

B.E.
Sixth Semester Examination, 2010
Industrial Engineering (ME-312-E)

Note : Attempt any five questions. All questions carry equal marks.

Q. 1. Define Method Study. Discuss various techniques of method study.

Ans. Method Study : Method study has already been defined, but the definition is worth repeating at this point.

"Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods and reducing costs."

From the above definition, it is clear that method study is concerned with the development of efficient and economical work methods. Proper development of these methods calls for the cooperative efforts of the design engineer, process engineer and method analyst. There is a continuing need for analyzing existing methods even in the case in which especial efforts are made to develop efficient original work method. The reason for this is that the best methods day may not necessarily remain the best method after some period. Subsequent investigations may reveal that more economical materials are available, more efficient machines, tools, jigs and fixtures have been designed, better inspection methods have been evolved, more satisfactory materials handling equipment can now be procured; the existing plant layout is obsolete because of change in the product design and so on. Therefore, opportunities to improve upon existing methods always exists because of technological developments.

The Objectives of Method Study :

- (i) The improvement of processes and procedures.
- (ii) The improvement of factory, shop and work place layout and of the design of plant and equipment.
- (iii) Economy in human effort and reduction of unnecessary fatigue.
- (iv) Improvement in the use of materials, machines and manpower.
- (v) The development of better physical working environment.
- (vi) To find the best way of doing a job.
- (vii) To standardize the best method.
- (viii) To train the individual worker in its practice as per standardized method.
- (ix) Reduction of waste and scrap, improvement in quality.
- (x) Effective material handling.

Basic Procedures/Steps in Method Study : The techniques of method study aim at doing 3 things:

- (i) To reveal and analyze the true facts concerning the situation.
- (ii) To examine those facts critically.

(iii) To develop from the examination of the facts the best answer possible under the present circumstances.

In examining problem there should be a definite and ordered sequence of analysis. Such a sequence may be summarized as follows :

- (i) Define the problem.
- (ii) Obtain all the relevant to the problem.
- (iii) Examine the facts critically and impartially.
- (iv) Consider the courses open and decide which to follow.
- (v) Act on the decision.
- (vi) Follow up the development.

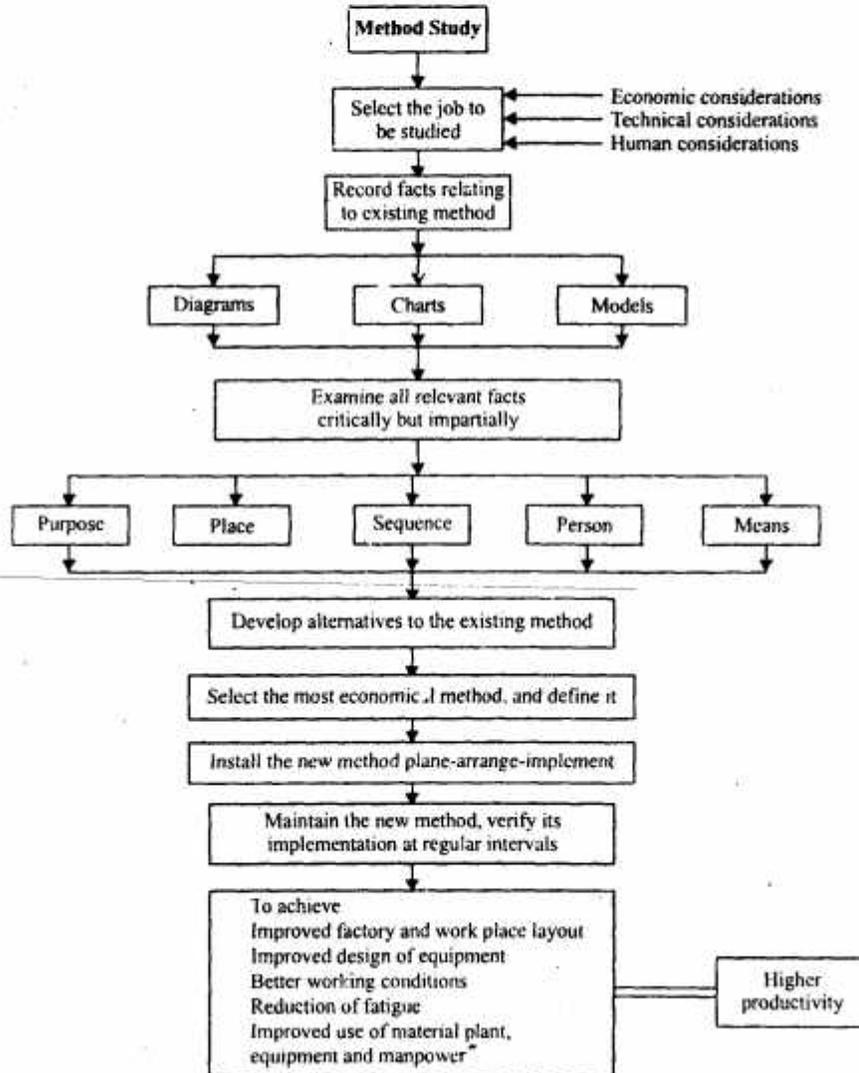


Fig. Steps in Method Study

Q. 2. (a) Discuss the need and methods of Job Evaluation.

Ans. Methods of Job Evaluation :

- (i) Its main objective to formulate an appropriate and uniform wage structure.
- (ii) Eliminates wage inequalities.
- (iii) Determines relative value of different jobs in an organisation and thereby establishes wage differentials between them.
- (iv) Clarifies the responsibility and authority associated with the jobs.
- (v) Provides a basis for recruitment, selection, promotion and transfer of employees.
- (vi) Identify need for training of the employees so as to prepare them for future jobs.
- (vii) Eliminates cause of employees' dissatisfaction and reduces conflicts in industrial relations.

War Man Power Commission, USA, published a "Guide for Analysing Jobs." It proposes a four point job analysis formula to be used in making an accurate and useful job study.

These four points are :

- (i) What does the worker do?
- (ii) How does he do it?
- (iii) Why does he do it?
- (iv) The skill involved in doing it.

It points out that the analyst must establish all the complete scope of the job and consider all the physical and mental activities involved in determining what worker does.

To analyse how the worker does it, the analyst must study the physical methods used by the worker, use of machinery, tools, his movements and the necessary know-how or mental operations. The 'why' for the job is the overall purpose for which the job is done.

The skill factor is necessary to discriminate between jobs and establish the degree of difficulty of any job. These factors include the experience and training by which the skill is involved and the working conditions and hazards associated with the jobs.

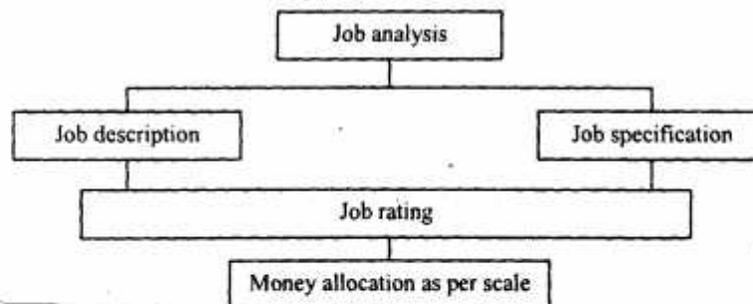


Fig. The components of job evaluation

Q. 2. (b) Discuss various incentive payment schemes.

Ans. Incentives Payment Schemes : Incentive is a reward given to the worker for its efficiency and hard work. In this system the worker gets a guaranteed minimum wages plus some extra payment or bonus for extra work done over and above the standard work. Incentive motivates and encourages the

worker to produce more and better. **An incentive scheme may be defined as,** 'a system of wage payment under which the earnings of an employee, or a group of employees, or all employees in an organisation is directly related to the output of an acceptable quality and over and above a standard laid down by means of predetermined formula.

Financial Incentive : In order to enhance the efficiency further, some financial incentives are given to the worker in the form of :

- (i) Bonus and
- (ii) Profit sharing

It excludes wages, overtime etc. Financial incentives is one of the most powerful motivator in India because of low wages at every level of employment.

Non-Financial Incentives : These do not provide financial gains to the workers, but help in increasing the efficiency and motivation of the workers. It includes :

- (i) Due praise of workers for good work.
- (ii) Service security.
- (iii) Training and other employee-improvement programmes.
- (iv) Better and healthy working condition.
- (v) Chances of promotion.
- (vi) Helpful and co-operative management.

Semi-Financial Incentives : Semi-financial incentives include :

(i) Provision of subsidised lunch, recreational and medical facilities to the workers and subsidised educational facilities for their children.

- (ii) Pension and other benefits.

The incentives may be paid at flat rate for all levels of output or at varying rates for different levels of output. When incentives are at varying rates, the rate goes on increasing with increase in level of output. The incentive schemes may be two types :

- (i) Individual incentive scheme
- (ii) Group incentive scheme

(i) Individual Incentive Scheme : Under this scheme each individual is paid incentive on the basis of his individual output/performance irrespective of aggregate output of his department or organisation. Employer has to pay incentive to those workers who produce more than the standard output even though actual output of the department is less than the standards.

(ii) Group Incentive Scheme : In this scheme each employee is paid incentive on the basis of collective performance of his work group. This scheme is generally preferred by employer because his liability for payment of incentive arises only when he has achieved something in return i.e., increase in aggregate output. This scheme is not liked by highly competent or productive employees whose colleagues are not highly competent.

Q. 3. (a) Differentiate between :

- (i) Direct and Indirect Cost
- (ii) Fixed and Variable Cost

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Ans. (i) Direct and Indirect Cost : It is the cost of materials required for the manufacturing of the product. It consists of :

(a) Cost of direct materials

(b) Cost of indirect materials

(a) Cost of Direct Materials : It is the cost of materials which are processed through various stages to form the main product or a component part of the product. The cost of direct materials includes the purchase price as well as incidental charges such as freight, insurance, loading and unloading expenses, octroi, import duties etc. Examples : m.s. bar used to manufacture spindles. High speed steel used to manufacture cutter, C.I. used to manufacture pulleys etc.

(b) Cost of Indirect Materials : It is the cost of materials which are essentially needed in various shops for helping the direct materials to be converted into finished product. The examples of indirect materials are grease, lubricating oil used to lubricate the equipments, coolants used to cool the job and the tool, cotton waste and kerosene used for cleaning equipments, screws, nails etc.

Cost of Labour :

(a) Cost of direct labour

(b) Cost of indirect labour

(a) Cost of Direct Labour : Direct labour cost consists of wages paid to the workers directly engaged in the manufacturing of the product. It also includes the wages paid to the workers engaged in handling the product inside the department. Examples : wages paid to the machinist, turner, black smith welder, moulder etc.

(b) Cost of Indirect Labour : The wages paid to the labour who helps the productive labour in performing their duties known as indirect labour cost. It cannot be charged directly to a particular job, but are charged on the number of products produced in the plant during a particular period.

Example, wages paid to the supervisor, inspector, time keeper, sweeper, watchmen, helper etc.

(ii) Fixed and Variable Costs : Cost can be classified on the basis of the degree to which they vary in total with changes in the rate of output as :

(a) Fixed costs

(b) Variable costs

This type of classification is useful for budgeting, for estimating costs of new orders and quoting prices and for break even analysis.

(a) Fixed Costs : These costs remain fixed or constant irrespective of the volume of production. So they are not affected whether production is large, smaller or standstill. These costs include the salaries of higher officers, interest on capital invested, taxes on property expenses incurred on lighting, insurance, repairs and maintenance, depreciation of building, plant and equipment etc.

(b) Variable Costs : Variable costs are those which vary directly with the quantity produced. Prime cost is also called as variable cost. Since, it is clear that if more things are to be produced, more raw material, more direct labour and more direct expenses will be required. Variable costs are the functions of output. Higher the output larger the variable cost. These become zero when the production is suspended.

Q. 3. (b) "Inventory is a necessary evil." Comment.

Ans. Inventory is a Necessary Evil : Forecasting has long been associated with processes that impacts on stock. Such process includes production, procurement and sales. Irrespective of the industry

type, whether "make to sell" or "buy to sell", elements of forecasting springs up. This is because the driving phenomenon of "demand" is inevitable.

In a "make to sell" industry, the producer can't wait for orders to be received before the production process is initiated. In like manner, the "buy to sell" entrepreneur can't wait for customers to request for an item before he procures the item. However, these behaviours might be practicable for special order.

From the foregoing, it is evident that some level of inventory must exist at any point in time. It can be raw materials for production and/or finished goods. The crux of the matter then becomes, what should be the relative inventory level at a particular point in time. In objectively answering this question, some form of forecasting must be made.

Inventory forecasting in my opinion is a proactive and futuristic strategy aimed at providing estimated stock level to meet demand at a particular point in time. Proactiveness can be interpreted as a step taken, prelude to a known event. Forecasting involves estimating what will be needed based on certain assumptions. It can also be viewed as projections of some sort.

A number of factors can determine the turn of demand for a particular product. They include but not limited to price, availability of close substitutes, market trends, season and advertising strategy. My concern in this posting is not to emphasize demand as a concept but the perception of inventory forecasting as a tool that can either make or mar an entrepreneur.

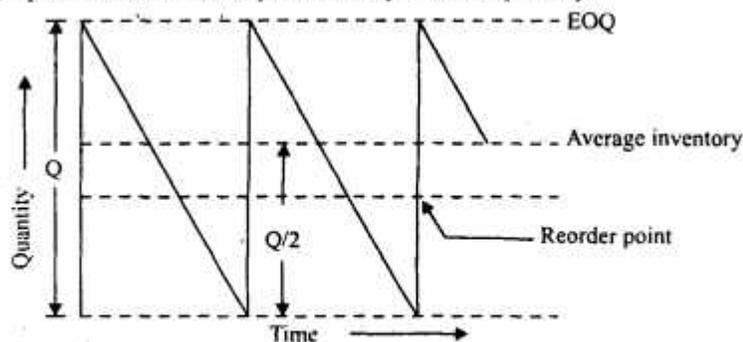
In analyzing the subject matter, it is worthy to briefly mention two important concepts namely "over stocking" and "under stocking". Inventory forecasting can give rise to the duo especially when it is faulty and the consequences can be grave as asserted in a prior posting titled:

Increasing Profitability through Inventory and Financial Reports Analysis: A case for SAP Business One.

Q. 4. (a) Derive a relation for Economic Order Quantity (EOQ).

Ans. Economic Order Quantity : Economic order quantity is that order quantity which will minimize the total variable cost of managing the inventory.

Method of Calculation of EOQ : Assuming that the inventory decreases at a constant rate from the order quantity 'q' to zero and then replenished by another quantity.



Symbols Used :

Let, S = Annual consumption of the product (units)

C_o = Cost of placing an order

C_u = Unit cost of an item (unit price Rs.)

q = Order quantity (units)

i = Interest rate charged per unit per year.

Now, the total variable cost of managing the inventory per year

= Annual ordering cost + Annual cost of carrying the inventory = E say.

$$\text{Therefore, } E = \left[\begin{array}{c} \text{No. of orders} \\ \text{per year} \end{array} \right] \times \left[\begin{array}{c} \text{Cost of placing} \\ \text{an order} \end{array} \right] \times \left[\begin{array}{c} \text{Average} \\ \text{Inventory} \end{array} \right] \times \left[\begin{array}{c} \text{Inventory} \\ \text{Carrying cost} \end{array} \right]$$

$$\text{i.e., } E = \frac{S}{q} \times C_o + \frac{q}{2} C_u i$$

$$\text{i.e., } E = C_o \cdot \frac{S}{q} + C_u i \cdot \frac{q}{2}$$

To determine economic order quantity (q_o) that minimizes the total cost of managing the inventory, we must differentiate E with respect to decision variable q and set the first derivative to zero. i.e., for minimum

$$\text{Total cost, } \frac{dE}{dq} = 0$$

$$\text{Therefore, } \frac{dE}{dq} = -\frac{C_o \cdot S}{q^2} + C_u i \cdot \frac{1}{2} = 0$$

$$\text{Or } \frac{C_o \cdot S}{q^2} = \frac{C_u i}{2}$$

$$\text{i.e., } q^2 = \frac{2C_o \cdot S}{C_u i} \quad \text{or } q = \sqrt{\frac{2C_o \cdot S}{C_u i}}$$

$$\text{Therefore, } EOQ(q_o) = \sqrt{\frac{2 \times \left[\begin{array}{c} \text{Annual Consumption} \\ \text{Cunits} \end{array} \right] \times \left[\begin{array}{c} \text{Cost of placing} \\ \text{an order} \end{array} \right]}{\text{Price / Unit} \times \text{Inventory carrying cost}}$$

Q. 4. (b) Discuss techniques of selective inventory control.

Ans. Inventory Control : Inventory control means making the desired item of required quality and in required quantity available to various departments when needed. Too much inventory creates a problem of their storage, huge investment and the maintenance of stored items from deterioration, pilferage, damage etc. However, low inventory leads to chances of stoppage of production, increase in overheads and disruption in production schedules and delivery promises. Therefore, optimum amount of inventory should be maintained in stores.

Every firm must maintain adequate stock of inventories for the following reasons :

(i) **To Ensure Against Delays in Deliveries** : When an order is placed for fresh stock, the materials are not immediately available but some time elapses before it arrives. This period between the time of placing the order and the time of stock arrival is often subjected to variations. A firm must therefore hold some reserve stock to allow production operations to continue if delay in procurement occurs.

(ii) **To Allow for Possible Increase in Output** : Changes in the manufacturing programme may occur because of the variation in the demand. To meet the increased demand of the finished goods the company should have enough stock of inventories so as to allow the production without interference.

(iii) **Maintain Smooth and Efficient Production Flow** : When a company has little inventory and runs out of stock, stock-out of essential materials means interruptions in production which raises cost of production.

(iv) **To Keep Better Customer Relations** : Stock outs means stoppage or interruptions in production, therefore it may delay the delivery of finished goods to the customer. After a few such delays even a most patient customer will start looking for a supplier who will give him better service.

(v) **To Take Advantage of Quantity Discounts** : Materials and components may be cheaper when purchased in large quantities owing to larger discounts and lower transportation costs. Furthermore, paper work and inspection of incoming materials are also simplified when larger quantities.

(vi) **To have a Better Utilization of Men and Machinery** : If there is a stock out of materials the men and machinery will remain idle. Therefore, the company should keep enough stock of inventories to have better utilization of men and machinery.

Advantages of Inventory Control :

- (i) There is no shortage of materials at any stage of production.
- (ii) Materials are made available at most economical rates.
- (iii) Exact and accurate delivery dates can be forecast.
- (iv) Production schedules and delivery dates are maintained.
- (v) There is an increase in overall efficiency/productivity of the company.

Q. 5. Discuss the methodology of double sampling plan.

Ans. Double Sampling Plan : In double sampling plan the decision on acceptance or rejection of the lot is based on two samples. A lot may be accepted at once if the first sample is good enough or rejected at once if the first sample is bad enough. If the first sample is neither good enough nor bad enough, the decision is based on the evidence of first and second sample combined.

Parameters, n_1 = Number of pieces in the first sample

c_1 = Acceptance number for the first sample,

i.e., the maximum number of defectives that will permit the acceptance of the lot on the basis of the first sample.

n_2 = Number of pieces in the second sample

$n_1 + n_2$ = Number of pieces in the two samples combined

c_2 = Acceptance number for the two samples combined

i.e., the maximum number of defectives that will permit the acceptance of the lot on the basis of the first and second sample combined.

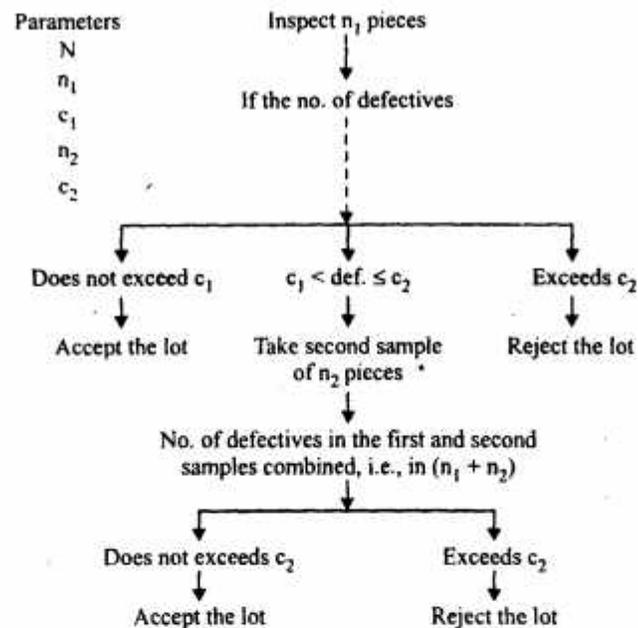


Fig. Double sampling plan

Q. 6. What are the objectives of PPC? Discuss the concept of Master Production Schedule.

Ans. Objectives of PPC : There are three M's of production viz., men, materials and machines without which production cannot be carried out. The **production planning and control (PPC)** system integrates and coordinates the use of manpower, machines and materials for the efficient production to meet the sales requirements.

In recent years it is increasingly become apparent that planning and control systems are the basic activities that determine the effectiveness of an enterprise. In fact it is the nerve centre of an organisation whose effort is mostly to minimize the output and profit subject to shop capacity and marketing constraints.

To run an industrial plant whether in public sector or in private sector, to stay in business and provide for its dynamic growth efficient production planning and control system is necessary.

The major objectives of PPC can be stated as :

- (i) To ensure efficient utilization of production facilities.
- (ii) To coordinate the production activities of different departments.
- (iii) To ensure production of right product in right quality at the right time.
- (iv) To maintain flexibility in manufacturing operations, to accommodate rush jobs or to meet contingencies.
- (v) To coordinate labour, machines and equipment in the most effective and economic manner.
- (vi) Ensuring smooth flow of materials by eliminating bottlenecks if any, in production.

- (vii) Establishing targets and checking it against performance.
- (viii) To provide alternative production strategies in case of emergencies.
- (ix) To determine the nature and magnitude of various input factors to manufacture the desired output.
- (x) The PPC department guide production by preparing and issuing manufacturing orders which direct the use of facilities and material and allocate labour to the output of the required quantity of products of the required quality.

In short PPC regulates and control "how", "where" and "when" work is to be done.

Master Scheduling : Let us consider a computer centre, from the past experience it is known that the maximum number of hours that the equipment can be operated in a five days week is 100 hrs. The remaining time must be available for routine maintenance and repair work. Assume that the minimum number of hours will be eight hrs. per day to run it economically. For a control purpose it is necessary to plan the working of the computer centre. As each job arrives at the centre the person maintaining the master schedule estimates the number of hours the job will require. The number of hours in the weekly column of the master schedule indicates the number of hours for the various jobs already assigned to the computer centre. Assume that a new job arrives at the centre which requires completion during the second week. If the number of hours required by the jobs does not exceed 27 hrs., it can be assigned directly to second week's work schedule. If the number of hours required is less than 40 and more than 27 hrs., it can be assigned to both the first and second week's work schedule and still it can be completed before the due time.

Master schedule for the computer centre Maximum production-100 hrs. per week Minimum production-8 hrs. per day				
Weekly	Week 2	Week 3	Week 4	Week 5
35	18	8	10	12
15	25	12	6	4
25	30	15		
12		5		
Balance 13 hrs.	Balance 27 hrs.			

Q. 7. (a) Discuss the role of MIS in enhancing productivity of an organization.

Ans. Management Information System (MIS) : Management information system can be defined as "a system of obtaining, abstracting, storing and analysing data to produce for use in planning, controlling and decision making by yielding information for managers, at the time they can most effectively use it." Information system incorporates (a) policy flow from management and (b) information flow to management.

Management needs informations so that it can plan intelligently for future; take right and proper decisions at proper time and control various activities. The system provides information on the past, present and projected future and on related events inside and outside the organisation. The MIS reduces uncertainly in decision making. It provides facts upon which most decision making depends. Quick and correct information flow is essential for effective control of various business activities and for survival and growth of the organisation. It helps the organisation to proceed from a state of uncertainty to a state of certainty. The management needs information to manage carry out the major functions of planning, organising, directing, staffing and controlling etc. The management takes the decisions on the basis of informations available, hence the effectiveness of the decision maker depends upon the accuracy, completeness, quality and quick flow of the requisite information. It is necessary that only relevant information should be supplied to management; since unrelevant or even inadequate information may lead to confusion.

Objectives of MIS : The main objectives of MIS are :

- (i) To provide the relevant information available in the right form at the right time.
- (ii) To bring the new facts to the knowledge of the management.
- (iii) To supply the desired information at a reasonable cost.
- (iv) To keep the information upto data.
- (v) To store important and confidential information properly for decision-making whenever required.
- (vi) To focus on those decisions where benefit/cost ratio is attractive.
- (vii) To have a clear interpretation of past experience.
- (viii) To supply reliable and logical data.
- (ix) To provide data for carrying out the major management functions.
- (x) To control the business effectively.

Q. 7. (b) Discuss the concept of Product Life Cycle.

Ans. The Product Life Cycle : A product's life cycle (PLC) can be divided into several stages characterized by the revenue generated by the product. If a curve is drawn showing product revenue over time, it may take one of many different shapes, an example of which is shown below :

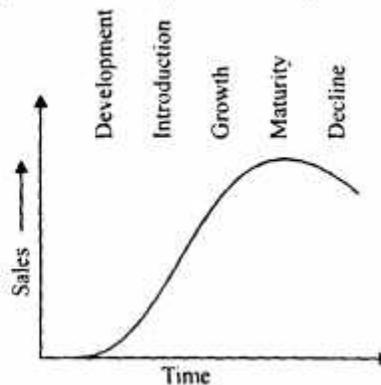


Fig. Product Life Cycle Curve

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The life cycle concept may apply to a brand or to a category of product. Its duration may be as short as a few months for a fad item or a century or more for product categories such as the gasoline-powered automobile.

Product development is the incubation stage of the product life cycle. There are no sales and the firm prepares to introduce the product. As the product progresses through its life cycle, changes in the marketing mix usually are required in order to adjust to the evolving challenges and opportunities.

Introduction Stage : When the product is introduced, sales will be low until customers become aware of the product and its benefits. Some firms may announce their product before it is introduced, but such announcements also alert competitors and remove the element of surprise. Advertising costs typically are high during this stage in order to rapidly increase customer awareness of the product and to target the early adopters. During the introductory stage the firm is likely to incur additional costs associated with the initial distribution of the product. These higher costs coupled with a low sales volume usually make the introduction stage a period of negative profits.

During the introduction stage, the primary goal is to establish a market and build primary demand for the product class. The following are some of the marketing mix implications of the introduction stage :

- (i) **Product :** One or few products, relatively undifferentiated.
- (ii) **Price :** Generally high, assuming a skim pricing strategy for a high profit margin as the early adopters buy the product and the firm seeks to recoup development costs quickly. In some cases a penetration pricing strategy is used and introductory prices are set low to gain market share rapidly.
- (iii) **Distribution :** Distribution is selective and scattered as the firm commences implementation of the distribution plan.
- (iv) **Promotion :** Promotion is aimed at building brand awareness. Samples or trial incentives may be directed toward early adopters. The introductory promotion also is intended to convince potential resellers to carry the product.

Growth Stage : The growth stage is a period of rapid revenue growth. Sales increase as more customers become aware of the product and its benefits and additional market segments are targeted. Once the product has been proven a success and customers begin asking for it, sales will increase further as more retailers become interested in carrying it. The marketing team may expand the distribution at this point. When competitors enter the market, often during the later part of the growth stage, there may be price competition and/or increased promotional costs in order to convince consumers that the firm's product is better than that of the competition.

During the growth stage, the goal is to gain consumer preference and increase sales. The marketing mix may be modified as follows :

- (i) **Product :** New product features and packaging options; improvement of product quality.
- (ii) **Price :** Maintained at a high level if demand is high, or reduced to capture additional customers.
- (iii) **Distribution :** Distribution becomes more intensive. Trade discounts are minimal if resellers show a strong interest in the product.
- (iv) **Promotion :** Increased advertising to build brand preference.

Maturity Stage : The maturity stage is the most profitable. While sales continue to increase into this stage, they do so at a slower pace. Because brand awareness is strong, advertising expenditures will be reduced. Competition may result in decreased market share and/or prices. The competing products may be very similar at this point, increasing the difficulty of differentiating the product. The firm places effort into encouraging competitor's customers to switch, increasing usage per customer and converting non-users into customers. Sales promotions may be offered to encourage retailers to give the product more shelf space over competing products.

During the maturity stage, the primary goal is to maintain market share and extend the product life cycle. Marketing mix decisions may include :

(i) **Product :** Modifications are made and features are added in order to differentiate the product from competing products that may have been introduced.

(ii) **Price :** Possible price reductions in response to competition while avoiding a price war.

(iii) **Distribution :** New distribution channels and incentives to resellers in order to avoid losing shelf space.

(iv) **Promotion :** Emphasis on differentiation and building of brand loyalty. Incentives to get competitors' customers to switch.

Decline Stage : Eventually sales begin to decline as the market becomes saturated, the product becomes technologically obsolete, or customer tastes change. If the product has developed brand loyalty, the profitability may be maintained longer. Unit costs may increase with the declining production volumes and eventually no more profit can be made.

During the decline phase, the firm generally has three options :

(i) Maintain the product in hopes that competitors will exit. Reduce costs and find new uses for the product.

(ii) Harvest it, reducing marketing support and coasting along until no more profit can be made.

(iii) Discontinue the product when no more profit can be made or there is a successor product.

Limitations of the Product Life Cycle Concept : The term "life cycle" implies a well-defined life cycle as observed in living organisms, but products do not have such a predictable life and the specific life cycle curves followed by different products vary substantially. Consequently, the life cycle concept is not well-suited for the forecasting of products sales. Furthermore, critics have argued that the product life cycle may become self-fulfilling. For example, if sales peak and then decline, managers may conclude that the product is in the decline phase and therefore cut the advertising budget, thus precipitating a further decline.

Nonetheless, the product life cycle concept helps marketing managers to plan alternate marketing strategies to address the challenges that their products are likely to face. It also is useful for monitoring sales results over time and comparing them to those of products having a similar life cycle.

Q. 8. Write notes on :

(a) Value Engineering

(b) Importance of Ergonomics

(c) Product Life Cycle

Ans. (a) Value Engineering : Value engineering is the application of exactly the same set of techniques to a new product at the design stage-project concept or preliminary design when no hardware exists. Its purpose is to ensure that no bad features are added in the product at the design stage. Value engineering is thus a preventive process.

Value engineering is a systematic approach to identify unnecessary costs. It utilizes few techniques which help to stimulate creative ideas or suggest definite course of action in particular circumstances. Value analysis techniques are just guide for the successful practice of value analysis and value engineering. They are not intended to be used as "rules" yet they are of great use of value analysts. These techniques were evolved by Lawrence D. Miles, who is named as Father of Value Analysis.

These techniques on skilful help to identify unnecessary cost, remove obstacles and provide a course of action for developing worthwhile alternatives. These are as under :

- (i) Obtain all available cost.
- (ii) Evaluate function by comparison.
- (iii) Seek information from the best or the most authentic source.
- (iv) Avoid generalities/work in specifics.
- (v) Get all the facts.
- (vi) Discuss with specialists and utilize their ideas.
- (vii) Use standard parts wherever possible.
- (viii) Consult your suppliers for new ideas.
- (ix) Think creatively.
- (x) Blast, create and refine ideas.
- (xi) Remove all the road blocks.
- (xii) Critically analyse the existing configuration.

(b) Importance of Ergonomics :

Definition of Ergonomics : Ergonomics defined as the scientific study of the relationship between man and his working environment. The primary aims of ergonomics is to optimize the functioning of a system by adapting it to human capacities and needs. Ergonomics is a Scientifically Based Discipline which integrates knowledge delivered from many sciences.

Why Ergonomics? : A stone-age human in an environment using a flint stone as a knife could modify the shape of the stone fitting the hand and task. Today, a product might be designed in one country manufactured in the second country, purchased by a wholesaler (buyer) in the third country and used by a customer in the fourth country. The designer might not know who are the end users and the buyer cannot influence the design of the product. Ergonomics is the only link between these four actors.

The Scope of Ergonomics : The scope of Ergonomics is extremely wide and is not limited to any particular industry or application. Ergonomics comes into everything which involves people. Work systems, sports and leisure, health and safety should all embody ergonomics principles if well designed. The ability of people to do their job is influenced by the person's capabilities (physical and mental), the job demand (physical and mental) and the condition (physical and organizational environment) under which the person is carrying out the job.

The Objectives of the Ergonomics is to enhance the effectiveness with which work and other human activities are carried out and to maintain or enhance certain desirable human values in the process, health, safety, satisfaction etc.

The aim of ergonomics is to enhance and preserve human health and satisfaction and to optimize the human performance in a system perspective. Ergonomics is concerned with both employees well-being as well as organisation well-being. Ergonomics aims to ensure that human needs for safe and efficient working are met in the design of work systems. The key words are; health, comfort and performance.

Factors to be Considered : (i) Accident frequency and severity : jobs where accidents occur frequently or where they occur infrequently but result in disabling injuries.

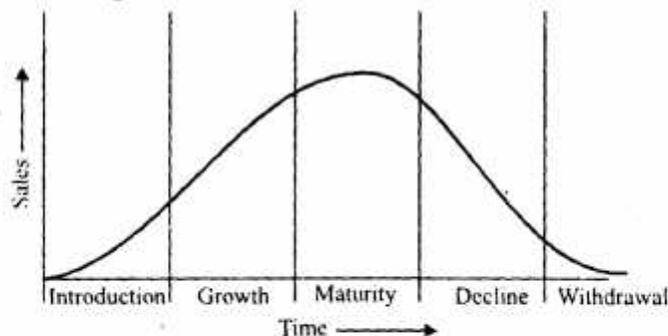
(ii) Potential for severe injuries or illnesses.

(iii) Newly established jobs : due to lack of experience in these jobs, workplace contributing factors may not be evident or anticipated.

(iv) Modified jobs : new workplace contributing factors may be associated with changes in job procedures.

(v) Infrequently performed jobs : workers may be at greater risk when undertaking non-routine jobs. and EWA provides a means of reviewing workplace contributing factors.

(c) Product Life Cycle : The product life cycle (PLC) is based upon the biological life cycle. For example, a seed is planted (introduction); it begins to sprout (growth); it shoots out leaves and puts down roots as it becomes an adult (maturity); after a long period as an adult the plant begins to shrink and die out (decline). In theory it's the same for a product. After a period of development it is introduced or launched into the market; it gains more and more customers as it grows; eventually the market stabilises and the product becomes mature; then after a period of time the product is overtaken by development and the introduction of superior competitors, it goes into decline and is eventually withdrawn. However, most products fail in the introduction phase. Others have very cyclical maturity phases where declines see the product promoted to regain customers.



The product life cycle (PLC)

Strategies for the Differing Stages of the Product Life Cycle :

Introduction : The need for immediate profit is not a pressure. The product is promoted to create awareness. If the product has no or few competitors, a skimming price strategy is employed. Limited numbers of product are available in few channels of distribution.

Growth : Competitors are attracted into the market with very similar offerings. Products become more profitable and companies form alliances, joint ventures and take each other over. Advertising spend is high and focuses upon building brand. Market share tends to stabilise.

Maturity : Those products that survive the earlier stages tend to spend longest in this phase. Sales grow at a decreasing rate and then stabilise. Producers attempt to differentiate products and brands are key to this. Price wars and intense competition occur. At this point the market reaches saturation. Producers begin to leave the market due to poor margins. Promotion becomes more widespread and use a greater variety of media.

Decline : At this point there is a downturn in the market. For example, more innovative products are introduced or consumer tastes have changed. There is intense price-cutting and many more products are withdrawn from the market. Profits can be improved by reducing marketing spend and cost cutting.