



FOR CA & CWA
(FINAL)

Advance Management Accounting

For C A Final Theory

Secure 30 Marks

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CVP Analysis

Cost-volume-profit analysis (as the name suggests) is the analysis of three variable viz., cost, volume and profit. Such an analysis explores the relationship existing amongst costs, revenue, activity levels and the resulting profit.

It aims at measuring variations of cost with volume. In the profit planning of a business, cost-volume-profit (C-V-P) relationship is the most significant factor.

The CVP analysis is an extension of marginal costing. It makes use of principles of marginal costing. It is an important tool of planning. It is quite useful in making short run decisions.

Marginal costing is defined as the ascertainment of marginal cost and of the effect on profit of changes in volume of output by differentiating between fixed costs and variable costs.

Sensitivity analysis focuses on how a result will be changed if the original estimates or underlying assumption change.

The assumption of CVP analysis:-

1. All costs can be segregated into fixed and variable elements.
2. Variable costs vary in proportion to output and fixed cost remains constant.
3. Profit is calculated on variable cost basis.
4. The analysis applies only to short term horizon.
5. Cost and revenue are influenced only by volume.

Limitations of Marginal Costing Techniques

1. It is difficult to classify exactly the expenses into fixed and variable category. Most of the expenses are neither totally variable nor wholly fixed.
2. Contribution itself is not a guide unless it is linked with the **key factor**.
3. Sales staff may mistake marginal cost for total cost and sell at a price; which will result in loss or low profits. Hence, sales staff should be cautioned while giving marginal cost.
4. Overheads of fixed nature cannot altogether be excluded particularly in large contracts, while valuing the work-in-progress. In order to show the correct position fixed overheads have to be included in work-in-progress.
5. Some of the assumptions regarding the behavior of various costs are not necessarily true in a realistic situation. For example, the assumption that fixed cost will remain static throughout is not correct.

Briefly discuss on curvilinear CVP analysis.

In CVP analysis, the usual assumption is that the total sales line and variable cost line will have linear relationship, that is, these lines will be straight lines. However, in actual practice it is unlikely to have a **linear relationship for two reasons**, namely:

- After the saturation point of existing demand, the sales value may show a downward trend.
- the average unit variable cost declines initially, reflecting the fact that, as output increases the firm will be able to obtain **bulk discounts** on the purchase of raw materials and can also benefit from division of labour.

SALE BELOW MARGINAL COST.

- I. Where material are of perishable nature.
- II. To popularize a new product.
- III. To capture foreign markets.
- IV. To shut down cost.
- V. To create a future market.
- VI. Where stock have been accumulated large quantity and the market price have fallen.

COST CONCEPT IN DECISION MAKING

For the purpose of decision making, costs are distinguished on the basis of their relevance to the different type of decisions.

For business decision making purposes, Relevant costs constitute a practical basis of decision making which is different from historical cost approach.

Relevant cost: Costs which are relevant for a particular business option, following two conditions need to be satisfied for a cost to be called a relevant cost:

Which are not historical cost but must be future costs.

Cost must be different for different alternative Courses of Action.



For example, while considering a proposal for plant replacement by discarding the existing plant, the original cost and the present depreciated book value of the old plant are irrelevant as they have no impact on the decision for replacement just going to be taken place.

However the expected sales value of the discarded plant is relevant, as it just goes to reduce the amount of investment to be made in the new plant and so it has an influence on the decision.

Moreover, outcome of the investment is also taken into consideration for decision making.

Relevant cost analysis helps in drawing the attention of managers to those elements of cost which are relevant for the decision.

RELEVANT COST OF MATERIAL

1. Relevant cost of regular used material is the Replacement cost (Buying Cost of new Material)
2. RELIABLE VALUE of material held in stock is no longer in use is relevant cost.
3. When the material specifically purchase for the proposal then PURCHASE COST is relevant cost.

RELEVANT COST OF LABOUR

1. RELEVANT COST of labour busy on other Job is :-
Actual Wages Plus Loss of Contribution.
2. Relevant cost of idle staff is NIL.
3. Labour cost of employee whose service is extended after retirement is SALARY PAID LESS PENSION RETAINED (IF ANY)

RELEVANT COST OF MACHINE

1. When the machine is in regular use then the relevant cost of machine is REPLACEMENT VALUE e.i. Difference of book value before use and after use.
2. Relevant cost of machine held for disposal is the difference in realizable value.

SUNK COST:- This cost is not relevant for decision making. Sunk Cost may be divided in 3 types:-

- (i) Past Cost or Historical costs of a resource which is not in use.
- (ii) Future cost, the obligation of which is settled in past.
- (iii) Cost incurred on a Job which could not be completed.

OTHER IRRELEVANT COST:-

- (i) It is Future Cost.
- (ii) It remains the same for different alternative.
- (iii) This Cost is irrelevant for decision of choice.
- (iv) This Cost may be relevant for accept reject decision.

Key Notes:-

- (a) Book value/Historical Cost of old equipment is irrelevant because it is a past cost.
- (b) The disposal value of an equipment is relevant because it adds to the cash inflow arising from the decision.

© Those variable cost which will be incurred in future but will not differ under various alternatives are irrelevant.

(d) if fixed expenses remains unchanged under different alternative then such fixed cost are irrelevant cost.

Opportunity cost

It is primarily an economic concept.

It is benefits forgone by rejecting the second best alternative in favour of the best.

Opportunity cost concept is helpful to the mgt. in making profitability calculation.

The opportunity cost of the value of opportunity foregone is taken into consideration when alternatives are compared.

Opportunity Cost is the value of the next best alternative.

In other words, it is the opportunity cost lost by diversion of an input factor from one use to another. It is the measure of the benefit of opportunity foregone.

The opportunity cost is helpful to managers in evaluating the various alternatives available when multiple inputs can be employed for multiple uses.

Decision making:

Opportunity costs apply to the use of scarce resources. Where resources are not scarce; there is no sacrifice from the use of these resources.

Where a course of action requires the use of scarce resources, it is necessary to incorporate the lost profit which will be foregone from using scarce resources.

If resources have no alternative use only the additional cash flow resulting from the course of action should be included in decision making as relevant cost.

Examples of opportunity cost:

- (a) The opportunity cost of using a machine to produce a particular product is the earnings foregone that would have been possible if the machine was used to produce other products.
- (b) The opportunity cost of funds invested in a business is the interest that could have been earned by investing the funds in bank deposit.
- (c) The opportunity cost of one's time is the salary which he would have earned by his profession.

RELEVANT COST

Relevant costs are those costs which are relevant to a decision. In other words, these are the costs which are influenced by a decision. Those costs which are not affected by the decision are not relevant costs.

Examples of relevant costs are:

- (1) All variable costs are relevant costs.
- (2) Fixed Costs which vary with the decision are relevant costs.
- (3) Incremental costs are relevant costs.
- (4) Relevant cost are valid cost for the decision making.
- (5) They must be expected future cost.

Examples of non-relevant costs:

- (1) All fixed costs are generally non-relevant.
- (2) Variable costs which do not vary with the decision are not relevant costs.
- (3) Book value of the asset is not relevant.

Relevant Cost:- They must be diff. among the alternative course of action.

Exp. Variable cost, disposal value of equipment, fixed cost that can be avoided, opportunity cost.

Cost Classification :-

1. By element
2. By function
3. By behavior
4. By controllability
5. By normality.

Short term decision:-

1. Accept reject Decision.
2. Make or buy Decision.
3. Sell or Process Decision
4. Reduce or Maintain Decision
5. Add or Drop Decision
6. Operate or Shut down Decision

Cut off Rate:-

It is the minimum rate of return expected from investment. These are:-

- i. Skimming pricing
- ii. Dual plan
- iii. NPV

DIFFERENTIAL COST

1. IT IS Difference in total cost that will arise from the selection of one alternative instead of another.
2. It may be incremental or Decremental cost.

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3. It involves the estimation of the impacts of decision alternatives on costs and revenues due to changes in prices products.

DIFFERENTIAL COST MAY BE 2 TYPES:-

- a. DIFFERENTIAL COST
 - I. Incremental cost
 - II. Decremental cost.
- b. DIFFERENTIAL REVENUE.
 - i. Incremental revenue.
 - ii. Decremental revenue.

Notes:- When incremental revenue is more than incremental cost, Decision is accepted.

When Decremental revenue is less than the Decremental cost, Decision is accepted.

When revenue is increased and cost is decreased, it is profitable.

When revenue is decreased and cost is increased, Decision is not profitable.

Incremental cost technique:

It is a technique used in the preparation of ad-hoc information in which only cost and income differences between alternative courses of action are taken into consideration.

The essential pre-requisite for making managerial decisions by using incremental cost technique, is to compare the incremental costs with incremental revenues.

So long as the incremental revenue is greater than incremental costs, the decision should be in favor of the proposal.

Applications of Incremental/Differential Cost:

- 1. Whether to process a product further or not.
- 2. Dropping or adding a product line.
- 3. Optimizing investment plan.
- 4. Accepting an additional order from a special customer at lower than existing price.
- 5. Make or buy decision.
- 6. Opening a new sales territory or branch.
- 7. Optimizing investment plan out of multiple alternatives.
- 8. Submitting tenders.
- 9. Lease or buy decisions.
- 10. Equipment replacement decisions.

Sunk cost

Sunk costs are costs that have been created by a decision made in the past and that cannot be changed by any decision that will be made in the future.

This cost is not relevant for decision making. Sunk Cost may be divided in 3 types:-

- (i) Past Cost or Historical costs of a resource which is not in use.
- (ii) Future cost, the obligation of which is settled in past.
- (iii) Cost incurred on a Job which could not be completed.

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It is irrelevant in decision-making, but irrelevant costs are not sunk costs". Explain with example.

For example, the written down value of assets previously purchased are sunk costs. Sunk costs are not relevant for decision making because they are past costs.

But not all irrelevant costs are sunk costs.

For example, a comparison of two alternative production methods may result in identical direct material costs for both the alternatives.

In this case, the direct material cost will remain the same whichever alternative is chosen. In this situation, though direct material cost is the future cost to be incurred in accordance with the production, **it is irrelevant, but, it is not a sunk cost.**

Make or buy (cost or non cost consideration)

Make or Buy decision is applicable only on parts but not for final product.

Cost consideration:-

- i. Where there is idle plant capacity.
- ii. Where there is no plant capacity.
- iii. Marginal Cost.

Non cost consideration:-

- i. Possible use of released capacity as a result of buying instead of making.
- ii. Whether there is possibility to expand the existing capacity.
- iii. Quality of goods supplied by supplier.
- iv. Reasonable certainty of supplier meeting the delivery date.
- v. Cost of making and purchasing.
- vi. Cost of labour redundancies.
- vii. Availability of labour to make the product.

Role of cost in product mix decision:-

- i. The cost should be expected as future cost.
- ii. The cost differs among the alternatives course of action.
- iii. The available production capacity.
- iv. The limiting factor.
- v. Contribution per unit of limiting factor.

Application of direct costing:-

- i. Stock valuation.
- ii. Minimum quantity to be produced to recover pattern.
- iii. Close down decision.

TEMPORARY CLOSURE OF A BUSINESS

- I. Very often it becomes necessary for a firm to close down a business or a part of it due to trade recession with a view to reopening it in the future.
- II. In such a case decision should be based on marginal cost analysis.
- III. If the product is making contribution towards fixed cost, business needs not to close.
- IV. By a temporary closure of a business or part of business, certain fixed cost may be avoided but at the same time certain fixed cost may be incurred.
- IV. If the contribution is more than different between the fixed cost incurred in normal operation and fixed cost incurred when business is closed.
- V. If the contribution exceeds the different between fixed cost , business need not be closed.
- vi. Shut down point = $\{(Total\ fixed\ cost - Shut\ down\ costs) \div Contribution\ per\ unit\}$

Non cost consideration :-

- i. Getting the skilled labour on restart of the business.

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- ii. Competitors may establish their product.
 - iii. Heavy capital expenditure on reopening the business.

PRICING DECISION

The pricing policy plays an important role in a business because the long run survival of a business depends upon the firm's ability to increase its sales and maximum profit from the existing and new capital investment.

Although cost is an important aspect of pricing.

Consumer demand and competitive environment are more significant in pricing decisions.

Thus costs alone do not determine prices. Cost is only one of the many complex factors which determine prices.

There must however, be some margin in prices over total cost.

PRICING OF FINISHED PRODUCT

1. COST PLUS PRICING.

Advantages:

- 1. Fair method.
- 2. Assured Profit.
- 3. Reduced risks and uncertainties.
- 4. Considers market factors.

Disadvantages:

- 1. Ignores demand.
- 2. Ignores competition.
- 3. Arbitrary cost allocation.
- 4. Ignores opportunity cost.
- 5. Price-Volume relationships.

2. Rate of Return Pricing: Determination of return on capital employed is one of the most crucial aspects of price fixation process.

The firm determines an average mark up on cost necessary to produce a desired rate of return on its investment. Under this method three issues arise:

- (a) The basis on which the capital employed is computed.
- (b) Which items should be covered in the return on capital.
- (c) What rate of return can be regarded as fair?

3. Variable costs pricing:

4. Competitive pricing: When a company sets its price mainly on the consideration of what its competitors are charging,

Its pricing policy under such a situation is called competitive pricing or competition-oriented pricing.

It is not necessary under competitive pricing to charge the same price as charged by the concern's competitors.

But under such a pricing the concern may keep its prices lower or higher than its competitors by a certain percentage.

Different type of competitive pricing are as follows:

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- (i) Going rate pricing
 - (ii) Sealed bid pricing

(i) Going rate pricing: It is a competitive pricing method under which a firm tries to keep its price at the average level charged by the industry.

The use of such a practice of **pricing is especially useful where it is difficult to measure costs**. Adoption of going rate pricing will not only yield fair return but would be least disruptive for industry's harmony. Going rate pricing primarily characterizes pricing practice in **homogeneous product markets**.

(ii) Sealed bid-pricing: Competitive pricing also dominates in those situations where firms compete on the basis of bids, such as original equipment manufacturer and defense contract work. The bid is the firm's offer price, and it is a prime example of pricing based on expectations of how competitors will price rather than on a rigid relation based on the concern's own costs or demand. The objective of the firm in the bidding situation is to get the contract, and this means that it hopes to set its price lower than that set by any of the other bidding firms. But however the firm does not ordinarily set its price below a certain level.

5. Incremental pricing: Incremental pricing is used because it involves comparison of the impact of decisions on revenues and cost.

If a pricing decision results in a greater increase in revenue than in costs, it is favorable. Such a decision is not merely confined to comparison of revenues and costs.

The following points will be useful to show how this technique gives consideration to all repercussions of a decision.

1. Relevant cost analysis
2. Product-Line relationship analysis
3. Opportunity cost analysis
4. Time factor analysis
5. CVP analysis.
6. Risk analysis:

PRICING STRATEGIES

Pricing strategy is defined as a broad plan of action by which an organization intends to reach its goal.

There are various types of pricing strategies which firm can adopt. Few of them are as follows:

Market-Entry strategies: While preparing to enter the market with a new product, management must decide whether to adopt a **skimming or penetration pricing strategy**.

(a) Skimming pricing: It is a policy of high prices during the early period of a product's existence and in the later years the prices can be gradually reduced. The reasons for following such a policy are :

- (i) Inelastic demand:
- (ii) Sales boost:
- (iii) Assured profit: .
- (iv) Cost revenue matching: High initial capital outlays, needed for manufacture, results in high cost of production.

(b) Penetration pricing: This policy is in favour of using a low price as the principal instrument for penetrating mass markets early. It is opposite to skimming price. The low price policy is introduced for the sake of long-term survival and profitability and hence it has to receive careful consideration before implementation.

This method is also used for pricing a new product. In order to popularize a new product penetrating pricing policy is used initially.

The company may not earn profit by resorting to this policy during the initial stage.

Later on, the price may be increased as and when the demand picks up.

The use of this policy by the existing concerns will discourage the new concerns to enter the market.

This pricing policy is also known as “stay-out-pricing”.

The **three circumstances** in which penetrating pricing policy can be adopted are as under:

- (i) Elastic demand:
- (ii) Mass production: When there are substantial savings on large scale production. Here increase in demand is sustained by the adoption of low pricing policy.
- (iii) Frighten competition: When there is threat of competition. The prices fixed at a low level act as an entry barrier to the prospective competitors.

Price discounts and Time differentials :

Distributors’ discounts:

- (i) Different net prices for different distributor levels:
- (ii) A uniform list price modified by a structure of discounts, each rate so determined is applied to a different level of distributor: .
- (iii) A single discount combined with differing supplementary discounts to different levels of distributors:

- Pre-requisites for determining Distributors’ Discounts:

- **Quantity discounts :**

Objectives of quantity discounts: The main objective of quantity discounts is to reduce the number of small orders and thus avoid the high cost of servicing them.

Advantages: Quantity discount system enables the dealer to avail such discounts by buying larger lots. The economic buying by a dealer may enable him to charge lower prices from his customers thereby benefiting them.

Finally, lower prices to customers may increase their demand for the commodities which in turn may enable the dealer to purchase larger quantities, reaping still greater discounts, and the manufacturer to reap economies of large-scale production.

In some cases, discounts become a matter of trade custom.

Disadvantages: Dealers may find it cheaper to purchase their requirement of commodities from wholesalers, availing themselves of these quantity discounts than from the manufacturers directly. This is because the wholesalers may pass on some of their discount to the dealers. Such a practice may affect the image of the manufacturer in the minds of the dealers.

Cash Discounts:

Cash discounts are price reductions based on promptness of payment. It is a convenient device to identify and overcome bad credit risks. In those trades where credit risk is high, the percentage of cash discount given is also high.

If a buyer decides to purchase goods on credit, he has to pay a higher price by foregoing the cash discount.

Time differentials : Charging different prices on the basis of time is another kind of price discrimination. Under time differentials the objective of the seller is to take advantage of the fact that buyer’s demand elasticities vary over time. Time differentials can be classified under the following heads.

- (i) Clock-time differentials:

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- (ii) Calendar-time differentials:
 - (iii) Geographical price differentials:
 - (iv) Consumer category price differentials:

Price Discrimination:

Price discrimination means charging different prices and it takes various forms according to whether the basis is customer, product, place or time. These are illustrated as under:

- (a) Price discrimination on the basis of customer:
- (b) Price discrimination based on product version
- (c) Price discrimination based on place:
- (d) Price discrimination based on time:

Price discrimination is possible if the following conditions are satisfied:

- (a) The maker must be capable of being segmented for price discrimination;
- (b) The customers should not be able to resell the product of the segment paying higher price; and
- (c) The chance of competitors' underselling in the segment of higher prices should not be possible.

Geographic Pricing Strategies

In pricing, a seller must consider the costs of shipping goods to the buyer. These costs grow in importance as freight becomes a larger part of total variable costs.

Pricing policies may be established whereby the buyer pays all the freight expense, the seller bears the entire cost, or the seller and buyer share this expense.

The strategy chosen can influence the geographic limits of a firm's market, locations of its production facilities, sources of its raw materials, and its competitive strength in various geographic markets.

Point-of-Production Pricing: In a widely used geographic pricing strategy, the seller quotes the selling price at the point of production and the buyer selects the mode of transportation and pays all freight costs.

This method of pricing is referred as FOB factory pricing.

Uniform Delivered Pricing: Under uniform delivered pricing, the same delivered price is quoted to all buyers regardless of their locations.

Uniform delivered pricing is typically used where freight costs are a small part of the seller's total cost. This strategy is also used by many retailers who believe "free" delivery is an additional service that strengthens their market position.

Zone-Delivered Pricing: Zone-delivered pricing divides a seller's market into a limited number of broad geographic zones and then sets a uniform delivered price for each zone.

Freight-Absorption Pricing:

Under freight-absorption pricing, a manufacturer will quote to the customer a delivered price equal to its factory price plus the freight costs that would be charged by a competitive seller located near that customer.

PARETO ANALYSIS

Pareto Analysis is a rule that recommends focus on the most important aspects of the decision making in order to simplify the process of decision making.

It is based on the 80 : 20 rule that was a phenomenon first observed by Pareto.

The management can use it in a number of different circumstances to direct management attention to the key control mechanism or planning aspects.

It helps to clearly establish top priorities and to identify both profitable and unprofitable targets.

Usefulness of Pareto Analysis: It provides the mechanism to control and direct effort by fact, not by emotions. It helps to establish top priorities and to identify both profitable and unprofitable targets.

Pareto analysis is useful to:

- Prioritize problems, goals, and objectives Identify root causes.
- Select and define key quality improvement programs.
Select key customer relations and service programs.
Select key employee relations improvement programs.
- Select and define key performance improvement programs Maximize research and product development time.
- Verify operating procedures and manufacturing processes.
- Product or services sales and distribution.
- Allocate physical, financial and human resources.

Application of Pareto Analysis: The Pareto Analysis is generally applicable to the following business situations:

- (i) Pricing of a product:
- (ii) Customer profitability.
- (iii) Quality Control
- (iv) ABC.

BUDGETRY CONTROL

1. **Strategic Planning:** Strategic planning is concerned with preparing long-term action plans to attain the organization's objectives by considering the changes at horizon.
2. **Budgetary Planning:** Budgetary planning is mainly concerned with preparing the short to medium term plan of the organization. It will be carried out within the framework of the strategic plan as already set.
3. **Operational Planning:** It concerns with the short-term or day-to-day planning process. It plans the utilization of resources and will be carried out within the framework of the budget.
4. **Preparation of Budgets :** The process of preparing and using budgets will differ from organization to organization.

Requirements of a budgetary control.

- a. Co-ordination: The budget committee:

Budgets provide a means of co-ordination of the business as a whole. In the process of establishing budgets, the various factors like production capacity, sales possibilities, and procurement of material, labour, etc. are balanced and co-ordinates so that all the activities proceed according to the objective.

- b. Participative budgeting:

CIMA defines participative budgeting as: A budgeting system in which all budget committee members are given the opportunity to apply their own budgets in practice.

- c. Budget Manual: manual is well written and index for guidance.

A budget manual is a collection of documents that contains key information for those involved in the planning process.

Identification of the principal budget factor:

The principal budget factor is the factor that limits the activities of functional

It includes

- i. brief explanation of the principal of budgetary control.
- ii. Objective and benefit.
- iii. Procedure to be adopted in operating the system.
- iv. Duties and responsibilities of operational executive, budget committee.

Budget controller.

- v. Budget period and control.
- vi. The follow up procedure.

Traditional Budgeting

vs

Zero-based budgeting.

Accounting Oriented

Responsibility Accounting oriented

Reference is past budget. Some Fresh approach without any previous managers only inflate them.

Nothing is taken into account without justification.

Routine Approach

Investigative approach

Performance Budgeting (PB)

Performance Budgeting provide a meaningful relationship between estimated inputs and expected outputs as an integral part of the budgeting system.

A performance budget is one which presents the purposes and objectives for which funds are required, the costs of the programmes proposed for achieving those objectives, and quantities data measuring the accomplishments and work performed under each programme.

Zero based budgeting

ZBB makes a significant departure from the traditional budgeting mainly in approach rather in basic planning and control philosophy.

Each manager re evaluate all the programmes and activities of his dept. and justify his entire budget request.

The manager has to build up his budget from gross root.

ZBB start with the assumption that zero will be spent on each activity.

Zbb applied to the service or support rather than production area.

Zbb is time consuming and costly exercise.

Characteristics of ZBB:-

- I. The tech. Deals practically with all the elements of budget proposals.
- II. A critical evaluation of all the ongoing activities is also done together with new proposal.
- III. It provides a systematic approach for evaluation of different activities.
- IV. It provides an opportunity for management to allocate resources to various activities after a proper cost benefit analysis.
- V. It helps in the identification and elimination of wasteful expenditure.
- VI. Introduction of system of management by objective.

Process of zero-base budgeting

The zero Base Budgeting involves the following steps:

- (i) Corporate objectives should be established and laid down in details.
- (ii) Decide about the techniques of ZBB to be applied.
- (iii) Identify those areas where decisions are required to be taken.
- (iv) Develop decision programmes and rank them in order of preferences.
- (v) Preparation of budget,

Advantages and Limitations of Zero base Budgeting

Advantage of ZBB

- (i) Systematic approach for evaluation of different activities and ranks them in order of preference for allocation of scarce resource.
- (ii) It ensures that the various functions undertaken by the organization are critical for the achievement of its objectives and are being performed in the best way.
- (iii) Allocation resources for various activities only after having a thorough cost-benefit analysis.
- (iv) The area of wasteful expenditure can be easily identified and eliminated.
- (v) Departmental budgets are closely linked with corporate objectives.
- (vi) The technique can also be used for the introduction and implementation of the system of management by objective'.

Limitations of ZBB

- (i) Various operational problems are likely to be faced in implementing the technique.
- (ii) The full support of top management is required.
- (iii) It is time consuming as well as costly.
- (iv) It requires proper trained managerial staff.

Benchmarking code of conduct

Benchmarking is the process of identifying and learning from the best practices anywhere in the world. It involves comparing a firm's product, services or activities against other best performing organization either internal or external to the firm. It is a powerful tool for continuous improvement. The objective is to determine how the product, service or activities can be improved.

Suggested benchmarking code of conduct:

- (i) Principle of legality.
- (ii) Principle of exchange.
- (iii) Principle of confidentiality.
- (iv) Principle of use.
- (v) Principle of first party contact
- (vi) Principle of third party contact
- (vii) Principle of preparation

Process of Benchmarking:

The process of benchmarking requires a Company to identify the areas i.e. processes, activity etc. which are central to its business and then selects the top-performing companies in those areas.

The benchmarking process is comprised of following stages.

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1. Planning:
 - (i) Determination of benchmarking goal statement:
 - (ii) Identification of best performance: .
 - (iii) Establishment of the benchmarking or process improvement team:
 - (iv) Defining the relevant benchmarking measurement: .
 2. Collection of data and information:
 3. Analyzing the findings:
 - (i) Review the findings and produce tables, charts and graphs to support the analysts.
 - (ii) Identify gaps in performance between our organisation and better performers.
 - (iii) Seek explanations for the gaps in performance. The performance gaps can be positive, negative or zero.
 - (iv) Ensure that comparisons are meaningful and credible.
 - (v) Communicate the findings to those who are affected.
 - (vi) Identify realistic opportunities for improvements.
 4. Recommendations:
 - (i) Deciding the feasibility of making the improvements in the light of the conditions that apply within own organization.
 - (ii) Agreement of the improvements that are likely to be feasible.
 - (iii) Producing a report on the Benchmarking in which the recommendations are included.
 - (iv) Obtaining the support of key stakeholder groups for making the changes needed.
 - (v) Developing action plan(s) for implementation.
 5. Monitoring and reviewing:
 - (i) Evaluating the benchmarking process undertaken and the results of the improvements.
 - (ii) Documenting the lessons learnt and make them available to others.
 - (iii) Periodically re-considering the benchmarks

Types of bench marking

The Benchmarking is of following types:

- a. Competitive benchmarking: It involves the comparison of competitors products, processes and business results with own.
- b. Strategic benchmarking: It is similar to the process benchmarking in nature but differs in its scope and depth.
- c. Global benchmarking: It is a benchmarking through which distinction in international culture, business processes and trade practices across companies are bridged and their ramification for business process improvement are understood and utilized.
- d. Process benchmarking: It involves the comparison of an organization critical business processes and operations against best practice organization that performs similar work or deliver similar services.
- e. Functional Benchmarking or Generic Benchmarking: This type of benchmarking is used When organizations look to benchmark with partners drawn from different business sectors or areas of activity to find ways of improving similar functions or work processes.
- f. Internal Benchmarking: It involves seeking partners from within the same organization, for example, from business units located in different areas.

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- g. External Benchmarking: It involves seeking help of outside organizations that are known to be best in class. External benchmarking provides opportunities of learning from those who are at the leading edge, although it must be remembered that not every best practice solution can be transferred to others.

Budget ratios

1. Efficiency Ratio = $(\text{Standard hours} + \text{Actual hours}) \times 100$
2. Activity Ratio = $(\text{Standard hours} + \text{Budgeted hours}) \times 100$
3. Calendar Ratio = $(\text{Available working days} \div \text{budgeted working days}) \times 100$
4. Standard Capacity Usage Ratio = $(\text{Budgeted hours} \div \text{Max. possible hours in the budgeted period}) \times 100$
5. Actual Capacity Usage Ratio = $(\text{Actual hours worked} + \text{Maximum possible working hours in a period}) \times 100$
6. Actual usage of Budgeted Capacity Ratio = $(\text{Actual working hours} \div \text{Budgeted hours}) \times 100$

Balanced Score Card

Balanced score card is a set of financial and non-financial measures relating to a company's critical success factors.

It is an approach which provides information to management to assist in strategy implementation.

The components to be included in the balanced scorecard must flow from strategy. The targets should be measurable and must flow from strategy and corporate plan of the company.

It is necessary that managers should agree to the components and targets because in absence of a consensus, managers may not commit to the targets established by the top management / the board of directors.

It is not sufficient that individual managers agree to their targets.

Successful implementation requires that the top management builds an overall consensus on the components and targets of the balanced score card.

Components of a balanced score card

An ideal Balanced score card combines financial measures of past performance with measures of the firm's drivers of future performance.

The following perspectives are evaluated:

- (i) Customer perspective - Measures of price / delivery / quality / support.
- (ii) Internal perspective – Measures of efficiency / sales penetration and new product introduction.
- (iii) Innovation and learning perspective - Measures of technology / cost leadership.
- (iv) Financial perspective - Sales / Cost of sales / Return on capital employed etc. "In many organizations, initiatives to introduce balanced score card failed because efforts were made to negotiate targets rather than to build consensus."

Flexible budget

A flexible budget is a budget which, by recognizing the difference between fixed, semi-variable and variable costs, is designed to change in relation to the level of activity attained.

E.g. seasonal products – e.g. soft drink industry

Industries in make to order business like ship building

Industries influenced by change in fashion.

Industries which keep on introducing new products / new designs.

Costing of Service Sector

Service sector companies provide their customers with services or intangible products.

The activities of service sector may be used for both:

- (i) Provision of services to outside customers
- (ii) Provision of services internally (i.e. captive consumption).

The general principles of costing relating to manufacturing sector also apply to service sector.

MAIN CHARACTERISTICS OF SERVICE SECTOR

- (i) Activities are labour intensive
- (ii) Cost unit is difficult to define.
- (iii) Product costs in service sector:

The following table provides some examples of the cost units for service sector.

Service Sector

Cost Unit

Hotel	Bed nights available, Bed night occupied.
School	Student hours, Full time students
Hospital	Patient per day, Room per day
Accounting firm	Charged out client hours
Internal services Staff canteen	Meals provided, No. of staff
Transport	Passenger km., quintal km.
Machine maintenance	Maintenance hours provided to user department
Computer department	Computer time provided to user department.

COSTING METHODS USED IN SERVICE SECTOR

Like manufacturing sector companies in the service sector, generally adopt one out of the following two basic costing methods to assign costs to services. These are:

1. Job costing method: In service sector like accounting firm, Advertising campaigns etc. job costing method is used. For assigning indirect costs (overheads) models such as Activity Based Costing may be used.
2. Process costing method: Retail banking, Postal delivery, Credit card etc. uses process costing method.
3. Hybrid costing method: Many companies' uses a method of costing which is neither job costing nor process costing method. They in fact uses a hybrid costing method which combines elements of both job costing and process costing methods.

Job costing method in service sector: The two significant costs which are incurred in service sectors are :

- (i) Direct labour
- (ii) Service overheads

For ascertaining the price of a service provided by service sector if job costing method is followed, the costs for each job are to be monitored continuously. There are two main uses of this job cost information:

Steps for assigning costs to individual jobs are as follows:

Identify the job that is chosen as cost object

Identify the direct cost categories for the job:

Identify indirect costs (overheads) associated with the job:

Select the cost allocation base to be used in assigning each indirect cost to the job:

Identify the rate per unit of the cost allocation base used to allocate cost to the job:

$$\text{Budgeted indirect cost rate} = \frac{\text{Budgeted total indirect cost}}{\text{Budgeted total quantity of cost allocation base}}$$

The indirect cost of job is computed as = Budgeted indirect cost rate × Professional labour hours reqd. for job

Customer costing in the service sector:

The customer costing is a new approach to management. In some service industries, such as public relations, the specific output of industry may be difficult to identify and even more difficult to quantify. Consider a banking sector.

A bank's activities for customer will include the following types of activities. These are:

- a. Stopping a cheque
- b. Withdrawal of cash
- c. Updation of pass book
- d. Issue of duplicate pass book
- e. Returning a cheque because of insufficient funds clearing of a customer cheque.

Different customers or categories of customers use different amount of these activities and so **customer profiles** can be built up and customer can be charged according to the cost to serve them.

Customer profile is important in analyzing cost under the following categories

1. Customer specific costs: These are the direct and indirect cost of providing service to customer plus customer related cost assigned to each customer.

For example: cost of express courier service to a client who requests over-night delivery of some agreement.

2. Customer – line categories: These are the costs which are broken into broad categories of customers and not individual customers.

Uniform Costing and Inter Firm Comparison

UNIFORM COSTING

When several undertakings start using the same costing principles and practices they are said to be following uniform costing.

The principles and methods of compilation, analysis, apportionment and absorption of overheads differ from one concern to the other in the same industry.

If a common or uniform pattern is adopted by all, it helps mutually in cost control and cost reduction. Therefore, it is necessary that a uniform method of costing should be adopted by the member unit of an industry.

Objectives/Advantages of Uniform Costing:

The main objectives/Advantages of Uniform Costing are as follows:

1. **Comparison:** To facilitate the comparison of costs and performances of different units in the same industry; it provides objective basis.
2. **Eliminates Competition:** To eliminate unhealthy competition among the different units of an industry.
3. **Improves Efficiency:** To improve production capacity level and labour efficiency by comparing the production costs of different units with each other.
4. **Provides Relevant Data:** To provide relevant cost information/data to the Government for fixing and regulating prices of the products.
5. **Reduces Cost:** To reduce production, administration, selling and distribution costs, and to exercise control on fixed costs.

Limitations of Uniform Costing:

1. Sometimes it is not possible to adopt uniform standards, methods and procedures of costing in different firms due to differing circumstances in which they operate. Hence, the **adoption of uniform costing becomes difficult** in such firms.
2. Disclosure of cost information and other data is an essential requirement of a uniform costing system. Many firms do **not wish to share such information** with their competitors in the same industry.
3. Small firms in an industry believe that uniform costing system is only meant for big and medium size firms, because they **cannot afford it**.
4. It induces monopolistic trend in the business, due to which prices may be increased artificially and supplies withheld.

INTER-FIRM COMPARISON

It is technique of evaluating the performance, efficiency, costs and profits of firms in an industry.

It consists of voluntary exchange of information concerning costs, prices, profits, productivity and overall efficiency among firms engaged in similar type of operations for the purpose of bringing improvement in efficiency and indicating the weaknesses.

Such a comparison will be possible where uniform costing is in operation.

An inter-firm comparison indicates the efficiency of production and selling, adequacy of profits. Such a comparison may be carried out in electrical industry, printing firms, cotton spinning firms, pharmaceuticals, cycle manufacturing, etc.

Requisites of inter-firm comparison system:

The following requisites should be considered while installing a system of inter-firm comparison:—

1. Centre for Inter-Comparison.

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2. Membership.
 3. Nature of information to be collected.
 4. Method of Collection and presentation of information.

Advantages of Inter-firm comparison :

The main advantages of inter-firm comparison are :—

1. Such a comparison gives an overall view of the industry as a whole to its members.
2. It helps a concern in knowing its strengths or weaknesses in relation to others so that remedial measures may be taken.
3. It ensures an unbiased specialized reporting on particular problems of the concern.
4. It develops cost consciousness among members of the industry.
5. It helps Government in effecting price regulation.
6. It helps to improve the quality of products manufactured
7. Reduce the cost of production.

Limitations of inter-firm comparison

The following are the limitations in the implementation of a scheme of inter-firm comparison:

1. Top management feels that secrecy will be lost.
2. Middle management is usually not convinced with the utility of such a comparison.
3. In the absence of a suitable Cost Accounting System, the figures supplied may not be reliable for the purpose of comparison.
4. Suitable basis for comparison may not be available.

Transfer Pricing

Transfer price is the price which one division of an organization charges for a product or service supplied to another division of the same organization.

The whole organization can be divided into a number of divisions; the performance of each division can be measured in terms of both the income earned and the costs which are incurred.

OBJECTIVES OF TRANSFER PRICING SYSTEM

The main-objectives of intra-company transfer pricing are as below:

- i) Emphasis on Profits
- ii) Maximum Utilization of plant capacity
- iii) Optimize allocation of financial resources

METHODS OF TRANSFER PRICING

The methods of pricing usually employed in industry when goods or services are transferred from one unit to the other can be broadly classified under the following three categories:

- i) At cost or variants of cost e.g. actual manufacturing cost; standard cost; full cost and full cost plus mark up.
- ii) At market price.
- iii) At bargained or negotiated prices.
- iv) International Pricing.

ACTIVITY BASED COSTING:-

1. It focuses on activities as the fundamental cost object.
2. Distribution of cost to cost unit on the basis of benefits received from indirect activities.
3. The cost drivers rate are based on activities.
4. ABC can be used for (a) pricing of new product (b) design and development of new product.

ABC info. Used in decision making:-

- a. Pricing.
- b. Make or buy.
- c. Transfer pricing
- d. Capital investment.
- e. Shut down costing.

Concept of ABC:-

- a. ABC is an accounting methodology that assigns cost on activities rather than products and service.
- b. This enables resources and o/h costs to be more accurately assigned to product and services.
- c. ABC assigns cost to activities based on their resources.

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|-----------------------------|--|
| (i) Unit level activities | (i) Use of indirect materials
(ii) Inspection or testing of every item produced or say every 100th item produced
(iii) Indirect consumables |
| (ii) Batch level activities | (i) Material ordering
(ii) Machine set up costs
(iii) Inspection of products—like first item of every batch |
| (iii) Product level | (i) Designing the product
(ii) Producing parts to a certain specification
(iii) Advertising costs, if advertisement is for individual Products |
| (iv) Facility level | (i) Maintenance of buildings
(ii) Plant security
(iii) Production manager's salaries |

Need for emergence of activity of ABC :-

1. Traditional product costing system was designed when most companies manufacture a narrow range of product.
2. Direct material and direct labour were the dominate factor of product than.
3. Companies were in seller's market.
4. Overhead were relatively small.
5. Cost processing information was high.
6. Simple method apportionment of o/h on the basis of Direct labour or machine hour was not correct.
7. Non volume related activities like material handling, set up are important and their costs cannot be apportioned on volume basis.

Which feature of the service organization may create problems for the application of ABC:-

i. Facility sustains cost: - it can be avoided if the organization ceases business. It may be impossible to establish appropriate cost driver.

ii. It is often difficult to define products where they are of intangible nature.

iii. Introduction of ABC may be expensive.

ABC corporate strategy:-

i. ABC system can effectively support the mgt. by furnishing DATA, at the operational level and strategic level.

ii. Info generated by ABC system can also encourage mgt. to redesign the product.

iii. ABC system will report on the resources spending.

iv. Performance based.

v. Mgt. attention to increase in profit.

TOTAL QUALITY MANAGEMENT

IT is defined as set of concept and tools for getting all employee focused on continuous improvement in the eyes of the customers.

The Organization constantly focuses for improvement so that more value can be added through improvement quality at lower cost.

Quality Cost:

Cost of performing the activities to check failure in meeting the quality specification.

These activities are of four types – i) Prevention costs ii) appraisal costs iii) Internal failure costs iv) External failure costs.

Prevention costs	Appraisal Costs	Internal Failure Costs	External Failure Costs
Quality Engineering	Inspection	Scrap	Revenue loss
Quality training	Product acceptance	Rework	Warranties
Quality Audits	Packaging inspection	Re-inspection	Discount due to defects
Design Review	Field testing	Re-testing	Product liability
Quality circles etc	continuing supplier Verification etc	Repair etc	warranty etc

Essential requirements for successful implementation of TQM

1. Commitment: Quality improvement must be everyone's job. Clear commitment from the top management, steps necessary to provide an environment for changing attitudes and breaking down barriers to quality improvement must be provided. Support and training for this must be extended.
2. Culture: Proper training must be given to effect changes in culture and attitude.
3. Continuous Improvement: Recognition of room for improvement continually as a process, and not merely a one-off programme.
4. Cooperation: Must be ensured by involving employees by resorting to mutually agreeable improvement strategies and associated performance measures.
5. Customer Focus: Perfect service with zero defectives with satisfaction to end user whether external customer or internal customer.
6. Control: Documentation, procedures and awareness of current practices ensure checking deviation from the intended course of implementation.

Implementation of a Total Quality Management.

The benefits accruing from the implementation of a Total Quality Management programme in an organization are:

- (i) There will be increased awareness of quality culture in the organization.
- (ii) It will lead to commitment to continuous improvement.
- (iii) It will focus on customer satisfaction.
- (iv) A greater emphasis on team work will be achieved

Critical success factors of TQM:

- Focus on customer needs.
- Everyone in the organization should be involved.
- Focus on continuous improvement.
- Design quality in product and production process.
- Effective performance measurement system.

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- Rewards and performance measurements should be renewed.
 - Appropriate training and education to everyone to understand the aim of TQM.

The Four P's quality improvement principles are as below:

1. People: It will quickly become apparent that some individuals are not ideally suited to the participatory process. Lack of enthusiasm will be apparent from a generally negative approach and a tendency to have prearranged meeting which coincide with the meetings of TOM teams.
2. Process: The rhetoric and inflexibility of a strict Deming approach will often have a demotivating effect on group activity.
3. Problem: Experience suggests that the least successful groups are those approaching problems that are deemed to be too large provide meaningful solutions within a finite time period.
4. Preparation: A training in the workings of Deming- like processes is an inadequate preparation for the efficient implementation of a quality improvement process.

TARGET COSTING

Target costing has been described as a process that occurs in a competitive environment, in which cost minimization is an important component of profitability.

It is a mgt. tool used for reducing a product cost over its entire life cycle.

It is driven by external market factor.

A target market price is determined by marketing mgt. prior to designing and introducing a new product.

This target price is set at a level that will permit the company to achieve a desired market share and sales volume.

A desired profit margin is deducted to determine product cost.

Advantages of Target Costing

1. It reinforces top-to-bottom commitment to process and product innovation, and is aimed at identifying issues to be resolved, in order to achieve some competitive advantage.
2. It helps to create a company's competitive future with market-driven management for designing and manufacturing products that meet the price required for market success.
3. It uses management control systems to support and reinforce manufacturing strategies; and to identify market opportunities that can be converted into real savings to achieve the best value rather than simply the lowest cost.

Features of Target Costing System

1. Target costing is viewed as an integral part of the design and introduction of new products.
2. For any given product, a target selling price is determined using various sales forecasting techniques.
4. Integral to setting the target selling price is the establishment of target production volumes, given the relationship between price and volume. .
5. It should be noted that a fair degree of judgment is needed where the allowable cost and the target cost differ.
6. Having achieved consensus about the product-level target cost, a series of intense activities commence to translate the cost challenge into reality.

Impact of Target Costing on Profitability

Target costing can have a startlingly large positive impact on profitability, depending on the commitment of management to its use, the constant involvement of cost accountants. In all phases of a product's life cycle, and the type of strategy a company follows.

Target costing improves profitability in two ways.

1. It places such a detailed continuing emphasis on product costs throughout the life cycle of every product that it is unlikely that a company will experience runaway costs.
2. It improves profitability through precise targeting of the correct prices at which the company feels it can field a profitable product in the marketplace that will sell in a robust manner.

Most Useful Situations for Target Costing

Target costing is most useful in situations where the majority of product costs are locked in during the product design phase.

This is the case for most manufactured products, but few services.

In the services area, such as consulting, the bulk of all activities can be reconfigured for cost reduction during the "production" phase, which is when services are being provided directly to the customer.

Target Costing Control Points

Control Points which should be taken care of in all target costing projects:

1. Identification of Principal control point:
2. Point of Go/No Go decision.
3. Milestone can be in terms of timer or points:

Implementing a Target Costing System

1. **Create a project charter:** The target costing effort should begin with a document, approved by senior management that describes its goals and what it is authorized to do.
2. **Obtain a management sponsor:** The next step is to obtain the strongest possible support from a management sponsor. This person is central to the success of target costing.
3. **Obtain a budget:** The target costing program requires funds to ensure that one or more well-staffed design teams can complete target costing tasks.
4. **Assign a strong team manager:** Because the typical target costing program involves so many people with different backgrounds and represents so many parts of a company, it can be difficult to weld the group together into a smoothly functioning team focused on key objectives.
5. **Enroll full-time participants:** A target costing team member puts the greatest effort into the program when he or she is focused only on target costing.
6. **Use project management tools:** Target costing can be a highly complex effort especially for high-cost products with many features and components.

LIFE CYCLE COSTING

Life cycle costing as the practice of obtaining over their life time, the best use of physical asset at the lowest cost of entity.

Life cycle costing is different to traditional cost accounting system which report cost object profitability on a calendar basis i.e. monthly, quarterly and annually.

In contrast life cycle costing involves tracing cost and revenues on product by product bases over several calendar periods. Costs and revenue can be analyzed by time period, but the emphasis is on cost revenue accumulation over the entire life cycle of each product.

Product life cycle

Each product has a life cycle. The life cycle of a product vary from a few months to several years. Product life cycle is thus a pattern of expenditure, sale level, revenue and profit over the period from new idea generation to the deletion of product from product range.

Phases of product life cycle

The life cycle of a product consists of four phases viz., Introduction; Growth; Maturity; Saturation and Decline.

- i. Introduction: During introductory phase, a product is launched into the market. Its customers are innovators. Competition is almost negligible and profits are non-existent.
- ii. Growth: Under growth phase, sales and profits rise, at a rapid pace. Competitors enter the market often in large numbers. As a result of competition, profits starts declining near the end of the growth phase.
- iii. Maturity: During the phase of maturity sales continue to increase, but at a decreasing rate.
- iv. Saturation and decline : At last a point comes, when it starts appearing that market has bought enough of the product. Decline in sales volume characterizes this last phase of the product life cycle.

Characteristics of product life cycle

The major characteristics of product life-cycle concept are as follows:

- (i) The products have finite lives and pass through the cycle of development, introduction, growth, maturity, decline and deletion at varying speeds.
- (ii) Product cost, revenue and profit patterns tend to follow predictable courses through the product life cycle. Profits first appear during the growth phase and after stabilizing during the maturity phase, decline thereafter to the point of deletion.
- (iii) Profit per unit varies as products move through their life cycles.
- (iv) Each phase of the product life-cycle poses different threats and opportunities that give rise to different strategic actions.
- (v) Products require different functional emphasis in each phase-such as an R&D emphasis in the development phase and a cost control emphasis in the decline phase.
- (vi) Finding new uses or new users or getting the present users to increase their consumption may extend the life of the product.

Stages of product life cycle

Typically the life cycle of a manufactured product will consist of the following stages:

- (i) Market research: Before any investment is made the investor must believe that what the company proposes to make can be sold at a price which will permit a profit to be made.
- (ii) Specification: When market research has established what is to be made, it will be necessary to turn the general statement of requirements into a detailed specification which will tell the designer and manufacturing engineer precisely what is required.
- (iii) Design: With a precise specification, the designers can produce the drawings and process schedules which define the geometry of the product and some of the manufacturing processes.
- (v) Prototype manufacture: From the drawings it will be possible to manufacture a small number of the product.

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- (vi) Development: When a product has been made for the first time, it is necessary to prove that it meets the requirements of the specification.
 - (vii) Tooling : When a product is shown to meet the requirements of the specification and if calculations suggest that it will be profitable, the decision will be made to make it to sell.
 - (viii) Manufacture: The manufacture of a product involves the purchase of the raw materials, the purchase of bought out components, the use of labour to make and assemble the product, and the use of supervisory labour.
 - (ix) Selling : When the product is fit to sell and available, it may be necessary to spend money on a campaign to sell the product.
 - (ix) Distribution : In the process of selling the product, it must be distributed to the sales outlets and to the customers.
 - (x) Product support : When the product has been bought, the customer will expect it to be supported.

Product life cycle costing

It is an approach used to provide a long term picture of product line profitability, feedback on the effectiveness of life cycle planning and cost data to clarify the economic impact of alternatives chosen in the design, engineering phase etc.

It is also considered as a way to enhance the control of manufacturing costs.

The thrust of product life cycle costing is on the distribution of costs among categories changes over the life of the product, as does the potential profitability of a product.

Hence it is important to track and measure costs during each stage of a product's life cycle.

Features of product life cycle costing

Product life cycle costing is important due to the following features:

- (i) Product life cycle costing involves tracing of costs and revenues of each product over several calendar periods throughout their entire life cycle.
- (ii) Costs and revenues can be analyzed by time periods, but the emphasis is on cost and revenue accumulation over the entire life cycle for each product.
- (iii) Product life cycle costing traces research and design and development costs etc., incurred to individual products over their entire life cycles.
- (iv) Life cycle costing ensures that costs for each individual product can be reported and compared with product revenues generated in later periods.
- (v) Hence the costs are made more visible.

Benefits of product life cycle costing

The benefits of product life cycle costing are summarized as follows:

- (i) The product life cycle costing results in earlier actions to generate revenue or to lower costs than otherwise might be considered. There are a number of factors that need to be managed in order to **maximize return on a product**.
- (ii) **Better decisions** should follow from a more accurate and realistic assessment of revenues and costs, at least within a particular life cycle stage.
- (iii) Product life cycle thinking can promote long-term rewarding in contrast to short-term profitability rewarding.
- (iv) It provides an overall framework for considering total incremental costs over the entire life of a product.

VALUE CHAIN ANALYSIS

Competitive advantage for a company means not just matching or surpassing their competitors, but discovering what the customers want and then profitably satisfying, and even exceeding, their expectations. As barriers to inter-regional and international trade are diminishing and as access to goods and services are growing, customers can locate after identification and acquire the best of what they want, at an acceptable price, wherever it is in the world. Under growing competition and, hence, rising customer expectations, a company's penalty for complacency becomes even greater.

A strategic tool to measure the importance of the customer's perceived value is value chain analysis. By enabling companies to determine the strategic advantages and disadvantages of their activities and value-creating processes in the marketplace, value chain analysis becomes essential for assessing competitive advantage.

Classification of business activities for Value Chain Analysis: Porter classified business activities under two heads.

1. **Primary activities** are directly involved in transforming inputs into outputs and delivery and after-sales support to output. In other words they include:
 - Material handling and warehousing
 - transforming inputs into final product
 - order processing and distribution
 - Communication, pricing and channel management, and
 - Installation, repair and parts replacement.
2. **Support activities** are the activities which support primary activities. They are handled by the organization's staff functions and include the following:
 1. Procurement
 2. Technology Development — know-how, procedures and technological inputs needed in every value chain activity.
 3. Human resource management.
 4. Firm infrastructure — general management, planning, finance, accounting, legal, government affairs and quality management.

Strategic Frameworks for Value Chain Analysis

Value chain analysis requires a strategic framework or focus for organizing internal and external information, for analyzing information, and for summarizing findings and recommendations. Because value chain analysis is still evolving, no uniform practices have yet been established.

JUST IN TIME

A just in time approach is a collection of ideas that streamline a company's production process activates to such an extent that wastage of all kinds viz., of time, material, and labour is systematically driven out of the process.

JIT has a decisive, positive impact on product costs. its use affects different variety of costs, capital investments, and measurements.

A complete JIT system begins with production, includes deliveries to a company's production facilities, continues through the manufacturing plant, and even includes the types of transactions processed by the accounting system.

To begin with, a company must ensure that it receives products/spare parts/materials from its suppliers on the exact date and at the exact time when they are needed.

Deliveries should be sent straight to the production floor for immediate use in manufactured products, so that there is no time to inspect incoming parts for defects.

Engineering staff must visit supplier sites and examine their processes, not only to see if they can reliably ship high-quality parts but also to provide them with engineering assistance to bring them up to a higher standard of product.

As soon as suppliers certify for their delivery and quality, the concern must install a system, which may be as simplistic as a fax machine or as advanced as an electronic data interchange system or linked computer systems, that tells suppliers exactly how much of which parts are to be sent to the company.

Impact/Benefit of JIT System

JIT system is its continuous focus on eliminating all waste from a system.

This can be a waste of assets, excessive inventory.

(e.g., work-in-process inventory held in a production queue). It can also be a waste of materials, such as unnecessary levels of obsolete inventory, defective products, rework, and the like. When fully installed, This reduces the amount of materials handling costs that used to be charged to overhead.

Supervisors/inspectors; accordingly, the cost of their pay can be eliminated from overhead costs.

All these costs (and more) do not directly add value to a product, so they are wasteful costs that are subject to elimination.

Queue time is eliminated by not allowing inventory to build up in front of machines.

By shrinking the amount of wastage time out of the manufacturing process.

Elimination of activities that do not contribute to the value of a product.

According to several estimates the annual cost of inventory is 25% of the total inventory investment. By **eliminating excessive storage of inventory a company** experiences not only a decline in its inventory investment but also the elimination of all associated costs.

I **Inventory-related costs are:**

- Interest cost related to the debt that funds the inventory investment
- Cost of inventory that becomes obsolete over time
- Cost of rent for inventory storage facilities
- Cost of all equipment used in the warehouse
- Cost of warehouse utilities
- Cost of warehouse employees
- Cost of insurance needed to cover the possible loss of inventory
- Cost of taxes on the inventory

Back flushing in a JIT System

Back flushing requires no data entry of any kind until a finished product is completed.

At that time the total amount finished is entered into the computer system, which multiplies it by all the components listed in the bill of materials for each item produced.

This yields a lengthy list of components that should have been used in the production process and which are subtracted from the beginning inventory balance to arrive at the amount of inventory that should now be left on hand.

There are some serious problems with back flushing that must be corrected before it will work properly. They are:

1. Production reporting: The total production figure entered into the system must be absolutely correct.
2. Scrap reporting: All abnormal scrap must be diligently tracked and recorded.
3. Lot tracing: Lot tracing is impossible under the back flushing system.
4. Inventory accuracy : The inventory balance may be too high at all times because the back flushing transaction that relieves inventory usually does so only once a day, during which time other inventory is sent to the production process.

LINEAR PROGRAMMING

Linear programming is a mathematical technique for determining the optimal allocation of re-sources and achieving the specified objective

When there are alternative uses of the resources like money, manpower, materials, machines and other facilities.

The objective in resource allocation may be either cost minimization or profit maximization.

All the limitations or constraints and the objective must be expressed as linear functions.

We know that there is an opportunity cost for scarce resources that should be included in the relevant cost calculation for decision making and variance calculations.

In practice several resources may be scarce.

The opportunity cost of these scarce resources can be determined by the use of linear programming techniques.

CONDITION

1. There must be decision variable.
2. The decision variable must have an objective:- to minimize the cost or maximize the profit.
3. The decision variable must be non negative.
4. The decision variable must be interrelated.
5. The action of decision maker must be constrained .
6. The must be expressed in terms of LLP equation.

PRACTIAL APPLICATION OF LP

LP can be used to find used to optional solution under constraints:-

1. In production () products mix (b) inventory management.

2. Sensitivity analysis.
3. Blending
4. Finance
5. Advertising mix.

NON INDUSTRIAL APPLICATION

1. AGRICULTURE
2. URBAN DEVELOPMENT
3. ENVIRONMENTAL PROTECTION
4. PUBLIC FACILITIES LOCATION.

LIMITATION OF LPP

1. Constraints are unlikely to be completely fixed.
2. Output of the model is dependent on the accuracy of estimates used.
3. Divisibility of product is not realistic in practice.
4. The graphical approach required only 2 variable be considered
5. Qualitative factor are not considered.

CONSTRAINTS

1. IT help the management to focus its attention on constraints and bottlenecks with in the organization.
2. In a manufacturing organized it constraints on maximizing the rate of output.
3. A bottleneck is always constraints but a constraints need not to be a bottleneck.
4. KEY measure of theory of constraints throughput contribution , investment , other operating cost.

Types of linear programming problems

- (i) General Linear Programming Problems.
- (ii) Transportation Problems.
- (iii) Assignment Problems.
- (iv) Blending Problems.

General Linear Programming Problems

1. **Formulate Linear Programming Problem**
 - a. Objective Function of Business.
 - b. Constraint of Business.
2. **Solution of Linear Programming Problem.**
 - a. Graphical Method (only 2 variables)
 - b. Simplex Method (any no. of variables)

Steps to be followed under graphical solution to a linear programming problem.

- i. Formulating the linear programming problem
- ii. Plotting the capacity constraints on the graph paper.
- iii. Identifying feasible region and coordinates of corner points.
- iv. Testing the corner point which gives maximum profit.
- v. For decision – making purpose, sometimes, it is required to know whether Optimal point leaves some resources unutilized.

Note : If the slope of the objective function be same as that of one side of feasible region, there are multiple solutions to the problem. However, the optimized value of the objective function remains the same.

The Transportation Problem

A transportation problem belongs to special class of linear programming problems.

OBJECTIVE

1. Minimize the transportation cost
2. Maximize the profit.

When there are alternative route of transporting goods from M origins to N destinations.

METHODS OF FINDING INITIAL SOLUTION TO TRANSPORTATION PROBLEMS

Northwest corner Rule:

Steps:

1. Before allocation ensures that the total of availability and requirement is equal. If not then make same equal.
2. The first allocation is made in the cell occupying the upper left hand corner (Northwest) of the matrix. The assignment is made in such a way that either the resource availability is exhausted or the demand at the first destination is satisfied.
4. The above procedure is repeated until all the row availability and column requirements are satisfied.

This method does not use transportation costs which we shall bring in later in the other method.

The Least cost method:

- i) Before starting the process of allocation ensures that the total of availability and demand is equal. if not then make same equal.
- ii) The least cost method starts by making the first allocation in the cell whose shipping cost (or transportation cost) per unit is lowest.
- iii) This lowest cost cell is loaded or filled as much as possible in view of the origin capacity of its row and the destination requirements of its column.
- iv) We move to the next lowest cost cell and make an allocation in view of the remaining capacity and requirement of its row and column.
- v) In case there is a tie for the lowest cost cell during any allocation, we can exercise our judgment and we arbitrarily choose cell for allocation.
- vi) The above procedure is repeated till all row requirements are satisfied.

Vogel's Approximation Method (VAM)

The Vogel's Approximation Method (VAM) is considered to be superior to the northwest and least cost rule in that it usually provides an initial solution that is **optimal or nearly so**.

VAM entails the following steps:

Step 1: For each row of the transportation table identify the smallest and next smallest costs.

Find the difference between the two costs and display it to the right of that row as "Difference" (Diff.). Likewise, find such a difference for each column and display it below that column. In case two cells contain the same least cost then the difference will be taken as zero.

Step 2: From amongst these row and column differences, select the one with the largest difference. Allocate the maximum possible to the least cost cell in the selected column or row.

Step 3: **If there occurs a tie amongst the largest differences**, the choice may be made for a row or column which has least cost.

In case there is a tie in cost cell also, choice may be made for a row or column by which maximum requirement is exhausted.

Step 4: Recomputed the column and row differences for the reduced transportation table and go to step 2.

5. Repeat the procedure until the entire column and row totals are exhausted.

OPTIMALITY TEST:

Now we know how to obtain the initial basic feasible solution but it remains to be tested whether it is optimal or not if it is not so, how do we go about deriving the optimal solution?

STEP 1:- ensure that initial solution is fit for optimality test.

An initial solution is fit, when the $M+N-1$ = No. of allocated. If $M+N-1$ is not equal to No. of allocated cell then we have to make it fit by making the sufficient allocation (dummy allocation).

STEP 2:- Prepare U+V Matrix for allocated cell:- $C_{ij} = U_i + V_j$

Where C_{ij} = shipping /transportation cost of ith row , jth column.(it will be given in the question)

U = value of ith row.

V = value of jth column.

STEP 3:- prepare delta matrix of for unallocated cells :- $C_{ij} - (U_i + V_j)$

Step 4:- use improvement procedure:- when the delta of any unallocated cell are negative , then improvement procedure is used.

when the delta of all the unallocated cell are zero or positive that means optimal solution is achieved.

Step 2,3 and 4 is repeated till we get optimal solution.

STEP 5:- calculate required transportation cost or profit.

Unbalanced transportation problem

If the total availability differs from the total requirement then the problem is said to be unbalanced.

In such a case we introduce dummy destination or dummy origin.

If availability exceeds requirement introduce dummy destination and if the availability falls short of requirement introduce a dummy origin.

The cost of transportation from any dummy origin or dummy destination is taken as zero.

Penalty cost of unsatisfied demand is taken as shipping cost of dummy demand.

Degeneracy (unfit)

If the number of allocated cell in initial solution are less than $M+N-1$ then the problem is said to be degenerate solution.

In such a case we introduce small allocation "e" to the list cost independent cell to make allocation equals to $M+N-1$.

PROHIBITED ROUTES:

Sometimes in a given transportation problem, some routes may not be available. There could be several reasons for this such as bad road conditions or strike etc. In such situations, there is a restriction on the route available for transportation.

To handle such type of a situation, a very large cost (or a negative profit for the maximization problem) represented by "M" is assigned to each of such routes which are not available.

Due to assignment of very large cost, such routes would automatically be eliminated in the final solution. The problem is solved in its usual way.

MAXIMISATION TRANSPORTATION PROBLEMS

IN some transportation problems the profit are calculated after deducting the shipping cost. The total profit thus to be maximized. Such problems are converted in to minimization problem by preparing loss table and then applying the minimization algorithm. The loss table is formed by subtracting all the figure of the profit table from the maximum value of the profit table. If there is dummy in the problem then first introduce the dummy and then prepare loss table.

LOOP

WHEN the delta of any unallocated cell are negative that means there is scope of improvement. If we made the allocation in the cell having negative delta then cost can be reduced.

We have to adjust at least 3 other allocated cells also.

If loop can be formed that means re allocation is possible otherwise reallocation is not possible.

A loop can be formed by moving horizontal or vertical line such that there is an allocated cell at the corner of the loop.

A cell is said to be independent if it is not possible to form a loop with the cell as a corner.

- i. The loop must start from the cell which has the highest negative value.
- ii. The corner point of the loop must be allocated cell.
- iii. The loop may be clockwise or anti clockwise
- iv. The loop consists of horizontal or vertical line.
- v. The starting point and ending point of the loop always must be same.

Question

How do you know whether an alternative solution exists for a transportation problem?

Question

Will the initial solution for a minimization problem obtained by Vogel's Approximation Method and the Least Cost Method be the same ? Why?

Answer

The initial solution need not be the same under both methods.

Vogel's Approximation Method uses the differences between the minimum and the next minimum costs for each row and column.

But least cost given preference to the lowest cost cell, irrespective of the next cost.

Vogel's Approximation Method will to result in a more optimal solution than least cost.

They will be the same only when the maximum penalty and the minimum cost coincide

ASSIGNMENT PROBLEMS

When there are 2 or more than 2 jobs and 2 or more than 2 worker.

Each job can be performed by each worker. Time taken by different worker for the same job is different.

In such a case assignment technology helps us in allocation of job to performer.

The Assignment Problem is another special case of LPP.

OBJECTIVE

1. MINIMISATION OF COST, SCRAP, TIME.
2. MAXIMISATION OF SALES, REVENUE, PROFIT, ROI, PRODUCTION.

STEPS IN ASSIGNMENT

1. Make row operation :- Smallest element of each row is deducted from all the element of that row.
2. Make column operation:- Smallest element of each column is deducted from all the element of that column.

3. Make line operation:- minimum number of line (horizontal or vertical) are drawn to cut all the zero through the minimum no of line.
4. Use improvement procedure:- when the no. of line are less than no. of job, then the improvement procedure are followed. Under this procedure smallest uncovered element is identified and deducted from all the uncovered element and added to the junction point/element.
After improvement procedure, we again draw the line, when the no. of line become equal to no of job then improvement procedure is stopped, otherwise improvement procedure is repeated.
5. Make the final assignment:- for the purpose of final assignment ,we start identifying zero, row by row. Row having 2 or more zero are ignored. Assignment is made to the row having only one zero. We again start identifying zero, column by column, column having 2 or more zero are ignored. Assignment is made to the column having one zero.
Zero in row/column in which assignment is made are cancelled by cross mark.
6. Calculate the desire result (object)

ARBITRARY ASSIGNMENT

When all the row and column having 2 or more zero, then we made arbitrary assignment. This condition also indicates that more than one best solution is possible.

Maximization PROBLEM

IN case of maximization problem, before making row operation we convert profit table in to the loss table.

For this purpose maximum sales revenue or profit is identified from the matrix.

Loss table is prepared by reducing the each element from the maximum revenue figure.

LEARNING CURVE

- I. Learning is the process by which an individual acquires skill, knowledge and ability.
- II. When a new product or process is started, performance of worker is not at its best and learning phenomenon takes place.
- III. As the experience is gained, the performance of worker improves, time taken per unit reduces and thus his productivity goes up.
- IV. This improvement in productivity of workers is due to learning effect.
- V. The amount of decrease will be less and less with each successive unit produced.
- VI. As more units are produced, people involved in production become more efficient than before.
- VII. Each additional unit takes less time to produce.

APPLICATION OF LEARNING CURVE

- I. Commercial activities
- II. Industrial activities
- III. Defense production.
- IV. Helps to analyze cost-volume profit relationships
- V. It helps in budgeting and profit planning.
- VI. It helps in pricing and consequent decision making.
- VII. It helps in setting standards in the learning phase.

LEARNING CURVE THEORY IN MANUFACTURING ENVIRONMENT

As the production quantity of a given item doubled, the cost of that item decrease at a fixed rate.

The key words, 'doubled' and 'rate' are important as the quantity produced doubles, the absolute amount of cost increase will be successively smaller but the rate of decrease will remain fixed.

- (i) Better tooling methods are developed and used.
- (ii) More productive equipments are designed and used to make the product.
- (iii) Designed problems are detected and corrected.
- (iv) Engineering changes decrease over the time.
- (v) Rejections and rework tend to diminish over time.

As the quantity produced increases and the cost per unit drops.

The reasons for this are that each unit will entail:

- (a) Less labour;
- (b) Less material;
- (c) More units produced from the same equipments;
- (d) Cost of fewer delays and less loss time.

LIMITATIONS OF LEARNING CURVE THEORY

1. All activities of a firm are not subject to learning effect. Following types of activities are subject to learning effect:

- (a) Those that have not been performed in this present operational mode.
 - (b) Those which are being performed by new workmen, new employees or others not familiar with the particular activity.
 - (c) Those involving utilization of material not used by firm so far.
2. In practice it is highly unlikely that there will be a regular consistent rate of decrease.
3. Considerable difficulty arises in obtaining valid data.
4. It is applicable only to manual work/labour and it is not applicable to automated work.

1. Learning Curve ratio : Average labour cost of first 2N units or lots/ Average labour cost of first N units

2. Learning index $s = \log \text{ of learning Curve ratio} / \log 2$

3. Learning Curve Equation:- $Y_x = KX^s$. $\log Y_x = \log K + s \log X$

Where,

Y is the cumulative average unit cost of those units X or lots.

K is time taken for first unit or lot

X is number of units or lots produced

s is learning index

ASSUMPTION:-

- I. Time taken p.u. is constant.
- II. Labour cost p.u. is constant.
- III. Time taken p.u. is reduced to the certain level.
- IV. It is applicable to manual work only.

SIMULATION

It is a tech. of conducting a series of organized trial and error experiments.

It is a tech. of estimating/predicting future event on the basis past event/information and using Random Number.

In simulation, we build mathematical models which we cannot solve and run them on trial data to simulate the behavior of the system.

The probabilistic simulation models deal with random phenomenon and the method of simulation applied is known as Monte Carlo simulation.

APPLICATION OF SIMULATION

1. Flight Scheduling.
2. Transport Scheduling.
3. Traffic light timing Control.
4. Planning Military Strategy.
5. Production Scheduling.
6. Hospital Emergency Facilities.
7. Parking Lots.

STEPS OF SIMULATION

1. PREPAIR STATEMENT OF RANDOM INTERVAL TABLE OF COMULATIVE PROBABILITIES.
2. PREPAIR STATEMENT OF SIMULATED DATA.

ADVANTAGE OF SIMULATION

1. IT is flexible and straightforward.
2. Simulation do not interfere with real world situation.
3. Once the model has been constructed it can be used for other situation.
4. It can be used to analyse large and complex real world situation that can not be solved by convenentional quantitative analyses model.

Disadvantage of simulation

1. It is trail and error.
2. It does not give optimal solution.
3. It is long, complicated process to develop a model.
4. Each simulation model is unique.

PERT/CPM

Planning, Scheduling and Controlling are three important functions of management.

Planning involves the formulation of objectives and goals that are subsequently translated into specific plans and projects.

Scheduling is concerned about the implementation of activities necessary to achieve the laid down plans.

The function of control is to institute a mechanism that can trigger a warning signal if actual performance is deviating (in terms of time, cost and some other measures of effectiveness) from the plan.

If such a deviation is unacceptable to the concerned manager, he will be required to take corrective action to bring performance in conformity with the plans.

The PERT and CPM models are extremely useful for the purpose of planning, scheduling and controlling the progress and completion of large and complex projects or for carrying out the analysis of these three managerial functions.

PROJECT

A project can be defined as a set of large number of activities or jobs that are performed in a certain sequence determined logically or technologically and it has to be completed within

- (i) A specified time,
- (ii) A specified cost and
- (iii) Meeting the performance standards.

EXAMPLE

- 1. Introducing a new product in the market.
- 2. Construction of a new bridge over a river or construction of a 25 storied building.
- 3. Executing a large and complex order on jobbing production.
- 4. Sending a spacecraft to the mars.

NETWORK

A network is a graphical representation of a project, as well as the sequence of well-defined activities and events.

The network approach helps project managers in planning, scheduling and controlling.

As a planning tool it helps the manager to estimate the requirements of resources viz., materials, equipment, manpower, cost and time for each activity or tasks of the project.

Developed during the 1950s, both CPM (Critical Path Method) and PERT (Programme Evaluation and Review Technique) are network techniques.

It helps in identification of those activities, jobs or events which control the completion of the project.

CRITICAL PATH ANALYSIS

- 1. The longest path of the network is called the critical path and its length determine the minimum duration in which the said project can be completed.
- 2. The critical path of a project will not remain static throughout its life; it can change during the course of project completion.
- 3. Due to variation in the time duration of the project activities, if some activities take more or less time than there expected time.
- 4. This may render some of the non critical activities as critical and vice-versa.

STEPS IN CPM and PERT:

- 1. Analyze and break down the project in terms of specific activities and/ or events.
- 2. Determine the interdependence and sequence of specific activities and prepare a net-work.
- 3. Assign estimates of time, cost or both to all the activities of the network.
- 4. Identify the longest or critical path through the network.

-
5. Monitor, evaluate and control the progress of the project by replanning, rescheduling and reassignment of resources.

ACTIVITY

An activity is any portion of a project which consumes time or resources and has a definable beginning and ending.

For example, "laying of pipe" is an activity requiring the use of resource mainly effort.

Activity may involve labour, paper work, contractual negotiations, machinery operations, etc.

Commonly used terms with "activity" are "task" and "job".

Activities are graphically represented by arrows, usually with description and time estimates written along the arrows.

The tail of the arrow portraying an activity represents the starting point of the activity and its head represents its completion.

The arrow may be straight slanting, or bent but not broken, the arrow is not a vector and need not be drawn to scale.

EVENT

The beginning and ending points of an activity or a group of activities are called events. An event is often represented graphically by a numbered.

All activities in a network must commence from some event. Such events are called the tail events because they are connected to the tail of an activity.

Similarly, all activities in a network must have terminal points called the head event, because it is at the head of an activity.

- (a) Time flows from left to right.
- (b) Head events always have a number higher than that of the tail events.

Graphical representation of events and activities: Events are represented by numbers within circles.

Activities are represented by arrows. The arrow-heads represent the completion of the activities.

- 1. An event cannot occur until all activities leading to it are complete.
- 2. No activity can start until its tail event is reached.
- 3. All activities must start and finish with an event.

DUMMY ACTIVITY

It is a hypothetical activity which consumes no resource and time. It is represented by dotted lines and is inserted in the network to clarify activity pattern under the following situations:

- (i) It is created to make activities with common starting and finishing events distinguishable.
 - (ii) to identify and maintain the proper dependence relationship between activities.
 - (iii) to bring all "loose ends" together.
- Example, problem of duplicate activities

DISTINCTION BETWEEN PERT AND CPM

The PERT and CPM models are similar in terms of their basic structure, rationale and mode of analysis. However, there are certain distinctions between PERT and CPM networks which are enumerated below:

- (i) CPM is activity oriented. On the other hand, PERT is event oriented.
- (ii) CPM is a deterministic model (It does not take into account the uncertainties involved in the estimation of time for execution of a job or an activity). PERT, however, is a probabilistic model (It uses three estimates of the activity time; optimistic, pessimistic and most likely).
- (iii) CPM places dual emphasis on time and cost. PERT is primarily concerned with time.

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- (iv) CPM is commonly used for those projects which are repetitive in nature. PERT is widely used for planning and scheduling research and development projects.

UPDATING THE NETWORK

The progress of various activities in a project network is measured periodically. Normally, either most of the activities are ahead or behind the schedule. It is therefore, necessary to update or redraw the network periodically to know the exact position of completion of each activity of the project. The task of updating the network may be carried out once in a month. Sometimes the updating of the network may provide useful information to such an extent that it may demand the revision of even those very activities which have not started.

PROJECT CRASHING

1. In many situation there may be compelling reason to complete the project earlier than the originally estimated time of critical path on the basis of normal activity times.
2. Under these circumstances, additional resources can be used to expedite certain activities resulting on earlier completion of the project.
3. Since the project duration is determine by the length of critical path, it can be shortened by reducing the time of critical activities.

Activity Cost : It is defined as the cost of performing and completing a particular activity or task.

Crash Cost C_c : This is the direct cost that is anticipated in completing an activity within the crash time.

Crash time, C_t : This is the minimum time required to complete an activity.

Normal Cost, N_c : This is the lowest possible direct cost required to complete an activity.

Normal time, N_t : This is the minimum time required to complete an activity at normal cost.

Activity cost slope: $\text{Crash cost} - \text{Normal cost} / \text{Normal Time} - \text{Crash Time}$.

Note:- Crashing is advised up to the stage, where the indirect cost is less than the crash cost.
