WORK BOOK

OPERATIONS MANAGEMENT & STRATEGIC MANAGEMENT

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA
(Statutory body under an Act of Parliament)
www.icmai.in

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OPERATIONS MANAGEMENT
&
STRATEGIC MANAGEMENT

INTERMEDIATE

GROUP — II

PAPER — 9

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Study Note – 1

OPERATIONS MANAGEMENT - INTRODUCTION

1. **Define Operations management.**

   Answer:

   Operations management designs and deals with operations of productive system—system which produces goods and services and operations manager is responsible for smooth running of this system. Every book one reads, every video one watches, every e-mail one sends, and every medical treatment one receives involves the operations function of one or more organizations.

2. **What is called operations/Operating System?**

   Answer:

   Operations is defined as a transformation—a transformation of input in the form of material, machines, Labour, Management, capital to output in the form of goods and services. Operations as a transformation process looks like following:
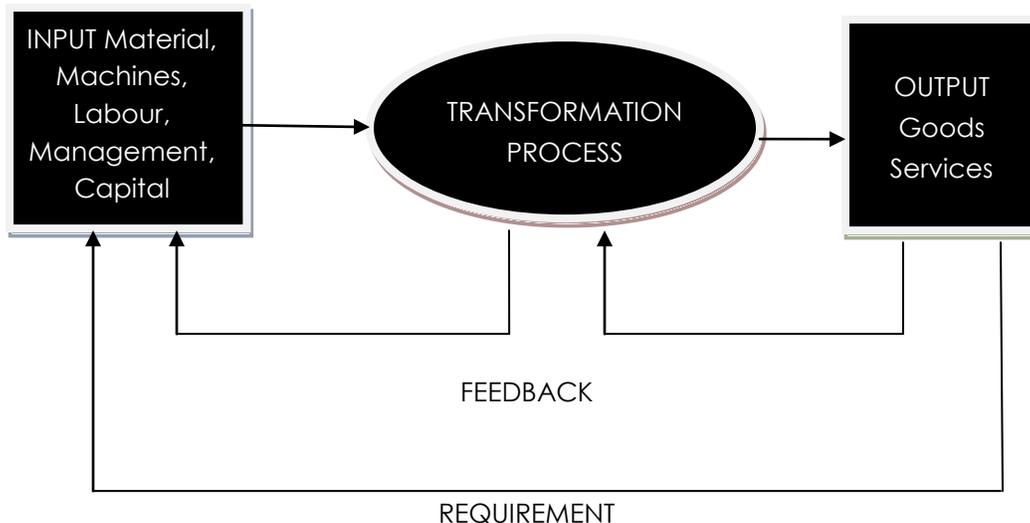
Therefore an Operating System is defined as a configuration of resources combined for the provision of goods or services Further to ensure that the desired output are obtained, an organization takes measurements at various points in the transformation process (feedback) and then compares with them with previously established standards to determine whether corrective action is needed(control).

3. **What is the Objective of Operations Management?**

Answer:

In operations management we try to ensure that the transformation process is performed efficiently and that the output is of greater value than the sum of the inputs. Input-transformation-output process itself can be viewed as a series of activities along a value chain extending from supplier to customer and operations management thrives for customer satisfaction with effective utilization of resources.

4. **Match the items in first column with that in second column:**

Transformation process	Sector where found
i) Physical	a) Communication
ii) Psychological	b) Health care
iii) Locational	c) Manufacturing
iv) Physiological	d) Entertainment
v) Informational	e) Retail Operations
vi) Exchange	f) Transport

   Answer: i)/(c); ii)/(d); iii)/(f); iv)/(b); v)/(a); vi)/(e)

5. **Match the item in Colum I with that in Column II**

Column I (Input)	Column II (output)
a) Physical	i) BSNL telecommunication service
b) Exchange	ii) Health Service in Medical College
c) Locational	iii) Railway Service
d) Psychological	iv) Shopping in Big bazar
e) Physiological	v) Movie in Inox
f) Informational	vi) Production of Ignis in Maruti Ltd

   Answer: (a)/(vi); (b)/(iv); (c)/(iii);(d)/(v);(e)/(ii);(f)/(i)

6. **Relate the following characteristics to either Product (P) or Service (S):**
   a) **High contact with clients or customers;**
   b) **Location dependent on location of local customers, clients and users;**
   c) **Large units that can take advantage of economies of scale;**
   d) **Availability achieved by keeping the productive system open for operation;**
   e) **Achievable Inventory;**
   f) **Markets served by the productive system are regional, national and international;**
   g) **Demand on system variable on weekly, monthly and seasonal basis;**
   h) **Complex and interrelated processing;**

   Answer: a) S; b) S; c) P, d) S; e) P; f) P; g) P; h) S;

7. **Choose the correct answer:**

   Modern views classifies Production management decisions pertaining to a) People; b) People, supply, space; c) People, supply, space and time; d) People, supply, space, time and feelings;

   Answer: (c)

8. **Choose the correct answer:**
   Under people centric production and operations management function to maintain desired quality and productivity which of the following people centric decision is required most?
   a) HR decision; b) Supply decision; c) Spatial decision; d) Timing decision;

   Answer: (a)

9. **For Outpatient ward of a general hospital name individual components in Input-Transformation process-Output system.**

   Answer:

   ► Input: Unhealthy patient (Physical)
   ► Transformation Process: Uses physical resources like Doctors, Nurses, and other Staff & Equipment etc.
   ► Output: Healthier/Cured Person (Physical)

10. **In an operating system's output goods-service combination is a continuum. Explain**

    Answer:

    An operating system can provide physical goods as well as services together and clear demarcation of the output activity may not be always possible. A mobile manufacturer in addition to mobile sets (good) also provides after sales service. Therefore the concepts of "physical goods production" and "service provision" are not mutually exclusive. In fact in most cases these are mixed, one being more predominant than the other.
    It can range from primarily goods, with little service, to primarily service, with few goods. Because there are relatively few pure goods or pure services, companies usually sell product packages, which are a combination of goods and services. There are elements of both goods production and service delivery in these product packages. This makes managing operations more interesting, and also more challenging.

11. **The four primary functional areas of a business unit are marketing, finance, operations and human resources. Write down the mutual interactions of operations with Marketing, HR and Finance functions.**

Answer:

Marketing to Operation	Operations to Marketing
Provides sales forecasts, customer Orders, customer feedback, Product Development.	Provides information on Product/Service availability, lead time estimates, Order status, delivery schedule etc.

HR to Operations	Operations to HR
Provides information on personnel need Skill sets, performance evaluation, Job Designs, work measurement.	Provides information on Hiring/firing Training, legal requirements Union contract negotiations.

Finance to Operation	Operations to Finance
Provides budgets, cost analysis Capital investments, Stockholders Requirements etc.	Provides information on Product & Inventory data, capital budgeting Requests, Capacity expansion plans etc

12. **Choose the correct answer:**

Configuration of resources combined for the provision of goods or services is known as: a) Productive System; b) Operating System; c) Service System; d) Operations Management;

Answer: b)

Study Note – 2
OPERATIONS PLANNING

1. **Define Forecasting. Why Productions and Operations departments need forecasts?**

   Answer:

   Forecasting means peeping into the future. As future is unknown and is anybody's guess but the business leaders in the past have evolved certain systematic and scientific methods to know the future by scientific analysis based on facts and possible consequences. Thus, this systematic method of probing the future is called forecasting.

   Production and Operation departments will produce goods as per the sales program given by the sales department, but it has to prepare forecast regarding machine capacity required, materials required and time required for production and so on. Knowledge on Forecasting helps in this regard.

2. **Why Sales Forecasting is the most important activity in the business?**

   Answer:

   All business and industrial activities revolve around the sale and its future planning. To know what a business will do we must know its future sales. All other activities depend upon the sales of the concern. Sales forecasting as a guiding factor for a firm because it enables the firm to concentrate its efforts to produce the required quantities, at the right time at reasonable price and of the right quality. Sales forecasting is the basis of planning the various activities i.e.; production activities, pricing policies, programme policies and strategies, personnel policies as to recruitment, transfer, promotion, training, wages etc.

3. **What are the time ranges for Short-term, Medium-term and Long-term Forecasting?**

   Answer:

   Short term forecasting period may be one week, two weeks or a couple of months. Medium term forecasting period may vary from 3 to 6 months. Long term forecasting period may vary from one year to any period. The objective of above said forecast is naturally different.

4. **Write down the objectives of Long-range Forecasting.**

   Answer:

   (i)   To work out expected capital expenditure for future developments or to acquire new facilities;
   (ii) To determine expected cash flow from sales;
   (iii) To plan for future manpower requirements;
   (iv) To plan for material requirement;
   (v)   To plan for Research and Development. Here much importance is given to long range growth factor;

5. **Write down the objectives of Medium-range Forecasting;**

   Answer:

   (i) To determine budgetary control over expenses;
   (ii) To determine dividend policy,
   (iii) To find and control maintenance expenses;
   (iv) To determine schedule of operations;
   (v) To plan for capacity adjustments;

6. **Write down the objectives of Short-range Forecasting;**

   Answer:

   (i) To estimate the inventory requirement;
   (ii) To provide transport facilities for finished goods;
   (iii) To decide workloads for men and machines;
   (iv) To find the working capital needed;
   (v) To set-up of production run for the products;
   (vi) To fix sales quota;
   (vii) To find the required overtime to meet the delivery promises;

7. **What are the factors influencing business forecasting?**

   Answer:

   (i) Environmental changes;
   (ii) Changes in the preference of the user;
   (iii) Number of competitive products;
   (iv) Disposable income of the consumer;

8. **What are the important factors for production forecasting?**

   Answer:

   (i) Demand from the marketing department;
   (ii) Rate of labours absenteeism;
   (iii) Availability of materials;
   (iv) Available capacity of machines;
   (v) Maintenance schedules;
   (vi) Delivery date schedules;

9. **Name the factors on which methods of forecasting depends.**

   Answer:

   (i)   Period selected for the forecast;
   (ii) The information or data available on hand;
   (iii) What are the expectation from you expect from the information from the forecast;

10. **Math the items in column (1) with those in column (2).**

(1)	(2)
a) A process of combining, averaging or evaluating, in some other way, the opinions and views of top executives;	i) Sales Forecasting under Expert's Opinions;
b) Quite appropriate when the product is quite new in the market or good estimators are not available or where buyers do not prepare their purchase plan;	ii) Market test method of sales forecasting;
c) More appropriate where users of the product are numbered and a new product is to be introduced for which no previous records can be made available;	iii) Composite method of sales forecasting;
d) Views of salesmen, branch manager, area manager and sales manager are secured for the different segments of the market;	iv) Executive judgment method of sales forecasting;
e) Opinions of experts given in the newspapers and journals for the trade, wholesalers and distributors for company's products, agencies or professional experts are taken.	v) User's Expectation method of sales forecasting;

   Answer:

   a)/(iv); b)/(ii); c)/(v); d)/(iii); e)/(i);

11. **Demand in (000 MT) for sugar of Sour India is given below:**

Year	2010	2011	2012	2013	2014	2015	2016
Demand	77	88	94	85	91	98	90

   (i)   Fit a straight line trend by method of least square;
   (ii) Calculate trend values and plot observed and trend values on a graph;
   (iii) Obtain the forecast of demand for the year 2017;

Ans:

i) The trend line is represented as $Y_t = a + bX$

Where Y_t = the trend value (which is to be predicted);

a = the Y axis intercept;

b = slope of the trend line;

X = the independent variable, the time;

a and b are computed as

$b = \frac{\Sigma XY - n\overline{X}\,\overline{Y}}{\Sigma X^2 - n\overline{X}^2}$, $a = \overline{Y} - b\overline{X}$

The computations are in the following table

Year	X	Demand, Y	XY	X²	Trend Values Yt
2010	0	77	0	0	83
2011	1	88	88	1	85
2012	2	94	188	4	87
2013	3	85	255	9	89
2014	4	91	364	16	91
2015	5	98	490	25	93
2016	6	90	540	36	95
Total	21	623	1925	91	125

$\overline{X} = \frac{21}{7} = 3$ & $\overline{Y} = \frac{623}{7} = 89$ So $b = \frac{(1925 - 7\times3\times89)}{(91 - 7\times3\times3)} = 2$ and $a = 89 - 2\times3 = 83$

ii) Trend values are calculated from equation $Y_t = a + bX$ and given in last column of the above table; Plot is shown below:
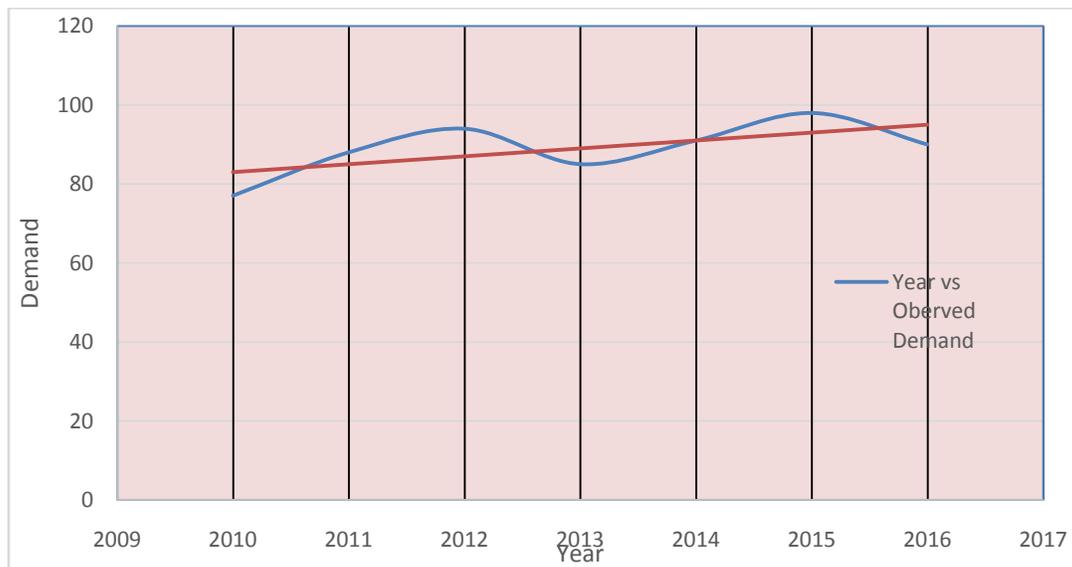
iii) Forecast value for 2017 = 83 + 2x7 = 97

12. The following table shows the profits, Rs. Y (in'000) of a shop in Xth year as given below:

X	2010	2011	2012	2013	2014
Y	1250	1400	1650	1900	2300

(i) Fit a straight line trend by method of least square;
(ii) Calculate trend values and plot observed and trend values on a graph;
(iii) Obtain the forecast of demand for the year 2017;

Ans:

i) The problem is similar to problem given in Q (11) above. But we will do this problem in a bit different way. Here n = 5 (in Q11 it was 7) an odd and therefore we could shift the origin to the middle time period, viz. 2012. Let X = t – 2012;

The trend line is represented as $Y_t = a + bX$

Where Y_t = the trend value (which is to be predicted);
a = the Y axis intercept;
b = slope of the trend line;
X = the independent variable, the time;
a and b are computed as
$b = \frac{\Sigma XY}{\Sigma X^2}$, $a = \overline{Y}$ as $\Sigma X = 0$

The computations are in the following table

Year(t)	X	Profits(Y)	X^2	XY	Trend values(Yt)
2010	-2	1250	4	-2500	1180
2011	-1	1400	1	-1400	1440
2012	0	1650	0	0	1700
2013	1	1900	1	1900	1960
2014	2	2300	4	4600	2220
Total	0	8500	10	2600	1700

$\overline{X} = \frac{0}{5} = 0$ & $\overline{Y} = \frac{8500}{5} = 1700$
So $b = \frac{(2600)}{(10)} = 260$ and a = 1700

ii) Trend values are calculated from equation $Y_t = a + bX$ and given in last column of the above table; Plot is shown below:
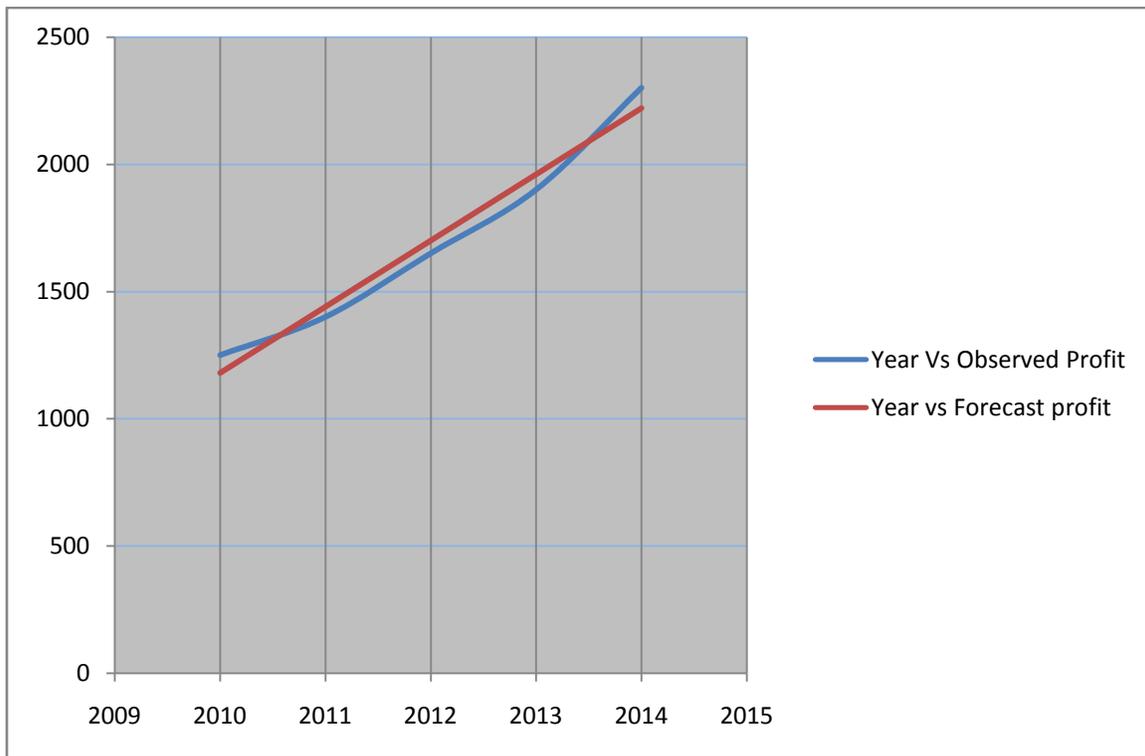
iii) Forecast value for 2017 = 1700 + 260x5 = 3000

13. The following table shows the profits, Rs. Y (in'000) of a shop in Xth year as given below:

X	2010	2011	2012	2013	2014	2015	2016	2017
Y	80	90	92	83	94	99	92	104

(i) Fit a straight line trend by method of least square;

(ii) Calculate trend values and plot observed and trend values on a graph;

(iii) Obtain the forecast of demand for the year 2018;

Ans:

i) The problem is similar to problem given in Q (12) above except here n = 8 an even and therefore we could shift the origin to the time which is the arithmetic mean of the two middle terms, viz.2013 & 2014 and we take

$$X = \frac{t - \frac{2013 + 2014}{2}}{1/2(\text{interval })} = 2(t\text{-}2013.5)$$

The trend line is represented as $Y_t = a + bX$

Where Y_t = the trend value (which is to be predicted);

a = the Y axis intercept;

b = slope of the trend line;

X =the independent variable, the time;

a and b are computed as

$$b = \frac{\Sigma XY}{\Sigma X^2}, \quad a = \overline{Y} \text{ as } \Sigma X = 0$$

The computations are in the following table

Year(t)	X	Profits(Y)	X²	XY	Trend Values(Yt)
2010	-7	80	49	-560	83
2011	-5	90	25	-450	85.5
2012	-3	92	9	-276	88
2013	-1	83	1	-83	90.5
2014	1	94	1	94	93
2015	3	99	9	297	95.5
2016	5	92	25	460	98
2017	7	104	49	728	100.5
Total	0	734	168	210	734

$$\overline{X} = \frac{0}{8} = 0 \ \& \ \overline{Y} = \frac{734}{8} = 91.75$$

So $b = \frac{(210)}{(168)} = 1.25$ and $a = 91.75$

ii) Trend values are calculated from equation $Y_t = a + bX$ and given in last column of the above table; Plot is shown below:
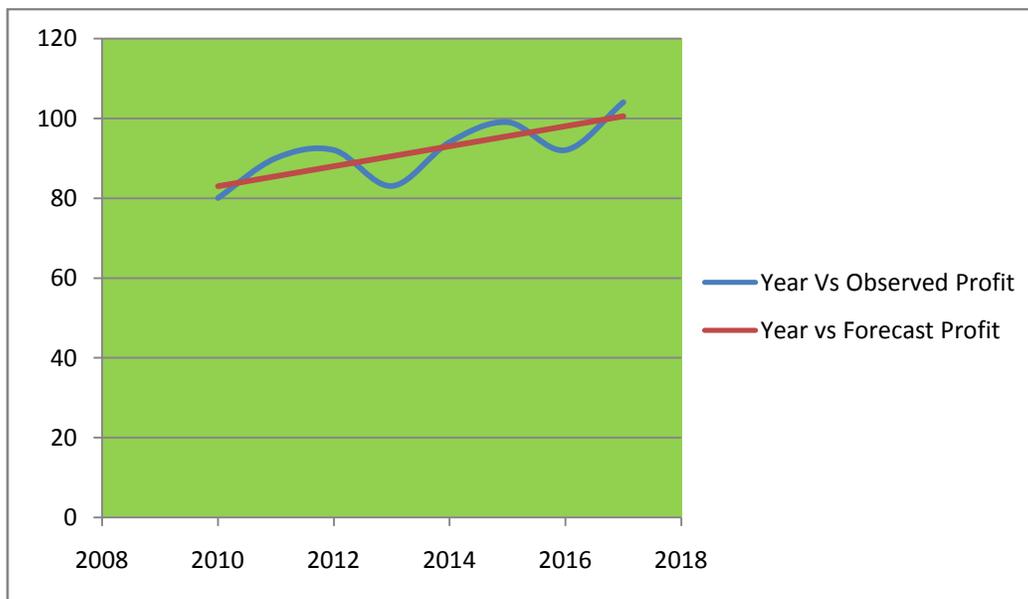
iii) Forecast value for 2018 = 91.75 + 1.25x9 = 103

14. Why Capacity planning is required?

Ans:

Capacity planning is required for the following:
➢ Sufficient capacity is required to meet the customers demand in time;
➢ Capacity affects the cost efficiency of operations;
➢ Capacity affects the scheduling system;
➢ Capacity creation requires an investment;
➢ Capacity planning is the first step when an organisation decides to produce more or new products;

15. How Capacity of a plant is measured?

Ans:

Capacity of a plant is usually expressed as the rate of output, i.e., in terms of units produced per period of time (i.e., hour, shift, day, week, month etc.). But when firms are producing different types of products, it is difficult to use volume of output of each product to express the capacity of the firm. In such cases, capacity of the firm is expressed in terms of money value (production value) of the various products produced put together.

15. What are the activities involved in Capacity Planning Decisions?

Ans:

Capacity planning involves activities such as:
➢ Assessing the capacity of existing facilities;
➢ Forecasting the long-range future capacity needs;
➢ Identifying and analysing sources of capacity for future needs;
➢ Evaluating the alternative sources of capacity based on financial, technological and economical
➢ Considerations;
➢ Selecting a capacity alternative most suited to achieve strategic mission of the firm;

16. Name the factors that affect determination of Plant Capacity.

Ans:
➢ Capital investment required;
➢ Changes in product design, process design, market conditions and product life cycles;
➢ Flexibility for capacity additions;
➢ Level of automation desired;
➢ Market demand for the product;
➢ Product obsolescence and technology obsolescence;
➢ Type of technology selected;

17. Which one of the following is not the factor influencing effective capacity?
   i) Level of automations desired;
   ii) Forecasts of Demand;
   iii) Plant and labour efficiency:
   iv) Multiple Shift operation;

   Ans: (i)

18. Plant and labour efficiency are very much essential to arrive at realistic capacity planning. Explain

   Ans:

   It is difficult to attain 100 per cent efficiency of plant and equipment. The efficiency is less than 100 percent because of the enforced idle time due to machine breakdown, delays due to scheduling and other reasons. The plant efficiency varies from equipment to equipment and from organisation to organisation. Labour efficiency contributes to the overall capacity utilisation. The standard time set by industrial engineer is for a representative or normal worker. But the actual workers differ in their speed and efficiency. The actual efficiency of the labour should be considered for calculating efficiency. Thus plant and labour efficiency are very much essential to arrive at realistic capacity planning.

19. Name five reasons because of which Over Capacity are preferred.

   Ans:

   ➢ Fixed cost of the capacity is not very high;
   ➢ Subcontracting is not possible because of secrecy of design and/or quality requirement;
   ➢ The time required to add capacity is long;
   ➢ The company cannot afford to miss the delivery, and cannot afford to loose the customer;
   ➢ There is an economic capacity size below which it is not economical to operate the plant;

20. Name reasons because of which Over Capacity are preferred.

   Ans:

   ➢ Shortage of products does not affect the company (i.e., lost sales can be compensated);
   ➢ The technology changes fast, i.e., the rate of obsolescence of plant and equipment are high;
   ➢ The cost of creating the capacity is prohibitively high;

21. What are the general factors considered for selecting Manufacturing facilities?

Ans:

➢ Land Costs;
➢ Construction Costs;
➢ Transportation costs pre & post operation stage;
➢ Proximity to suppliers;
➢ Labour availability;
➢ Electricity/Utilities availability;
➢ Environmental & other Govt. Regulations;

22. What are the general factors considered for selecting Retail & Service facilities?

Ans:

➢ Land /Leasing Costs;
➢ Proximity to customers;
➢ No of customers;
➢ Environmental & other Govt. Regulations;

23. Match the item in Column (1) with that in Column (2).

(1)	(2)
a) It produces distinguished products in different locations;	**i) Ordnance factories of India;**
b) It produces multiple products in same location;	**ii) ACC Cement;**
c) It produces same products in different locations;	**iii) Indian Railways;**
d) It feeds one plant with products of another plant;	**iv) Maruti Udyog;**

Ans:

a)/(iii); b)/(iv); c)/(ii);d)/(i);

24. What are the costs associated with decision on plant layout?

Ans:

➢ Cost of movement of materials from one work area to another;
➢ Cost of space;
➢ Cost of production delay, if any, which are the indirect costs;
➢ Cost of spoilage of materials;
➢ Cost of labour dissatisfaction and health risks;
➢ Cost of changes required, if the operational conditions change in the future. This is long term cost;
➢ Cost of customer dissatisfaction due to poor service (quality, delivery, flexibility, responsiveness) which may be due to poor lay out;

25. What are the most common reasons for design of new layout?

Ans:

(i) Layout is one of the key decisions that determine the long-run efficiency in operations;

(ii) Layout has many strategic implications because it establishes an organisation's competitive priorities in regard to capacity, processes, flexibility and cost as well as quality of work life, customer contact and image (in case of service organisations);

(iii) An effective layout can help an organisation to achieve a strategic advantage that supports differentiation low cost, fast response or flexibility;

(iv) A well designed layout provides an economic layout that will meet the firm's competitive requirements;

26. Match the item in Column (1) with that in Column (2).

(1)	(2)
a) It is to avoid waste of labour and time and to minimize cost of material handling;	i) Layout principle of Compactness;
b) It is to use effectively every unit of available space;	ii) Lay out Principle of Sequence
c) It is for harmonious fusion of all the relevant factors so that the finallayout looks well integrated and compact;	iii) Lay out Principle of Minimum Investment:
d) It permits revisions with the least difficulty and at minimum cost;	iv) Lay out Principle of Safety and Satisfaction:
e) It is followed for comfort and convenience of the workmen so that they feel satisfied.	v) Lay out Principle of Minimum Travel:
f) It is for savings in fixed capital investment, not by avoiding installation of the necessary facilities but by an intensive use of available facilities;	vi) Lay out Principle of Usage
g) It arranges Machinery and operations in a sequential order.	vii) Principle of Flexibility

Ans:

a)/(v);b)/(vi);c)/(i);d)/(vii);e)/(iv),f)/(iii),g)/(ii)

27. A company produces 2000 TV sets in a year for which it needs an equal number of tubes of a certain type. Each tube costs D10 and the cost to hold a tube in stock for a year is D2.4. The cost of placing an order is D150 which is not related to size. Consider no of working days as250 days. Lead time is 15 working days. Compute EOQ and reorder level.

Ans:

EOQ $= \sqrt{\frac{2AD}{h}}$ where A = cost of placing an order, D = annual demand, h = holding cost;

$= \sqrt{\frac{2 \times 150 \times 2000}{2.40}} = \sqrt{\frac{600000}{2.4}} = \sqrt{250000} = 500$

With no of working days in the year = 250 days and lead time = 15 working days, the daily demand = 2000/250 = 8 tubes.
Demand during lead time = 15 x 8 = 120 tubes.
So re-order level = 120 tubes.

28. **Using the following data obtain the EOQ and the total variable cost associated with the policy of ordering quantities of that size:**
    Annual Demand (in D) = D20000
    Ordering Cost = D150/order
    Inventory carrying cost = 24% of average inventory value

Ans:

EOQ $= \sqrt{\frac{2AcD}{i}}$ where A = cost of placing an order, cD = the annual demand in rupee terms, i = the holding rate.

$= \sqrt{\frac{2 \times 150 \times 20000}{0.24}} = D5000$

Total cost $= \sqrt{2 \times A \times cD \times i} = \sqrt{2 \times 150 \times 20000 \times 0.24} = D\ 1200$

29. **Bearing Hub Company is going to build a new plant to manufacture bearings. The site selection team is evaluating three sites and they have scored the important factors for each as follows. Compute total score of each locations under location factor rating scheme.**

Location factor	Scores(0 to 100)			
	Weight	Site 1	Site 2	Site 3
Labour pool and climate	0.30	80	65	90
Proximity to suppliers	0.20	95	88	78
Wage rates	0.15	75	95	85
Community environment	0.15	60	80	90
Proximity to customers	0.10	65	90	95
Shipping modes	0.05	85	90	60
Air service	0.05	50	65	90

Ans:

	Weight	Site 1	Site 2	Site 3	Wtd Scores Site 1	Wtd Scores Site 2	Wtd Scores Site 3
	0.3	80	65	90	24	19.5	27
	0.2	95	88	78	19	17.6	15.6
	0.15	75	95	85	11.25	14.25	12.75
	0.15	60	80	90	9	12	13.5
	0.1	65	90	95	6.5	9	9.5
	0.05	85	90	60	4.25	4.5	3
	0.05	50	65	90	2.5	3.25	4.5
				Total	76.5	80.1	85.85

Site 3 has the highest factor rating compared with the other locations, however, this evaluation would have to be used with other information, particularly a cost analysis before making a decision in favour of site 3 or others.

30. **M/s. ABC Ltd. are the manufacturers of a product called "Super Z" The following are the details of their operation during2017:**
    Average monthly market demand 5,000 units
    Ordering cost B200 per order
    Inventory carrying cost 25% per annum
    Cost of productionB500 per unit
    Normal usage 1000 units per week
    Minimum usage 500 units per week
    Maximum usage 2000 units per week
    Lead time to supply 6 – 8 weeks

    Compute from the above:
    (1) Economic order quantity. If the supplier is willing to supply quarterly 1,000 units at a discount of 5%, is it worth accepting?
    (2) Maximum level of stock.
    (3) Minimum level of stock.
    (4) Re-order level of stock.

    Ans:

    (1) Economic Order Quantity:
       Annual usage of Super Z = Normal usage per week × 52 weeks = 1000units × 52 weeks
       = 52000 units.
       Ordering cost per order = B200.
       Inventory carrying cost per unit per annum = 25% of B500 = B125.

$$EOQ = \sqrt{\frac{2AD}{h}} = \sqrt{\frac{2 \times 200 \times 52000}{125}} = 408 \text{ (approx.)}$$

Evaluation of order size of 1,000 units at 5% discount

No. of orders = 5,200 units/1,000 units = 5.2units or 6 (in case of a fraction, the next whole number is considered).

Ordering cost order per year at B 200 per order = B 1200

Carrying cost of average inventory:

1,000 units/2 × B(500 less 5%) × 25/100 = B59375

Total annual cost (excluding item cost) B 1200 + B59375 = B60575

Annual cost if EO Q (408 units) is adopted:

Ordering cost: 52000 ÷ 408 orders per year @B 200 per order B25490

Carrying cost of average inventory 408 units

408 units/2 × B (500) × 25/100 = B25500

Total annual cost (excluding item cost) = B25490+ B25500 = B50990

Increase in annual cost: B (60575 – 50990) = B9585.

Amount of quantity discount: 5% × B500 × 52000 units = B1300000

Since the amount of quantity discount (B1300000) is more than the increase in total annual cost (B9585.), it is advisable to accept the offer. This will result in a saving of B(1300000 - 9585) or B1290415 p.a. in inventory cost.

(2) Maximum Level of Stock:

= Re-order level + Re-order quantity – (Minimum usage × Minimum delivery period) = 16000 units + 408 units – (500 units × 6 weeks) = 13408units.

(3) Minimum Level of Stock:

= Re-order level – (Normal usage × Normal delivery period) [see Note] = 16000 units – (1000 units × 7 weeks) = 9000 units. Note: Normal delivery period is taken to be the average delivery period.

(4) Re-order Level of Stock:

= Maximum usage × Maximum delivery period = 2000 units × 8 weeks = 16000 units.

31. **"Carpet for Golden foot" company in Kashmir stocks carpet in its warehouse and sells it through an adjoining showroom. The store keeps several brands and styles of carpet in stock. The store wants to determine the optimal order size. The order quantity is received gradually over time and the inventory level is depleted at the same time it is being replenished i.e. the store here faces a non-instantaneous receipt. Estimated annual demand is 15000 yards of carpet with an annual carrying cost of B2.50 per yard and an ordering cost B200. The manufacturing facility operates the same days the store is open(i.e.300 days) and produces 200 yards of the carpet per day.**

Determine the optimal order size, total inventory cost, the length of time to receive an order, the number of orders per year and the maximum inventory level.

Ans:

EOQ with non-instantaneous receipt

$EOQ = \sqrt{\dfrac{2AD}{h(1-\frac{d}{p})}}$ where A = cost of placing an order, D = annual demand, h = holding cost, d = daily rate at which inventory is demanded & p = daily rate at which the order is received over time also known as production rate.

$EOQ = \sqrt{\dfrac{2 \times 200 \times 15000}{2.5 \times (1-\frac{50}{200})}} = 1789$ (Approx.)

$d = \dfrac{15000}{300} = 50$, p = 200

Total minimum inventory cost:

$TC_{min} = \dfrac{AD}{EOQ} + \dfrac{hEOQ}{2}(1-\dfrac{d}{p}) = \dfrac{200 \times 15000}{1789} + \dfrac{2.5 \times 1789}{2}(1-\dfrac{50}{200}) = B\ 3354$

The length of time to receive an order for this type of manufacturing operation is commonly called the length of the production run.

Production run $= \dfrac{EOQ}{p} = \dfrac{1789}{200} = 8.945$ days /order

The number of orders per year is actually the number of production runs that will be made. So number of production runs (from orders) $= = \dfrac{D}{EOQ} = \dfrac{15000}{1789} = 9$ orders (Approx)

Finally the maximum inventory level is $= EOQ\left(1-\dfrac{d}{p}\right) = 1789 \times \left(1-\dfrac{50}{200}\right) = 1342$ yards

32. **A contractor is evaluating its machine shop's current layout. Figure below (Table 1) shows the current layout and the adjoining table (Table II) shows the closeness matrix for the facility measured as the number of trips per day between department pairs. Safety and health regulations require the following department pairs close to each other: A & E, C & F, A & B and C & E as shown in the third table (Table III) below.**

How much better is your layout than the current layout in terms of the wd score? Use rectilinear distance.

E	B	F
A	C	D

Table I

Department	Trips Between Departments					
	A	**B**	**C**	**D**	**E**	**F**
A	-	9	2	-	8	5
B	-	-	-	3	-	-
C	-	-	-	-	7	8
D	-	-	-	-	-	3
E	-	-	-	-	-	4
F	-	-	-	-	-	-

Table II

E	C	F
A	B	D

Table III

Ans:

Department Pair	Current layout			Proposed Layout	
	Number of Trips (1)	Distance (2)	wd Score (1 x 2)	Distance (3)	wd score (1 X 3)
A,B	9	2	18	1	9
A,C	2	1	2	2	4
A,E	9	1	9	1	9
A,F	5	3	15	3	15
B,D	3	2	6	1	3
C,E	7	2	14	1	7
C,F	8	2	16	1	8
D,F	3	1	3	1	3
E,F	4	2	8	2	8
	Total		91		66

The above table reveals that the wd score drops from 91 from the current plan to 66 for the revised plan. So we can change the layout as proposed.

33. **Baker Machine Company is a job shop that specializes in precision parts for firms in the aerospace industry. Figure (Table I) shows the current block plan for the key manufacturing centers of the 75000 sq. ft facility. Refer to following closeness matrix (Table II) and use rectilinear distance (the current distance from inspection to shipping and receiving is three units) to calculate the change in the weighted distance, wd, score if Baker exchanges the locations of the tool crib and inspection. Put up your decision.**

C	D	B
A	E	F

Table I

Department	Trips Between Departments					
	A	B	C	D	E	F
Burr & Grid (A)	-	8	3	-	9	5
Numerically Controlled Equipment (B)	-	-	-	3	-	-
Shipping & Receiving (C)	-	-	-	-	8	9
Leather & Drills (D)	-	-	-	-	-	3
Tool Crib(E)	-	-	-	-	-	3
Inspection(F)	-	-	-	-	-	-

Table II

Ans:

Proposed Layout Plan:

C	D	B
A	F	E

Department Pair	Current layout			Proposed Layout	
	Number of Trips (1)	Distance (2)	wd Score (1 x 2)	Distance (3)	wd score (1 X 3)
A,B	8	3	24	3	24
A,C	3	1	3	1	3
A,E	9	1	9	2	18
A,F	5	2	10	1	5
B,D	3	1	3	1	3
C,E	8	2	16	3	24
C,F	9	3	27	2	18
D,F	3	2	6	3	9
E,F	3	1	3	1	3
	Total		101		107

The above table reveals that the wd score increased from 101 from the current plan to 107 for the revised plan. So we should not adopt the layout as proposed.

34. **Bharat Forge does its annual production planning over four quarters. Its demand projections for the coming year are as follows:**

Quarter	Demand (tonnes)
I	70
II	130
III	110
IV	90

Bharat's workforce can produce 60 tonnes of output/quarter. The workforce needs to be increased but that is going to be a distant plan. Overtime can be used. Of course the output rate during the overtime period is observed to be 20% greater than that during the regular time. But there is a legal cap on the overtime limiting it to a maximum time of 25% of the regular time in any quarter. Overtime costs 40% more than the regular time production. It can subcontract to smaller company at a premium of 45% of the cost of the regular production. The regular time costs are B200000/T (does not include cost of materials). Inventory carrying cost is B400000/T/year. As a management policy, no shortages allowed. Suggest an economical aggregate production plan for Bharat Forge. Assume zero inventories of the product at the beginning of the plan year. What is the total production cost for this plan?

Ans:

Regular time production cost: B200000/T
Overtime production cost: B200000/T X 1.40 = B280000/T
Subcontracting cost: B200000/T X 1.45 = B290000/T
Cost of producing in overtime and carrying the inventory to the next quarter = 200000+400000/4 = B300000
The approach to the aggregate planning will be:
Produce during regular time
If this quantity is not adequate to meet the demand, produce the additional quantity in overtime

However, the maximum overtime production possible in a quarter is 20% of the regular production capacity = 0.25 X 60 X 1.20 = 18T

Hence in any quarter the maximum that can be produced in regular plus overtime would be = 60+18=78T.

If in any quarter the demand exceeds 78T, the quantity over and above 78T will have to be sub contracted. The aggregate production plan can now be as follow:

Quarter	Output (T) obtained through			
	Regular	Overtime	Subcontract	Total
I	60	10		70
II	60	18	52	130
III	60	18	32	110
IV	60	18	12	90

There is no limit on the amount to subcontract. Therefore the last option, the most expensive one, will not be used.
The production costs for this aggregate production plan are as:
Quarter I: (60 X 200000) + (10 X 280000) = B14800000;
Quarter II: (60 X 200000) + (18 X 280000) + (52 X 290000) = B32120000;
Quarter III: (60 X 200000) + (18 X 280000) + (32 X 290000) = B26320000;
Quarter IV: (60 X 200000) + (18 X 280000) + (12 X 290000) = B20520000;

35. What are the conditions to be met for Product-layout.

Ans:

- ➢ Adequate volume for reasonable equipment utilization;
- ➢ Reasonably stable product demand;
- ➢ Product Standardisation;
- ➢ Part Interchangeability;
- ➢ Continuous supply of materials;

Study Note – 3

DESIGNING OF OPERATIONAL SYSTEM AND CONTROL

1. **Define Importance of Product Design**

   Answer:

   Production or operations strategy is directly influenced by product design for the following reasons:

   (i)   As products are designed, all the detailed characteristics of each product are established;

   (ii)   Each product characteristic directly affects how the product can be made or produced (i.e., process technology and process design);

   (iii) How the product is made determines the design of the production system (production design) which is the heart of production and operations strategy;

   iv)   A good product design can improve the marketability of a product by making it easier to operate or use, upgrading its quality, improving its appearance, and/or reducing manufacturing costs.

2. **Which one of the following is not correct?**
   a) **An excellent design provides competitive advantage to the manufacturer, by ensuring appropriate quality;**
   b) **An excellent design provides competitive advantage to the manufacturer, by ensuring reasonable cost;;**
   c) **An excellent design provides competitive advantage to the manufacturer, by ensuring sustainability;**
   d) **An excellent design provides competitive advantage to the manufacturer, by ensuring expected product feature;**

   Answer: (c)

3. **What Does Product Design Do?**

   Answer:

   The activities and responsibilities of product design include the following:
   (i)   Translating customer needs and wants into product and service requirements (marketing);
   (ii)   Refining existing products (marketing);
   (iii) Developing new products (marketing, product design and production);
   (iv)   Formulating quality goals (quality assurance, production);
   (v)   Formulating cost targets (accounting);
   (vi)   Constructing and testing prototype (marketing, production);
   (vii) Documenting specifications (product design);

4. What are the Reasons for Product Design or Redesign?

Answer:

The most obvious reason for product design is to offer new products to remain competitive in the market. The second most important reason is to make the business grow and increase profits. Also, when productivity gains result in reduction of workforce, developing new products can mean adding jobs and retaining surplus workforce instead of downsizing by layoffs/ retrenchment.

Sometimes product design is actually redesign or modification of existing design instead of an entirely new design. The reasons for this include customer complaints, accidents or injuries during product use, excessive warranty claims or low demand. Sometimes product redesign is initiated to achieve cost reductions in labour and material costs.

5. Which one of the following is not an Objective of Product Design?
(i) To generate profit in the long run;
(ii) To reduce the development time and cost to the minimum;
(iii) To facilitate easy handling of the product;
(iv) To ensure productibility or manufacturability (design for manufacturing and assembly);

Answer: (iii)

6. Match the item in column (1) to that of in column (2)

Factors Influencing Product Design	Feature
a) Customer Requirement	i) It goes hand in hand with product design and attractiveness of this enhances the sales appeal of the product;
b) Convenience of the operator	ii) the designer should have the knowledge of the this for the manufacturing facilities and specify tolerances which can be achieved by the available machines and equipments;
c) Cost/price ratio	iii) This partly depends on quality of design and partly on quality of conformance and quality policy of the firm has a say on this;
d) Work methods &equipments	iv) Designers must keep abreast of improvements on this for utilization in product design to achieve reduction in cost;
e) Trade off between function and form	v) It influences the product design so that the design suits the convenience of customers for use;
f) Process Capability	vi) it influences to make the design cost effective in a competitive market;
g) Packaging	vii) Under this the design combines both performance and aesthetics or appearance with a proper balance between the two.
h) Types of materials used	viii) This influences design of industrial products mainly;
i) Product quality	ix) This is considered to keep the cost of implementing the changes to a minimum;
j) Effect on existing product	x) Designers keep in touch with the latest developments taking place in this field and any new discovery in this improves the product design

Answer:

a)/v; b)/viii; c)/vi; d/iv; e)/vii; f)/ii; g)/i; h)/x; i)/iii; j)/ix

7. **What are the determinants of sequence of operations?**

   Answer:

   ➢ The nature of the product;
   ➢ The materials used;
   ➢ The quantities to be produced;
   ➢ The existing physical layout of the plant;

8. **What are the primary questions before deciding on process selection?**

   Answer:

   (i) How much variety of products or services will the system need to handle?
   (ii) What degree of equipment flexibility will be needed?
   (iii) What is the expected volume of output?

9. **Define Process Strategy and write down its key aspects.**

   Answer:

   A process strategy is an organisation's approach to process selection for the purpose of transforming resource inputs into goods and services (outputs). The objective of a process strategy is to find a way to produce goods and services that meet customer requirement and product specification (i.e., design specifications) within the constraints of cost and other managerial limitations. The process selected will have a long-term effect on efficiency and production as well as flexibility, cost, and quality of the goods produced. Hence it is necessary that a firm has a sound process strategy at the time of selecting the process.
   Key aspects in process strategy include:
   (i) Make or buy decisions;
   (ii) Capital intensity;
   (iii) Process flexibility;

10. **The probability that a product will function for a specific time period without failure is termed as product's:**
    i) Maintainability; ii) Availability; iii) Reliability; iv) Predictability;

    Answer: iii

11. **High reliability and maintainability of a product ensures**
    i) High productivity; ii) High productibility; iii) Highly standard quality; iv) High availability;

    Answer: iv

12. Name the following product design activity:

It reduces variety among a group of products or parts. It results in economies of scale due to high volume of production of standard products. However it may lead to reduced choices for customers.

Answer: Standardisation:

13. Define Specification

Answer:

A specification is a detailed description of a material, part or product, including physical measures such as dimensions, volume, weight, surface finish etc. Specifications indicate tolerances on physical measures which provide production department with precise information about the characteristics of products to be produced and the processes and production equipment to be used to achieve the specified tolerances (acceptable variations).Interchangeability of parts in products produced in large volumes (mass production and flow-line production)is provided by appropriate specification of tolerances to facilitate the desired fit between parts which are assembled together.

14. Which one of the following is correct?

To avoid damage during transportation and storage of the product i) a proper package has to be provided; ii) a proper specification has to be provided; iii) a proper transportation layout has to be provided; iv) a reliable design has to be provided:

Answer: i

15. Explain Process Focus Strategy.

Answer:

Majority (about 75 per cent) of global production is devoted to low volume, high variety products in manufacturing facilities called job shops. Such facilities are organised around performing processes. For example, the processes might be welding, grinding or painting carried out in departments devoted to these processes. Such facilities are process focused in terms of equipment, machines, layout and supervision. They provide a high degree of product flexibility as products move intermittently between processes. Each process is designed to perform a wide variety of activities and handle frequent changes. Such processes are called intermittent processes. These facilities have high variable costs and low utilization of facilities.

16. Say true or false:

i) Batch process is characterized by high customization (made to order), high flexibility of equipment and skilled labour and low volume;

ii) Under maturity stage of product life cycle the manufacturers introduce new models or adopt methods such as trading-in, etc., to promote the sale of their brands with a view to retaining their position in the market;

iii) A product is born, grows lustily, attains a dynamic maturity, and then enters its most productive years;

iv) Repetitive process is also referred to as line process as it include production lines and assembly lines in job production;

v) Repetitive process is suitable to "manufacture-to-stock" strategy with standard products held in finished goods inventory;

vi) Developing a new product is Job shop process;

vii) In batch processing, volumes are higher because same or similar products or services are repeatedly provided;

viii) A job shop uses a flexible flow strategy, with resources organized around the job;

ix) In project process equipment flexibility and labour skills can range from low to high depending on the type of projects;

x) A continuous process is the extreme end of high volume, standardised production with flexible line flows;

xi) The process design is concerned with Kind of labour skills available, amount of labour available and their wage rates;

xii) Capital intensity refers to the mix of equipment and material which will be used by the firm;

xiii) Production planning and development is followed by introduction stage of product life cycle and this stage requires greater investment;

xiv) The process design is concerned with whether the process should be capital-intensive or labor-intensive;

xv) Batch processing is used when a high volume of goods or services is required and also a moderate variety in products or services;

Answer:

i)False; ii) True; iii) False; iv) False; v) True; vi) False; vii) True; viii) False; ix) True; x) False; xi) True; xii) False; xiii) True; xiv) True; xv) False;

Study Note – 4

PRODUCTION PLANNING AND CONTROL

1. **What Is The Meaning Of Production Planning?**

   Answer:

   Production planning is the planning of production and manufacturing modules in a company or industry. It utilizes the resource allocation of activities of employees, materials and production capacity, in order to serve different customers.

2. **In a work measurement exercise, a worker was observed for 30 minutes continuously. In this period, the worker completed 42 parts. The performance rating for the worker is 130. If the company allows 15% as a fatigue and personal time allowance, what should be the**

   a) Normal time for the job   b) Standard time for the job

   Answer:

   Time required by worker for completion of one part (observed time) = $\dfrac{30}{42}$ = 0.714 min.

   The performance rating of the worker = 130%
   So, the normal time = observed time × performance rating = 0.714 × 1.3 = 0.9286 min.
   Company allows 15% as a fatigue and personal time allowance on normal time. i.e., (0.9286×0.15) min = 0.13929 min.

   ∴ Standard time for the job

   = (Normal time) + (fatigue and personal allowance)
   = (0.9286 + 0.13929)
   = 1.06789 mins.

3. **What Is PPC In Production?**

   Answer:

   The PPC Cycle refers to Production Planning Control. It has three phases—preplanning, planning, controlling. The pre-planning phase consists of product development, sales forecasting, factory or plant layout, equipment selection policy, and preplanning of production just prior to large scale production.

4. **State the different options a company have in matching demand and capacity.**

   Answer:

   There are three general categories of options used
   1. Level
   2. Chase and
   3. Combination

   Level planning approach establishes a level set of resources and implies the demand will fluctuate around those available resources, or in, some cases, attempts to alter the demand patterns themselves to more effectively match the resource levels established. This approach tends to be more common and certainly more appealing in environments where resources are difficult or expensive to alter.

   Chase approach represents the other extreme, in that demand is not altered, but resources are. In fact in a "pure" chase environment the resources are continually being raised or lowered to meet the demand as it fluctuates under the normal conditions.

   Combination approach is by far the most common approach. As the name implies, companies using this approach will "mix and match", altering demand and resources in such a way to maximize performance to their established criteria, including profit, inventory investment, and the impact on people.

5. **If the arrival and departure rates in a public telephone booth with a single phone are 1/12 and1 /14 respectively, find the probability that the phone is busy.**

   Answer:

   P[Phone is busy] = 1 – P [No customer in the booth]

   $$= 1 - P_0 = 1 - \left(1 - \frac{\lambda}{\mu}\right) = \frac{\lambda}{\mu} = \frac{1}{12} \Big/ \frac{1}{4} = \frac{1}{3}$$

   λ= Rate of Arrival μ = Service Rate

6. **Briefly describe the M|G|1 queuing system. Answer:**

   Answer:

   Poisson arrival / General Service / Single server queuing system.

7. **Briefly describe the JIT philosophy.**

   Answer:

   Just-in-time (JIT) inventory systems are not just a simple method that a company has to buy in to; it has a whole philosophy that the company must follow. The ideas in this philosophy come from many different

disciplines including; statistics, industrial engineering, production management and behavioral science. In the JIT inventory philosophy there are views with respect to how inventory is looked upon, what it says about the management within the company, and the main principle behind JIT.

Inventory is seen as incurring costs instead of adding value, contrary to traditional thinking. Under the philosophy, businesses are encouraged to eliminate inventory that doesn't add value to the product. Secondly, it sees inventory as a sign of sub par management as it is simply there to hide problems within the production system. These problems include backups at work centres, lack of flexibility for employees and equipment, and inadequate capacity among other things.

In short, the just-in-time inventory system is all about having "the right material, at the right time, at the right place, and in the exact amount."

8. **Choose the correct answer:**
    A key to just-in-time production is
    a) the elimination of all inventories.
    b) to rely very heavily upon purchased items rather than in-house production.
    c) production in large lot sizes.
    d) the elimination of all or most product options.

    Answer: a)

9. **What is the difference between the Toyota Production System and Lean Manufacturing?**

    Answer:

    For all practical purposes, the two terms mean the same thing. The term "Lean Manufacturing" was coined by James Womac and Daniel Jones in their 1990 book The Machine That Changed the World to describe the phenomenal success that Japanese manufacturers were having in global markets. Since the Toyota Motor Company was the most successful of these Japanese companies to explain the Japanese manufacturing philosophy with their supply base and strategic partners, the term "Toyota Production System, or TPS, was born. Regardless of what it is called, the goal is always to eliminate waste from processes in order to reduce total lead-time.

10. **Choose the correct answer:**

    In transportation models designed in linear programming, points of demand is classified as
    a) ordination
    b) transportation
    c) destinations
    d) origins

    Answer: c)

11. **Jobs A through E in the aircraft repair facility must each pass through the Sheet Metal centre and then through Paint centre. The processing time for each job in each centre is shown below. Find the sequence that minimizes completion time of the job. Calculate the cumulative flow time and idle time.**

Processing Time in Days

Jobs	Wc-1 (Sheet metal centre)	Wc-2 (Paint centre)
A	4	5
B	17	7
C	14	12
D	9	2
E	11	6

Answer:

JOBS	A	B	C	D	E
Wc-I	4	17	14	9	11
Wc-II	5	7	12	2	6

Applying Johnson's Algorithm, we find the optional sequence as follows:

The minimum processing time for Job D (TIME : 2) is in the process of machine Wc-II. So, it should be placed at the end of the sequence. As the job is allotted, so that is crossed out from the list.

Next, minimum processing time for job A (TIME: 4) is in the process of machine Wc-I, so, it should be placed at the beginning of the sequence. As it is already allotted, it should be crossed out. In the same method, the job allocation has been performed.

A	C	B	R	D

The optimum sequence has obtained as above.

Computation of the total elapsed time and machine idle time.

JOB	M/C A		M/C B		Idle Time	
	IN	OUT	IN	OUT	M/C A	M/C B
A	0	4	4	9	0	4
C	4	18	18	30	0	9
B	18	35	35	42	0	5
E	35	46	46	52	0	4
D	46	55	55	57	0	3
					57-55=2 Hrs.	25 Hrs.

Total flow time = 57 hrs.
Idle time for Wc-I = 2 hrs.
Idle time for Wc-I = 25 hrs.

12. List TWO advantages of simulation models as compared to analytical models

1. Simulation can be used for highly complex system where analytical models are not possible.
2. Simulations are more flexible than mathematical modeling and have fewer assumptions.

13. Consider an M/M/1 queuing system with an arrival rate λ = 0.4 and service rate μ =0.5. Compute the system load and tell if the system stable or not?

Answer:

Traffic Intensity, p = λ /μ = 0.4/0.5 = 0.8
The system is stable because p<1

14. Choose the correct Answer:

In transportation model analysis the stepping-stone method is used to
a. **obtain an initial optimum solution**
b. **obtain an initial feasible solution**
c. **evaluate empty cells for potential solution improvements**
d. **evaluate empty cells for possible degeneracy**
e. **balance supply and demand**

Answer: c.

Study Note – 5

PRODUCTIVITY MANAGEMENT AND QUALITY MANATEMENT

1. **What do you mean by Total Productivity Index and Partial Productivity Index?**

    Answer:

    Productivity may be measured either on aggregate basis or on individual basis, which are called total and partial measure.

    Total productivity Index/measure = Total output/ Total input
    = (Total production of goods and services)/ (Labour + Material + Capital + Energy + Management)

    Partial productivity indices, depending upon factors used, it measures the efficiency of individual factor of production
    Labour productivity Index /Measure = Output in unit / Man hours worked
    Management productivity Index/Measure = Output / Total cost of management
    Machine productivity Index/Measure = Total output/ Machine hours worked
    Land productivity Index/Measure = Total output / Area of Land used

2. **Find out various productivity measures like total, multifactor and partial measure based on the following information:**

    Output and Input production data in dollar ($)

    Output
    1. **Finished units 10,000**
    2. **Work in progress 2,500**
    3. **Dividends 1,000**
    4. **Bonds -------**
    5. **Other income --------**

    Input
    1. **Human 3,000**
    2. **Material 153**
    3. **Capital 10,000**
    4. **Energy 540**

    Other Expenses 1,500.

Answer:

Total measure = Total Output/Total Input = 13,500/15,193 = 0.89

Multi factor measure = Total Output/ Human + Material =13,500/3153 =4.28

Multi factor measure = Finished units/ Human + Material = 10000/3,153 = 3.17

Partial Measure1 = Total Output /Energy = 13500/ 540 =25

Partial Measure2 = Finished Units /Energy = 10000/ 540 = 18.52

3. **What are the Benefits of Quality Management System?**

   Answer:

   1. Improvement in internal quality (reduction in scrap, rework and non-conformities in the shop)
   2. Improvement in external quality (customer satisfaction, claims of non-conforming products, returned products, warranty claims, penalty claims etc)
   3. Improvement in Production reliability (number of break downs, percentage down time etc)
   4. Improvement in Time performance (on-time delivery, time to market etc)
   5. Reduction in the cost of poor quality (external non-conformities, scrap, rework etc)

4. **What are the Dimensions of Quality?**

   Answer:

   Dimensions of Quality:
   1. Features
   2. Conformance
   3. Reliability
   4. Durability
   5. Service
   6. Response
   7. Aesthetics
   8. Reputation

5. **Give the Obstacles associated with TQM Implementation?**

   Answer:

   Obstacles for TQM implementation:
   1. Lack of management commitment
   2. Inability to change organizational culture •Improper planning
   3. Lack of continuous training and education
   4. Incompatible organizational structure and isolated individuals and departments
   5. In-effective measurement techniques and lack of access to data and results.
   6. Paying inadequate attention to internal and external customers.
   7. Inadequate use of empowerment and teamwork.

6. Define Quality Costs.

Answer:

Quality Costs are defined as those costs associated with the non achievement of product or service quality as defined by the requirements established by the organization and its contracts with customers and society.

7. What are the goals of Quality Management System (QMS)?

Answer:

The positive effects that are valued by a certified QM system according to ISO 9001 are usually:
1. Clear responsibilities.
2. Better-understood processes that are generally better implemented.
3. Greater confidence in management.
4. Better relationships with suppliers.
5. Better understanding of customers' needs.
6. Improved starting position vis-a-vis banks and insurance companies.
7. Advantage when orders are awarded, e.g. in the case of public tenders.

8. Can the ISO 9001 certification be combined with other certifications?

Answer:

ISO 9001 is a sector-neutral standard and therefore suitable for the certification of quality management systems of all companies. Audits according to ISO 9001 can be combined with other industry-specific audits for quality management systems as well as other management systems.

Combined certifications of ISO 9001 are usually combined with the following certifications (a selection): Quality standard ISO/TS 16949 for the automotive industry, the standards EMAS and ISO 14001 for environmental management and the ISO 50001 for energy management.

9. What is ISO 9000?

Answer:

The ISO 9000 family of standards represents an international consensus on good management practices with the aim of ensuring that the organization can time and time again deliver the product or services that meet the client's quality requirements. These good practices have been distilled into a set of standardized requirements for a quality management system, regardless of what your organization does, its size, or whether it is in the private, or public sector. The family of ISO 9000 standards has been developed by ISO and it is made up of four core standards:

ISO   9000:2005 –   Fundamentals and Vocabulary

ISO   9001:2008 –   Quality Management Systems – Requirements

ISO   9004:2009 –   Quality Management Systems - Guidelines for performance improvements

ISO 19011: 2011 –   Guidelines for quality and/or environmental management systems auditing

10. What are the benefits of implementing IS/ISO 14001:2004?

Answer:

Following are the benefits to an organization by implementing IS/ISO 14001:2004:

1. Provides framework for
   a) Pollution prevention and waste reduction
   b) Compliance with legislative and regulatory requirements

2. Reduction in liability/risks
3. Competitive advantage for `Green' products Globally
4. Creation of an improved community goodwill
5. Improved environmental performance

11. Choose the correct answer:

"The degree to which a set of inherent characteristics of an object fulfils requirements" is known as:
a) Conformity
b) Quality
c) Grade
d) Capability
e) None of the above

Answer: b)

12. Choose the correct answer:

ISO 9001:2015 requires that the quality policy:
a) Must be reviewed for continuing suitability
b) Must be communicated and understood within the organization
c) Must provide a framework for establishing and reviewing quality objectives
d) All of the above
e) None of the above

Answer: d)

13. Choose the correct answer:

Which of the following is not one of the seven Quality Management Principles?
a) System Approach to Management
b) Engagement of people
c) Leadership
d) Customer focus
e) None of the above

Answer: a)

14. Choose the correct answer:

Which of the following indicates that a quality system is effective?
(a) The required system is in place and continuous improvement is evident.
(b) An audit was conducted and no non-conformances were found.
(c) An audit report states that the intent of the standard is being met.
(d) No corrective action requests have been issued for a specified period of time.

Answer: a)

15. What is Product mix & Production price discrimination?

The product mix is the collection of products and services that a company chooses to offer its market. Most products are part of a broader product mix. Consequently, they must be priced accordingly. Product Mix Pricing Strategies address this issue. We will explain the basic product mix pricing strategies that change a product's pricing when it is part of a product mix.

Cost Plus
Cost-plus pricing is the most basic type of pricing and simply represents setting the cost of a product at some level above the cost of producing and distributing that product. So, for instance, a jeweler might decide to price products at a 100 percent mark-up based on the costs that go into creating the product.

Competition Based
Competition-based pricing is pricing that is established specifically to address and respond to the prices of competitors' products. Businesses may decide to price either higher or lower or at about the same levels of the competition, but their decisions are based on an evaluation of what competitors are doing and how they want to position their product mix.

Skimming
Skimming is a pricing strategy used most frequently by new entrants to a market or by companies who have developed new products that have little to no competition. Skimming establishes pricing at a high price point to take advantage of sales that will occur before competitors enter the market--which they ultimately will.

Penetration

Penetration pricing is a product mix pricing strategy designed to gain market share by introducing a new product or service at a low price point to encourage consumers to try the product. Companies using penetration pricing may even price their products at lower than cost to raise awareness and capture a large share of the market.

Study Note – 6

PROJECT MANAGEMENT

1. **What is a Project? Name two important Project Network analysis and their features.**

    Answer:

    A project is a carefully defined set of activities that use resources (money, people, materials, energy, space, provisions, communication, etc.) to meet the predefined objectives.

    Programme Evaluation and Review Techniques (PERT) and Critical Path Method (CPM) are two important project network analysis techniques.

    The use of PERT and CPM techniques is made in both planning and controlling of the projects. These techniques help the project managers to determine the expected project completion date; the scheduled start and completion time for the different activities comprising the project; the key activities of the project which must be completed at the scheduled time; the time period by which the non-key activities may be delayed without causing a delay in the completion of the whole project etc.

    PERT is useful for analyzing project scheduling problems in which the completion time of the different activities and therefore the whole project is not certain. It thus emphasizes the uncertainties of the completion times of the activities. On the other hand, CPM is most appropriately used in projects in which the activity durations are known with certainty along with certain knowledge on amounts of resources required for performing each of the activities. This technique is basically concerned with obtaining the trade-offs between the project duration and cost.

2. **A work project consists of twelve activities labelled A through L. Upon being asked to specify the order in which jobs had to be done, the manager answered as follows:**

    A, B and C are the first activities of the period and can start simultaneously and immediately. A and B precede D while B precedes E, F and H. Activities F and C precede G while E and H precede I and J. C,D,F and J precede K which in turn precedes L. Further I, G and L are the terminal activities of the project.

    The completion times of the various activities are listed here:

Activity	A	B	C	D	E	F	G	H	I	J	K	L
Time(days)	6	4	10	1	1	3	14	6	9	2	7	5

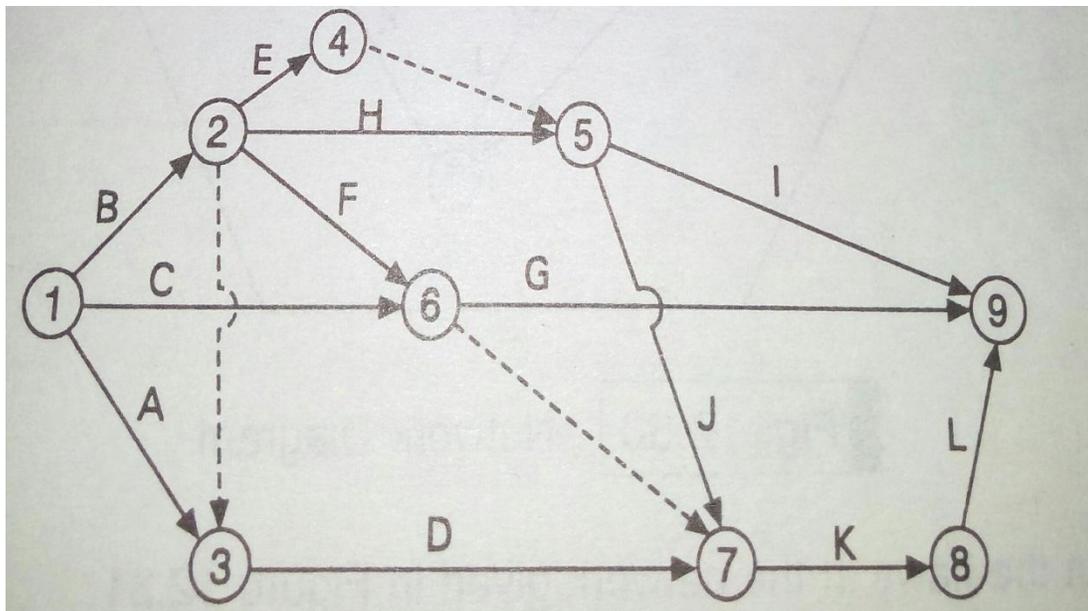   **(a) Draw a network diagram corresponding to this project;**
    (b) Obtain the lengths of all the paths and determine critical path.

Answer:

The precedence relationships implied from the given information are:

Activity	Immediate Predecessor(s)	Activity	Immediate Precedence(s)
A	-	G	C,F
B	-	H	B
C	-	I	E,H
D	A,B	J	E,H
E	B	K	C,D,F,J
F	B	L	K

The various paths and their lengths are as follows:

| Path	Length
1-3-7-8-9	19
1-2-3-7-8-9	17
1-2-4-5-7-8-9	19
1-2-5-7-8-9	24* Critical
1-2-5-9	19
1-2-4-5-9	14
1-2-6-7-8-9	19
1-2-6-9	21
1-6-7-8-9	22
1-6-9	24* Critical

3. a) Draw a network corresponding to the following information;
    b) Find the earliest and the latest scheduling time of various activities.
    c) Obtain the total, interfering, free and independent floats for each of the activities.
    d) Can the project be completed within 65 days?
    e) What would be the effect on the project length of reducing the resources to be used for activity 8-10 by such an amount as would increase the time for this activity by 5 days?
    f) The head of the department in which activity 6-8 is to be performed requests that he be allowed to work overtime so that the activity can be completed in 6 days. Should his request be considered in the interest of project completion at an earlier date? How about a similar request from the manager of the activity 2-7?
    g) It has come to be known that due to non-availability of resources in time, activity 3-5 would be delayed by 9 days. Will it affect (i) the project completion time? (ii) the start of its successor activity? By how much?

Activity	Time (Days)	Activity	Time(Days)
1-2	8	6-8	10
1-3	2	7-10	12
1-4	6	8-9	3
1-5	12	8-10	6
2-4	5	9-12	8
2-7	9	10-12	18
3-5	3	10-14	9
3-6	7	11-12	7
4-10	4	11-14	4
5-11	10	12-13	11
6-7	2	13-14	4

Answer:

The network diagram is shown the following figure:
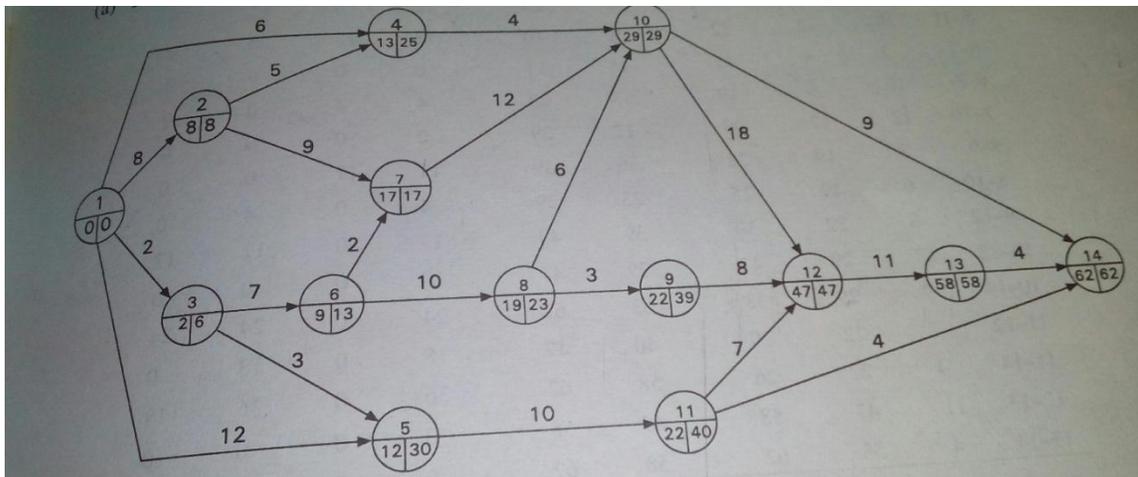
b) and c): The earliest and the latest starting and finishing times of various activities are indicated in the figure and are given in the following table. Also given in the table are the floats.

d) Yes the project can be completed in 65 days.

e) Since the activity 8-10 has a total float equal to 4 days, a delay by 5 days in it would increase the project length by one day.

f) The activity 6-8 is non-critical and has a total float equal to 6 days. Therefore it is no use working overtime on it as a decrease in its time would not cause a change in the project duration. However activity 2-7 is worthwhile working overtime on. This is because activity 2-7 is a critical one.

g) (i) The activity has a total float equal to 25 days. A delay of 9 days would not affect the project completion time. However the delay of 9 days, would

   ii) affect the start of its successor activity by 2 days because it has free float equal to 7 days.

Determination of scheduling time and floats

Activity	Time	Earliest		Latest		Float			
		Start	Finish	Start	Finish	Total	Int.	Free	Indep.
1-2	8	0	8	0	8	0	0	0	0
1-3	2	0	2	4	6	4	4	0	0
1-4	6	0	6	19	25	19	12	7	7
1-5	12	0	12	18	30	18	18	0	0
2-4	5	8	13	20	25	12	12	0	0
2-7	9	8	17	8	17	0	0	0	0
3-5	3	2	5	27	30	25	18	7	3
3-6	7	2	9	6	13	4	4	0	0
4-10	4	13	17	25	29	12	0	12	0
5-11	10	12	22	30	40	18	18	0	0
6-7	2	9	11	15	17	6	0	6	2
6-8	10	9	19	13	23	4	4	0	0
7-10	12	17	29	17	29	0	0	0	0
8-9	3	19	22	36	39	17	17	0	0
8-10	6	19	25	23	29	4	0	4	0
9-12	8	22	30	39	47	17	0	17	17
10-12	18	29	47	29	47	0	0	0	0
10-14	9	29	38	53	62	24	0	24	24
11-12	7	22	29	40	47	18	0	18	0
11-14	4	22	26	58	62	36	0	36	18
12-13	11	47	58	47	58	0	0	0	0
13-14	4	58	62	58	62	0	0	0	0

4. **What is the difference between a Project and a Process?**

   Answer:

   A project is a temporary and one-time endeavor undertaken to create a unique product or service, which brings about beneficial change or added value. This property of being a temporary and one-time undertaking contrasts with processes, or operations, which are permanent or semi-permanent ongoing functional work to create the same product or service over and over again.

5. **What are the challenges of Project Management?**

   Answer:

   ➢ To make sure that a project is delivered within defined constraints;
   ➢ To optimize allocation and integration of inputs needed to meet predefined objectives;

6. **Say True or False**
   a) **Horizontal lines in Gantt chart divide the chart into sections which can represent various work tasks (work schedule) or work centers (load schedule);**
   b) **The critical path can be located by all those activities or events for which slack time is either zero or float time is the least;**
   c) **For calculation of Earliest Finish time, Total project time is required;**
   d) **Total float is the maximum amount by which duration time of an activity can be increased by increasing the total duration time of the project;**
   e) **Free Float is that fraction from total float of an activity which can be used for rescheduling the activity without affecting the succeeding activity;**

   Answer: a) T; b) T; c) F; d) F; e) T;

7. **How float information is helpful in decision making?**

   Answer:

   The float information can be used in decision-making in the following ways:
   ➢ Total float can affect both the previous and the subsequent activities;
   ➢ Total float can be used without affecting the subsequent activities;
   ➢ Independent float can be used in allocating the resources elsewhere and increasing the time of some noncritical activities;
   ➢ Negative float signifies reduction in target time to finish the work in time;

8. The following table gives the activities in a construction project and other relevant information:

Activity	Immediate Predecessors(s)	Time (days)		Direct Cost (B)	
		Normal	Crash	Normal	Crash
A	-	4	3	60	90
B	-	6	4	150	250
C	-	2	1	38	60
D	A	5	3	150	250
E	C	2	2	100	100
F	A	7	5	115	175
G	D,B,E	4	2	100	240

Indirect costs vary as follows:

Days	Costs(B)
15	600
14	500
13	400
12	250
11	175
10	100
9	75
8	50
7	35
6	25

a) Draw an arrow diagram for the project;

b) Determine the project duration which will return in minimum total project cost

Answer:
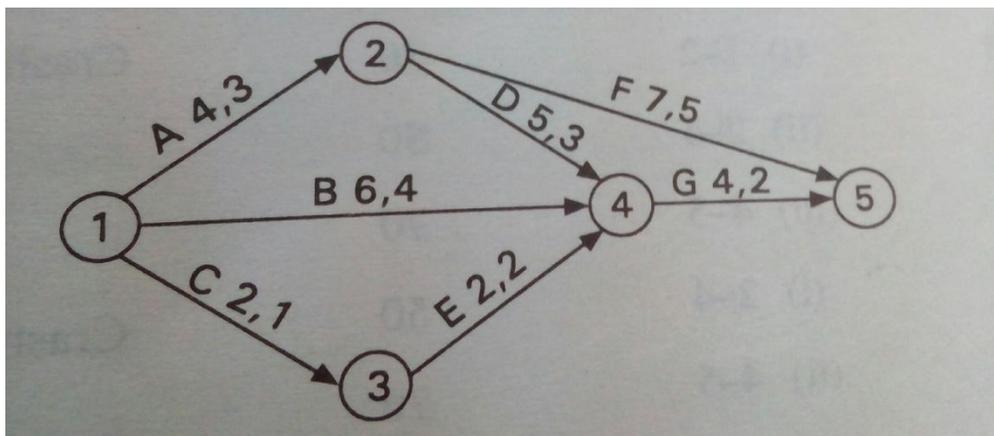
From the diagram we have

Path	Length	
	Normal time	Crash Time
1-2-5	11	8*(Critical)
1-2-4-5	13*(Critical)	8*(Critical)
1-4-5	10	6
1-3-4-5	8	5

Thus the normal duration is 13 days while the minimum completion time of the project is 8 days.

$$\text{Crashing Cost} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}}$$

Accordingly for activity A, we have

$$\text{Crashing Cost} = \frac{90 - 60}{4 - 3} = ₹\ 30 \text{ / day}$$

For various activities the crashing costs are:

Activity	Node	Cost /day(B)
A	1-2	30
B	1-4	50
C	1-3	22
D	2-4	50
E	3-4	-
F	2-5	30
G	4-5	70

The step wise crashing is given in following table while the cost of completing the project in 13, 12... Days is given in next to next table:

Crashing	Critical path(s)	Options	Cost	Decision	Duration after crashing
I	1-2-4-5	(i) 1-2	30	Crash 1-2	12
		(ii) 2-4	50		
		(iii) 4-5	70		
II	1-2-4-5	(i) 2-4	50	Crash 2-4	11
		(ii) 4-5	70		
III	1-2-4-5	(i) 2-4	50	Crash 2-4	10
		(ii) 4-5	70		
IV	1-2-5	(i) 2-5,4-5	100	Crash 2-5,4-5	9
	1-2-4-5				
	1-4-5				
V	1-2-5	(i) 2-5,4-5	100	Crash 2-5,4-5	8
	1-2-4-5				
	1-4-5				

The length of various paths after each crashing is given here:

Path	Normal length	Length after crashing				
		I	II	III	IV	V
1-2-5	11	10	10	10	9	8
1-2-4-5	13	12	11	10	9	8
1-4-5	10	10	10	10	9	8
1-3-4-5	8	8	8	8	7	6

Determination of total cost

Project Duration (Days)	Direct Cost			Indirect Cost	Total Cost (B)
	Normal	Crashing	Total		
13	713	0	713	400	1113
12	713	30	743	250	993
11	713	80	793	175	968
10	713	130	843	100	943*(Min)
9	713	230	943	75	1018
8	713	330	1043	50	1093

Study Note – 7

ECONOMICS OF MAINTENANCE AND SPARES MANAGEMENT

1. **Explain breakdown maintenance &Preventive maintenance**

   Answer:

   Here the production facility is run without much routine maintenance until it breakdown. Once the machine breakdown it is taken for repair and inspected to find out the defects. After identifying the defect, the required repair is planned and the spares are procured to repair the machine. As the breakdowns are random in nature and the machine cannot be used during the repair period, production hours are lost hence the productivity is reduced. Repair maintenance is not a recommended practice, in general, but many a time many organizations prefer this, because they do not want to keep the machine idle for maintenance. But they ignore the fact that the break down repair costs more than the regular maintenance practice. It is however, an economical way of maintaining certain non-critical items whose repair and down time costs are less this way than with any other system of maintenance.

   Preventative maintenance (or preventive maintenance) is maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing. Preventative maintenance is performed while the equipment is still working, so that it does not break down unexpectedly. Replacement of candle in water filters in every 6 months.

2. **Which one of the following is not correct in respect of preventive maintenance?**
   a) **It locates weak parts in all equipments, provides them regular inspection and minor repairs thereby reducing the danger of unanticipated breakdowns;**
   b) **This reduces the unanticipated breakdowns, increases the availability of the equipment, maintain optimum productive efficiency of equipment and machinery;**
   c) **The system of preventive maintenance varies from plant to plant depending on the requirement of the product and services;**
   d) **As the preventive maintenance is a costly affair, it is better to maintain records of cost (both labour, materials used and spares used);**

   Answer :   (c)

3. **Say true or false:**
   a) **Effectiveness of breakdown maintenance planning = (Labour hours on scheduled maintenance) / (Total available hours spent);**
   b) **Preventive maintenance results in less standby or reserve equipment or spares;**
   c) **Preventive maintenance is done while the equipment is running or during preplanned shut-downs;**
   d) **Under Shifting production during breakdown method spare capacity is maintained in the form of standby machines;**

e) A proper stores management is essential as a backup service of good maintenance;

f) Preventive maintenance policy is justified only when the average downtime and its cost is less than the average time taken to carry out breakdown repairs;

Answer: a) F; b) T; c) F; d) F; e) T; f) T;

4. Write down the objectives of maintenance.

Answer:

➢ To keep all the production facilities and other allied facilities such as building and premises, power supply system, etc in an optimum working condition;

➢ To ensure specified accuracy to products and time schedule of delivery to customers;

➢ To keep the down time of the machine at minimum, so that the production program is not disturbed;

➢ To keep the production cycle within the stipulated range;

➢ To modify the machine tools to meet the augmented need for production;

➢ To improve productivity of existing machine tools and to avoid sinking of additional capital;

➢ To keep the maintenance cost at a minimum as far as possible, thereby keeping the factory Overheads at minimum;

➢ To extend the useful life of plant and machinery, without sacrificing the level of performance;

5. What are the requirements for getting full benefits of effective maintenance?

Answer:

➢ Good Supervision and administration of maintenance department;

➢ Good and clear instructions to be given to maintenance crew regarding the repair;

➢ Proper control of work in coordination with production department;

➢ Good training should be given to the maintenance personnel;

➢ Good scheduled maintenance program should be chalked out;

➢ Proper maintenance record keeping is a must;

➢ There should be adequate stock of spare parts, particularly insurance spares;

7. Assume the following three breakdown probability distribution

Month following Maintenance	Probability of Breakdown		
	(1)	(2)	(3)
1	0.5	0.1	0.1
2	0.1	0.1	0.1
3	0.1	0.1	0.5
4	0.1	0.1	0.1
5	0.1	0.2	0.1
6	0.1	0.4	0.1

Which, if any, of these distributions lend themselves to a preventive maintenance program? Why?

Answer:

Policy 1:

Month following Maintenance (i)	Probability of Breakdown (p)	Average free run time (i * p)
1	0.5	0.5
2	0.1	0.2
3	0.1	0.3
4	0.1	0.4
5	0.1	0.5
6	0.1	0.6
		∑2.5months/breakdown/machine

Therefore the average number of breakdowns for the pool of say 100 machines per month will be:

For 1 machine in 2.5 months 1 breakdown

So for 1 machine in 1 month (1/2.5) breakdown

So for 100 machines in 1 month (100/2.5) = 40 breakdowns

Policy 2:

Month following Maintenance (i)	Probability of Breakdown (p)	Average free run time (i * p)
1	0.1	0.1
2	0.1	0.2
3	0.1	0.3
4	0.1	0.4
5	0.2	1.0
6	0.4	2.4
		∑4.4months/breakdown/machine

Therefore the average number of breakdowns for the pool of say 100 machines per month will be:

For 1 machine in 4.4 months 1 breakdown

So for 1 machine in 1 month (1/4.4) breakdown

So for 100 machines in 1 month (100/4.4) = 22.73 breakdowns

Policy 3:

Month following Maintenance (i)	Probability of Breakdown (p)	Average free run time (i * p)
1	0.1	0.1
2	0.1	0.2
3	0.5	1.5
4	0.1	0.4
5	0.1	0.5
6	0.1	0.6
		∑3.3months/breakdown/machine

Therefore the average number of breakdowns for the pool of say 100 machines per month will be:

For 1 machine in 3.3 months 1 breakdown
So for 1 machine in 1 month (1/3.3) breakdown
So for 100 machines in 1 month (100/3.3) = 30.30 breakdowns

Preventive maintenance programs are generally applicable to breakdown distributions with low variability. Policy 2 has the lowest variability as no of breakdowns in a month for a pool of say 100 machines are 22.73--- the lowest among three policies.

Therefore we may conclude that policy 2 could lead to a preventive maintenance program.

7. **Refer Q1. Let us take Average Repair Cost on breakdown C_R = ₹90 & Cost of Preventive maintenance C_{PM} = ₹30.**
   Could you prove your conclusion given in A1 for a pool of 100 machines?

   Answer:

   Repair Policy Cost of Policy 1 = Average number of repairs per month X Average repair cost on breakdown
   = 40 X 90 = ₹3600

   Data taken from Ans 1.

Preventive Maintenance Costs for the Six Preventive Maintenance Cycles : Table-I

Preventive Maintenance Cycle (n), months	Expected Breakdowns in PM Cycle	Average No of Breakdowns per month (Col.2/Col.1)	Expected Monthly Breakdown Cost (Col.3 x `90)	Expected Monthly PM Cost (`30 x 100)/ Col.1	Expected Monthly Cost of each PM cycle (Col.4 + Col.5)
1	50	50	4500	3000	7500
2	85	42.5	3825	1500	5325
3	117.5	39.17	3525.3	1000	4525.3
4	152.25	38.06	3425.4	750	4175.4
5	191.38	38.28	3445.2	600	4045.2
6	236.16	39.36	3542.4	500	4042.4

Computation of Col.2:
Month 1: 100*0.5 =50
Month2: 100*(0.5+0.1) +50*0.5 = 85
Month3: 100*(0.5+0.1+0.1) + 50*0.1 +85*0.5 = 117.5
Month4: 100*(0.5+0.1+0.1+0.1) + 50*0.1+85*0.1+117.5*0.5 = 152.25
Month5: 100*(0.5+0.1+0.1+0.1+0.1) +50*0.1+85*0.1+117.5*0.1+152.25*0.5 = 191.38
Month6: 100*(0.5+0.1+0.1+0.1+0.1+0.1) +50*0.1+85*0.1+117.5*0.1+152.25*0.1+191.38*0.5 = 236.16

Graphical Representation Policy 1: Fig-I
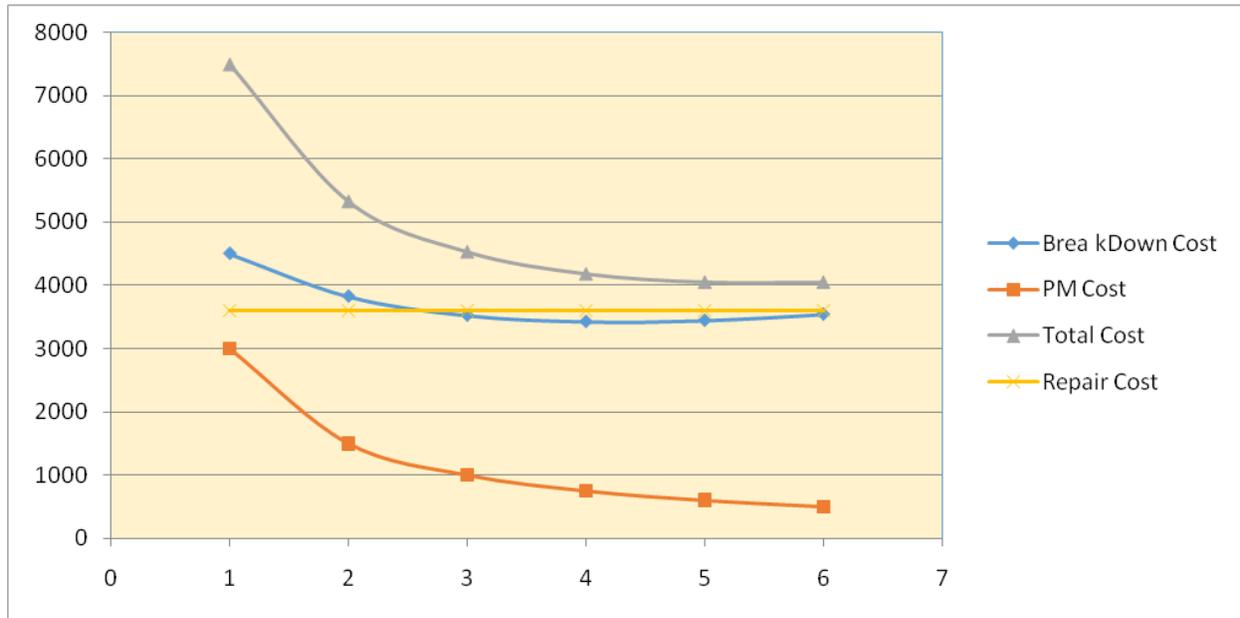
Repair Policy Cost of Policy 2 = Average number of repairs per month X Average repair cost on breakdown
= 22.73 X 90 = ₹2045.7

Data taken from Ans 1.

Preventive Maintenance Costs for the Six Preventive Maintenance Cycles

Preventive Maintenance Cycle (n) , months	Expected Breakdowns in PM Cycle	Average No of Breakdowns per month (Col.2/Col.1)	Expected Monthly Breakdown Cost (Col.3 x ₹90)	Expected Monthly PM Cost (₹30 x 100)/ Col.1	Expected Monthly Cost of each PM cycle (Col.4 + Col.5)
1	10	10	900	3000	3900
2	21	10.5	945	1500	2445
3	33.1	11.03	992.7	1000	1992.7
4	46.41	11.60	1044	750	1794
5	71.05	14.21	1278.9	600	1878.9
6	119.16	19.86	1787.4	500	2287.4

Computation of Col.2:

Month 1: 100*0.1=10

Month2: 100*(0.1+0.1) +10*0.1 = 21

Month3: 100*(0.1+0.1+0.1) + 10*0.1 +21*0.1 = 33.1

Month4: 100*(0.1+0.1+0.1+0.1) + 10*0.1+21*0.1+33.1*0.1 = 46.41

Month5: 100*(0.2+0.1+0.1+0.1+0.1) +10*0.1+21*0.1+33.1*0.1+46.41*0.1 = 71.05

Month6:100*(0.4+0.2+0.1+0.1+0.1+0.1)+10*0.2+21*0.1+33.1*0.1+46.41*0.1+71.05*0.1= 119.16

Graphical Representation Policy 2:   Fig-II
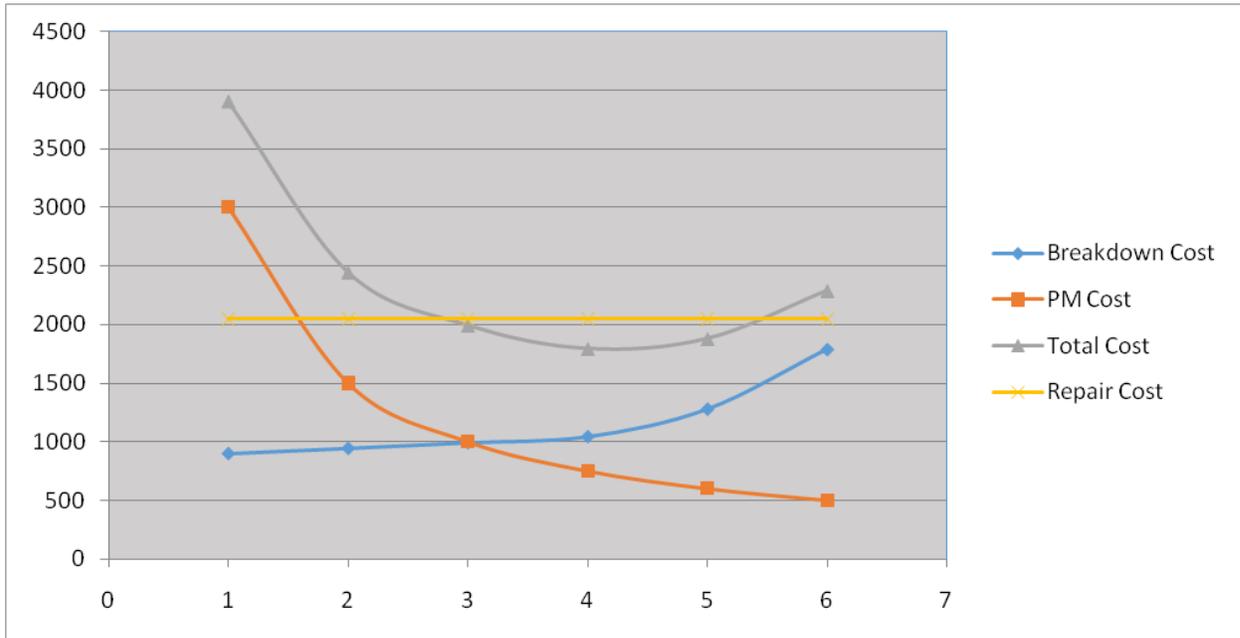
Repair Policy Cost of Policy 3 = Average number of repairs per month X Average repair cost on breakdown
= 30.30 X 90 = ₹2727

Data taken from Ans 1.

Preventive Maintenance Costs for the Six Preventive Maintenance Cycles

Preventive Maintenance Cycle (n) , months	Expected Breakdowns in PM Cycle	Average No of Breakdowns per month (Col.2/Col.1)	Expected Monthly Breakdown Cost (Col.3 x ₹90)	Expected Monthly PM Cost (₹30 x 100)/ Col.1	Expected Monthly Cost of each PM cycle (Col.4 + Col.5)
1	10	10	900	3000	3900
2	21	10.5	945	1500	2445
3	73.1	24.37	2193.3	1000	3193.3
4	94.41	23.60	2124	750	2874
5	118.25	23.65	2128.5	600	2728.5
6	160.92	26.82	2413.8	500	2913.8

Computation of Col.2:

Month 1: 100*0.1=10

Month2: 100*(0.1+0.1) +10*0.1 = 21

Month3: 100*(0.5+0.1+0.1) + 10*0.1 +21*0.1 = 73.1

Month4: 100*(0.1+0.5+0.1+0.1) + 10*0.5+21*0.1+73.1*0.1 = 94.41

Month5: 100*(0.1+0.1+0.5+0.1+0.1) +10*0.1+21*0.5+73.1*0.1+94.41*0.1 = 118.25

Month6:100*(0.1+0.1+0.1+0.5+0.1+0.1)+10*0.1+21*0.1+73.1*0.5+94.41*0.1+118.25*0.1= 160.92

Graphical Representation Policy 3:   Fig-III
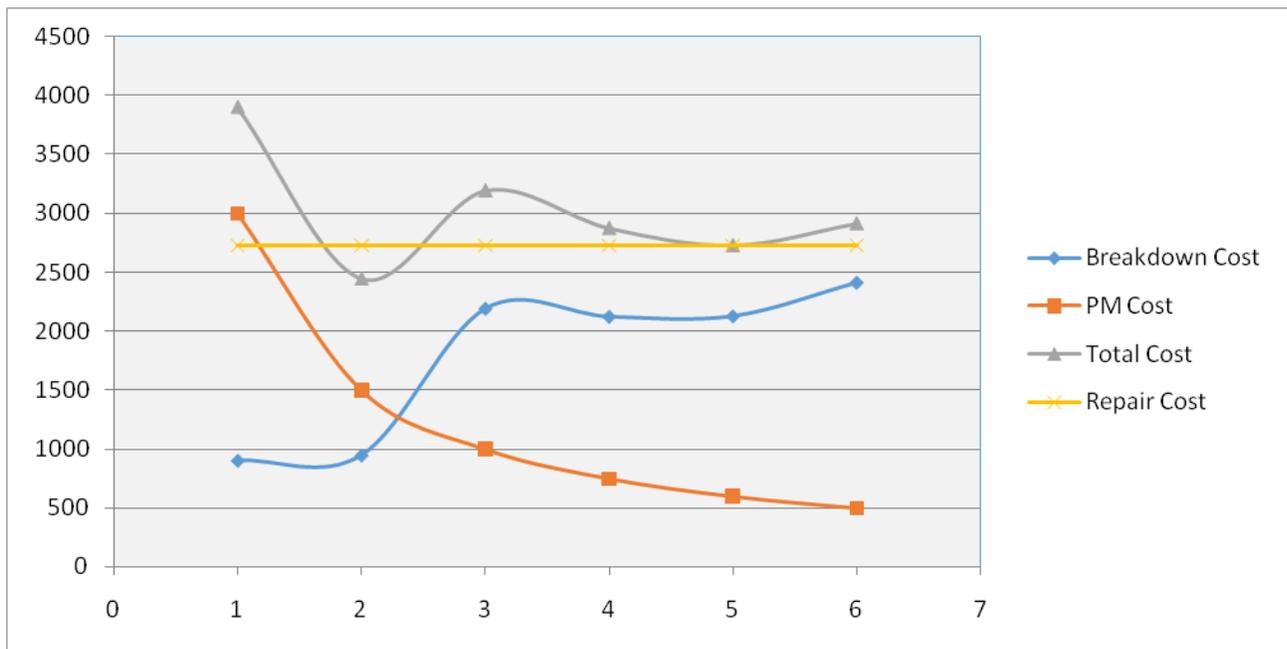
If we refer three graphs it is clear that –

Under Policy 1 (Fig –I) Repair cost ₹3600 is always less than cost of all PM cycles -Refer Col.6 of Table-I. Therefore if breakdown probability distribution is like under Policy 1, management will opt for policy of repairing machine when it breaks down.

Under Policy 2 (Fig –II) PM cycle of 4 months with the cost of ₹1794 -Refer Col.6,Row 4 of Table-II, is less than Repair cost ₹2045.7. Therefore if breakdown probability distribution is like under Policy 2, management will opt for PM policy of 4 months instead of going for policy of repairing machine when it breaks down. This way management can save ₹251.7

On similar logic Under policy 3 PM is preferable to Repair as and when required policy. But in comparison to policy 2, policy 3 is inferior as

Repair cost under policy 2- ₹2045.7   < Repair cost under policy 3-₹2727
PM policy Cost under policy 2- ₹1794 < PM policy Cost under policy 3- ₹2445

The decision concerning preventive maintenance versus Repair depends on i) factor costs C_R and C_{PM} ii) the breakdown probability distribution; besides other sensitivities.

Study Note – 8

STRATEGIC MANAGEMENT - INTRODUCTION

1. **Define Strategy.**

   Answer:

   Strategy is the direction and scope of an organisation in the long-run, which helps achieve advantages for the organisation through the configuration of resources in a changing environment and realise stakeholders' expectations.

2. **What are the characteristics of a strategic decision/strategy?**

   Answer:

   • Strategy is likely to be concerned with the long-term direction of an organisation.
   • Strategic decisions are normally about trying to help achieve some advantages for the organisation in the context of competition.
   • Strategy is likely to be concerned with the scope of the organisation's activities.
   • Strategy can be seen as matching the resources and activities to the environment in which it operates.
   • Strategy can be seen as stretching an organisation's resources and competences to create new opportunities&/or to capitalise on them.
   • Strategies may require major resource changes for an organisation.
   • Strategic decisions are likely to influence operational decisions.
   • The strategy of an organisation is influenced not only by environmental factors and resource availability but also by the values and expectations of those who have power in and around the organisation.

3. **What do you understand by the Mission and the Vision of an organisation?**

   Answer:

   Mission is a general expression of the overall purpose of the organisation. It is in line with the values and expectations of the major stakeholders and concerned with the scope and boundaries of the organisation. It describes what the company does. Essentially, the Mission answers three questions. What is our business? What will it be? What should it be?

   Vision of a company lays some desired future state. It articulates, often in bold terms, what the company would like to achieve. Good Vision statements are meant to challenge a company by articulating some ambitious but attainable future state that will help motivate the employees at all levels and drive strategies.

4. Distinguish between Objectives and Goals.

Answer:

The distinction between these two concepts is important because Strategic Management needs both. The difference between **Objectives** and **Goals** may be drawn in terms of the four dimensions discussed below.

a. **Time Frame**: **Objectives** are timeless, enduring, and unending. **Goals** are temporal, time-phased, and intended to be superseded by subsequent **Goals**. Because **Objectives** relate to the on-going activities of an organisation, their achievement tends to be open-ended in the sense of not being bounded by time. For example, the survival **Objective** of a business organisation is never completely attained since failure is always a future possibility.

b. **Specificity**: **Objectives** are stated in broad, general terms, dealing with matters of image, style, and self-perception. These are aspirations to be worked in the future. **Goals** are much more specific, stated in terms of a particular result that will be accomplished by a specific date. Survival as an **Objective** is not very specific because it leads to different interpretation of the stale of survival. On the other hand, **Goals** can be expressed in terms of, say, achievement of 10 per cent. growth in the net sales in the next year. This is more specific and time bound.

c. **Focus**: **Objectives** are usually stated in terms of some relevant environment which is external to the organisation. **Goals** are more internally focused and carry important implications about how resources of the organisation are utilised or will be utilised in future. Therefore, **Objectives** are more generalised statements like maintaining market leadership, striving continuously for technological superiority, etc. A **Goal** may imply a resource commitment requiring the organisation to use those resources in order to achieve the desired outcomes.

d. **Measurement**: Both **Objectives** and **Goals** can be stated in terms which are quantitatively measured but the character of measurement is different. Generally, quantitative **Objectives** are set in relative terms. Quantitative **Goals** are expressed in absolute terms.

5. Explain the different strategic levels of an organisation.

Answer:

There are primarily three strategic levels in an organisation.

a. **Corporate Level:**
The **Corporate Level** of management consists of the chief executive officer (CEO), other senior executives, the board of directors, and corporate staff. These individuals occupy the top-committees for decision-making within the organisation. The CEO is the principal general manager. In consultation

with other senior executives, the role of corporate-level managers is to oversee the development of strategies for the whole organisation. This role includes defining the **Mission** and the **Goals** of the organisation, determining what businesses it should be in, allocating resources among the different businesses, formulating and implementing strategies that span individual businesses, and providing leadership for the organisation.

b. **Business Level:**

   A business unit is a self-contained division (with its own functions, for example, finance, purchasing, production, and marketing departments) that provides a product or service for a particular market. The principal general manager at the **Business Level**, or the **Business Level** manager, is the head of the division. The strategic role of these managers is to translate the general statements of direction and intent that come from the **Corporate Level** into concrete strategies for individual businesses. Thus, whereas the **Corporate Level** general managers are concerned with strategies that span individual businesses, **Business Level** general managers are concerned with strategies that are specific to a particular business.

c. **Functional Level:**

   Functional Level managers are responsible for the specific business functions or operations (human resources, purchasing, product development, customer service, and so on) that constitute a company or one of its divisions. Thus, a Functional manager's sphere of responsibility is generally confined to one organisational activity, whereas general managers oversee the operation of a whole company or division. Although they are not responsible for the overall performance of the organisation, Functional managers nevertheless have a major strategic role: to develop Functional strategies in their area that help achieve the strategic **Objectives** set by the business and the **Corporate Level** general managers. Moreover, Functional managers provide most of the information that makes it possible for **Business Level** and **Corporate Level** general managers to formulate realistic and attainable strategies. Indeed, because they are closer to the customers than the typical general manager, Functional managers themselves may generate important ideas that subsequently may become major strategies for the company. Thus, it is important for the general managers to listen closely to the ideas of their Functional managers. An equally great responsibility for the managers at the operational level is strategy implementation, i.e., the execution of the **Corporate Level** and **Business Level** plans.

6. **Discuss briefly the steps involved in the strategic management process.**

   Answer:

   Strategy is the outcome of a formal planning process and the top management plays a very important role in this process. The steps of Strategic Management process are stated below.

   Step 1: **Identifying and Defining Business Mission, Purposes and Objectives**: Identifying and defining an organisation's existing **Mission**, **Purposes** and O**bjectives** is the logical starting point as they lay foundation for Strategic Management.

Step 2: **Environmental Analysis**: Environmental (both internal and external) factors, are analysed to:
(i)   identify the changes in the environment,
(ii) identify the **Threats** and the **Opportunities** (present & future), and
(iii) assess critically the **Strengths** and the **Weaknesses**.

Step 3: **Revise Organisational Direction**: A thorough analysis of organisation's environment pinpoints its **Strengths**, **Weaknesses**, **Opportunities** and **Threats** (**SWOT**). This can often help management to reaffirm or revise the **Organisational Direction**.

Step 4: **Strategic Alternatives** and **Choice**: Many **Strategic Alternatives** are formulated based on possible options and in the light of organisational analysis and environmental appraisal. **Strategic Alternatives** will be ranked based on the **SWOT Analysis**. The best **Strategic Alternative** out of the alternatives will be chosen.

Step 5: **Strategy Implementation**: The fifth step of the Strategic Management process is the **Strategy Implementation**. The logically developed strategy is to be put into action. The managers should have clear **Vision** and idea about the competitors' Strategy, organisation's culture, handling change, skills of the managers-in-charge of implementation and the like. The progress from the stage of **Identification** of business **Mission**, **Purposes** and **Objectives** to the stage of achieving desired performance must overcome many obstacles.

Step 6: **Strategic Evaluation** and **Control**: The final step of the Strategic Management process is **Strategic Evaluation** and **Control**. It focuses on monitoring and evaluating the Strategic Management process in order to improve it and ensure that it functions properly. The managers must understand the process of **Strategic Control** and the role of **Strategic Audit** to perform the task of control successfully.

7. **Fill in the blanks with the appropriate word.**
    a.   _____sets the direction for the strategic development of an organisation.
    b.   **Desired states/outcomes are** _____.
    c.   _____ **are objectives which have been scheduled for attainment during the planned period.**
    d.   _____**is considered as either planning or a set of activities related to the formulation and implementation of strategies to achieve the organisational objectives.**
    e.   **Identifying or defining business mission, purpose and objective is a part of the** _____.
    f.   **Strategic management processes are designed to provide an organisation with the** _____benefits.
    g.   **The** _____of a firm defines its reasons for existence.

    Answer:

    a.   Mission
    b.   objectives
    c.   Goals
    d.   Strategic Management
    e.   strategic management process
    f.   long-term
    g.   mission

8. **Match the following:**

1	Business Unit	a	provides a road map relating to the company's future
2	Corporate Level Management	b	responsible for the specific business functions or operations
3	Vision	c	is the main goal of a business organisation
4	Objectives	d	is a necessity in a dynamic business environment
5	Profitability	e	Performance targets which organisations want as results or outcomes in the specified period.
6	Functional Level managers	f	a self-contained division that provides a product or service for a particular market
7	Proactive Change	g	consists of the chief executive officer (CEO), other senior executives, the board of directors, and corporate staff

Answer: 1(f) 2(g) 3(a) 4(e) 5(c) 6(b) 7(d)

Study Note – 9

STRATEGIC ANALYSIS AND STRATEGIC PLANNING

1. (a) Multiple Choice Questions

    (i) Question mark in the BCG Matrix is an investment, which
        a. yields low current income but has bright growth prospect.
        b. yields high current income and has bright growth prospect.
        c. yields high current income and has bleak growth prospect.
        d. yields low current income and has bleak growth prospect.

    (ii) Directional Policy Matrix is the same as the
        a. BCG Model.
        b. 9-cell GE Matrix.
        c. Life Cycle Portfolio Analysis.
        d. PIMS Matrix.
        e. 3x3 Competitive Positioning Matrix.

    (iii) Successful Differentiation Strategy allows the company to
        a. gain buyer loyalty to its brands.
        b. charge too high a premium price.
        c. depend only on intrinsic product attributes.
        d. have product quality that exceeds buyers needs.
        e. segment a market into distinct buyer groups.

    (iv) The condition of Low Share, Negative Growth, and Negative Cash Flow indicates
        a. Dog.
        b. Dodo.
        c. Donkey.
        d. Dinosaur.

    (v) The condition of market which denotes High Share, Negative Growth and Positive Cash Flow is known as
        a. Star.
        b. Warhorse.
        c. Cash Cow.
        d. Question Mark.

(vi) As per the ADL Matrix, which among these is not the external factor?
   a. Market Growth Rate
   b. Growth Potential
   c. Customer Switch Over
   d. Customer Loyalty

Answer: (i) - a   (ii) – b (iii) – a (iv) –b (v) – b (vi) - c

(b) Fill in the Blanks.

(i) Dogs are products with a _____ share of a _____ growth market.
(ii) _____ denote negative cash flows in the condition of a Product Life Cycle with market share/ market growth classification.
(iii) _____ and _____ have suggested a seven-step process for Contingency Planning.
(iv) The ADL Portfolio Matrix suggested by Arthur D. Little (ADL) consists of _____ cells.
(v) Joint development with owners of another product who need access to the firm's distribution channels or brands is an example of _____.

Answer: (i) low   low   (ii) Infants
              (iii) Robert Linneman and Ranjan Chandran   (iv) 20
              (v)Product Development Strategy

(c) True or False

(i) Concentric Diversification means that there is a technological similarity between the industries which means that the firm is able to leverage its technical know-how to gain some advantage.
(ii) The condition of market which denotes High Share, Negative Growth and Positive Cash Flow is known as Star.
(iii) As per the ADL Matrix, 'Dominant' position denotes a rare situation where the SBU enjoys a monopoly position or very strong market ability of its products.
(iv) As per the ADL Matrix, in 'Favourable' competitive position, no firm will enjoy dominant market share and the competition will be intense.
(v) Introducing the products to a new branch of users is an example of Product Development Strategy.
(vi) Approaching the industrial buyers for a good that was previously sold only to the households is a part of Market Development Strategy.
(vii) The consistent weak performance may need a firm to divest or withdraw from the product line.

Answer: (i) - True   (ii) - False   (iii) - True   (iv)- True   (v) - False   (vi) - True
              (vii) - True

(d) Match & Pair

(i)

	Column 1		Column 2
1	Forward Integration	A	when the firm is moving along the value system of its existing industry towards its suppliers
2	Backward Integration	B	when the firm is moving along the value system of its existing industry towards its customers
3	Concentric Diversification	C	A collection of businesses without any relationship to one another
4	Unrelated Diversification	D	when there is a technological similarity between the industries which means that the firm is able to leverage its technical know-how to gain some advantage

Answer: 1-B 2-A 3-D 4-C

(ii)

	Column 1		Column 2
1	Star	A	Low Market Growth Potentiality and Low Market Share
2	Question Mark	B	Low Market Growth Potentiality and High Market Share
3	Cash Cow	C	High Market Growth Potentiality and Low Market Share
4	Dog	D	High Market Growth Potentiality and High Market Share

Answer: 1-D 2-C 3-B 4-A

(iii)

	Column 1		Column 2
1	Market Penetration	A	when the firm is getting involved in an entirely new industry
2	Market Development	B	this denotes that the firm develops through finding another group of buyers for its products
3	Product Development	C	this involves extending the product range available in the firm's existing markets
4	Diversification	D	when the firm increases its sales in its present line of business

Answer: 1-D 2-C 3-B 4-A

2. **Explain Situation Analysis, stating also how the Situation Analysis can be done by the companies.**

   Answer:

   A company's macro-environment consists of all the related dimensions and influences outside the company's boundaries. The factors that become relevant are direction, objectives, strategy, and business model. Influences coming from the outer globe of the macro-environment have some impact on a company's business situation. They shape the limits of the company's direction and strategy. There are enough strategically-relevant trends and developments in the macro-environment. As company managers scrutinize the external environment, they must examine the potentially important environmental forces, assess their impact and influence, and adapt the company's direction and strategy to the situation as needed. Enterprises and businesses worldwide carry out analyses to assess conditions and environment for strategic planning. Every company has certain framework that permits it to understand the market and analyze the products. Companies carry out market research by conducting surveys to evaluate market requirements and trends. The SWOT & PEST Analyses are two methods through which companies plan ahead by conducting research. The PEST Analysis refers to the Political, Economical, Social, and Technological factors which manipulate the business environment. The SWOT Analysis refers to the Strengths, Weaknesses, Opportunities and Threats. These factors are the prime determinants of strategic planning. Without SWOT Analysis and PEST Analysis companies might fail to achieve the desired goals.

   Both the SWOT Analysis & PEST Analysis are simple and easy to list the relevant factors but hard to implement fully. It takes time and research to completely analyze the situation. The SWOT Analysis might not be able to provide the results for each factor for the analysis to be successful. it requires expertise which would analyse all possible Threats and Weaknesses and turn them into Strengths and Opportunities. It requires resources and capital to perform and a positive outcome cannot be always guaranteed. The PEST Analysis is to be used if the SWOT Analysis of a company fails and it needs to study the markets. It focuses on external factors and not on the firm's internal factors which can cause conflict. The PEST Analysis works on a macro-scale as it includes the economic factors. These factors are uncertain and change constantly depending on the state of the country. The SWOT Analysis is considered the best because it focuses on the internal and external factors both while the PEST Analysis focuses only on the external factors. Some top companies like Ford, Microsoft and Sony prefer monthly SWOT Analysis as their markets are expanding and growing every month and they consider internal factors of the company important.

3. **Define Contingency Planning. What are its advantages? State the basic steps in Contingency Planning.**

   Answer:

   Contingency plans can be defined as alternative plans that can be put into effect, if certain key events do not occur as expected. Only high-priority areas require the insurance of contingency plans. Strategists cannot and should not try to plan for all possible contingencies. In any case, Contingency Plans should be as simple as possible.

Some situations are mentioned below which can force a firm to go for Contingency Planning.

1. If a major competitor plans to withdraw from a particular market, as the intelligence reports indicate, what actions should the firm take?
2. If the sales objectives are not reached, what actions should the firm take to avoid losses?
3. If demand for the new product exceeds the planned demand, what actions should the firm take to meet the higher demand?
4. If certain disasters occur (such as loss of computer capabilities; a hostile takeover attempt; loss of patent protection; destruction of manufacturing facilities because of earthquakes, tornadoes, or hurricanes), what actions should the firm take?
5. If a new technological advancement makes the new or the existing product obsolete sooner than expected, what actions should the firm take?

Benefits of Contingency Planning

(i)   It will help in the future through proactive planning and advanced preparation.
(ii)   It will lead to new action by removing/reducing the present difficulties.
(ii)   It enables to anticipate the future problems.
(iv)   It will help change the goals accordingly to suit the internal and external changes.
(v)   It helps experiment with new ideas and initiate proper actions.
(vi)   It will help shape the future and create a more desirable environment.
(vii) It permits quick response to change,
(viii) It prevents panic in crisis situations.
(ix)   It makes managers more adaptable to the unforeseen changes.

Steps in Contingency Planning

Robert Linnemam and Rajan Chandran have suggested a seven- step process.

Step 1 - Identify the beneficial and adverse events that could possibly affect the strategy(ies).

Step 2 – Specify the trigger points. Calculate when the contingent events are likely to occur.

Step 3 - Assess the impact of each contingent event. Estimate the potential benefits or damages arising out of each contingent event.

Step 4 - Develop Contingency Plans. Be sure that Contingency Plans are compatible with the current strategy and are economically feasible.

Step 5 - Assess the counter impact of each Contingency Plan. Doing this will quantify the potential value of each Contingency Plan.

Step 6 - Determine early warning signals for the key contingency event. Monitor the early warning signals.

Step 7 – For a contingent event with reliable early warning signals, develop advance action plans to take advantage of the available lead time.

4. **State the approaches in Strategic Planning. In this context, also discuss the various stages and the steps involved in Strategic Planning. Compare between Strategic Planning and Strategic Management.**

Answer:

Approaches in Strategic Planning

It is important to operate a planning process which will not only produce realistic and potentially-rewarding plans but will also secure the support of all those involved in implementing them. There are three approaches that can be adopted for **Strategic Planning.**

(i) A top-down process, in which the managers are given targets to achieve which they pass on down the line.

(ii) A bottom-up process, in which the functional and line managers in consultation with their staff submit plans, targets and budgets for approval by higher authority.

(iii) An iterative process, which involves both the top-down process and the bottom-up process of setting targets. There is a regular interactive movement between different levels until an agreement is reached. However, this agreement will have to be consistent with the overall **Mission**, **Objectives** and **Priorities** and will have to be made within the context of the financial resources available to the organization. The Iterative approach, which involves the maximum number of people, is the one most likely to deliver worthwhile and acceptable Strategic Plans.

Stages in strategic Planning

The stages in strategic planning are given below.

Stage I- **Generation of Strategic Options**
At this stage, a variety of alternatives are considered relating to the firm's product and markets, its competitors and so forth. Some examples of strategies are given below.

(a) Increase the market share
(b) penetration into the international market
(c) concentration on the core competencies
(d) acquisition or expansion, etc.

Stage II – **Evaluation of Strategic Options**

Each option is then examined in terms of its merits.
(a) Does it increase the existing Strengths?
(b) Does it alleviate the existing Weaknesses?
(c) Is it suitable for the firm's existing position?
(d) Is it acceptable to the stakeholders?

Stage III - **Strategic Selection**

It involves choosing between the alternative strategies. This process is strongly influenced by the values of the managers involved in selecting the strategies.

Steps in Strategic Planning

A systematic approach to formalizing Strategic Plans consists of the steps mentioned below.

(i) An Internal Analysis that encompasses assessing the company's Strengths and Weaknesses, financial performance, people, operational limitations, corporate culture, current positioning in the market(s), the overall characterization of the condition of the company and critical issues faced by the organization.

(ii) An External Analysis that focuses on analyzing competitors, assessing market opportunities and Threats, evaluating changing technology that could impact the organization, analyzing regulatory or legislative concerns, changes and trends in the market(s) the company operates in and other potential outside influences on the organization.

(iii) Summarizing the Current Situation based on the information gathered and evaluated in steps (i) & (ii). This step is important to the process because it brings together relevant and critical data and information and allows members of the planning team to more easily get a feel for what opportunities and obstacles lie ahead.

(iv) Development of a Mission, Vision or Purpose Statement

It really does not matter what it is called but this step is important perhaps more because of the process that the team will go through to develop it than the words that eventually end up on paper. In this step, the team is starting the process of focusing the organization and its people on what the organization is all about and what is important to the organization.

(v) Goal Setting

Every organization needs **Goals**. Again, focus is a critical element in the success of any business. This step may be the most important of all of the **Strategic Planning** steps because it establishes the framework and basis for the development of the other key elements of the plan.

(vi) Defining Objectives that support the Goals

Objectives are more specific in nature and are supportive of the **Goals**. They bring into even greater focus to the **Goals** of the organization.

(vii) Development of strategies

Strategies begin defining how the **Goals** and **Objectives** are going to be achieved.

(viii) While not all Strategic plans include tactics, a good **Strategic Plan** will include at least the key **Tactics** thought to be important to supporting the strategies developed in step (vii). Generally, **Tactics** are more fully developed and added to the **Strategic Plan** as time goes on. **Tactics** are the specific tasks associated with carrying out strategies.

Strategic Management and Strategic Planning: Distinction

The basic difference between Strategic management and Strategic planning are as given below.

Strategic Management	Strategic Planning
1. It is focused on producing/developing strategic results; new markets; new products; new technologies, etc.	1. It is focused on making optimal strategic decisions.
2. It is management by results.	2. It is management by plans.
3. It is an organizational action process.	3. It is an analytical process.
4. It broadens focus to include psychological, sociological and political variables.	4. It is focused on business, economic and technological variables.
5. It is about choosing things to do and also about the people who will do them.	5. It is about choosing things to do.

5. Write Short notes on the following:

    (a)   **PEST Framework**

    (b)   **BCG Matrix**

    (c)   **Ansoff Matrix**

    (d)   **ADL Matrix**

    (e)   **Relationship between Strategic Planning and Long-range Planning**

Answer:

(a) PEST Framework

PEST Analysis looks at the external factors and is primarily used for market research. It is sometimes used as an alternative to SWOT Analysis.

(i) Political – These are the external factors that influence the business environment. Government decisions and policies affect a firm's position and structure, tax laws, monetary and fiscal policies as well as reforms relating to labour and workforce--all influence companies in future. These factors are important and need to be managed in order to overcome uncertainty.

(ii) Economic – Economic factors are the most important since these impact business in the long run. Inflation, interest rates, economic growth and demand/supply trends are to be considered and analyzed effectively before planning and implementing strategy. Economic factors affect both consumers and enterprises.

(iii) Social – Social factors involve the trends of population, domestic markets, cultural trends and demographics. These factors help businesses assess the market and improve their products/services accordingly.

(iv) Technological—The technological trends and advancements in the business environment are the major determinants for strategy formulation. Innovations and advancements lower barriers to entry. Research and development and automation play a major role.

This framework helps a business identify its standing and position, i.e., whether it is weak or strong. It informs about both internal and external factors that affect a firm's success and/or failure. It helps firms assess the situation and take measures for improvement and analysis of the Threats. It forecasts

the future and sheds light on the current situation. It helps evaluate business environment and allows firms to make strategic decisions. It prevents future failure and helps create a system of continuous success. It provides companies with a reality check on their performance and shortcoming. It enables firms to understand the economy and the market and expand. It provides a mechanism to identify the Threats and the Opportunities. It enables companies to learn about the markets and enter the new markets nationally or globally.

(b) BCG Matrix

The Boston Consulting Group (**BCG**)'s **Matrix** analyses products and businesses by market share and market growth.' This growth/share matrix for the classification of products into **Cash Cows**, **Dogs**, **Stars** and **Question Marks** is known as the Boston classification for product-market strategy.
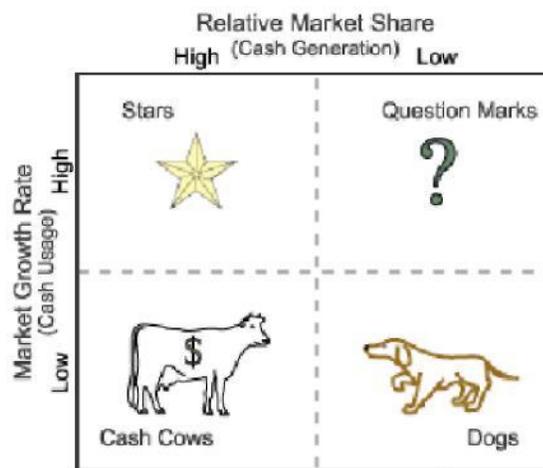
a. **Stars** are products with a high share of a high-growth market. In the short term, these require capital expenditure, in excess of the cash they generate, in order to maintain their market position, but promise high returns in the future.

b. In due course, however, **Stars** will become **Cash Cows**, with a high share of a low-growth market. **Cash Cows** need very little capital expenditure and generate high levels of cash income. The important strategic feature of **Cash Cows** is that they are already generating high cash returns, which can be used to finance the stars.

c. **Question Marks** are products in a high-growth market but where they have a low market share. A decision needs to be taken about whether the products justify considerable capital expenditure in the hope of increasing their market share or whether they should be allowed to 'die' quietly as they are squeezed out of the expanding market by the rival products. Because considerable expenditure would be needed to turn a **Question Mark** into a **Sta**r by building up market share, **Question Marks** will usually be poor cash generators and show a negative cash flow.

d. **Dogs** are products with a low share of a low growth market. They may be ex-**Cash Cows** that have now fallen on hard times. **Dogs** should be allowed to die or should be killed off. Although they will show only a modest net cash outflow or even a modest net cash inflow, they are 'cash traps' which tie up funds and provide a poor return on investment and are not enough to achieve the organisation's target rate of return.

Limitations of the BCG Matrix

The **BCG Matrix** analyses products in the light of two variables: the growth in the market as a whole and the growth of the product's share of the market in relation to other products. It suggests that there is a relationship between these variables and the product's propensity to generate cash or consume it. It rests on the assumption that the firm with the highest market share can be the lowest cost producer. The matrix suggests that the **Cash Cows** should be used to fund the **Stars**. There are a number of limitations of this Matrix (and one has to remember that it is only a model and any model necessarily simplifies the real world which it tries to depict).

(i)   How to define one's market? Segmentation strategies can provide a niche. A niche is inevitably a low or restricted share of the market, yet it is the heart of a focus strategy. Firms can profit by servicing small low-growth niches.

(ii) Market growth and market share are assumed to be reliable pointers for cash flow. This is often not true. High market share does not necessarily mean high profits, especially if a firm has high costs or has bought market share by low pricing with the hope of increasing their market share. Sometimes such firms should be allowed to 'die' quietly as they are squeezed out of the expanding market by the rival products. Because considerable expenditure would be needed to turn a **Question Mark** into a **Star** by building up market share, **Question Marks** will usually be poor cash generators and show a negative cash flow.

(iii) **Dogs** are products with a low share of a low growth market. They may be ex-**Cash Cows** that have now fallen on hard times. **Dogs** should be allowed to die or should be killed off. Although they will show only a modest net cash outflow or even a modest net cash inflow, they are 'cash traps' which tie up funds and provide a poor return on investment and are not enough to achieve the organisation's target rate of return.

   There are also **Infants** (i.e., products in an early stage of development) and **Warhorses** (i.e., products which were **Cash Cows** in the past, and are still making good sales and earning good profits even now). The car industry provides interesting examples to fit the **BCG Matrix**. Ford, with the Fiesta, Escort and, to a lesser extent, the Sierra has had a range of **Stars**, which cost a substantial amount to develop and launch but which soon became **Cash Cows**. Vauxhall invested heavily in the Cavalier with great success, and here one sees an example of a **Question Mark** turning into a **Star** and then a **Cash Cow**, and the Cavalier has been at the forefront of Vauxhall's return to marketing success.

(iv) Relative market share amongst competitors is not necessarily an indication of their competitive strengths at any particular time. After all, market leaders are vulnerable.

(v)   The **BCG Matrix** might become a self-fulfilling prophecy. **Dogs** which could be made profitable might simply be left rather than be given life.

(vi) It does not suggest any response to the declining markets other than withdrawal. Many firms can make money in 'sunset industries'.

(vii) It ignores the extent to which a firm which serves a number of markets can exploit production synergies.

(viii)It ignores the threat of substitute products.

(c) Ansoff Matrix

Ansoff (1965) has demonstratesd the choices of strategic direction which are open to a firm in the form of a matrix. Firm increases its sales in its present line of business. This can be accomplished by

(i)   price reductions.

(ii)   increases in promotional and distribution support.

(iii) acquisition of a rival in the same market.

(iv) modest product refinements.

These strategies involve increasing the firm's investment in a product/market and those are generally used only in the markets which are growing and hence the investment may be recouped.

Ansoff Matrix

	Existing Product	New Product
Existing Market	Market penetration Increase sales in the existing markets Penetrate more deeply into the existing markets	Product development New product developed for the existing markets
New Market	Market development Existing products sold in the new markets	Diversification New products sold in the new markets

Product Development Strategy:

This involves extending the product range available to the firm's existing markets. These products may be obtained by

(i)   investment in the research and development of additional products.

(ii) acquisition of rights to produce someone else's product.

(iii) buying-in the product and 'badging' it.

(iv) joint development with the owners of another product who need access to the firm's distribution channels or brands.

The critical factor to the success of this strategy is the profitability of the customer group for which the products are being developed. Also the firm's present competitive advantages in serving the market must cover the new product. These can include

(i)   customer information that allows accurate targeting.

(ii) established distribution channels.

(iii) a brand which can be credibly applied to the new product.

Market Development Strategy:

Here the firm develops through finding another group of buyers for its products.

Examples include

(i) different customer segments - for example, introducing younger people to goods previously purchased mainly by adults.

(ii) industrial buyers for a good that was previously sold only to households.

(iii) new areas or regions of the country.

(iv) foreign markets.

This strategy is more likely to be successful where

(i) the firm has a unique product technology it can leverage in the new market.

(ii) it benefits from economies of scale if it increases output.

(iii) the new market is not too different from the one it has experience of.

(iv) the buyers in the market are intrinsically profitable.

Diversification Strategy:

Here the firm is becoming involved in an entirely new industry, or a different stage in the value chain of its present industry. Ansoff has distinguishes several forms of diversification.

1. **Related Diversification:**
   Here there is some relationship and there is potential for synergy between the firm's existing business and the new product/market space.
   (a) Concentric Diversification means that there is a technological similarity between the industries which means that the firm is able to leverage its technical know-how to gain some advantage.
   (b) Vertical Integration means that the firm is moving along the value system of its existing industry towards its customers (Forward Vertical Integration) or towards its suppliers (Backward Vertical Integration). The benefits of this are assumed to be
   - taking over the profit margin presently enjoyed by suppliers or distributors,
   - securing a demand for the product or a supply of key inputs
   - better synchronisation of the value system, and
   - reduction in buyer or supplier power.
   However, it also means increasing the firm's investment in the industry.

2. **Unrelated Diversification:**
   This is otherwise termed as conglomerate growth because the resulting corporation is a conglomerate, i.e., a collection of businesses without any relationship to one another. The strategic justifications advanced for this strategy are to
   - take advantage of poorly managed companies which can then be turned around and either run at a gain for the shareholders or sold-on at a profit,
   - spread the risks of the firm across a wide range of industries, and
   - escape from a mature or declining industry by using the positive cash flows from it to develop into new and more profitable areas of business.

(d) ADL Matrix

The **ADL Portfolio Matrix** suggested by Arthur D. Little (ADL) consists of 20 cells, identified by the competitive position and the stage of industry maturity. In this Matrix, the stage of industry maturity is identified in terms of four stages, viz., **embryonic**, **growth**, **maturity** and **ageing**. The competitive position is categorized into five classes, viz., **dominant**, **strong**, **favourable**, **tenable** and **weak**. The purpose of this Matrix is to establish the appropriateness of a particular strategy in relation to these two dimensions.

The position within the life cycle and of the company is determined in relation to eight external factors (or disciplines) with respect to the evolution of the industry. These are stated below.
(a) market growth rate
(b) growth potential
(c) breadth of product line
(d) number of competitors
(e) spread of market share among the competitors
(f) customer loyalty
(g) entry barriers
(h) technology

It is the balance of these factors which determines the life cycle. The competitiveness of the organization can be established by looking at the characteristics of each category. The weights must be defined to calculate the Matrix position of a particular business. The Matrix location of each unit can be used to formulate a natural strategy to accomplish the business Goals of the firm.

The competitive position of a company's SBU or product line can be classified as below.

Dominant - It is comparatively a rare situation where the SBU enjoys monopoly position or very strong market ability of its products. This may be due to high level of entry barriers or protected technology leadership.

Strong - When an SBU enjoys strong competitive position, it can afford to chalk out its own strategies without too much concern for the competitors.

Favourable - In this competitive position, no firm will enjoy dominant market share and the competition will be intense. The strategy formulation much depends on the competitors' moves. The market leader will have a reasonable degree of freedom. Analysis of its product portfolio and learning from it would help others while framing their own strategies.

Tenable - The tenable competitive position implies that a firm can survive through specialization and focus. These firms are vulnerable to stiff competition in the market. They can withstand with cost focus and differentiation focus strategies.

Weak - The weak firms will generally show poor performance. They can withstand with niche strategy and can become strong players in their areas. The consistent weak performer may need to divest or withdraw from the product line.

ADL Matrix

		Industry Life Cycle Stage			
		Embryonic	Growth	Mature	Ageing
Competitive Position	**Dominant**	All out push for share Hold position	Hold position Hold Share	Hold Position Grow with industry	Hold Position
	Strong	Attempt to improve position All out push for share	Attempt to improve position Push for share	Hold Position Grow with industry	Hold Position or Harvest
	Favorable	Selective or all out push for share Selective attempt to improve position	Attempt to improve position Selective push for share	Custodial or maintenance Find niche and attempt to protect it	Harvest or phased out withdrawal
	Tenable	Selective push for position	Find niche and attempt to protect it	Find niche and hang on or phased out withdrawal	Phased out withdrawal or Abandon
	Weak	Up or out	Turnaround or abandon	Turnaround or phased out withdrawal	Abandon

(e) Relationship between Strategic Planning and Long-range Planning

The basic divergence between **Strategic Planning** and **Long-range Planning** lies in the difference in the assumption regarding the future environment of an organisation. In case of **Long-range Planning**, current knowledge about future conditions is known with certainty that can be relied upon by executives. Accordingly, the course of action for achievement of organisational goals is drawn on the basis of this knowledge. In **Long-range Planning**, the forecast for future is made through extrapolation of the historical growth.

On the contrary, **Strategic Planning** assumes that an organisation must be ready to respond to a dynamic environment and future environmental conditions are not known with perfect certainty. Thus, there is a need to emphasise and understand how the assumed environment is charging. Accordingly, the issue of developing courses of action in response to these changes will have to be taken up. Here, a number of alternatives are generated for several situations for the future. In case of **Strategic Planning**, the firm tries to identify the Opportunities, the Threats and the trends based on which the future prospect is analysed.

In case of **Long-range Planning**, forecast of Objectives made through extrapolation are translated into budgets, programmes and profit plans. These are finally implemented. An operating control system is established and the feedback is provided which suggests a change in Objectives, if required. The **Strategic Planning** leads to the setting-up of two sets of goals – Operating Performance Goals and Strategic Goals. The Operating Performance Goals are translated into operating budgets and Strategic Goals are translated into strategic budgets. Accordingly, two types of control, namely, Operating Control and Strategic Control are established.

Study Note – 10

FORMULATION AND IMPLEMENTATION OF STRATEGY

1. **Fill in the blanks with the suitable words.**

   a. _____ stands for the arrangement/location of production machinery, work centres and auxiliary facilities and activities for the purpose of achieving efficiency in manufacturing the products &/or rendering the consumer services.

   b. Preventing break downs by replacing worn-out machines is called_____.

   c. The part of business performance that directs the flow of goods and services from the producer to the consumer/ user is called _____.

   d. The concept that calls for a customer-orientation backed by integrated marketing, for generating customer satisfaction and long-run customer welfare, as the key to attaining long-run profitable volume is _____.

   e. _____ is the framework necessary for any organization in the context of division of tasks, deployment of resources and co-ordination of departments.

   f. _____ is the sum-total of the external factors within which the enterprise operates.

   Answers:

   a. Plant layout
   b. Preventive Maintenance
   c. Marketing
   d. Societal Marketing
   e. Organizational Structure
   f. Marketing Environment

2. **Match the following:**

1	Business Process Reengineering	A	commonly-held beliefs, mindsets and assumptions that shape how an organisation behaves
2	Hybrid Structure	B	permits workers to choose own working hours within the overall working hours with certain limitations
3	Functional Structure	C	Involves increasing the number of operations an individual performs and, thereby, increasing the individual's work satisfaction
4	Corporate Culture	D	Individuals are moved from job to job and, thus, they are not required to perform a particular job for a long time
5	Job Rotation	E	form of departmentalization that adopts parts of both functional structure and divisional structure at the same level of management
6	Job Enlargement	F	the key components of BPR that are essential for an organization to focus on the outcome that it needs to achieve
7	Flexitime	G	characterised by simultaneous combination of the similar activities and separation of the dissimilar activities on the basis of function
8	Redesign, Retooling and reorchestrating	H	fundamental rethinking of business processes to achieve dramatic improvements in critical contemporary measures of performance

   Answer: 1(H) 2 (E) 3(G) 4(A) 5(D) 6(C) 7(B) 8(F)

3. Choose the correct answer.

   1. Reorchestration includes
      A. synchronization, process, IT, human resources.
      B. networks, intranets, extranets.
      C. simplification, standardisation, empowerment.
      D. groupware, measurements, work flow.

   Answer:

   synchronization, process, IT, human resources

   2. Matrix Structure
      A. is structural grouping in the geographical sense.
      B. Simultaneously combines similar activities on the basis of function.
      C. adopts parts of both functional structure and divisional structure at the same level of management.
      D. creates a dual chain of command.

   Answer:

   creates a dual chain of command

   3. McKinsey's 7-S Framework does not include
      A. skills.
      B. structure.
      C. SBU.
      D. shared values.

   Answer:

   SBU

      A. Behaviour Modification is related to
      B. Involvement of employees in decision-making.
      C. positive reinforcement.
      D. job enlargement.
      E. job enrichment and flexitime.

   Answer:

   positive reinforcement

4. **Theory X**
    A. **stands for positive assumptions which managers try to use.**
    B. **relates to good communication with the people in the organisation.**
    C. **stands for negative assumptions that managers often use as the basis for dealing with people.**
    D. **helps become better acquainted with the sub-ordinates**

    Answer:

    Stands for negative assumptions that managers often use as the basis for dealing with people

4. **What is Organisational Structure? Discuss the different types of Organisational Structure.**

    Answer:

    Organizational Structure means the framework in terms of which the organization defines how tasks are divided, resources are deployed and departments are co-ordinated.

    The different types of **Organisational Structure** are stated below.

    - **Functional Structure**

      The **Functional Structure** is characterized by the simultaneous combination of similar activities and the separation of dissimilar activities on the basis of function. The functional organization form is one of the most common organizational structures found in firms pursuing strategy of concentration or very high relatedness. A **Functional Structure** is most appropriate when the organization is small to medium in terms of size and relatively stable.

    - **Geographic Structure**

      Another basic form structural grouping is **Geographic Structure** in which activities and personnel are grouped in terms of specific geographic locations. Each geographic unit includes all functions required to produce and market products in that region. **Organization Structure**, according to geographic areas or territories, is rather a common structural form for the large-scale enterprises whose strategies need to be tailored keeping in mind the particular needs and features of different geographic locations.

    - **Matrix Structure**

      Another way to achieve focus on multiple outcomes is to go for the **Matrix Structure**. The **Matrix Structure** creates a dual chain of command; two lines of budget authority and two sources of performance and reward. The key feature of the **Matrix Structure** is that the product (or the business) and functional lines of authority are overlaid to form a Matrix or grid between the product manager and the functional manager.

    - **Hybrid Organization**

      A single type of structural design is not always sufficient to meet the requirements of the strategy. When this occurs, one opinion is to mix and blend the basic organizations forms, matching structure to strategy, requirement by requirement and unit by unit. **Hybrid Structure** is a form of departmentalization that adopts parts of both functional structure and divisional structure at the same level of management. The potential advantage of the **Hybrid Structure** is that the combination may allow the firm to gain the advantages offered by the primary structures while, at least, diminishing the impact of the disadvantages.

5. **Explain the McKinsey's 7-S Framework.**

   Answer:

   The McKinsey Company, a well known management consultancy firm in the United States, towards the end of 1970s was asked to find a solution to a knotty issue broadly relating to strategy implementation. The researchers, Peters and Waterman, found after examining the best-run companies in America that the real problem relating to strategy lies in its implementation and structure is only one lever in the hands of management. The other levers are *systems*, *staff*, *style*, *skills* and *super-ordinate goals*. A strategy is usually successful only when the other Ss in the 7-S Framework fit into or support the strategy.

   - **Strategy:** A set of decisions and actions aimed at gaining a sustainable competitive advantage
   - **Structure:** The organisation chart and associated information that shows who reports to whom and how tasks are both divided and integrated
   - **Systems:** The flow of activities involved in the daily operation of a business, including its core processes and its support systems
   - **Style:** How managers collectively spend their time and attention and how they use symbolic behaviour and the management action is more important than what the management says
   - **Staff:** How companies develop employees and shape basic values
   - **Shared Values:** Commonly-held beliefs, mindsets and assumptions that shape how an organisation behaves; its corporate culture
   - **Skills:** An organisation's dominant capabilities and competencies

6. **Write short notes on the following:**

   a. **Business Process Reengineering**

   It is a business management strategy, originally pioneered in the early 1990s, focusing on the analysis and design of workflows and processes within an organisation. **Business Process Reengineering** (**BPR**) aims to help organisations fundamentally rethink how they do their work in order to dramatically improve customer service, cut operational costs, and become world-class competitors. **BPR** seeks to help companies radically restructure their organisations by focusing on the ground-up design of their business processes. It involves the redrawing of organisational boundaries, the reconsideration of jobs, tasks, and skills. This occurs with the creation and the use of models. Whether those are physical models or mathematical/ computer/ structural models, the engineers build and analyse models to predict the performance of designs or to understand the behaviour of devices. More specifically, **BPR** is defined as the use of scientific methods, models and tools to bring about the radical restructuring of an enterprise. That results in significant improvements in performance. Redesign, retooling and reorchestrating form the key components of **BPR** that are essential for an organisation to focus on the outcome that it needs to achieve.

b. Matrix Organisation Structure

The known structures (Functional, Divisional and SBU) consist of flow of authority from top to bottom, i.e., vertical flow, whereas the **Matrix Structure** contains both vertical and horizontal flow of communications or authority. This type of structure is frequently used in IT organisations for managing different projects. Each individual project is managed by a project manager and projects manager will have his/her team arranged under him/her. The **Matrix Structure** is useful for some specific industries like Information Technology, Healthcare, etc. Employee can see visible results of their efforts. It removes barriers to communications and managing projects become easy. This is very effective when the environment is very dynamic. However, it is very complex, involving high cost due to more management positions, involving dual lines of authority and giving rise to conflicts in the allocation of resources.

c. Role of Marketing

Market is an arrangement that provides an opportunity for exchange of goods and service, for money or money's worth. It is the means to settle the terms of exchange. **Marketing** is the performance of business activities directing the flow of goods and services from the producer to the consumer or user. The first and foremost thing is that it stimulates potential aggregate demand and thus enlarges the size of the market. It helps in the economic growth of a country through stimulation of demand. People are motivated to work harder and earn additional money to buy the various ideas, goods and services being marketed. An additional advantage which accrues in the above context that it accelerates that process. Another important role which **marketing** plays is that it helps in the discovery of entrepreneurial talent. Peter Drucker, a celebrated writer in the field of management, makes this point very succinctly when he observes that **marketing** is a multiplier of managers and entrepreneurs. It helps in sustaining and improving the existing levels of employment.

d. Plant Layout

Plant Layout involves the arrangement and location of production machinery, work centres and auxiliary facilities and activities (inspection, handling of material storage and shipping) for the purpose of achieving efficiency in manufacturing products or rendering consumer services. **Plant Layout** should co-ordinate use of material, men and machines to facilitate the manufacturing process, minimise materials handling, maintain flexibility of arrangement and operation, maintain high turnover of work-in-process, hold down investment in equipment, promote effective utilisation of manpower, promote employee convenience, safety and comfort in doing the work. In designing **Plant Layout**, a number of factors such as nature of product, volume of production, quality, equipment, type of manufacturing, developing plant site personnel plan and materials handling plan should be kept in view.

e. Preventive Maintenance

Preventive Maintenance is based on the premise that good maintenance prevents breakdowns. **Preventive Maintenance** means preventing breakdowns by replacing worn-out machines or their parts before their breakdown. It anticipates likely difficulties and does the expected repairs required at a

convenient time before the repairs are actually needed. **Preventive Maintenance** depends upon the past knowledge that certain parts will need replacement after a normal interval of use. Another and quite different kind of **Preventive Maintenance** is there concerned with designing machines which will be both trouble-free and can be easily repaired. The most strategic decision which a production manager has to make in this regard is to determine whether **Preventive Maintenance** is more expensive than repairing on call. This requires comparison of total costs involved in **Preventive Maintenance** with those involved in repairing. There are more elaborate models for special maintenance problems such as an inspection policy for equipment that can be restored to an operating condition and policy for equipment renewal after a certain length of service. However, such sophisticated analyses are appropriate when the investment involved is large or service reliability is critical. A typical **Preventive Maintenance** strategy is otherwise simple as compared to the sophisticated mathematical modeling. The guiding principle is that the time spent on **Preventive Maintenance** should be less than the time required for repairs and the value imported to machines by **Preventive Maintenance** should exceed the cost.

7. **Elaborate the steps in formulating Production Strategy.**

The steps discussed below are involved in the formulation of Production Strategy.

1. Study of Corporate Plan and Statement of Objectives: As in other operating areas, Production Planning begins with the corporate Objectives and the planning premises. Examination of the overall Corporate Planning not only provides overall directions for manufacturing but also answers questions about overall economic, industrial, market and company factors which will limit and otherwise affect the Production Planning. Within the framework of these overall planning factors, the planner establishes the production objectives and the definitions of the general product and theprocess areas in which production operations should concentrate.

2. Analysis of the Present Production Operations and the Environmental Forces: The production manager should analyse the current manufacturing operations amid the present and future environmental trends to determine the company's manufacturing Strengths and Weaknesses and to isolate environmental factors such as the manpower supply and the new process and equipment developments, which significantly affect manufacturing operations. During this phase of manufacturing planning, the planner examines the premises or factors that affect the manufacturing operations specifically. A study of plant location should be made to assess the effectiveness of present location with respect to key supplies and channels of distribution, and to analyse the economies of plant location in terms of labour costs and reservoir of labour skills, both short-term and long-term. Percentage of plant capacity being currently used effectively should also be studied. The existing condition of the machinery should be studied and its quality and efficiency should be compared with others in the same field including the overseas competitors. It must also be ascertained as to how many new equipment developments within the industry have been used by the company such as the list of computers for scheduling, automated warehouses, miniaturisation, programmed equipment, etc. Current schedule for replacement of machinery and cost of such replacement also need examination. Regarding maintenance, production

manager should check availability of replacement parts. He/she should also see if the company has work standards to measure productivity. In production scheduling, information regarding machinery down time, accuracy of scheduling, history of production delays and the reasons thereof, method changes over the past few years and the future trends, etc., should be gathered and analysed. Regarding materials aspect of production, it is very important to analyse the purchase requirements, rate of inventory turnover, production delays due to out of stock materials, condition of the material handling equipment, adequacy of the existing facilities of the material handling equipment, adequacy of the existing facilities for storing and warehousing materials and other similar matters.

3. Review of Sales Forecast and Marketing Mix: Since planning in other areas affects manufacturing plans, the planner should examine the plans in those areas. Sales goals are the basis upon which specific operating plans for manufacturing are built. Hopefully, the manufacturing manager has participated in the development of these goals so that the sales goals can be reconciled with the limitations of the operations. Once settled, manufacturing plans can be developed to meet sales goals. The impact of marketing mix, research and development and new product administration on manufacturing are also examined.

4. Making Strategic Decisions: Keeping in mind the overall corporate business mix, present production operations, environmental forces, sales forecast and marketing mix, the production manager has to decide about the extent of manufacturing activity, choice of the manufacturing process, capacity of the machines and equipment to be used, and the physical facilities.

(a) Extent of Production Activity: The first vital decision which a production manager has to make, particularly in consultation with marketing and finance managers, is regarding the extent of manufacturing activity the firm will carry out. There is usually a great deal of choice with respect to the extent of commitment to production. At one end of the spectrum, the production manager needs to consider all the items used in production including standard parts, small special components and major components that can be manufactured and completely assembled. At the other end, the finished products are there which can be bought and the company's name is attached. Nature of the manufacturing operation dictates, to a certain extent, the area where the optimization is likely to take place. Even then, there is often a considerable range of variation. Many factors influence managerial decision regarding extent of manufacturing activity. A firm will be tempted to manufacture raw materials and components for the products to be sold along with the parts to be assembled, if it finds that this will ensure supplies in accordance with required quality, quantity and timely availability. This temptation will be further strengthened when costs of producing raw materials and components are found to be less than the price at which suppliers will supply these materials. Uncertainty regarding ready availability of supplies further suggests that the firm should have a captive source of supply of vital raw materials and ingredients. Size of investment involved in developing production facilities also influences the extent of the firm's production activity. Where the investment involved is large, introducing new products or changing the product design with consequential changes in the plant facilities are likely to be too costly to bear. In such situations, it will be desirable for the firm to procure its materials from outside sources for having

greater flexibility and greater adjustment to changes, if required. Financial strength of the firm plays a significant role in deciding the extent of the production activity of the firm. Thus, a firm with a strong financial position is better placed in integrating manufacturing and processing of components and products than the one whose financial position is weak. Similarly, availability of managerial expertise in the firm decides the range of manufacturing activity. Where a firm has executives with specialised skills and competences in a particular line of activity, it must recruit new executives with equal efficiency. It will, therefore, be prudent on the part of the production manager to consult the top management if the firm can afford the cost of new executives. The finance manager may also be involved in working out the cost-benefit implications of the decision.

(b) Choice of the Manufacturing Process: Selection of a suitable process in advance of the actual production of goods is another strategic decision that considerably influences the success of an industrial enterprise. The design of the manufacturing process is not restricted to new concerns or new products. Existing enterprises have also to review their operations in the light of the competition in order to increase production at lower costs. Production process refers to the design of a series of operations to transform inputs into desired outputs. Process planning involves the steps stated below.

1. A careful review of the product design and specifications to make sure that economic manufacture is feasible
2. Determination of the methods of manufacture that will result in the optimum manufacturing cost
3. Selection or development and procurement of all machines, tools, and other equipment required for the manufacture of the product for the required quality and rate of production
4. Layout of the production area and auxiliary spaces and installation of the manufacturing facilities
5. Planning for and establishing the necessary control of materials, machines and manpower to ensure the effective utilisation of the manufacturing facilities for economical production of the product

   Thus, the process design activity comprises all such activities as are necessary to arrange for the manufacture of the product by the most economical means and in compliance with all safety regulations

(c) Capacity Decisions: While considering a new plant design or redesign or expansion of an existing system, a high level decision regarding the production capacity is called for. In order to determine the future capacity of the plant, adequate consideration should be given to certain factors such as sales forecast of physical volume, policy decisions on what will be purchased instead of made, engineering estimates of machine productivity and production plans on how equipment will be used. Upon this must be superimposed central management policies regarding the desired capacity including policies regarding provisions for peak versus normal requirements. One of the most vital decisions which have to be made regarding production capacity is whether the company should build so much capacity to satisfy all demands during peak periods or whether it should maintain a smaller capacity and hope that failure to render service during requirements will not have unbearable consequences. Generally, companies providing utilities have a policy of building

capacity to cope with peak demands. But the investment made for peak demands is tremendous. In view of burgeoning amount of investment, the moot question that arises is whether capacity installed in order to meet the maximum expected demand should be maintained at all times. It may not be disadvantageous to maintain the excess capacity throughout the year if one is confident that excess capacity can be utilised by expanding exports or by accumulating stocks if the duration of the surplus capacity is expected to be limited. There are some organisations that prefer to build smaller capacity to take care of normal requirements and meet peak demands by way of imports or subcontracting. Some organisations employ measures such as off-peak discounts, mail early campaign, etc., to induce customers to avoid peak periods. Another way of meeting high peak demands is to switch over to two shifts from the single shift. Before making a final decision in this direction, cost-benefit analysis must be undertaken. Many other costs are also involved. Wage premium, say 10 to 15 per cent., are generally given for second shifts. Multiple shifts also increase supervision costs. An analysis of building and equipment costs resulting from doubled shifts is necessary to determine the total additional cost. Additional costs should be matched with additional benefits. Where benefits exceed costs, it will be in the interest of the organisations to run double shifts to cope with peak demands. Adequate provision for coping with growth requirements of the organisation must be made while determining production capacity. For this, it is necessary for the top management to decide how much growth is expected and the extent to which investment will be made in anticipation of growth. This decision will have to be taken very carefully. Otherwise it may result in too much or too little capacity having serious consequences.

(d) Choosing Machines and Equipment: Another strategic decision to be made by a production manager is what type of equipment the organisation will require for production purposes, how much it will cost, what will be its operating cost and what services it will render to the organisation and for how long. Choice of equipment for making a particular product essentially depends on the basic manufacturing process. The decision-maker must, therefore, familiarise himself/herself with the production process to be adopted. Another consideration in the choice of new equipment for a plant is the type and degree of operating skills required and presently available skills within the organisation. Other factors worth consideration are the ease with which the equipment can be operated and the safety features of the equipment. While deciding about the number of each type of machines needed to produce a product, production engineer must take into account the quality of product to be made within any given period of time, number of working hours in the plant during this period, the various production rates for the operations to be performed, set-up time for each operation, number of set-ups per machine for the time period, the operating efficiency of the plant and finally the scrap loss during each operation. To find the requirements for any particular piece of equipment in a process, the total number of hours per month (or other time period) that the equipment requires to produce the desired quantity is divided by the total number of hours per month available for the equipment, taking plant efficiency into consideration. Then the total requirements for all operations to be performed on each unit of equipment are considered in terms of the number of set-ups involved and the time required for each set-up. In a product-line layout of equipment, where each machine is set up to perform only one operation, the set-up time can be neglected But the problem of line balancing becomes important. In the process type layout, where

machines are commonly used on several different parts and/or operations, set up and scheduling time losses must be carefully considered. For balancing the capacities of various machines in a product-line layout, it may be desirable to buy more than enough machines, if the equipment is not very expensive and if this can avoid possible shutdown or restriction of the entire manufacturing line. Where the equipment is quite costly, it may be necessary to provide only the minimum number of machines and rely upon overtime or extra-shifts to meet production requirements when breakdowns occur.

(e) Equipment Investment: Acquisition of equipment involves capital expenditure which will have long-term effects on the financial position of the company. Hence, before taking a final decision regarding investment in a machine, detailed analysis of such investment in terms of cost-benefit must be made and its desirability and worthiness should be evaluated with the help of Internal Rate of Return or Present Value method. The decision to replace the existing machine is equally important for the enterprise. In this regard, the management has to decide when the replacement should be made. It has to decide the replacement policy necessary for making comparisons between an existing unit of equipment and its possible replacement. In order to make a sound economic comparison, all the factors must be converted into cost considerations. Then, cost savings resulting from the proposed equipment must be related to incremental capital expenditure. The rate of return is to be compared with the cut-off rate to ascertain whether the replacement is economically viable. Thus, clear-cut policy guidelines regarding computation of net investment outlay, incremental operating expenditure and income depreciation, obsolescence, salvage value, etc., will help management in taking decisions regarding acquisition and/or replacement of machines.

(f) Decisions regarding Physical Facilities: Strategy for facilities covers plans for location analysis and plans for selection, design and specifications including layouts of equipment, plant, warehouses and related services, specifying and providing for maintenance. Planning for facilities deals with separate but interrelated costs of materials, supplies, manpower services and facilities. Its purpose is to find ways to minimise the aggregate of such costs in making and distributing the products at the proper time.

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