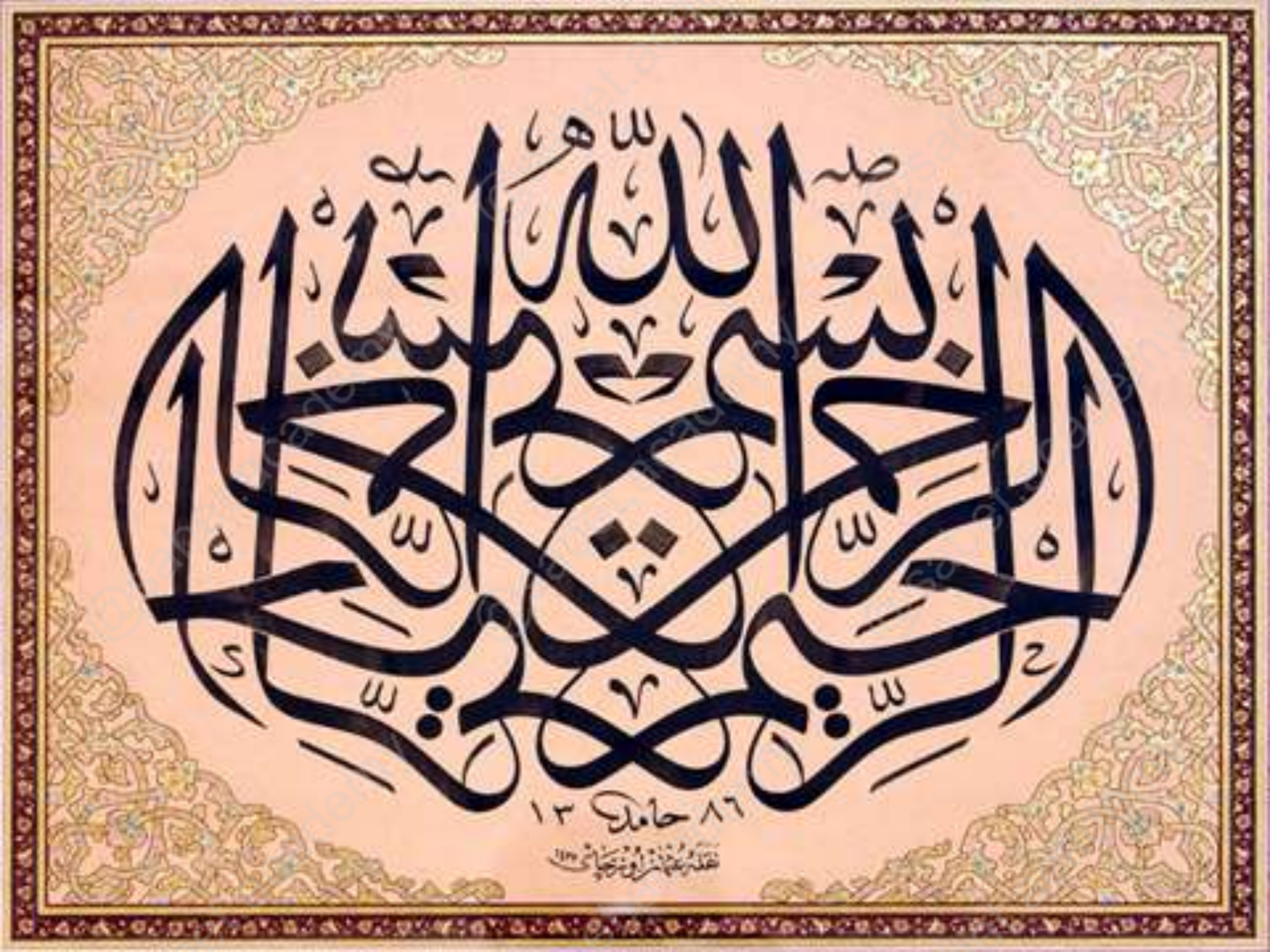
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PROJECT COST MANAGEMENT

Based on Project Body of Knowledge
(PMBOK)

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Project Cost Management

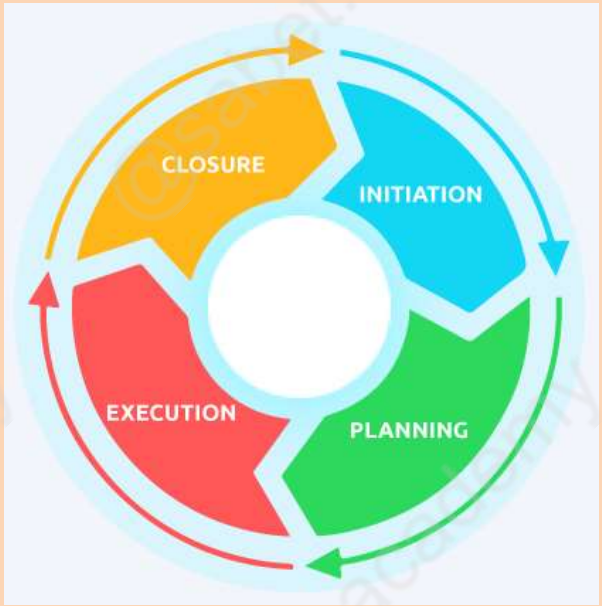
- A project is a temporary endeavor undertaken to create a unique product, service or result. So a project has a definite beginning and end.

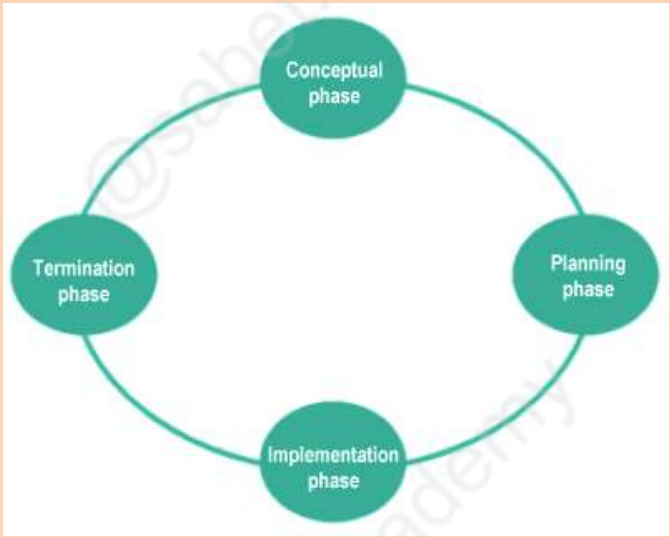
- Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.

- Project Cost Management is primarily concerned with the project life cycle (not the product life cycle)

- Projects vary in size and complexity. All projects can be mapped to the following simple life cycle structure:

1. Starting the project
2. Organizing and preparing
3. Carrying out the work
4. Closing the project





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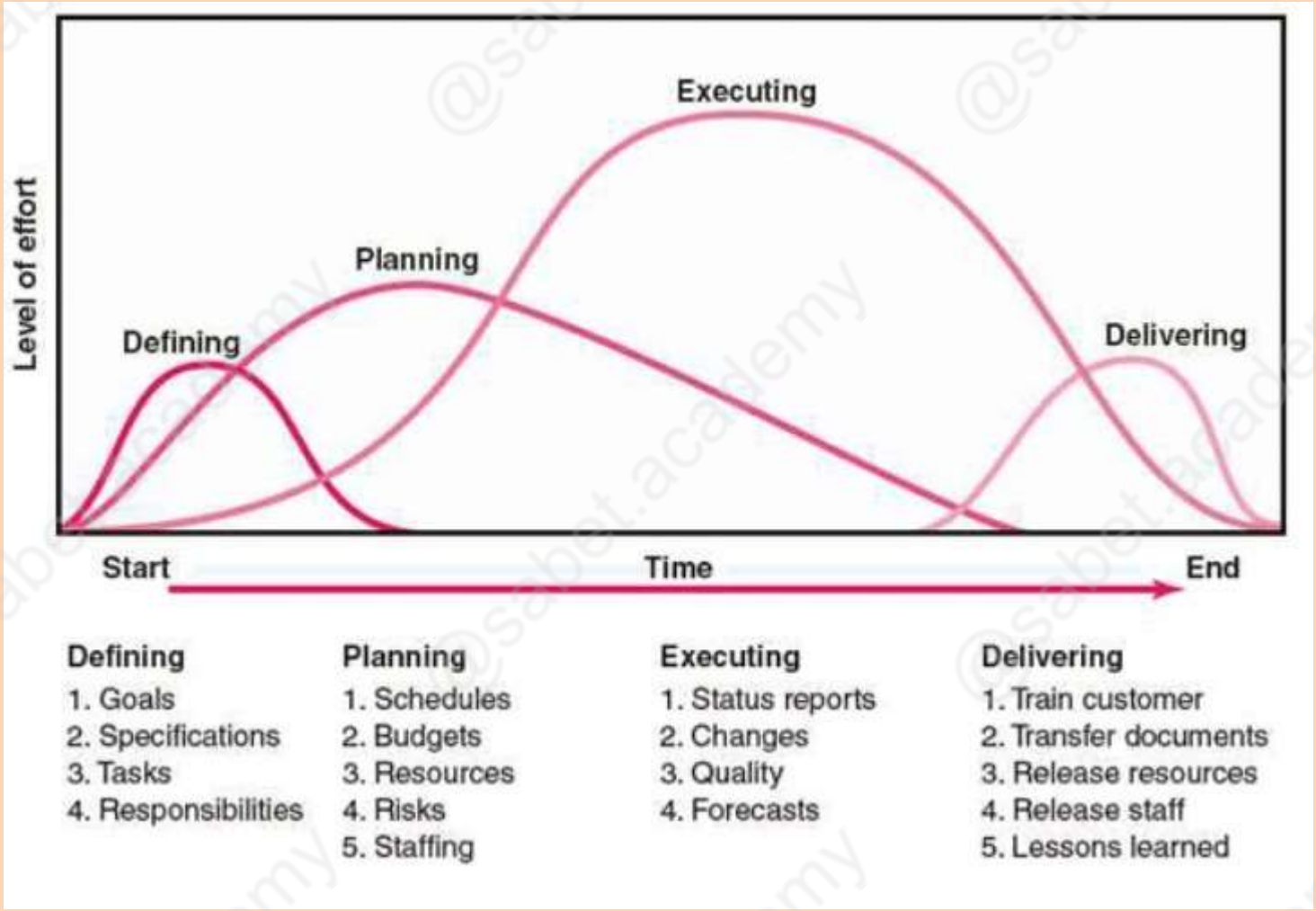
Project Life Cycle



Defining	Planning	Executing	Delivering
1. Goals	1. Schedules	1. Status reports	1. Train customer
2. Specifications	2. Budgets	2. Changes	2. Transfer documents
3. Tasks	3. Resources	3. Quality	3. Release resources
4. Responsibilities	4. Risks	4. Forecasts	4. Release staff
	5. Staffing		5. Lessons learned

Different Types of Cost

$$\text{Project cost} = \begin{cases} \text{Direct cost} \\ \text{Indirect cost} \\ \text{Fixed cost} \\ \text{Variable cost} \\ \text{Sunk cost} \end{cases}$$

Direct cost

Direct costs are those directly linked to doing the work of the project. These are expenses that come out of the project budget directly. For example;

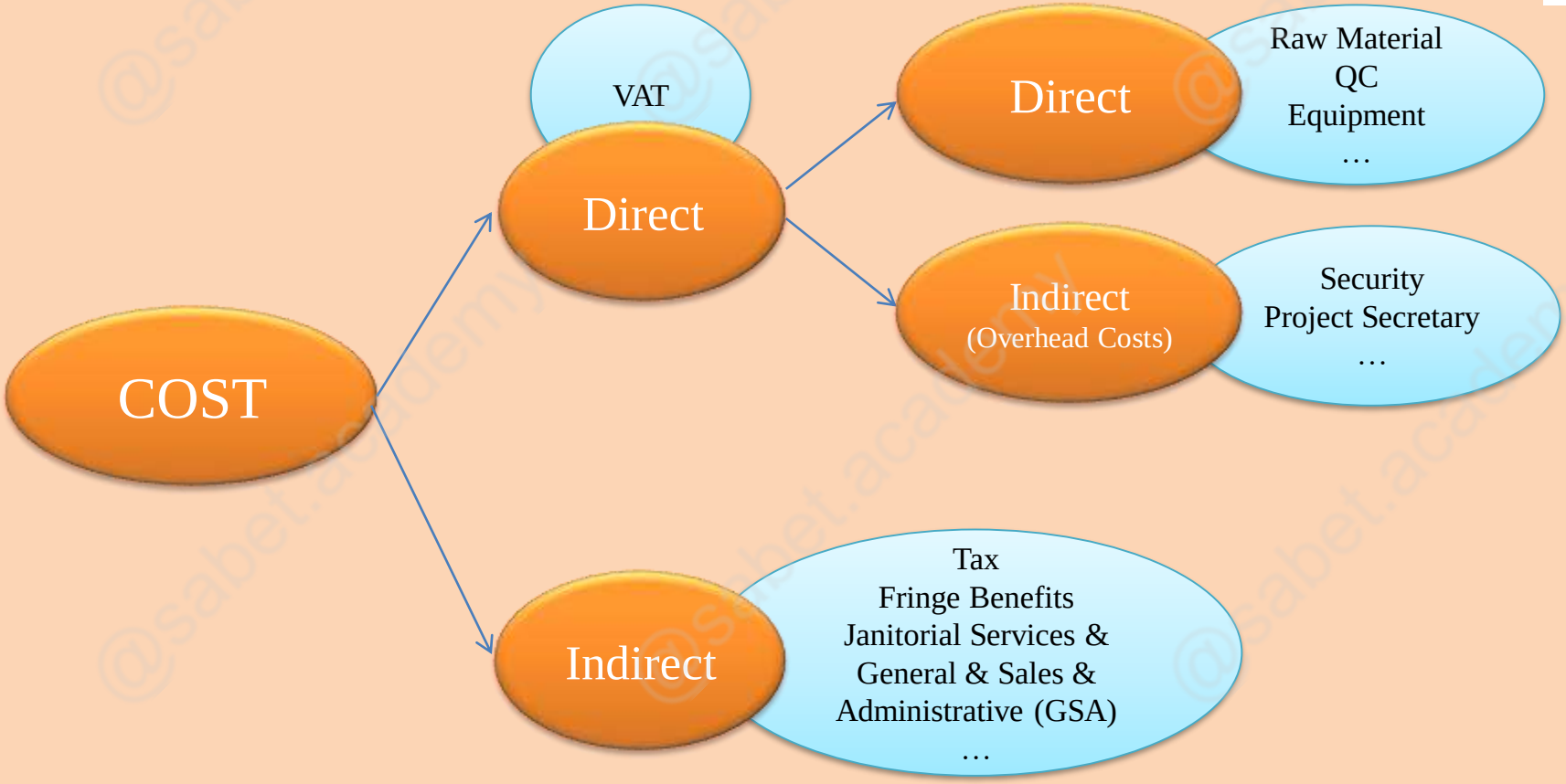
- hiring specialized contractors
- buying software licenses
- commissioning your new building
- Purchasing equipment and material
- Design man-hours
- Bank charges for bank guarantees
- Project travels and accommodations

Indirect cost

These costs are not specifically linked to your project but are the cost of doing business overall. These are shared across multiple projects. These are sometimes also referred to as Oversight costs. For example, in software development projects, it is common for a project manager or an architect to be partially allocated across several projects. Hence, the cost of the project manager or architect will be shared among the projects they are allocated to.
Other examples:

- office space rental (unless your project gets its own offices hired specially)
- stocking the communal coffee machine
- Salary and benefits of top management (Project managers are usually an indirect cost to the project. This is because their work is to supervise. They don't actually do the work! The people who do the work, like developers and designers, are Direct Costs to the project)
- Costs of supporting units (accounting, administration, IT, …)
- Headquarters' utility costs (water, electricity (heating, lighting,…), telephone, …)

Project Cost Management



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Fixed cost

Fixed costs are everything that is a one-off charge. These fees are not linked to how long your project goes on for. So if you need to pay for one-time advertising to secure a specialist software engineer, or you are paying for a day of Agile consultancy to help you start the project up the best way, those are fixed costs.

Fixed costs are those that do not change throughout the life-cycle of a project. For example, if you are constructing a road, the excavators and bulldozers are fixed costs. For software development projects, the physical development space and development computers are fixed costs to the project.

Variable cost

These are the opposite of fixed costs - charges that change with the length of your project. It's more expensive to pay staff salaries over a 12 month project than a 6 month one. Machine hire over 8 weeks is more than for 3 weeks.

Variable costs, as the name suggests, are costs that change during the project life-cycle. Construction projects usually have a long duration and can easily span several years.

For example, in 1987, the Channel (Euro) Tunnel project begun. The objective of this project was to construct an undersea high-speed train tunnel that would connect Great Britain to France. The project was completed over a period of 3-4 years and at a cost of about 13 billion U.S. dollars. The project employed over 15,000 people and had mammoth cost overruns. This project required tremendous risk management skills. During the construction of this project there were several variable costs, such as fuel costs and labor rates.

Sunk cost

Sunk costs refer to expenses that have already been incurred and arose as a result of decisions taken in the past. Sunk costs are a type of irrelevant cost. Irrelevant costs are costs that do not influence managerial decision making as they are a thing of the past. Since these costs and investments have already been made they cannot be reversed or recovered, and irrelevant costs such as sunk costs should not be used as a basis for making future decisions regarding a project or investment.

A simple example of a sunk cost is: a company purchases a software program for $100. However, the program does not work as the company intended to use it, and the seller does not offer any refunds and does not accept any returns. In this case, the $100 is a cost that has already been incurred and cannot be recovered, and it is referred to as a sunk cost.

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Project Cost Management

Price

Profit

Company's Overhead

Budget

Contingency Reserve

Budget at Completion (BAC)

Management Reserve

Control Account

Control Account

Control Account

Work Package

Planning Package

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Project Cost Management

Contract Price	
	Company's Profit
	Company's Overhead
For Unidentified (Unknown) Risks	Management Reserve
For Identified (known) Risks	Contingency Reserve
Project Budget	Project Overhead
	Project Management
	Design & Engineering
	Equipment & Material Supply
	Construction & Erection
	Commissioning & Startup

Will be assigned to Project Manager

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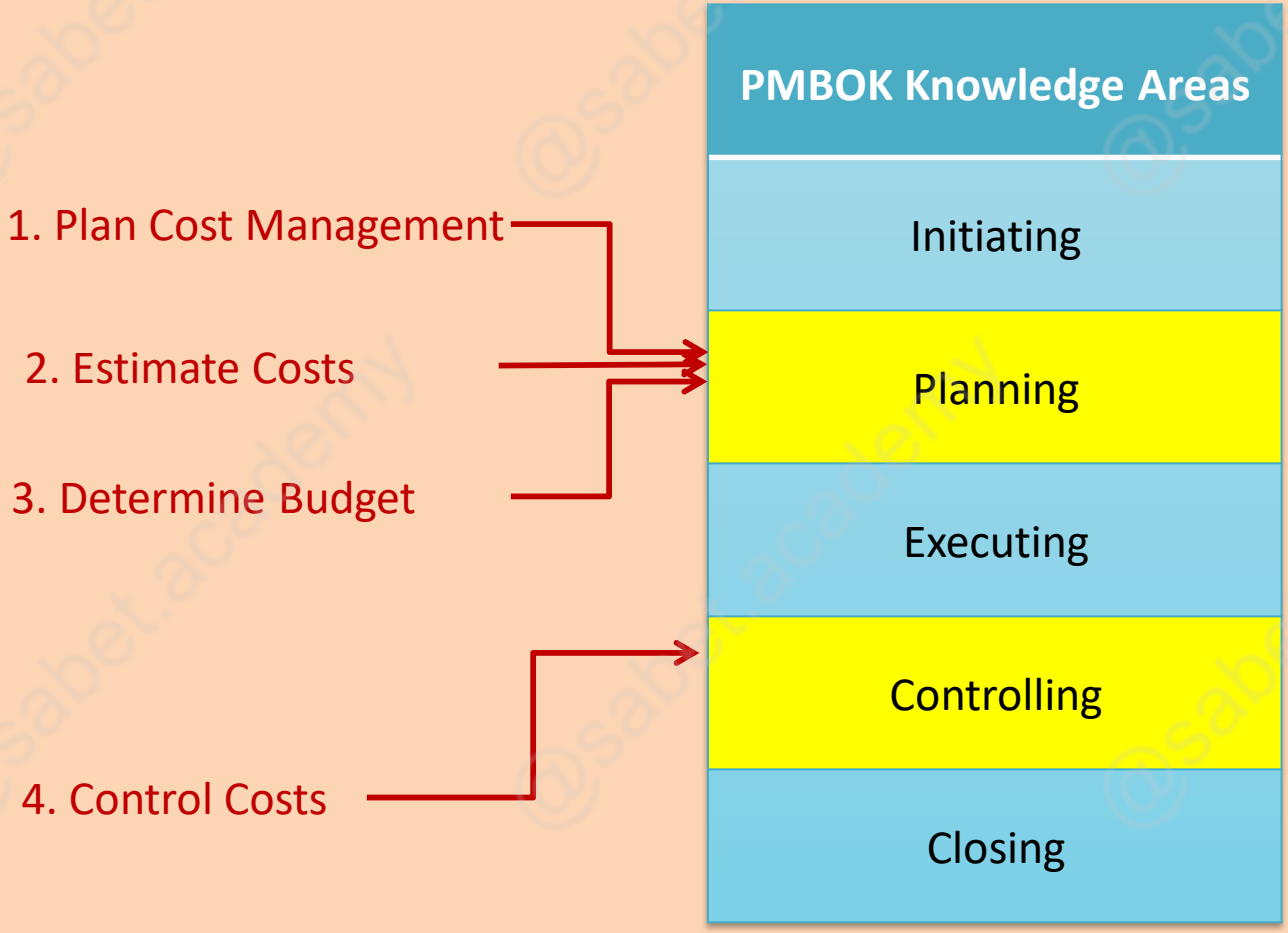
Project Cost Management



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Project Cost Management Overview

7.1 Plan Cost Management

1) Inputs
1. Project management plan
2. Project charter
3. Enterprise environmental factors
4. Organizational process assets

2) Tools & Techniques
1. Expert judgment
2. Analytical techniques
3. Meetings

3) Outputs
1. Cost management plan

7.2 Estimate Costs

1) Inputs
1. Cost management plan
2. Human resource management Plan
3. Scope baseline
4. Project schedule
5. Risk register
6. Enterprise environmental factors
7. Organizational process assets

2) Tools & Techniques
1. Expert judgment
2. Analogous estimating
3. Parametric estimating
4. Bottom-up estimating
5. Three-point estimating
6. Reserve analysis
7. Cost of quality
8. Project management software
9. Vendor bid analysis
10. Group decision-making techniques

3) Outputs
1. Activity cost estimates
2. Basis of estimates
3. Project documents updates

7.3 Determine Budget

1) Inputs
1. Cost management plan
2. Scope baseline
3. Activity cost estimates.
4. Basis of estimates
5. Project schedule.
6. Resource calendars
7. Risk register
8. Agreements
9. Organizational process assets

2) Tools & Techniques
1. Cost aggregation
2. Reserve analysis
3. Expert judgment
4. Historical relationships
5. Funding limit reconciliation

3) Outputs
1. Cost baseline
2. Project funding requirements
3. Project documents updates

7.4 Control Costs

1) Inputs
1. Project management plan
2. Project funding requirements
3. Work performance data.
4. Organizational process assets

2) Tools & Techniques
1. Earned value management
2. Forecasting
3. To-complete performance index (TCPI)
4. Performance reviews
5. Project management software
6. Reserve analysis

3) Outputs
1. Work performance information
2. Cost forecasts
3. Change requests
4. Project management plan updates
5. Project documents updates
6. Organizational process assets updates

Plan Cost Management

Plan Cost Management is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.

Plan Cost Management

Inputs:

Project Management Plan

Component that is important for this process are primarily the scope and Schedule baselines.

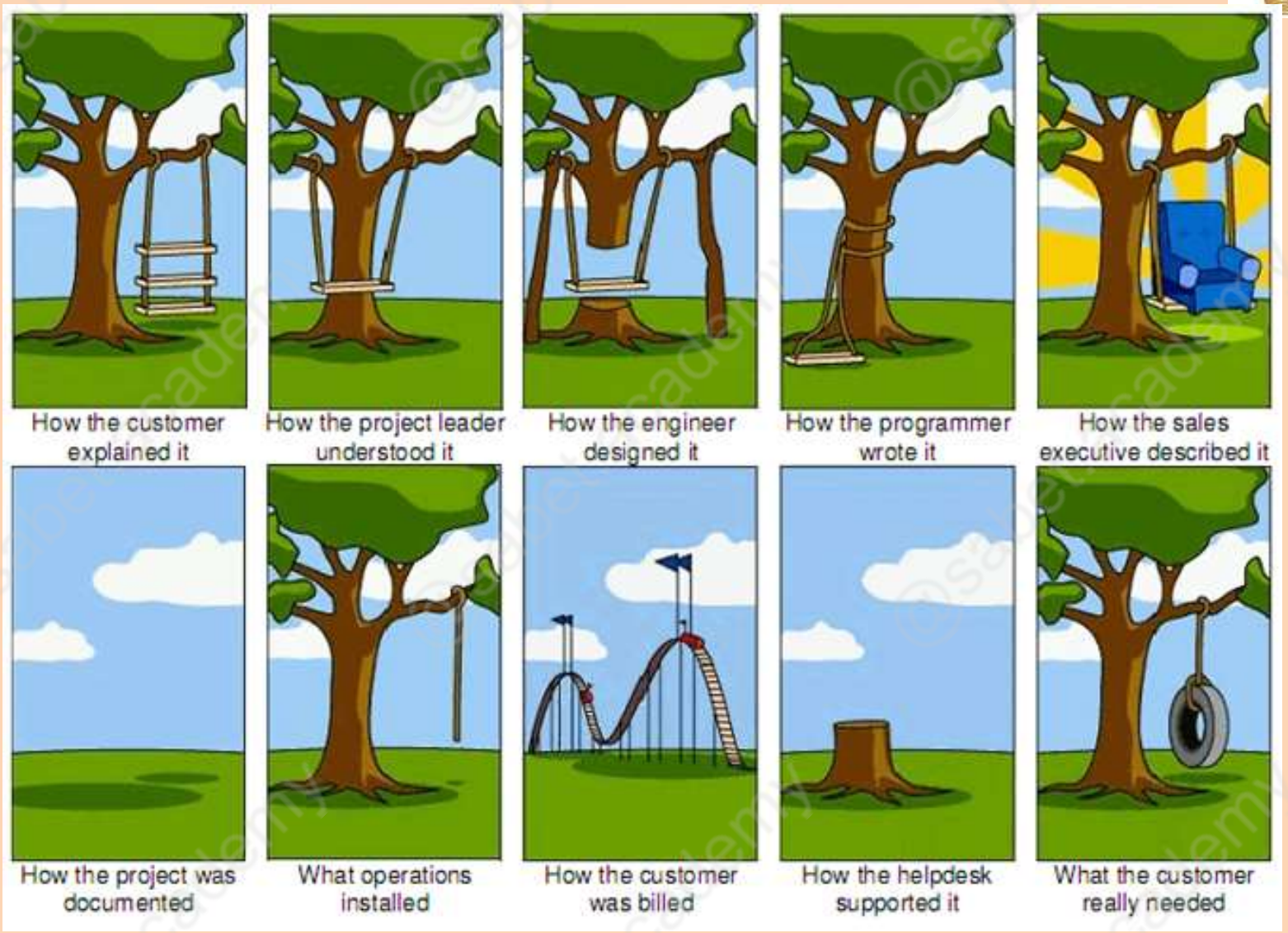
- **Scope baseline:** The scope baseline includes the project scope statement and WBS (Work Breakdown Structure) detail for cost estimation and management.
- **Schedule baseline:** The schedule baseline defines when the project costs will be incurred.
- **Other information:** Other cost-related scheduling, risk, and communications decisions from the project management plan.

Project Charter

Provides the summary budget from which the detailed project costs are developed. It also defines the project approval requirements that will influence the management of the project costs.

Plan Cost Management

Why Clarifying the Scope of Project is so important?



Plan Cost Management

Project Charter

Project Name:	**XYZ Computer System**
Company:	XYZ Manufacturing Company Ltd.
Division:	Computer Systems
Department:	Information Technology
Process or Product:	Servers and Displays manufacturing

Prepared By:

Document Owners	Project or Organization Role
Ken Owttrim	Project Manager
John Smith	Director, IT – Project Owner
Joe Blow	VP, Manufacturing – Project Sponsor

Version Control

Ver #	Date	Author	Change Desc
0	02/01/09	Ken Owttrim John Smith Joe Blow	Document created
1			
2			

PROJECT CHARTER

Project Title	Project Title
Business Case	▪ Why should you do this project? ▪ What are the benefits of doing this project?
Problem Statement	What is the problem, issue and/or concern?
Goal	What are your improvement objectives and targets?
Metrics (CTQ's)	▪ **PRIMARY Metric(s):** Key measures to be used for the objectives ▪ **SECONDARY Metric(s):** Those measures which indicates impacts on secondary concerns and which indicates that problem is not shifted to other key areas.
Project Scope	▪ What authority do you have? ▪ Which processes/products you are addressing? ▪ What is not within this project?
Project Team	▪ Who are the team leader, sponsor, and members? ▪ What are their roles and responsibilities in this project?
Project Plan	How and when are you going to get this project done (DMAIC stages)
Communication Plan	▪ What are your interfaces with each other? ▪ What are your meeting & reporting times?

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Plan Cost Management

Inputs:

Enterprise Environmental Factors

Include factors such as organization structure/culture, market conditions, currency exchange rates (for project sourced from more than one country) that influence the project cost.

Organizational Process Assets

Include financial control procedures, historical information, procedures and guidelines.

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Plan Cost Management

Enterprise Environmental Factors

conditions, not under the control of the project team, that INFLUENCE, CONSTRAIN, or DIRECT the project

- Organizational culture, structure, and governance
- Geographic distribution of facilities and resources
- Government or industry standards
- Infrastructure
- Existing human resources
- Personnel administration
- Company work authorization systems

Organizational Process Assets (OPA)

- Plans
- Processes
- Policies
- Procedures
- Knowledge Bases

specific to and used by the performing organization

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Plan Cost Management

Tools & Techniques:

Expert Judgment

- They provides valuable insight on costing methods
- Apply experience & information from prior similar projects
- Examine & compare different approaches (cost of Quality, cost benefit analysis, etc.)
- Provide input for financial analytical techniques (ROI, IRR, etc.)

Plan Cost Management

Tools & Techniques

Analytical Techniques

some of the techniques such as payback period, return on investment, internal rate of return, discounted cash flow and net present value can be useful in this process. (see slides 73 to 84)

For Example: defining funding options:

- Self-funding
- Equity-funding
- Debt-funding

Meeting

Project team may hold meetings to develop the cost management plan. These meetings may include; project sponsor, project manager, selected team members, selected stakeholders and anyone with responsibility for project costs.

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Plan Cost Management

Output:

Cost Management Plan:

it is a part of Project Management Plan (PMP) and describes how the project costs will be planned, structured and controlled. The cost management plan can establish the following:

- **Units of Measure:**

Each unit of measure for each resource

- **Level of precision:**

The degree to which activity cost estimates will be rounded up or down.

- **Level of Accuracy:**

the acceptable range (e.g. ±10%) used in determining realistic activity cost estimate is specified, may include an amount for contingencies.

- **Control Threshold:**

Variance threshold for monitoring cost performance may be specified indicate an agreed upon amount of variation to be allowed before some action need to be taken.

Plan Cost Management

Output:

Cost Management Plan:

- **Rules of performance measurement:**

Earned value management (EVM) rules of performance measurement are set for example:

1. Define the points in the WBS at which measurement of control account will be performed.
2. Establish the earned value measurement techniques (e.g. weighted milestone, fixed formula, percent complete, etc.) to be used.
3. Specify tracking methodologies and the earned value management computation equations for calculating projected estimate at completion (EAC) forecasts to provide a validity check on the bottom-up EAC.

Estimate Cost

Estimate Costs is the process of developing an approximation of the monetary resource needed to complete project activities.

The key benefit of this process is that it determines the amount of cost required to complete project work.

The table below shows five different types of estimates:

Time Spent on Estimate

Estimate Type	Range
Order of Magnitude Estimates	-25% to +75%
Conceptual Estimate	-30% to +50%
Preliminary Estimate	-20% to +30%
Definitive Estimate	-15% to +20%
Control Estimate	-10% to +15%

When each Estimation done in Project Duration?

Very Early
(Initiating Process)
Early
(Planning Phase)
Later
(During Project)

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Estimate Cost

Inputs

- Management Plans for Cost & Human Resource
- Scope Baseline
- Project Schedule
- Risk Register
- Enterprise Environmental Factors
- Organizational Process Assets

Tools & Techniques

- Expert Judgement
- Analogous & Parametric Estimating
- Bottom-up & Three-point Estimates
- Reserve Analysis
- Cost of Quality
- Project Management Estimating Software
- Vendor Bid Analysis
- Group Decision Making techniques

Outputs

- Activity Cost Estimates
- Basis of Estimates
- Project Document Updates

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Estimate Cost

Inputs:

Human Resource Plan: Provides details on Project staffing attributes, personnel rates, and related rewards/recognition, these are necessary components for developing the project cost estimates

Risk Register: A Risk Register, also referred to as a Risk Log, is a master document which is created during the early stages of your project. It is a tool that plays an important part in your Risk Management Plan, helping you to track issues and address problems as they arise.
The cost of responding to a risk need to be a part of the estimated costs. It could be a threat and hence, increase the cost or could be an opportunity reducing the cost

Risk Register Example:
Training Project

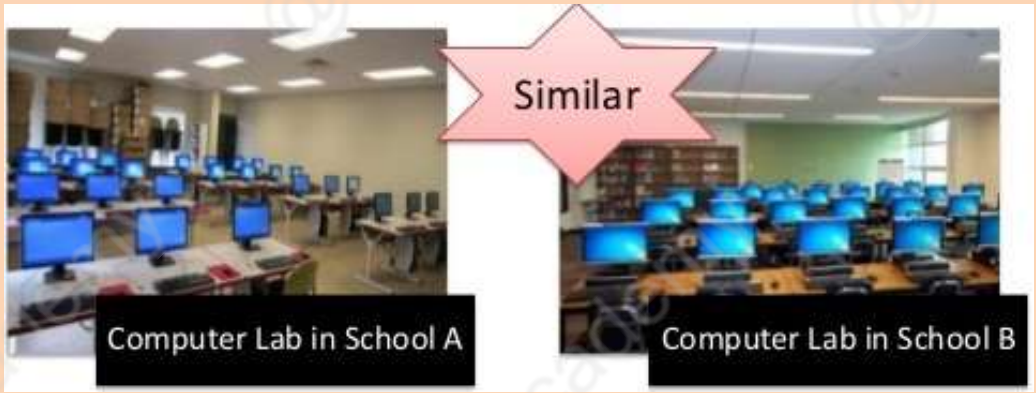
S.No	Risk	Probability	Impact	Owner	Score
1	Training material s not arriving on time	Medium 5	High 10	Mr.	5 * 10 = 50
2	Computer/ Projector malfunction	Low 2	Medium 5	Mr.	2 * 5 = 10
3	Trainer resigns without prior notice	Low 2	High 10	Mr.	2 * 10 = 20
4	Training requirement (scope) changes	Medium 5	Impact 10	Mr.	50

Estimate Cost

Tools & Techniques:

Analogous estimating

- Uses historical data from similar projects as a basis for the cost estimate. It can used for expert judgment.
- The estimate can be adjusted for known differences between the projects.
- Used in the early phases of a project, when only similar project information is available.
- This method is less costly, less time consuming and less accurate.



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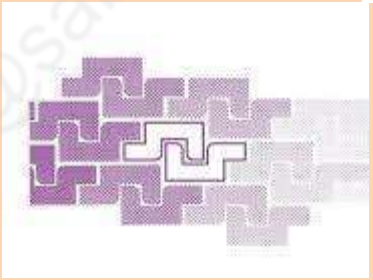
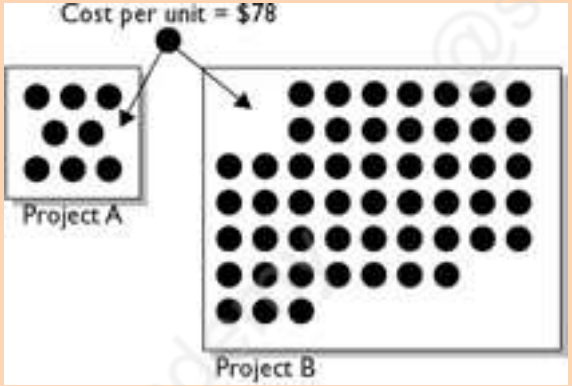
Estimate Cost

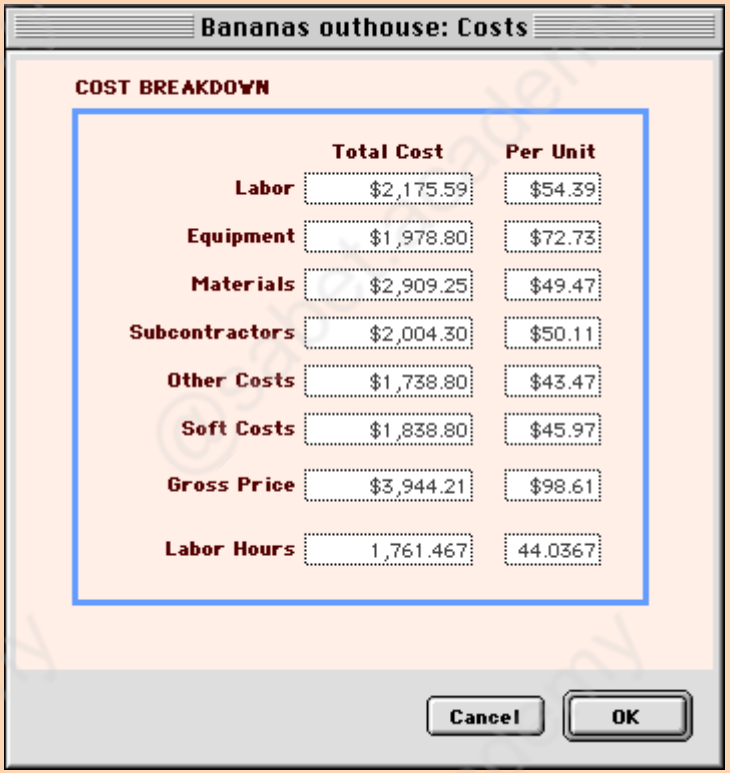
Tools & Techniques:

Parametric estimating



- Uses statistical relationship between historical data & other variables.
- Sophisticated algorithm are used to calculate cost based on historical data & multiple quantifiable parameters.
- It provides higher levels of accuracy depending upon the sophistication of algorithm or tools.





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Estimate Cost

Tools & Techniques:

Bottom-Up Estimating

- Estimating project cost by aggregating the estimates of the lower-level components of the WBS (Individual work packages)
- When an activity cannot be estimated with confidence, the work within activity is decomposed further.
- These estimates are then aggregated into a total cost for each of the activity (summarized or rolled up to higher level)
- This type of estimate is generally more accurate than other methods since it is looking at costs from a more granular perspective.

Estimate Cost

Tools & Techniques:

Three-Point Estimation/PERT (Program evaluation and review technique)

- A technique used to estimate cost by applying an average of optimistic, pessimistic & most likely estimates.
- Used when there is uncertainty with the individual activity estimates

Optimistic (O):
- Based on analysis of the best-case scenario.

Most likely (M) :
- Based on realistic effort assessment for required work & any predicted expenses (or ML)

Pessimistic (P).
- Based on analysis of the worst-case scenario.

Triangular Distribution = (O + M + P) / 3
Beta Distribution (Weighted average) = (O + 4M + P) / 6
Standard Deviation (SD) = (P – O)/6
Activity Variance = SD ^ 2

Activity	O	M	P	Trangular	SD	PERT
Activity1	6	20	30	18.67	4.00	19.333
Activity2	10	20	40	23.33	5.00	21.667
Activity3	13	20	50	27.67	6.17	23.833

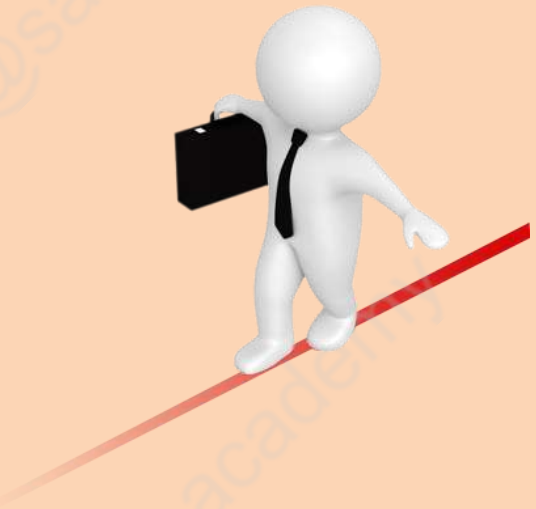
Estimate Cost

Tools & Techniques:

Reserve Analysis

Contingency Reserve:

- It is a budget within cost baseline that is allocated for identified & accepted risks (known-unknowns)
- Allocation can be for specific activity / project, or both.
- Allocation can be % of the estimated cost or a fixed number- Quantitative analysis.
- Contingency can be reduced, or eliminated.
- Contingency should be clearly documented.
- It is a part of the cost baseline & overall funding requirements.



Estimate Cost

Tools & Techniques:

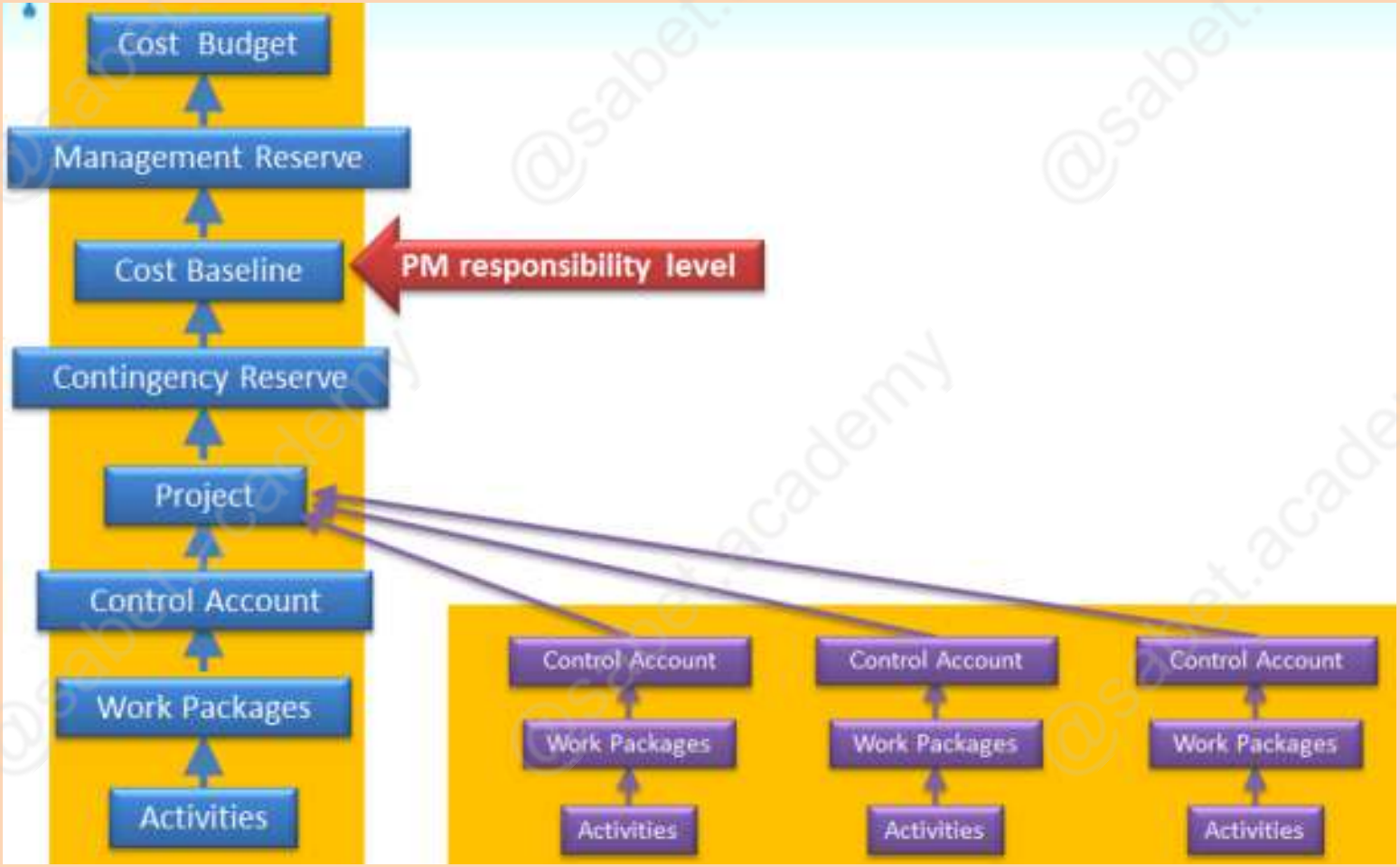
Reserve Analysis

Management Reserve:

- It is project budget withheld for management control purposes.

- Reserved for unforeseen risks (unknown- unknowns) related to the work that is within scope of the project.
- Not included in the cost baseline but it is part of the overall project budget and funding requirements.
- When management reserve used, it is added to cost baseline, thus requiring an approved change to cost baseline.

Estimate Cost

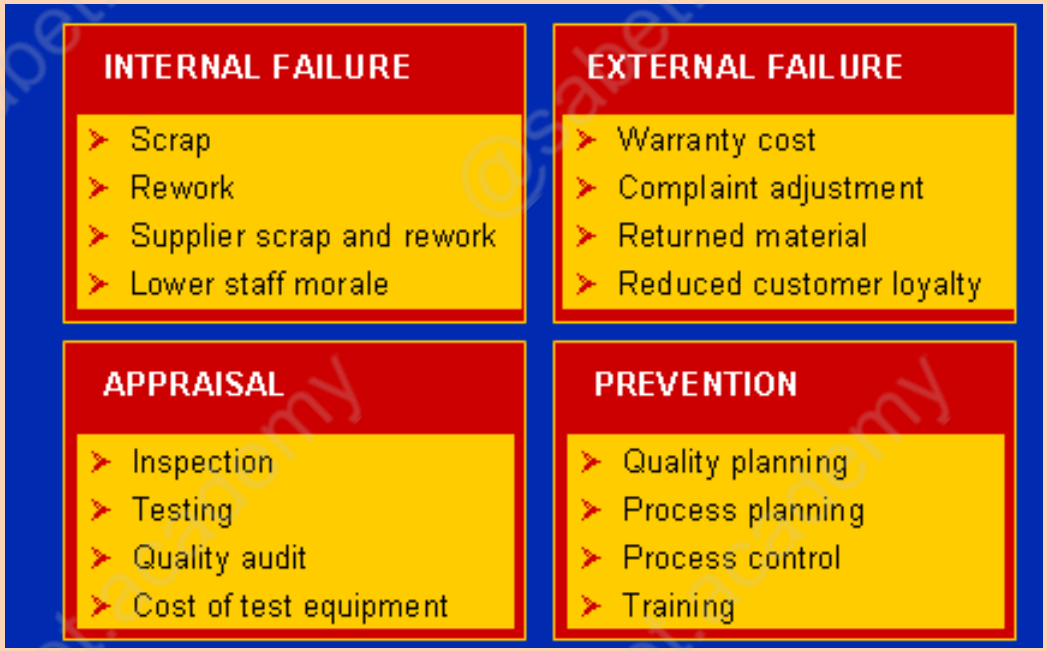


Estimate Cost

Tools & Techniques:

Cost of Quality:

- Cost of quality should be included in estimate.
- Assumptions about costs of quality is used to prepare activity cost estimate.



Estimate Cost

Tools & Techniques:

Project Management software:

- Assist, simplify, facilitate estimations & helps in rapid alternative estimations.
- Plan, organize & manage the resource costs.
- Develop resource estimates.
- Can automatically aggregate cost estimates.
- Can help manage & track cash flow.
- Can generate reports.

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Estimate Cost

Tools & Techniques:

Vendor Bid Analysis:

Analysis of project cost, based on the bids from vendors.

Additional cost estimating may be required to examine price of each deliverables & supports final total project cost.

		ALTERNATIVES					
		Supplier A		Supplier B		Supplier C	
Criteria	Weightings	Score	Weight	Score	Weight	Score	Weight
Cost	60%	75	45	100	60	90	54
Supplier Quality System Rating	20%	100	20	80	16	60	12
Supplier Response Time	10%	100	10	90	9	70	7
Previous Reliability on jobs	10%	70	7	80	8	100	10
Performance			82		93		83

Estimate Cost

Tools & Techniques:

Group Decision Making:

- Team based estimation approach. Helps to get commitment on emerging estimates.
- Required to improve estimation accuracy.

Individual Decision Making		Group Decision Making	
+	-	+	-
Faster	Fewer Idea	Diversity of ideas, more information is available and more alternative solutions	Takes longer (time-consuming)
Best individual in a group usually outperforms the group	Identifying the best individual can be challenging	Greater commitment to ideas – increases solution understanding & acceptance	Group dynamics such as groupthink can occur
Accountability is easier to determine	Possible to put off making decisions if left alone to do it	Interaction can be fun and serves as a team building task	Domination by individuals

Estimate Cost

Tools & Techniques:

Types of Group Decision Making :

1. Unanimous (100%)

Unanimous decisions occur when all agree without reservation. They are easier for trivial matters, but very difficult for important and/or higher-pressure situations. Be careful not to confuse unanimity with consensus.

2. Consensus

In a consensus, each person agrees to support the decision, though all may not agree, and gives his or her consent. Despite differing perspectives, all agree that they can live with the decision. Consensus is the process most likely to ensure that each person's input is valued, heard and considered. Consensus decision-making is where all team members get a chance to air their opinions and must ultimately agree on the outcomes. If any team member does not agree, discussions continue. Compromise must be used so that every team member can agree with and commit to the outcome.

3. Plurality

The largest block in a group decides even if a majority is not achieved. it is generally used when the number of options nominated is more than two.

Estimate Cost

Tools & Techniques:

Types of Group Decision Making :

4. Majority Rule (more than 50%)

Majority rule decisions are made when more than half the group votes in favor. This process is used frequently in democracies, and rarely in organizations. Majority decisions, as with any voting situation, risk that you won't have full support and that those not in agreement with the majority may do something less than helpful later. It also carries the possibility of establishing an "us" versus "them"

5. Expert

the group delegates the decision-making responsibility to an expert or small subgroup. This type of process is good for situations that do not require the entire group's participation. If you don't already have someone in your team, find or hire an expert, listen to what they say, and follow their recommendations.

6. Decision by authority (Dictatorship)

This method can be described as "one person decides." This might mean assigning the decision to the most expert person or to a person who decides after listening to the group discuss the problem. Often, the person making the decision is a positional leader.

Estimate Cost

Group Creativity Techniques:

Brainstorming:

A technique used to generate and collect multiple ideas about an issue.

Delphi Technique:

A selected group as experts answers questionnaires and provides feedback. The responses are only available to the facilitator to maintain anonymity.

Affinity Diagram:

This technique allows large numbers of ideas to be classified into group for review and analysis.

Idea/Mind Mapping:

Ideas created through individual brainstorming are consolidated into a single map to reflect commonality and differences in understanding and generate new ideas.

Nominal group:

This technique enhances brainstorming with voting process used to rank the most useful ideas for further brainstorming or for prioritization.

Multi- Criteria Decision Analysis:

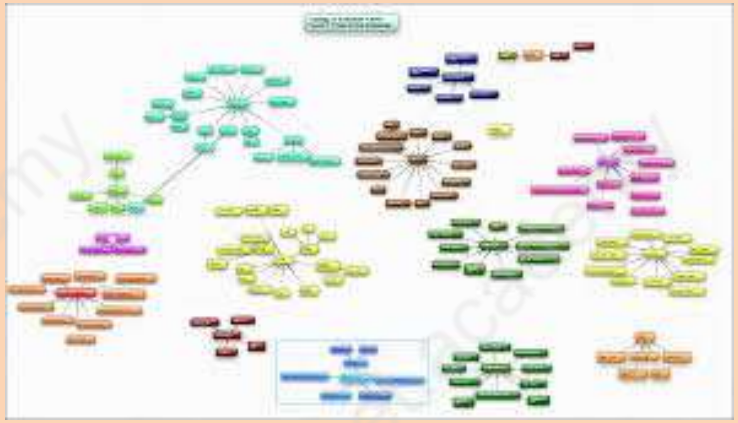
A technique that utilizes a decision matrix to provide a systematic analytical approach for establishing criteria, such as risk levels, uncertainty, valuation, to evaluate and rank many ideas.

Estimate Cost

Brainstorming & Delphi Technique → For Extract ideas

Affinity Diagram & Idea/Mind Mapping → For Categorization of ideas

Nominal group Multi-Criteria Decision Analysis → For Prioritizing ideas



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Estimate Cost

Outputs:

Activity cost Estimate

- Quantitative assessment of the probable costs required to complete project work. It can be presented in summary form or in detail.
- Cost are estimated for all resources that are applied to the activity cost estimate
- It Can be at activity level or work package level

Basis of Estimate

The amount and type of additional details supporting the cost estimates vary by application area

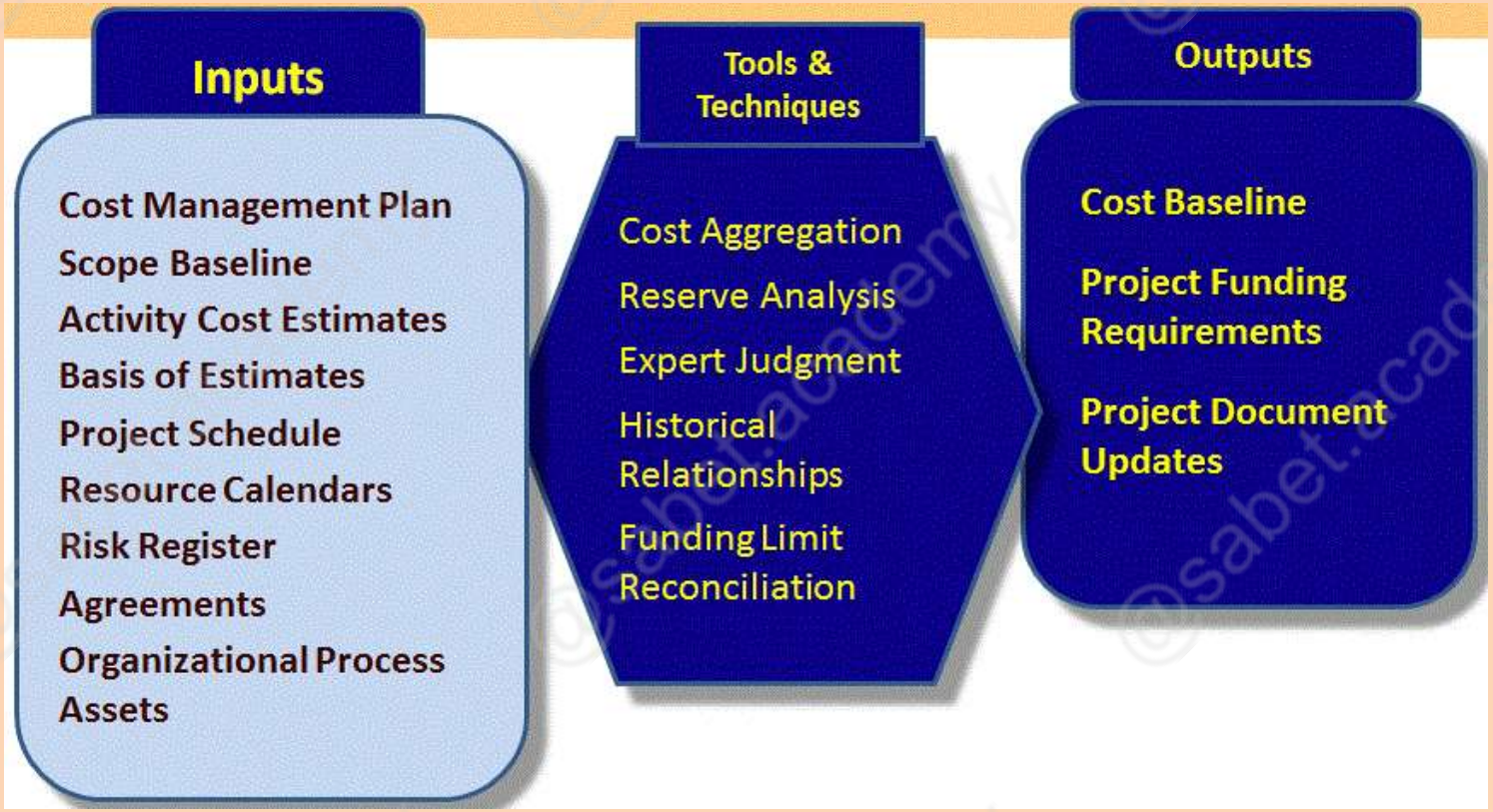
Supporting detail may include:

- Documentation of the basis of the estimate (how it was developed)
- Documentation of all assumptions made
- Documentation of any known constraints
- Indication of the range of possible estimates (like +/- 10%) to indicate that the item is expected to cost between a range of values
- Indication of the confidence level of the final estimate

Do not communicate single number estimate, give range of estimate mentioning type & degree off confidence.

Determine Budget

Determine Budget is the process of aggregating the estimated costs for individual activities or work packages to establish an authorized cost baseline. The baseline include all authorized budgets, but excludes management reserves.



Determine Budget

Inputs:

Cost Management Plan

Describes how the project costs will be managed and controlled, and it helps to give you the framework for creating your budget.

Scope Baseline

Use the scope baseline to make sure that you don't forget to cost any elements of the project. Its associated WBS and WBS dictionary.

Activity Cost Estimates

It determines how much effort and money is required for each activity, building on the detail in the scope baseline.

Basis of Estimates

Includes supporting detail for cost estimates. It's useful when it comes to the overall project budget because it helps to determine what, if any, contingency should add.

Project Schedule

Helps in mapping the cost back to time for planning purpose, Roll up the estimates into date-constrained packages to give you the total cost over a certain time.

Determine Budget

Inputs:

Resource calendar

Shows details of when the particular resource can be active and when it would be inactive.
These are only really useful if you have to include resource costs in the project budget. If you are working mainly with internal resources you'll find that you don't often need this data. However, if you are cross-charging a client for your time then you'll definitely find it helpful to check who is working on what and what their daily rate is.

Risk register

The risk register may include details of the cost of risk mitigation activities. Pull these out and put them in your project budget as well. Many of project comes unstuck because risks were identified but there was no money put aside to mitigate potential problems.

Agreements

Applicable agreement information and costs relating to products, services or results that have been or will be purchased. These costs also need to be included in the budget and having the original documents can helps because it's useful to cross-check to see what taxes, delivery charges and other elements have been added in to the quote.

Determine Budget

Inputs:

Organizational Process Assets

Budgeting policies that will help you budget in accordance to your company's guidelines

Tools such as spreadsheets or accountancy packages, or your project management software

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Determine Budget

Tools and Technique:

Cost Aggregation:

Involves aggregating the costs of individual activities to work packages that are further aggregated to higher levels of WBS and finally into the project cost.

Determine Budget

Tools and Technique:

Reserve Analysis:

Include contingency reserve and management reserves for the project.

Expert Judgment:

This can be from internal organization resource or external sources.

Historical relationship :

Result in parametric estimates or analogous estimates that involve parameter to develop mathematical models to predict total project costs.

For example: design should be 20% of the cost of manufacturing.

Funding limit reconciliation:

Refers to reconciliation of planned spending with the funding limit.

Expenditure towards the project are reviewed against limits set by the customer, periodically.

Determine Budget

Outputs:

Cost Baseline:

it is an authorized time-phased budget (excludes management reserves)used to measure, monitor and control overall cost performance on the project.

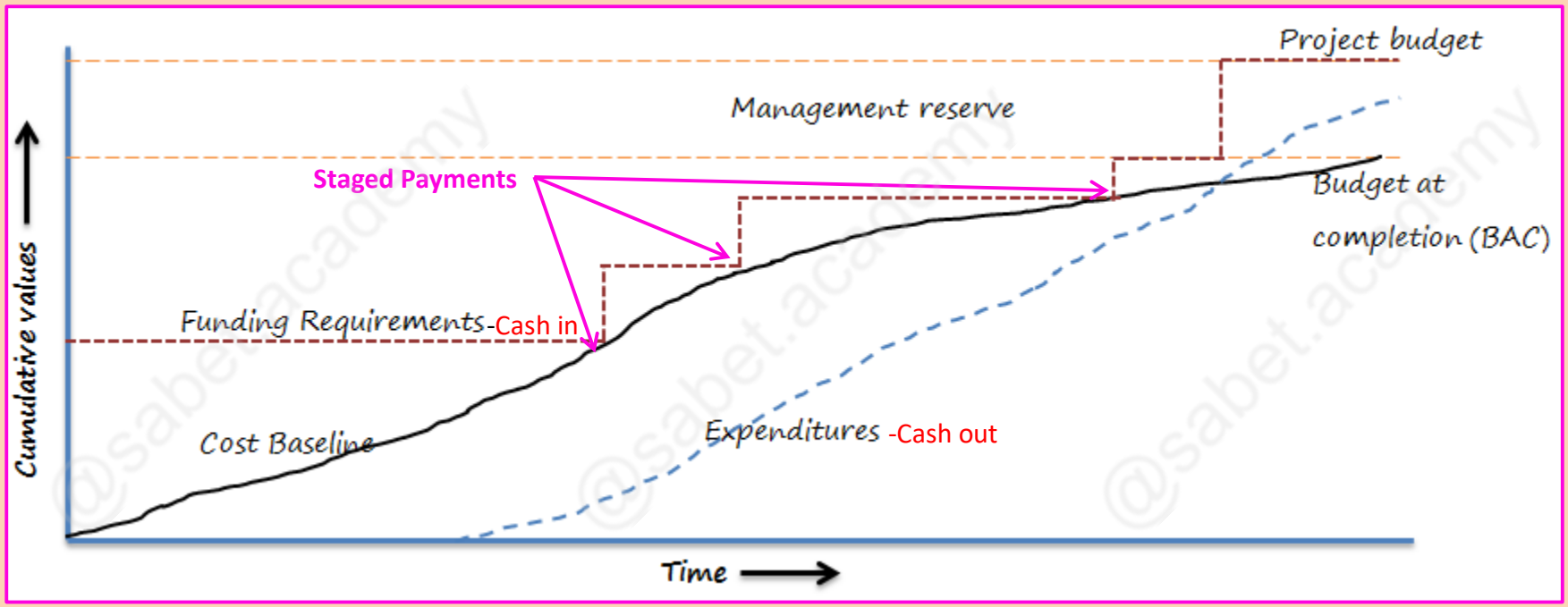
It is developed as a summation of the approved budgets by time period and is typically displayed in the form of an S-curve.

Determine Budget

Outputs:

Project Funding Requirement:

It is derived from cost baselines. Total funding requirement is sum of cost baseline and management reserve.



Project document updates:

Include updates to risk register, cost estimates and project schedule.

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Control Cost

Control Costs is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.

Cost control typically includes:

1) investigative procedures to detect variance of actual costs from budgeted costs
2) diagnostic procedures to ascertain the cause(s) of variance
3) corrective procedures to effect realignment between actual and budgeted costs.

Control Cost

Inputs

- Project Management Plan
- Project Funding Requirements
- Work Performance Data
- Organizational Process Assets

Tools & Techniques

- Earned Value Management
- Forecasting
- To-complete Performance Index
- Performance Reviews
- Project Management Software
- Reserve Analysis

Outputs

- Work Performance Information
- Cost Forecasts
- Change Requests
- Updates:
  - PM Plan
  - Project Documents
  - Organizational Process Assets

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Control Cost

Inputs:

Project Management Plan:

Contains cost management plan and cost performance baseline, these are helpful in controlling the cost.

Project Funding Requirements:

As explained earlier include projected expenditures plus anticipated liabilities.

Work Performance Data:

Provides information on the status and cost of project activities and ensures that the project goals and objectives are met as per the project management plan.

Organizational Process Assets:

That can influence this process include cost budgeting policies, procedures, guidelines, cost budgeting tools and reporting methods.

Control Cost

Tools and Technique:

Earned Value Management

It is used to measure the performance of the project, it integrates project scope, cost and schedule measures to help the project management team assess and measure project performance and progress.

The EVM technique involves evaluating the planned value, earned value and the actual cost for each schedule activity, work package or control account.

The key purpose of Earned Value management is to inform a project team's decision making and to highlight cost and schedule issues early, allowing time for recovery action to be taken.

Earned Value data is expressed in budget terms (using the currency of the local environment). it's not a financial tool, it is a tool for project management.

Control Cost

Tools and Technique:

Planned Value (PV):

Is the authorized (or approved) budget assigned to the schedule work to be accomplished for a schedule activity or work breakdown structure component. It is also known as budgeted cost of work schedule (BCWS)

The total PV of a task is equal to the task's budget at completion (BAC or the total amount budgeted for the task)

Example:

A project has a budget of £10M and schedule for 10 months. It is assumed that the total budget will be spent equally each month until the 10th month is reached:

BAC: £10M

After 2 Month, PV= £2M

Control Cost

Tools and Technique:

Earned Value (EV):

Is the value of work performed expressed in terms of the approved budget assigned to that work for a schedule activity or a WBS component.

The approved budget for the work actually completed by the specified date.

It is also known as budgeted cost of work performed (BCWP)

Example:

A project has a budget of £10M and schedule for 10 months. It is assumed that the total budget will be spent equally each month until the 10th month is reached. After 2 months the project manager finds that only 5% of the work is finished

BAC: £10M **After 2 Month, PV=** £2M

Actual Progress = 0.05

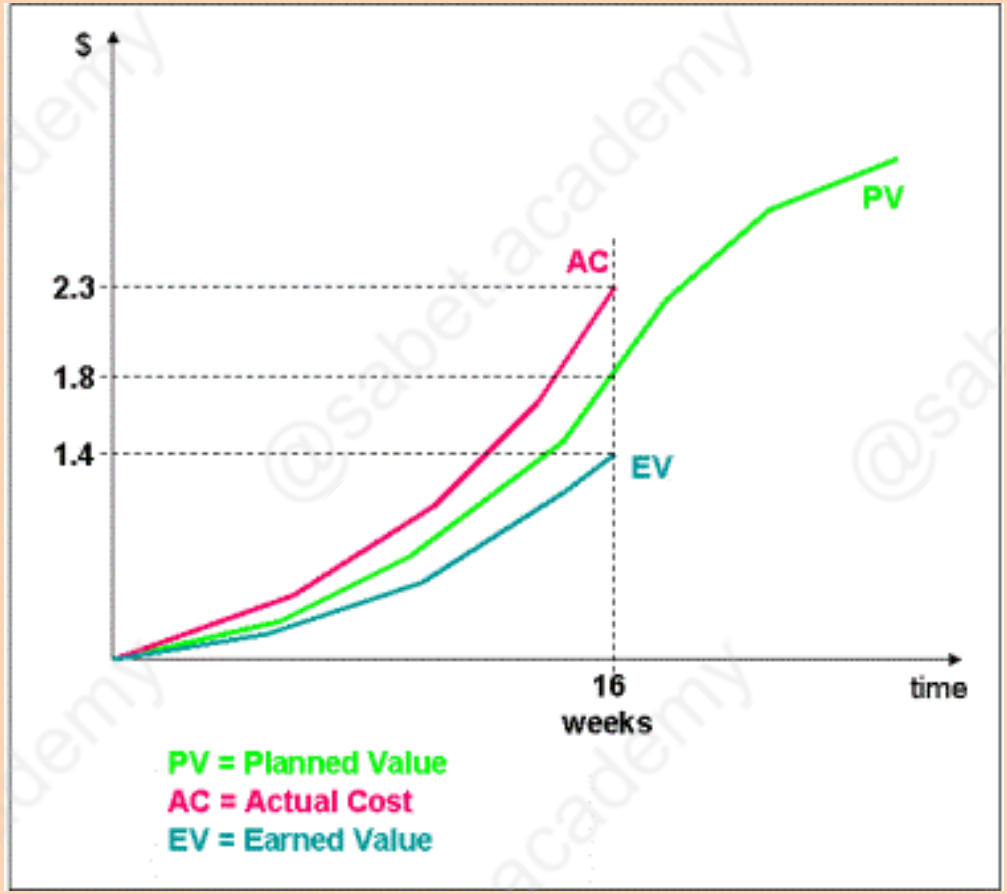
EV= BAC * Actual Progress = £10M * **0.05 =** £0.5M

Control Cost

Tools and Technique:

Actual Cost (AC)

Is the total cost actually incurred and recorded in accomplishing work performed for an activity or work breakdown structure component.



Control Cost

Tools and Technique:

Variance Analysis

It helps in analyzing the performance of the project via cost and schedule baselines.

Schedule Variance (SV)

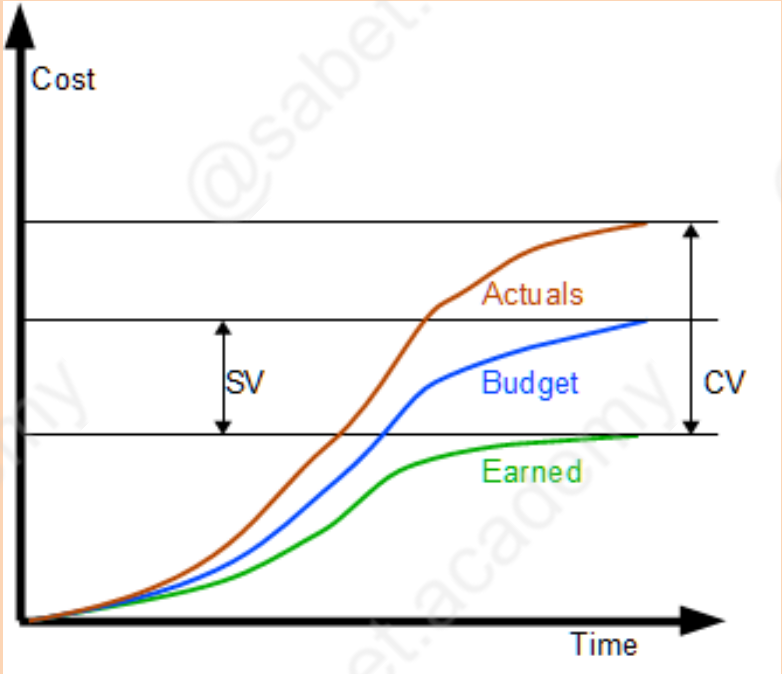
It is a measure of schedule performance on a project. It is equal to the earned value (EV) minus the planned value (PV).

SV= EV-PV

Cost Variance (CV)

It is a measure of cost performance on a project. It is equal to the earned value (EV) minus the actual costs (AC).

CV = EV-AC



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Control Cost

Tools and Technique:

Example

A project has a budget of £10M and schedule for 10 months. It is assumed that the total budget will be spent equally each month until the 10th month is reached. After 2 months the project manager finds that only 5% of the work is finished and a total of £1M spent.

Solution:

PV = £2M

EV = £10M * 0.05 = £0.5M

AC = £1M

CV = EV-AC = 0.5-1 = -0.5M

CV% = 100 * (CV/EV) = 100*(-0.5/0.5) = -100% overrun

The Project spent 100% Over Budget

SV = EV-PV = 0.5-2 = -1.5 months

SV% = 100 * (SV/PV) = 100*(-1.5/2) = -75% behind

The project is 75% Behind the Schedule

Control Cost

Tools and Technique:

Schedule Performance Index (SPI)

In addition to project status is used to predict the completion date.

SPI= EV/PV

Cost Performance Index (CPI)

Measures the cost efficiency for the work completed, it is the ration of EV to AC.

CPI= EV/AC

If CPI & SPI is 1. it means project is on Budget & on Schedule.

In the previous example:

CPI = EV/AC = 0.5/1 = 0.5 – the Project cost efficiency is 0.5, so it is over Budget and if the project goes ahead with the current efficiency, it will face a deficit.

SPI = EV/PV = 0.5/2 = 0.25- the project time efficiency is 0.25, so it is behind Schedule and if the project goes ahead with the current efficiency, it will face delay.

Control Cost

Tools and Technique:

Forecasting Techniques

Are used to calculate estimate at completion (EAC) and Estimate to complete (ETC).

EAC = AC + ETC

EAC forecast for ETC work performed at the budgeted rate

EAC = AC+ BAC –EV

EAC forecast for ETC work considering both SPI and CPI

EAC = BAC/cumulative CPI

EAC forecast for ETC work considering both SPI and CPI factors.

AC + ((BAC-EV)/(cumulative CPI * cumulative SPI))

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Control Cost

In the previous example:

EAC = BAC/CPI = 10/0.5 = £20M

At the end of the project, we will spend £20M instead of £10M

ETC = (BAC-EV) / CPI = (10-0.5)/0.5 = £19M

We spend £1M up now (as AC) so we will spend £19M from now until the end of the project.

EAC_{time}= (BAC/SPI)/(BAC/project $duration_{month}$) = (10/0.25)/(10/10) = 40

ETC_{time} = (BAC-EV) SPI = (10-0.5)/0.25 = 38 Months

This project will take TOTAL £20M (19+1) and 40 (38+2) Months to complete.

Control Cost

Tools and Technique:

To-complete performance index (TCPI)

Is the calculated projection of cost performance that must be achieved work to meet a specified management goal, such as the BAC or the EAC.

TCPI based on the BAC: Work Remaining (BAC-EV) / Fund Remaining (BAC-AC)

TCPI based on EAC: (BAC-EV)/(EAC-AC)

It means For the project to close on approved budget (the cost is to be reimbursed), the cost efficiency should be equal to TCPI (instead of CPI).

In the previous example:

TCPI = (10-0.5)/(20-1) = 1.052

Control Cost

Tools and Technique:

Performance Reviews

Involves following three types of analysis

1. Variance Analysis

Compares actual project performance to planned or expected performance. Cost and schedule variances are the most frequently analyzed.

2. Trend Analysis

Examines project performance over time to determine if performance is improving or deteriorating.

3. Earned Value Management

Compares the baseline plan to actual schedule and cost performance.

Control Cost

Tools and Technique:

Project Management Software

Is often used to monitor the three EVM dimensions (PV, EV and AC). To display graphical trends, and to forecast a range of possible final project results.

Reserve Analysis

During cost control, reserved analysis is used to monitor the status of contingency and management reserves for the project determine if these reserves are still needed or if additional reserves need to be requested.

Control Cost

Outputs:

Work performance information

Includes the calculated CV, SV, CPI and SPI values for WBS components, in particular the work packages.

Cost Forecasts

includes a calculated EAC value or a bottom- up EAC value.

Organizational Process Assets Updates

include causes of variances, corrective action chosen and the reasons and other types of lessons learned from project cost control.

Change requests

include change request to the cost performance baseline or other components of the project management plan. Change requests can include preventive or corrective actions and are processed for reviews and disposition through the perform integrated change control process (ICC)

Control Cost

Outputs:

Project Management Plan Updates

Elements of the project management plan that may be updated include cost performance baseline and cost management plan.

Project Documents Updates

Include updates to cost estimates and basis of estimates.

Organizational Process Assets Updates

Organizational Process Assets that may be updated include, but are not limited to:

Cause of variances

Corrective action chosen and the reasons

Financial databases

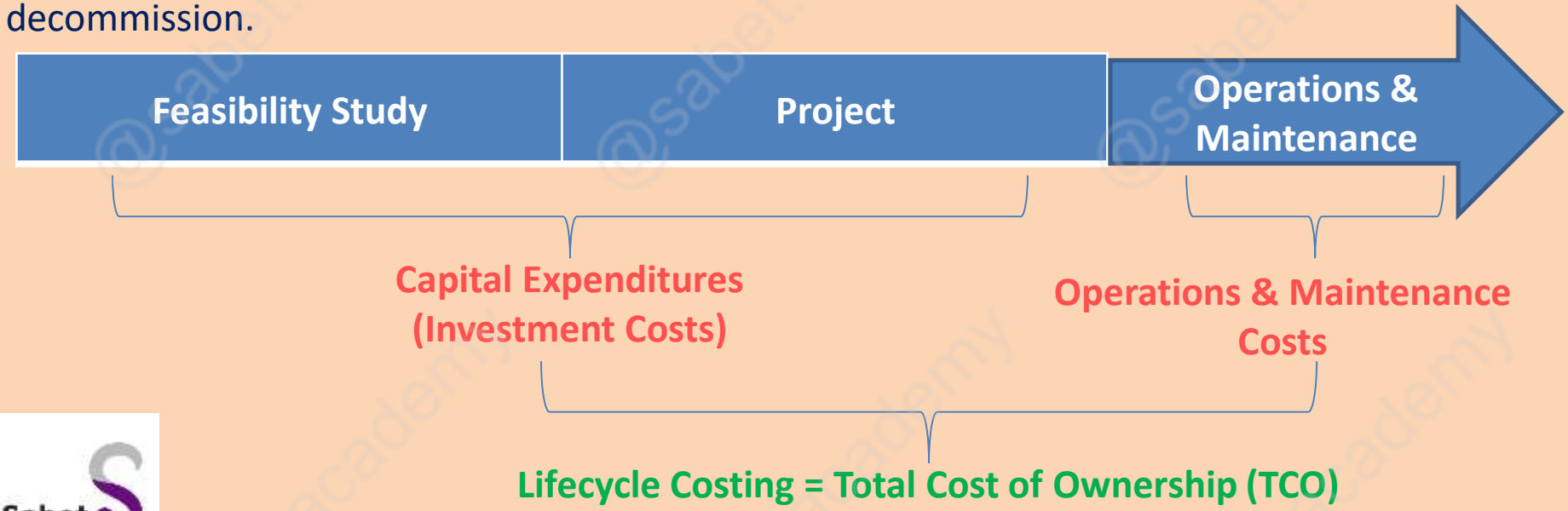
Other types of lesson learned from project cost control

Opportunity Cost

When there is a decision to be made between two opportunities, the opportunity cost is the value/money forgone for the not doing the project.

Lifecycle Costing (LCC)

Takes into account cost of development of a project and also the cost of supporting during the lifecycle. LCC is the process od economic analysis to asses the total cost of ownership of a product. Including its cost of installation, operation, maintenance, conversion and/or decommission.



Project Cost Management

Project (Contractor): Wants to minimize capital costs as the only criteria

Maintenance Engineering: Wants to minimize repair hours

Production: Wants to maximize uptime hours

Accounting: Wants to maximize project net present value

Shareholders: Wants to increase stockholder wealth

LCC can be used as a management decision tool for synchronizing the divisional conflict by focusing on facts, money and time.

Among Stakeholders of a project, the "Owner" is mostly concerned to consider costs of operations & maintenance (O & M).

Policies to encourage a contractor to apply life-cycle costing:

- Awarding a BOT contract (Build, Operate, Transfer)
- Requiring a longer guarantee period
- Awarding the maintenance contract to the same contractor
- Sharing benefits of value engineering and …

Accounting / Financial Metrics

- Payback Period (PBP)
- Benefit /Cost Ratio
- ROI
- Present Value (PV)
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Economic Value Added (EVA)
- Law of Diminishing Returns

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Payback Period (PBP)

The time it takes to recover your investment in the project before you start accumulating profit.

- This method ignores cash flows after the payback period
- Lack of emphasis on the magnitude of the profitability
- Ignores the time value of money
- it typically used on only relatively short term projects
- Used as a supplemental tool to accompany other methods

Benefit /Cost Ratio

It indicates how much benefit (as%) you will get for each unit of cost that you will invest.

BCR = Benefit / Cost

BCR< 1 is bad

BCR> 1 is good

The project with the bigger BCR is the better one.

It Also called as profitability index.

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ROI

A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. ROI measures the amount of return on an investment relative to the investment's cost.

$$\frac{[\text{Money Gained} - \text{Money Spent}]}{\text{Money Spent}} \times 100$$

- ROI is attractive for its simplicity, but it doesn't reflect the time value of money or profitability.

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Present Value (PV)

It means the value today of future cash flows and can be found by the formula:

$$PV = FV \frac{1}{(1+r)^n}$$

$FV = Future\ Value$
$r = rate\ of\ return$
$n = number\ of\ periods$

- **Example:** You can get 10% interest on your money.

So $1,000 now can earn $1,000 x 10% = $100 in a year.
Your $1,000 now can become $1,100 in a year's time.
So $1,000 now is the same as $1,100 next year (at 10% interest).
We say the Present Value of $1,100 next year is $1,000
Because we could turn $1,000 into $1,100 (if we could earn 10% interest).

Net Present Value (NPV)

It is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of a projected investment or project.

The following is the formula for calculating NPV:

where

C_t = net cash inflow during the period t

C_o = total initial investment costs

r = discount rate

t = number of time periods

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_o$$

Generally, an investment with a positive NPV will be a profitable one and one with a negative NPV will result in a net loss. This concept is the basis for the net present value rule, which dictates that the only investments that should be made are those with positive NPV values.

Internal Rate of Return (IRR)

It is a project selection technique that takes a comparative approach for project selection.

Interest rate received for an investment consisting of payments & income that occur at regular periods.

- It is similar to the interest rate you get from the bank.
- The IRR is the inverse of the NPV, and is based on the same formula. While NPV shows the cost of capital, IRR shows a break-even rate of return.
- Calculating IRR is complex and requires the aid of a computer.

Bigger IRR is better

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Economic Value Added (EVA)

The amount of added value the project produces for the company's shareholders.

Law of Diminishing Returns:

The law states that after a certain point, adding more input will not produce a proportional increase in productivity.

A concept in economics that if one factor of production (number of workers, for example) is increased while other factors (machines and workspace, for example) are held constant, the output per unit of the variable factor will eventually diminish.

this law is expressed as ”the gain is not worth the pain”.

A single programmer may produce at 1 module per hour. With a second programmer, the two may produce at 1.75 modules per hour. With a third programmer, the group may produce at 2.25 modules per hour.

This disparity may be due to many factors. For example, added coordination is required between programmers.

Working Capital

Working capital is a measure of both a company's efficiency and its short-term financial health. Working capital is calculated as:

Working Capital = Current Assets - Current Liabilities

It is the amount of money the company has available to invest, including investment in projects.

Depreciation

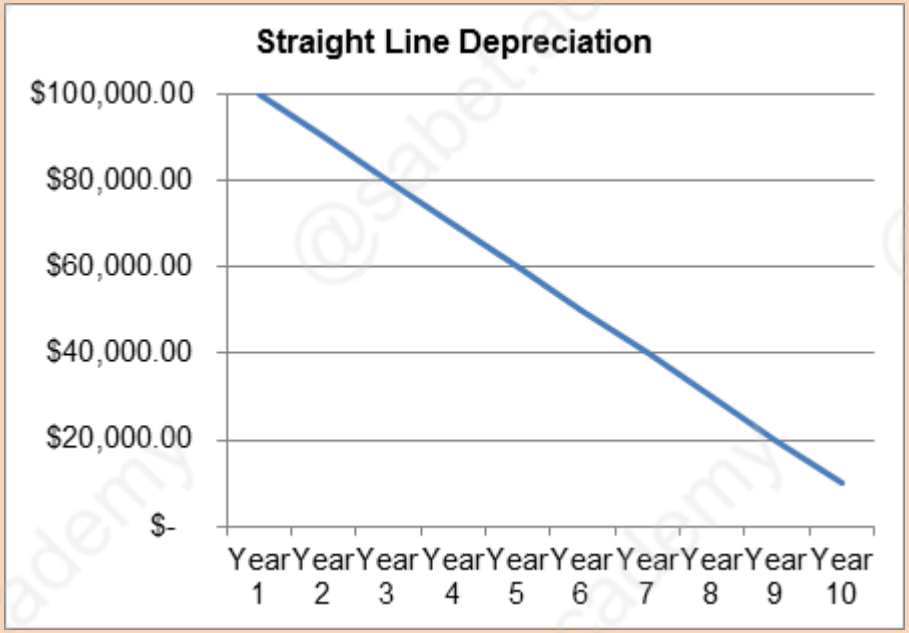
Is the decrease in value of an asset over a period of time for accounting and tax purposes.

Depreciated Cost = Purchase Price (or cost basis) – {Cumulative Depreciation}

These are two forms of depreciation:

Straight-Line Depreciation

It is the default method used to gradually reduce the carrying amount of a fixed asset over its useful life.



Straight-Line Depreciation

Year	Asset Value Used in Calculation	Percent	Depreciation Amount Debited
1	$10,000	20%	$2,000
2	$10,000	20%	$2,000
3	$10,000	20%	$2,000
4	$10,000	20%	$2,000
5	$10,000	20%	$2,000
	Total Depreciation:		$10,000

Depreciation

Accelerated Depreciation:

There are two forms of accelerated depreciation:

- Double Declining Balance

- 2 × Straight-line depreciation rate × Book value at the beginning of the year
- Book Value= cost – Accumulated depreciation
- Sum of the Years Digits

Sum of Years - Digits Depreciation Method

$$\text{Sum Of Years Digits} = y * (y + 1) / 2$$

y = Estimated Useful Life (years)

$$\text{(Acquisition Cost - Salvage Value)} \times \frac{\text{Remaining Useful Life}}{\text{Sum Of Years Digits}}$$

Depreciation

Example of Double Declining Balance Depreciation

ABC Company purchases a machine for $100,000. It has an estimated salvage value of $10,000 and a useful life of five years. The double declining balance depreciation calculation is:

Year	*Net book value, beginning of year*	*Double-declining balance depreciation computed as 2 × SL rate × beginning NBV*	*Net book value, end of year*	
1	$100,000	$40,000	$60,000	
2	60,000	24,000	36,000	
3	36,000	14,400	21,600	
4	21,600	8,640	12,960	
5	12,960	2,960	10,000 salvage value	
Total		$90,000		