizational process assets 3. Scope Baseline 4. Project Schedule 5. Human Resource Plan 6. Risk Register 	<ol style="list-style-type: none"> 1. Expert Judgement 2. Analogous estimating 3. Bottom-up estimating 4. Parametric estimating 5. Three Point Estimates 6. Project management estimating software 7. Vendor bid analysis 8. Reserve analysis 9. Cost of quality 	<ol style="list-style-type: none"> 1. Activity cost estimates 2. Basis of estimates 3. Project Document Updates

7.1 Estimate Costs : Tools & Techniques

1. Expert Judgment :

- Expert judgment , guided by historical information , provides valuable insight about the environment and information from previous similar projects .

7.1 Estimate Costs : Tools & Techniques

2. Analogous Estimating

- Analogous estimating relies on historical information to predict the cost of the current project. It is also known as top-down estimating.
- The process of analogous estimating takes the actual cost of a historical project as a basis for the current project.
- Analogous estimating uses historical data and expert judgment.
- Less costlier than other methods, faster but less accurate

7.1 Estimate Costs : Tools & Techniques

3. Parametric Estimating

- ❖ Parametric estimate uses statistical relationship between historical data and other variables
- ❖ Per sq.ft cost of previous project of similar nature was XYZ and hence the new project shall cost XYZ multiplied by new total area.
- ❖ Parametric estimate can be applied to total project or part of project.

7.1 Estimate Costs : Tools & Techniques

4. Bottom-up Estimating

- ❖ Cost estimation starts from bottom level.
- ❖ Each WBS work package is estimated and rolled up to higher level.
- ❖ While this method is more expensive, it is also one of the most accurate.



7.1 Three-Point Estimates (PERT)

5. Three Point Estimates

PERT analysis calculates An Expected $c(E)$ activity cost using a **weighted** average of three estimates :

$$c(E) = [c_o + 4c_m + c_p]/6$$

- PERT analysis consider estimation uncertainties and risks and hence accuracy of estimate is improved.

7.1 Estimate Costs : Tools & Techniques

6. Reserve Analysis

- ❖ Reserves are added to costing to manage risks, cost overruns and error associated with costing.
- ❖ More details about reserve analysis in Risk Management
- ❖ Padding is not a good project management practice.

7.1 Estimate Costs : Tools & Techniques

7. Cost of Quality (COQ)

- ❖ Details about cost of quality in quality knowledge area



7.1 Estimate Costs : Tools & Techniques

7. Project Management Estimating Software

- ❖ Several different computer programs are available that can streamline project work estimates and increase their accuracy. These tools can include project management software, spreadsheet programs, and simulations.

7.1 Estimate Costs : Tools & Techniques

8. Vendor Bid Analysis

- ❖ Sometimes it's just more cost effective to hire someone else to do the work. Other times, the project manager has no choice because the needed skill set doesn't exist within the organization.
- ❖ In either condition, the vendors' bids need to be analyzed to determine which vendor should be selected based on their ability to satisfy the project scope, the expected quality, and the cost of their services.

7.1 Estimate Costs :Outputs

1. Activity Cost Estimates

- ❖ The output of cost estimating is the actual cost estimates of the resources required to complete the project work.
- ❖ Each resource in the project must be accounted for and assigned to a cost category. Categories include the following:
 - ✓ Labor costs
 - ✓ Material costs
 - ✓ Travel costs
 - ✓ Supplies
 - ✓ Hardware costs
 - ✓ Software costs
 - ✓ Special categories (inflation, cost reserve, and so on)

Project Cost Estimating - Estimating Accuracy

- Accuracy of estimate is normally refined during the course of project to reflect additional details as it becomes available.
- **Rough order of magnitude** This estimate is “rough” and is used during the initiating processes and in top-down estimates. The range of variance for the estimate can be from +/- 50%.
- Later the estimate can be refined to a range of +/- 10%
- Refinements and range of accuracy depends on policies of individual organizations.

7.1 Estimate Costs :Outputs

2. Basis of estimates

- ❖ Once the estimates have been completed, supporting detail must be organized and documented to show how the estimates were created.
- ❖ Specifically, the supporting detail includes the following:
 - ✓ **Document basis of estimate (how it was developed)**
 - ✓ **Information on the assumptions and constraints made while developing the cost estimates.**
 - ✓ **Information on the range of variance in the estimate** For example, based on the estimating method used, the project cost may be \$220,000 ± \$15,000.
 - ✓ **Indication of the confidence level of the final estimate**

7.1 Estimate Costs :Outputs

3. Project Document Updates : project documents that may get updated include, but not limited to the risk register



7.2 Determine Budget

- Cost of completing individual activities are now completed.
- During budgeting, the cost of individual activities are compiled to generate a complete time phased budget.
- Cost of individual activities are rolled up to work package level and as the work packages are now part of schedule baseline, this will result in a time phased cost.
- Schedule, estimate and risk analysis shall be complete prior to budgeting
- This cost is now linked to organization accounting system through control accounts placed above work package.

7.2 Determine Budget

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Activity cost estimates 2. Basis of estimates 3. Scope Baseline 4. Project schedule 5. Resource calendars 6. Contracts 7. Organizational Process Assets 	<ol style="list-style-type: none"> 1. Cost aggregation 2. Reserve analysis 3. Expert Judgement 4. Historical Relationships 5. Funding limit reconciliation 	<ol style="list-style-type: none"> 1. Cost Performance Baseline 2. Project funding requirements 3. Project Document Updates

7.2 Determine Budget :Tools & Techniques

1. Cost Aggregation

- ❖ Activity costs are rolled up to work package costs. Work package costs are rolled up to control account costs and finally into project costs.

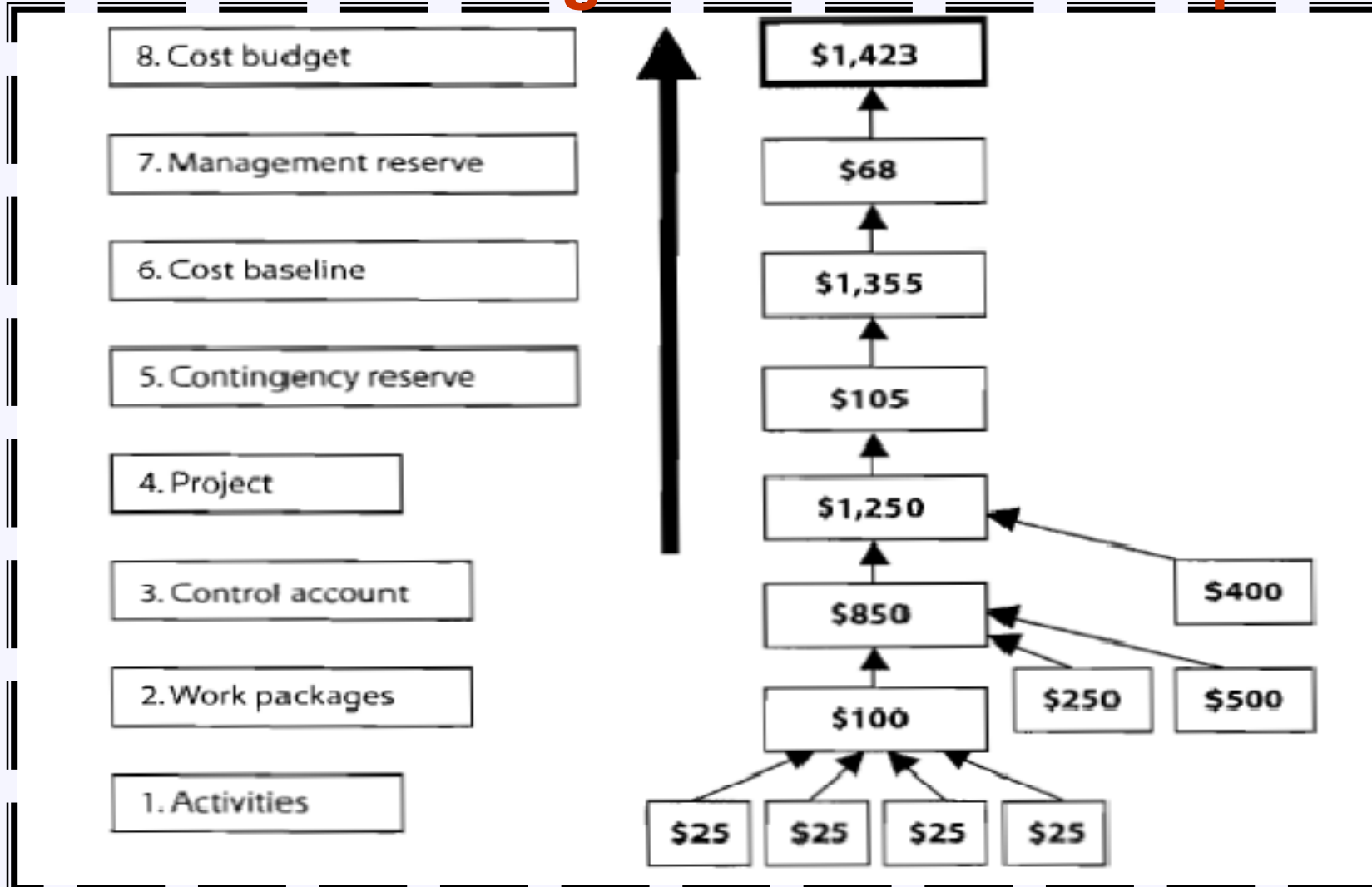
2. Reserve Analysis

- ❖ Budget reserves are kept for both contingency reserve and management reserve.
- ❖ **Contingency Reserves** – Monetary reserves kept for identified but unplanned changes (risks). Project manager will normally have the authority to utilize contingency reserves.
- ❖ Contingency reserves are placed for changes that can result from an identified risk.

7.2 Determine Budget :Tools & Techniques

- **Management reserve** - Budget set aside to cover unforeseen risks or changes to the project. This is the budget kept for unidentified risks.
- Management reserve will not be part of project budget and hence project manager need approval from management for using this reserve.
- The cost baseline will contain the contingency reserve and the cost budget will include the management reserve.
- Management reserves are not part of earned value calculations (since it is not part of cost baseline & measurements are based on baselines)

7.2 Determine Budget : Tools & Techniques



7.2 Determine Budget :Tools & Techniques

3. Expert Judgment

4. Historical Relationships :

- A historical knowledge of previous projects of similar nature can be used for determining budget.
- Parametric or Analogous estimates can be used. This method uses the statistical relationship between historical data and variable (Data multiplied by variable)

7.2 Determine Budget :Tools & Techniques

5. Funding Limit Reconciliation

- ❖ Funding limit reconciliation is an organization's approach to managing cash flow.
- ❖ Budgeting will result in S curve showing time phased cost requirements and project manager shall negotiate fund requirements with organization prior to finalization of cost baseline and schedule.
- ❖ Changes in funding may results in changes to project management plan and schedule
- ❖ An unrealistic budget is project manager's fault
- ❖ Funding normally happens in steps where are expenditure follow S curve.

7.2 Determine Budget : Outputs

1. Cost Performance Baseline

- ❖ A project's cost baseline is an authorized time-phased budget used to measure, monitor and control overall cost performance of the project.
- ❖ Cost baselines forms the shape of an S-curve indicating low spending in the initial stages of project and increasing towards end of the project.

7.2 Determine Budget : Outputs

2. Project Funding Requirements

- ❖ Funding requirements are derived from cost baselines
- ❖ Funding often occurs in incremental rather than continuous
- ❖ Total funds required are cost baseline plus management reserve, if any.

7.2 Determine Budget : Outputs

3. Project Document Updates : documents that may get updated include , but are not limited to :

- ❖ Risk register
- ❖ Cost estimates
- ❖ Project schedule

7.3 Control Costs

- Control cost is the processes of monitoring the status of project based on cost baseline
- Do not confuse control cost with cost control
- Any change in authorized funding shall only be done through integrative change control

7.3 Control Costs

Inputs	Tools & Techniques	Outputs
<ol style="list-style-type: none"> 1. Project Management Plan 2. Project funding requirements 3. Work performance information 4. Organizational Process Assets 	<ol style="list-style-type: none"> 1. Earned Value Technique 2. Forecasting 3. To- complete performance index 4. Performance reviews 5. Variance Analysis 6. Project Management Software 	<ol style="list-style-type: none"> 1. Work Performance Measurements 2. Budget Forecasts 3. Organizational process assets (updates) 4. Change Requests 5. Project management plan (updates) 6. Project Document Updates

7.3 Control Cost

➤ 1. Earned Value Management

- ❖ Earned value management will indicate status and health of project at any time and can predict possible outcomes.
- ❖ EVM can be used for analysis of cost and schedule baselines
- ❖ Earned Value Management is carried out using the three main inputs
 - Planned Value (**PV**)
 - Earned Value (**EV**)
 - Actual Cost (**AC**)

7.3 Control Cost

- Planned Value (PV)
- ❖ Authorized budget assigned to the work to be accomplished on a particular Day
- ❖ It means, value of planned work to be done as on today
- ❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage.

What is the PV on 3rd Week = Total value of planned work to be completed on third week in monetary terms ($500 \times 3 = 1500$)

- ❖ Total Planned Value for project will be approved total budget (Remember – Management reserve is not part of EVM) and is known as Budget at Completion (**BAC**)

7.3 Control Cost

➤ Earned Value(PV)

- ❖ **Estimated** (not actual) value of work actually completed in monetary terms
- ❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage. End of 2nd week 3 stages were completed what is the PV and EV

PV on 2nd Week = Total value of planned work to be completed on second week in monetary terms ($500 \times 2 = 1000$)

EV on 2nd week = Estimated value of work completed ($500 \times 3 = 1500$)

7.3 Control Cost

➤ Actual Cost(AC)

❖ **Actual** cost spend to complete the work completed

❖ Work package XX have a 4 stages and each stage will take one week to complete with \$500 estimated cost per stage. End of 2nd week 3 stages were completed and contractor has spend 1700. What is the PV, EV & AC

PV on 2nd Week = Total value of planned work to be completed on second week in monetary terms ($500 \times 2 = 1000$)

EV on 2nd week = Estimated value of work completed ($500 \times 3 = 1500$)

AC on 2nd Week = Actual cost spend of work already completed (1700)

7.3 Control Cost

- ❖ Variances from approved baselines (Cost & Schedule) can now be analysed

SV (Schedule Variance) = EV-PV (Difference between estimated value of work completed and estimated value of work planned)

CV (Cost Variance) = EV-AC (Difference between estimated value of work completed and actual cost of work completed)

SPI (Schedule Performance Index) = EV/PV

CPI (Cost Performance Index) = EV/AC

Tips

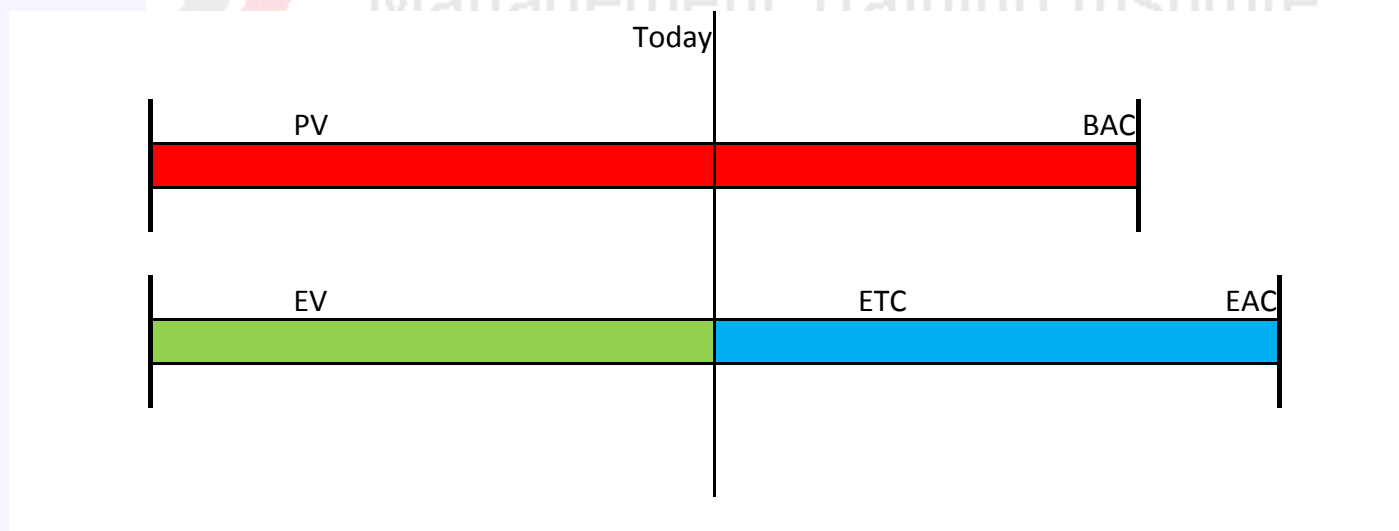
– EV comes first in all equations.

- For Schedule related equation there is PV and AC for cost related

7.3 Control Cost

➤ 2. Forecasting

- ❖ Using the earned value analysis, team can now forecast the project performance.
- ❖ Estimate at completion (EAC) may differ from Budget at Completion (BAC)
- ❖ Estimate to complete (ETC) is the estimate of remaining work. Now Estimate at completion = AC + ETC.



7.3 Control Cost

➤ EAC can be calculated by

1. There will be no variation for remaining work and will progress as planned before $ETC = BAC - EV$ & that means $EAC = AC + ETC (BAC-EV)$
2. The changes project experience will continue to occur for remaining work. $EAC = BAC/CPI$ (Only cost efficiency is considered now)
3. Here team considers that remaining work will be completed at the same efficiency rate considering cost and schedule performance $EAC = AC + (ETC/CPI \times SPI)$ & $ETC = BAC-EV$

A variation to this is to weight CPI or SPI at different values as per project managers judgement (to give weight to schedule performance or cost performance as per previous performance). In case of an 70/30 ratio

$$EAC = AC + ((BAC-EV)/0.7CPI \times 0.3SPI)$$

7.3 Control Cost

4. Team think that original estimate if fundamentally flawed. Team need to prepare new estimate for remaining work. This the best way to forecast but requires management effort and additional expenditure of costing

$EAC = AC + \text{New Estimate for remaining work}$



7.3 Control Cost

➤ 3. To Complete Performance Index (TCPI)

❖ TCPI predicts the efficiency that must be achieved for remaining work to complete the remaining works with available budget

❖ TCPI = Work Remaining/Funds remaining

$$= (\text{Budget At Completion} - \text{Earned Value}) / (\text{BAC} - \text{Actual cost})$$

$$= (\text{BAC}-\text{EV})/(\text{BAC}-\text{AC})$$

If it is obvious that earlier estimated budget at completion can not be achieved, Project manager develops a forecasted estimate at completion (EAC). Once approved through integrative change control process, EAC will superseded BAC and cost baselines will be revised.

$$\text{Now TCPI} = (\text{BAC}-\text{EV})/(\text{EAC}-\text{AC})$$

7.3 Control Cost

❖ Now TCPI = Work Remaining/Funds remaining as per forecasted EAC

$$= (\text{Budget At Completion} - \text{Earned Value}) / (\text{EAC} - \text{Actual cost})$$

TCPI (based on original estimate or forecasted budget) will set a new baseline for performance efficiency to be achieved to complete the works with funds remaining.

If CPI falls below TCPI baseline, remaining works will not be completed with available funds. All future works shall be accelerated to bring CPI within TCPI range.

TCPI value >1 means in future, more work must be achieved per every dollar spent in the future compared to actual work achieved previously per dollar.

TCPI value <1 means in future lesser work need to be achieved for every dollar spent compared to past performance

Examples

- A project has the following *Earned value data assessed*: AC: \$ 4,000,000 CV: \$ -500,000 SPI: 1.12 BAC: \$ 9,650,000 What is the Earned value of the project? What is the CPI? What is the TCPI?
- In your project, there have been several changes in the cost and schedule estimates and the original estimating assumptions are no longer valid. What is the Estimate at Complete for your project? BAC = \$ 300,000, AC = \$ 100,000, EV = \$ 150,000, CPI = \$ 1.2, ETC = \$ 120,000

7.3 Control Costs – Outputs

- Work Performance Measurements
- Budget Forecasts
- Organizational process assets (updates)
- Change Requests
- Project management plan (updates)
- Project Document Updates

Till Now

- Projects are authorized by project charter
- SOW is issued as a preliminary scope guideline
- Project manager and project management team are appointed now
- Project manager & team decides whether projects need to be divided in to phases.
- Stakeholders are identified
- Project management plan is prepared (determining how to do planning)
- Requirements for the projects are collected
- Scope of the project is created (need iteration)
- Scope is too big to handle. Scope is now decomposed using WBS (based on deliverables)

Till Now

- Scope is decomposed till work package level & Scope baseline is created
- Control accounts are placed in WBS to link the work to accounting system
- Work packages level is further decomposed to activities
- Activities are arranged in a logical sequence by creating network diagram and PDM
- Leads or lags are introduced
- Activity resource is estimated
- Activity duration is estimated
- Critical path is now calculated (forward pass and backward pass)
- Resource levelling is carried out

Till Now

- Schedule compression methods (Crashing or fast tracking) to achieve a milestone or completion date demanded by customer/client
- Critical path is revised
- Schedule baseline is prepared and floats are identified (free float, total float and project float)
- Schedule is signed off by all parties.
- Cost of activities are estimated and rolled up to project level (or reverse).
- Cost is now loaded to activities. PM software now can produce a time based cost for the project (S Curve) and budget is created
- Contingency reserves and Management reserves are added (after risk analysis).

Till Now

- Cost baseline is prepared (except management reserve) and the project can be now monitored with baseline for performance.
- Cost budget is now negotiated with organization to ensure proper funding.
- Iterate from schedule if required
- Remember, Integration and change control is a repeated process from starting to end

