1.5 COST BENEFIT ANALYSIS (CBA)

- Cost in a project is due to the requirements for software, hardware and human resources. Software cost estimation is the process of predicting the amount of effort required to build/develop a software system.
- Cost estimates are needed throughout the software life cycle. Preliminary estimates are required to determine the feasibility of a project. Detailed estimates are needed to assist with project planning.
- The actual effort for individual tasks is compared with estimated and planned values, enabling project managers to reallocate resources when necessary.
- The bulk of the cost of software system development is due to the human resources needed, and most cost estimation procedures focus on this aspect. Most cost estimates are determined in terms of Person-Months (PM).
- As the cost of the project depends on the nature and characteristics of the project, at any point, the accuracy of the estimate will depend on the amount of reliable information we have about the final product.

Concept Cost Benefit Analysis (CBA):

- When money is spent/expend on some equipment, it is expected to bring some benefits. Thus, before making any investment, whether in human or resources, it is essential to analyse how well or how poorly the planned action will turn out. To do this, a Cost Benefit Analysis (CBA) is carried out.
- The CBA takes into account all the factors that contribute to the benefits, quantifies these benefits, and adds up all the benefits, It also identifies the factors that incur cost, quantifies them, and subtracts them from the benefits.
- The difference between the benefits derived and the costs incurred indicates whether the planned action is advisable. Thus, in a CBA, all the benefits are assessed and all the costs are calculated; the difference guides the rationale for expenditure on the system.
- The CBA compares the expected financial gain derived from a particular set of actions with the expected cost of providing each action to determine the most profitable option. The projected benefits of a plan or program are divided by its estimated total long-term cost.
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- The CBA has following two main applications:
  1. To determine if an investment (or decision) is sound, ascertaining if – and by how much – its benefits outweigh its costs.

2. To provide a basis for comparing investments (or decisions), comparing the total expected cost of each option with its total expected benefits.

- The objective of performing a CBA is to determine the extent to which the benefits outweigh cost. The steps involved in a CBA are explained below:

  Step 1: Determine the costs and benefits relating to a project.

  Step 2: Classify the costs and benefits under various types of costs and benefits.

  Step 3: Choose a cost-benefit evaluation method for analysis.

  Step 4: Interpret the result produced by the analysis.

  Step 5: Take a suitable action.

- CBA is related to Cost Effectiveness Analysis, (CEA (which assigns a monetary value to the measure of effect)). Cost–benefit analysis is often used by organizations to appraise the desirability of a given policy. It is an analysis of the expected balance of benefits and costs
- We can define benefit as, Profit or Benefit = Income – Costs

Example:

Cost Benefit Analysis: Customer Service System				
Costs:				
Category	**Item**	**Quantity**	**Price**	**Total**
Hardware and Services	User workstations	7	₹ 2,000	₹ 14,000
	Server system	2	₹ 4,000	₹ 8,000
	Secure networked printers	2	₹ 1,750	₹ 3,500
	Cable installation	2	₹ 6,200	₹ 12,400
	Software licenses	2	₹ 22,000	₹ 44,000
System training	System overview	10	₹ 625	₹ 6,250
	Software	10	₹ 625	₹ 6,250
	Tools	15	₹ 875	₹ 13,125
Total Cost				**₹ 107,525**
Benefit:				
More effective promotion campaigns				₹ 58,000
Improved lead conversion				₹ 42,000
Better customer retention and loyalty				₹ 28,000
Enhanced productivity				₹ 35,000
Workflow efficiencies				₹ 28,000
Higher quality database				₹ 45,000
Total Benefits				**₹ 2,36,000**

Types of Costs and Benefits in CBA:

- The real idea to do a CBA well is in making sure we include all the costs and the benefits and properly quantify them. For this, we must be aware of different types of costs and benefits. The costs and benefits may be following:

1. **Direct Costs:**

- The costs directly associated with a system are known as direct costs. For example, purchase of a router for ₹ 2,000 is a direct cost, as the association of the router with the money spent is direct.
- Similarly, direct benefits can also be attributed to a given project. For example, the installation of a new system that can handle 40 percent more transactions per day is a direct benefit.

2. **Indirect Costs:**

- These costs are not directly associated with a particular activity and are considered as overhead expenses.
- For example, the cost of space, heat, light and maintenance is tangible but it is not easy to quantify the proportion attributable to any specific activity.
- Indirect benefits are realized as the by-product of some other activity. For example, a system installed for tracking sales calls to customers is an indirect benefit in marketing as it gives additional information about the market and competition. However, its evaluation in terms of money cannot be done exactly.

3. **Tangible Costs:**

- The costs and benefits that can be measured easily are termed as tangible. The amount of cash dispensed for any specific item or service is known as its tangible cost. Such costs are known and are estimated accurately.

4. **Intangible Cost:**

- The costs that exist but are not visible immediately are called intangible costs. For example, the delay in procurement of raw material may result in losses that are not immediately known and thus are intangible costs.
- Similarly, the benefits that are known to exist but cannot be exactly measured are called intangible benefits. The estimate can only be approximated; it cannot be exact.
- For example, the benefits of providing some welfare measures undertaken by the management to motivate, and boost the morale of employees cannot be exactly measured in monetary terms.

5. **Fixed Costs:**

- The costs and benefits that remain constant irrespective of how a system is used are termed as fixed costs. Fixed costs are sunk cost and are constant.
- They are one-time costs. For example, investment on installation of a computer system is a fixed cost, which is constant whether the system is in use or not.
- Like fixed costs, fixed benefits also remain constant. For example, the reduction in manpower by 20 percent after installing a new system is a fixed benefit. Such benefit of saving manpower may occur every month.

6. **Variable Costs:**

- The variable costs incur on a regular basis. They are proportional to the volume of work and continue to occur as long as the system is in operation. For example, the cost of computerized forms varies in proportion to the amount of processing or the size of the reports.
- In the same way, variable benefits are realized on day-to-day operations and on a regular basis. For example, consider a library information system that saves two minutes providing information to the borrower about a specific book as compared to the manual system. The amount of time saved depends on the number of books of which the information is required.

Cost Benefit Evaluation Methods:

- Some commonly used cost-benefit evaluation methods in CBA are explained below:

1. **Net Benefit Analysis** method involves evaluating the net benefit i.e., total benefits minus total costs. It is simple and easier to calculate, interpret and present. However, it does not take into account the time value of money and does not discount future cash flow.
2. **Present Value Analysis** used in long-term projects, it is difficult to calculate and compare the cost incurred today with the complete value of future benefits. To overcome this problem, present value analysis calculates the costs and benefits in present day's value of investment. The present values are compared with the future values by considering the time value of the money to be invested. The amount that we are going to invest today is determined by the value of benefits at the end of a given period. The formula for calculating the present value is, $P = F/(1 + i)^n$. Where F is the future value of the present value, P, at the end of nth year at the interest rate i.
3. **Payback Analysis** is simply an analysis of how long it will take for the accumulated benefits to become equal to the investment. The shorter the payback period, the sooner the organization will make profits and the more attractive will be the investment. The formula for calculating the payback period is given below:

Payback Period (in Years) = Initial Investment/Annual Savings

4. **Net Present Value (NPV) Analysis** is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyse the profitability of an investment or project. In other words, NPV is calculated by summing up the rupee-valued benefits and then subtracting all of the rupee-valued costs, with discounting applied to both the benefits and the costs, as appropriate. NPV is expressed as a percentage of the investment.
5. **Break-Even Analysis** is the point at which the costs and the benefits of the organization become equal is called the break-even point. In other words, break-even point is the point where the organization neither earns profits nor incurs loss. This method involves the use of a chart to depict the overall benefits required to cover the costs. Break-even analysis can be used as a control device as well as an aid for decision-making.

- Following are the uses of break-even analysis in the decision-making process:
  (i) Providing information and data that aid in decision-making for adding or removing products.
  (ii) Finding the minimum sales required to meet the desired profit goals.
  (iii) Providing information that is useful in making pricing decisions.
  (iv) Finding the minimum sales required for prevention of loss.

Example for CBA: Cost for the proposed system:

Cost Category \ Year	1	2	3	4	5
Hardware	30				
Software	30				
Personnel	10	12	14	16	18
Maintenance	0	2	3	4	5
Cost at year end	70	24	17	20	23
Cumulative cost	70	94	111	131	154

Benefit for the propose system:

Benefits \ Year	1	2	3	4	5
From finished reports	15	15	15	15	15
Increase in sales	25	35	45	55	65
Benefits at year end	40	50	60	70	80
Cumulative benefits	40	90	150	220	300

Profit = Benefits – Costs
= 300,000 – 154,000
= ₹ 146,000

Since we are gaining, this system is feasible.

Example for Present Value Analysis: Present value of ₹ 3000 invested at 15% interest at the end of 5th year is calculates as,

P = 3000/(1 + .15)5
= 1491.53

Table below shows present value analysis for 5 years:

Year	Estimation Future Value	Present Value	Cumulative present Value of Benefits
1	3000	2608.69	2608.69
2	3000	2268.43	4877.12
3	3000	1972.54	6,849.66
4	3000	1715.25	8564.91
5	3000	1491.53	10056.44

Example Net Present Value: The net present value is equal to benefits minus costs. It is expressed as a percentage of the investment.

Net Present Value = Costs – Benefits
% = Net Present Value/Investments

Example: Suppose total investment is ₹50,000 and benefits are ₹80,000
Then Net Present Value = ₹(80,000 – 50,000)
= ₹30,000
% = 30,000/80,000
= 0.375

Example of Break-Even Analysis:

- Fig. 1.11 is a break-even chart comparing the costs of current and candidate systems. The attributes are processing cost and processing volume.
- Straight lines are used to show the model's relationships in terms of the variable, fixed, and total costs of two processing methods and their economic benefits. B' point is break-even.
- Area after B' is return period. A'AB' area is investment area. From the chart, it can be concluded that when the transaction are lower than 70,000 then the present system is economical while more than 70,000 transaction would prefer the candidate system.

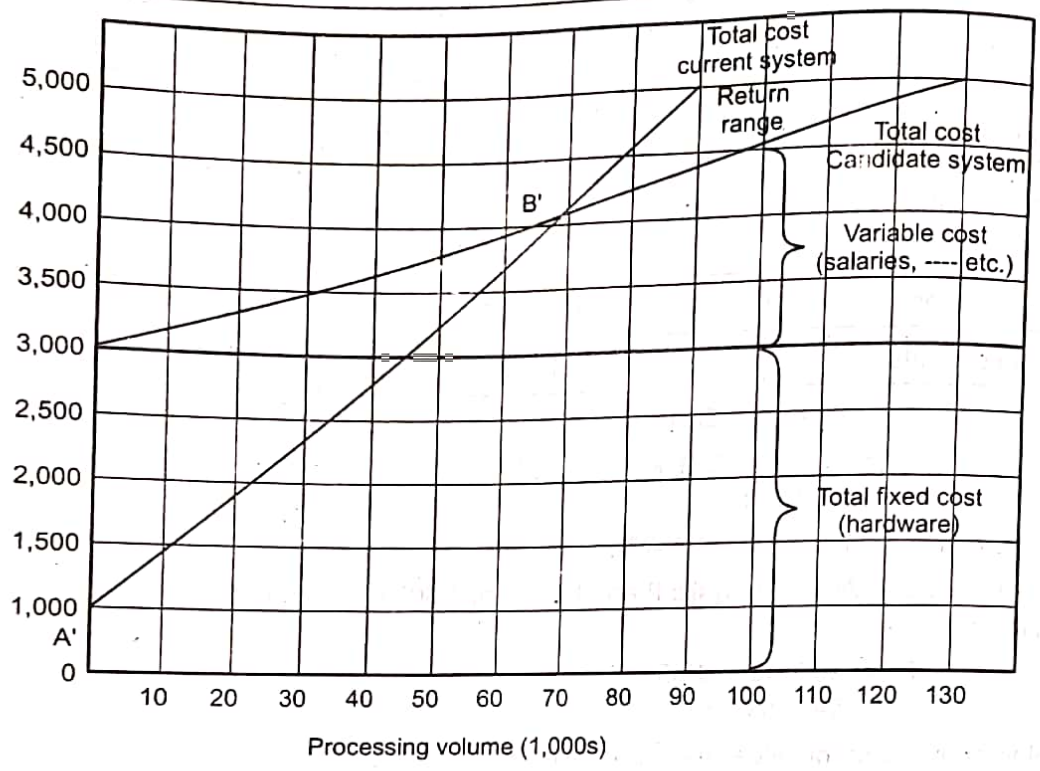

Fig. 1.11

1.6 COCOMO MODEL