IV/IV B.Tech (Mech. Engg.) – VII sem Regular Exam, Feb 2021

Sub: **OPERATIONS MANAGEMENT [14ME705/A]**

Scheme of valuation

PART-A

1. **1 x 12 = 12 M**

a) **Quantitative methods of forecasting**

1. Naive approach
2. Moving averages
3. Exponential smoothing
4. Trend projection
5. Linear regression

b) In **Product layout**, machines and equipments are arranged in one line depending upon the sequence of operations required for the product.
The materials move form one workstation to another sequentially without any backtracking or deviation.

c) **Job production** comprises of manufacturing one or few quantity of products designed and produced as per the specification of customers within prefixed time and cost.
The distinguishing feature of this is low volume and high variety of products.

d) **Economic order quantity** (**EOQ**) is the ideal order quantity a company should purchase to minimize inventory costs such as holding costs, shortage costs, and order costs.

e) The **reorder point** (ROP) is the **level** of inventory which triggers an action to replenish that particular inventory stock. It is a minimum amount of an item which a firm holds in stock, such that, when stock falls to this amount, the item must be reordered.

f) MRP Logic:
Net requirements:
Net Requirements = Gross Requirements – Available Inventory
Available Inventory:
Available Inventory = Projected on hand– Safety stock – Inventory allocated to other items

g) **Loading -** assignment of jobs to process centers. Loading is a type of scheduling that loads or packs work into available work time.

h) A **pure strategy** is one that varies only one factor—for example, maintain a constant work force level or maintain a constant inventory.

i) **Scheduling** is establishing the timing of the use of equipment, facilities and human activities in an organization.

j) It is expanded approach to production resource planning, involving other areas of a firm in the planning process and enabling capacity requirements planning.

k) Inventory Control Systems

- Continuous system (fixed-order-quantity) or Q-system
- Periodic system (fixed-time-period) or P-system

l) **Benefits of ERP**

- Enhanced Business Reporting: Better reporting tools with real-time information. ...
- Better **customer service**: Better access to customer information. ...
- Improved Inventory **Costs**: ...
- Boosted Cash Flow: ...
- **Cost** Savings: ...
- Better Data & Cloud **Security**: ...
- Modernized Business Process Standardization: ...
- Superior Supply Chain Management:

PART-B

2.

(a) Forecasting Techniques: 6M

Jury of executive opinion

i. Delphi method

ii. Sales force composite

iii. Consumer market survey

i. Jury of executive opinion:

It is a forecasting technique that uses the opinion of a small group of high-level managers to form a group estimate of demand.

Here opinions of experts are invited about the sale in future. It is simple & fast but not scientific.

ii. Delphi method

It is a forecasting technique that uses a group process that allows experts to make forecasts.

iii. Sales force composite

It is a forecasting technique based on salespersons' estimates of expected sales. In this forecast, all the marketing & sales peoples (Sales-man, traders middle men etc) express their considered opinion of the volume of the sales expected in the future. These opinions are then collected & evaluated.

iv. Consumer market survey

It is a forecasting technique that uses the inputs from customers or potential customers regarding future purchasing plans. In this method, representative sample of customers are approached & asked, what they intend to buy. By doing so, it is possible to predict, with some degree of certainty, how the population will respond. Here economic, political, changes, customs, habits, social requirements are considered.

2 (b) **Benefits of Plant Layout:** 6M

Plant layout planned according to the above noted objectives helps in attaining high productivity in the use of plant, equipment, labour and materials.

Its benefits can be summarised as under:

(i) Good plant layout facilitates accurate planning and control of production. A steady quantity of output is assured by proper layout of the productive capacity and its utilization. Idleness of machinery and man would be reduced to the minimum and production capacity would be maintained intact.

(ii) A sound layout ensures more efficient utilisation of machinery and men. It avoids congestion of production areas, overcrowding of personnel at the production spots and thus seeks to avoid delay in flow of product of eliminates bottlenecks that cause slowdown of the product-schedule. Thus overhead costs are reduced by continuous or uninterrupted use of machines and personnel.

(iii) The proper arrangement of equipment and plant operations would also minimise the effort and cost of materials handling.

(iv) Ideal plant layout secures better utilisation of available floor space. Well-designed plant layout economises the space required for production and reduces the unit cost and at the same time makes provision for additional floor space that may be felt necessary for expansion of productive capacity or diversification of product lines.

(v) Proper machine arrangement and service facilities will reduce “the overall time of work in process” by securing a smooth flow of work over the shortest routes of production. The work in process, the hold of stock, costs of inventory are all minimised by sound layout of plant operations in logical sequence.

(vi) A well designed layout is regarded as “a prerequisite to effective supervision.” Good layout makes it easy for the workers to carry out their assigned activities without the need for elaborate instructions and supervision.

Since the ideal plant layout involves standardised sequence of operations with greater degree of automatic movement of materials and operational processes, supervisory efforts and costs are obviously reduced to the minimum.

(vii) Good plant layout ensures safety to the operating personnel. The risks or hazards in mechanical operations at work centres are eliminated by safety devices built into the design of the plant and the allied layout of the equipment. Plant layout which incorporates safety element will result in lesser accidents and lesser loss of man-hours.

(viii) A good plant layout buttressed by wholesome service facilities, better working conditions like lighting, ventilation, noise-control etc. improves employee morale and enhances their efficiency in performance.

In short, plant layout brings about:

(a) Economies in materials and product handling;

(b) Reduction in number of accidents, loss of man-hours and wastage of equipment;

(c) Better utilisation of available floor space;

(d) Cut-back in idle capacity, superfluous work and delay in operations;

(e) Better provision for maintenance and inspection of the production capacity, work in process and the work completed;

(f) Reduction in cost of supervision; and

(g) improvement in personnel morale and response.

3.(a) Importance of facilities location: 6M

Systematic arrangement of plant and its ancillaries in accordance with the nature of the job to afford maximum convenience to the workers to operate the activities assigned to them is the basic objective of plant layout.

Since production is nothing but the movement of materials in different stages for conversion into finished products, plant layout is intended to fulfill the following fundamental objectives, which are also the criteria for an ideal layout.

(a) Providing facilities to receive the materials intended to be used in the manufacturing processes.

(b) Proper arrangement of machinery and equipment in each department to provide ample room to place materials within easy reach of the workers.

(c) Near accessibility (through proper routing) to stores centres and ensuring direct and continuous movement of stores materials to initial and subsequent operations.

(d) Free access to machines and assembly lines for quick delivery of materials within each department and for fast pick up of outbound material and wastes.

(e) Adequate storage facilities for materials in process between consecutive operations.

(f) Grouping of machines and departments in such a manner that movement of materials or job on hand between the successive operations is as short as possible with minimum of back tracking and needless handling.

(g) Stock-rooms and tool cabins with facilities for storing, recording and handling of materials, tools, etc. with minimum delay.

(h) Arrangement for packing and creating finished products instantly and automatically moving them to warehouses or different corners bound for different markets destinations.

(i) Arrangement of plant, tools and physical facilities consistent with maximum convenience, safety and health of workers.

3(b) Comparison of Rural and Urban sites regarding site selection (6M)

Urban	*Rural*
1. Labour availability-diversified type of labour is available	Difficult to get requisite skilled labour
2. Local demand for the product is fairly high due to large population.	Market place is far away from the enterprise so cost of distribution of finished product is more
3. Good transportation facilities are available	Requisite transportation facilities are not available.
4. In proximity of allied industries.	Away form allied units.
5. Education, recreational health and other social facilities are available.	Absence of educational, recreational social and health facilities.
6. Sufficient land is not available even at higher rates.	Sufficient land is available at cheaper rates.
7. There are many restrictions on factory building construction.	No restrictions on building construction.
8. Certain facilities and public utility services such as water supply drainage and fire fighting etc. are available.	These facilities and public utility services are not available.
9. Prompt postal and communication services are available.	Prompt postal and public telephone services are not available.
10. Tax rates are high.	Taxes are quite low.

4. (a) OBJECTIVES OF MATERIALS MANAGEMENT 6M

- Reducing the overall costs of materials
- Better handling of materials
- Reduction in duplicated orders
- Materials will be on site when needed and in the quantities required
- Improvements in labor productivity
- Improvements in project schedule
- Quality control
- Better field material control
- Better relations with suppliers
- Reduce of materials surplus

- Reduce storage of materials on site
- Labor savings
- Stock reduction
- Purchase savings
- Better cash flow management

4 **(b)EOQ problem**

Given D = 24000 units/yr, Co = Rs 150/year

Cc = Rs 50×0.2 = Rs 10/- per unit/year

(a) 2M

EOQ = Q* =SQRT(2 × Demand × Co / Cc)

=SQRT(2 × 24000 × 150 /10)=848.53

= 849 units

(b) No. of orders/year = D / Q* 2M

= 24000 / 849 = 28.27

= 29 orders

(c) Time between successive order = t* = Q* / D 2M

= 849 / 24000 = 0.035375 Year

= 0.035375 × 12 × 30)

= 12.7 days

= 13 days

5. (a) (6M)

An MRP system is intended to simultaneously meet three objectives:

- Ensure raw materials are available for production and products are available for delivery to customers.
- Maintain the lowest possible material and product levels in store.
- Plan manufacturing activities, delivery schedules and purchasing activities.

  - It is a Computer-based information system that translates master schedule requirements for end items into time-phased requirements for subassemblies, components, and raw materials.
  - Materials requirements planning (MRP) is a means for determining the number of parts, components, and materials needed to produce a product.
  - MRP provides time scheduling information specifying when each of the materials, parts, and components should be ordered or produced.

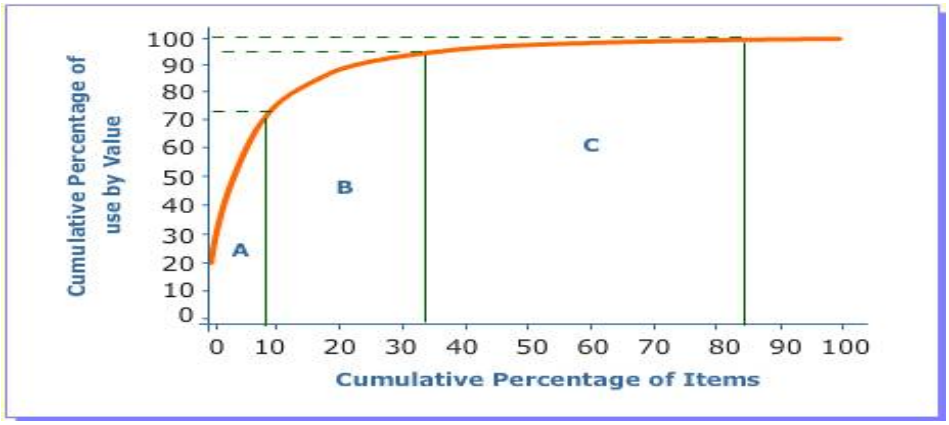
- Based on a master production schedule, a material requirements planning system:
  - Creates schedules identifying the specific parts and materials required to produce end items
  - Determines exact unit numbers needed

Determines the dates when orders for those materials should be released, based on lead times

5 (b) **(6M)**

ABC analysis for selective control

- ABC analysis underlines a very important principle "vital few-trivial many". Statistics reveals that just a handful of items account for bulk of the annual expenditure on materials. These few items are called "A" items, therefore hold the key to the business. The other items, known as B and C items, are numerous in number, but their contribution is less significant. ABC analysis thus tends to segregate all items into 3 categories: A, B, C on the basis of their annual usage.



3M

- By controlling the inventory of 'A' category items, the total inventory costs can be considerably reduced.

Purpose of ABC analysis

The object of carrying out ABC analysis is to develop policy guidelines for selective controls. Normally, once ABC analysis has been done, the following broad policy guidelines can be established in respect of each category.

3M

6. Types of implementing Aggregate planning strategies:

1. Pure strategy
2. Mixed strategy

A pure strategy is one that varies only one factor—for example, maintain a constant work force level or maintain a constant inventory.

Mixed strategy is a planning approach in which two or more options, such as overtime, subcontracting, hiring and layoff, etc., are used. There are both inventory changes and work force and production rate changes over the planning horizon. Typically, mixed strategies are better (result in lower costs) than pure strategies. **(6M)**

Pure Aggregate Planning Strategies

Strategy	Vary Work-Force Size?	Use Over-time and Idle Time?	Carry Large Inventories?	Incur Stockout Costs?	Use Sub-contractors?	Adjust Capacity?
1 Employment	(Yes)	No	No	No	No	No
2 OT, IT, and PT	No	(Yes)	No	No	No	No
3 Inventories	No	No	(Yes)	No	No	No
4 Back orders	No	No	No	(Yes)	No	No
5 Subcontracting	No	No	No	No	(Yes)	No
6 Plant capacity	No	No	No	No	No	(Yes)

Combination The most favorable solution to the nonuniform demand problem, however, does not usually result from a choice of one of the pure strategies. Indeed, the pure strategies are often infeasible from a practical standpoint.

Instead, a combination, or mix, is typically used. Very often the intention and result, is not to respond totally to the random fluctuations but rather to generate a modified response that is judged to be best for the firm over the long run. So the mix may very well include some anticipated stockout costs (strategy 4). We will go into some examples of the uses of these strategies later in the chapter.

(6M)

7. We define supply and demand points as follows:

Supply Points: Point 1 _ initial inventory (s_1 _ 10)
Supply Points: Point 2 _ quarter 1 regular-time (RT) production (s_2 _ 40)
Supply Points: Point 3 _ quarter 1 overtime (OT) production (s_3 _ 150)

Supply Points Point 4 _ quarter 2 RT production (s_4 _ 40)
Supply Points Point 5 _ quarter 2 OT production (s_5 _ 150)
Supply Points Point 6 _ quarter 3 RT production (s_6 _ 40)
Supply Points Point 7 _ quarter 3 OT production (s_7 _ 150)
Supply Points Point 8 _ quarter 4 RT production (s_8 _ 40)
Supply Points Point 9 _ quarter 4 OT production (s_9 _ 150)

There is a supply point corresponding to each source from which demand for sailboats can be met:

Point 1 _ quarter 1 demand (d_1 _ 40)
Demand Points Point 2 _ quarter 2 demand (d_2 _ 60)
Demand Points Point 3 _ quarter 3 demand (d_3 _ 75)
Demand Points Point 4 _ quarter 4 demand (d_4 _ 25)
Demand Points Point 5 _ dummy demand point (d_5 _ 770 _ 200 _ 570)

A shipment from, say, quarter 1 RT to quarter 3 demand means producing 1 unit on regular time during quarter 1 that is used to meet 1 unit of quarter 3's demand. To determine, say, c_{13}, observe that producing 1 unit during quarter 1 RT and using that unit to meet quarter 3 demand incurs a cost equal to the cost of producing 1 unit on quarter 1 RT plus the cost of holding a unit in inventory for 3 _ 1 _ 2 quarters. Thus, c_{13} _ 400 _ 2(20) _ 440. Because there is no limit on the overtime production during any quarter, it is not clear what value should be chosen for the supply at each overtime production point. Total demand _ 200, so at most 200 _ 10 _ 190 (_10 is for initial inventory) units will be produced during any quarter. Because 40 units must be produced on regular time before any units are produced on overtime, overtime production during any quarter will never exceed 190 _ 40 _ 150 units. Any unused overtime capacity will be "shipped" to the dummy demand point. To ensure that no sailboats are used to meet demand during a quarter prior to their production, a cost of M (M is a large positive number) is assigned to any cell that corresponds to using production to meet demand for an earlier quarter. 6M

6M

	1	2	3	4	Dummy	Supply
Initial	0 10	20	40	60	0	10
Qtr 1 RT	400 30	420 10	440	460	0	40
Qtr 1 OT	450	470	490	510	0 150	150
Qtr 2 RT	*M*	400 40	420	440	0	40
Qtr 2 OT	*M*	450 10	470	490	0 140	150
Qtr 3 RT	*M*	*M*	400 40	420	0	40
Qtr 3 OT	*M*	*M*	450 35	470	0 115	150
Qtr 4 RT	*M*	*M*	*M*	400 25	0 15	40
Qtr 4 OT	*M*	*M*	*M*	450	0 150	150
Demand	40	60	75	25	570	

8. (a) *Enterprise Resource Planning (ERP):* **(6M)**

- Next step in an evolution that began with MRP and evolved into MRPII
- Integration of financial, manufacturing, and human resources on a single computer system.
- ERP software provides a system to capture and make data available in real time to decision makers and other users in the organization
- Provides tools for planning and monitoring various business processes
- Includes
    - Production planning and scheduling
    - Inventory management
    - Product costing
    - Distribution

- Service applications such as:
    - Professional services
    - Postal services
    - Retail
    - Banking
    - Healthcare
    - Higher education
    - Engineering
    - Logistical services
    - Real estate

ERP Strategy Considerations

- High initial cost
- High cost to maintain
- Future upgrades
- Training

8 (b) **(6M)**

Ex: Annual demand for an item is 4800 units. ordering cost is Rs 500/- per order. inventory carrying cost is 24% of the purchase price per unit. the price break are given below.

Quantity		Price
$0 < Q_1 < 1200 (b_1)$	→	10
$1200 \le Q_2 < 2000 (b_2)$	→	9
$2000 \le Q_3 (b_3)$	→	8

(a) Find optimal order size.

Solution (a) D = 4800, Co = 500, I = 0.24

Step- 1 P_3 = Rs 8/- $Q_3 = \sqrt{\frac{2\,CoD}{i\,P3}} = \sqrt{\frac{2\times500\times4800}{0.24\times8}} = 1581$

Since Q3 < b2, i.e., 2000, go to step-2

Step- 2 P_2 = Rs 9/- $Q_2 = \sqrt{\frac{2\,CoD}{i\,P2}} = \sqrt{\frac{2\times500\times4800}{0.24\times9}} = 1491$

Since $Q_2 > b_1$ i.e., 1200, find the following costs & select the order size based on least cost.

$$TC(Q_2) = 9 \times 4800 + 500 \times \frac{4800}{1491} + \frac{0.24\times9\times1491}{2} = \text{Rs } 46420 \text{ (approx)}$$

$$TC(b_2) = 8 \times 4800 + 500 \times \frac{4800}{2000} + \frac{0.24\times8\times2000}{2} = \text{Rs } 41{,}520 \text{ (approx)}$$

The least cost is Rs 41,520. Hence optimal order size is 2000.

9

EOQ = Economic Order Quantity.

EOQ represent the size of the order (or lot size) such that the sum of carrying cost (due to holding the inventory) and ordering cost is minimum. it is shown by point A of figure 2.1.

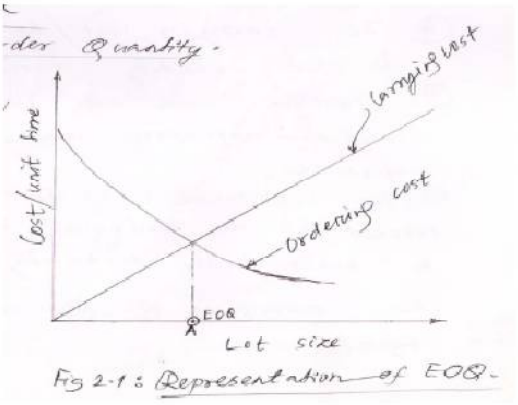


Fig 2-1 : Representation of EOQ.

As mentioned earlier, the two most important decisions related to inventory control are:

- When to place an order? &
- How much to order?

In 1913, F.W. Harris developed a rule for determining optimum number of units of an item to purchase based on some fundamental assumptions. This model is called Basic Economic Order Quantity model. It has broad applicability.

Assumptions

The following assumptions are considered for the sake of simplicity of model.

1) Demand (D) is assumed to be uniform.
2) The purchase price per unit (P) is independent of quantity ordered.
3) The ordering cost per order (Co) is fixed irrespective of size of lot.
4) The carrying cost/holding cost (Cc) is proportional to the quantity stored.
5) Shortage are not permitted i.e., as soon as the level of inventory reaches zero, the inventory is replenished.
6) The lead time (LT) for deliveries (i.e. the time of ordering till the material is delivered) is constant and is known with certainty.

The assumptions 5 and 6 are shown graphically in fig 2.2.

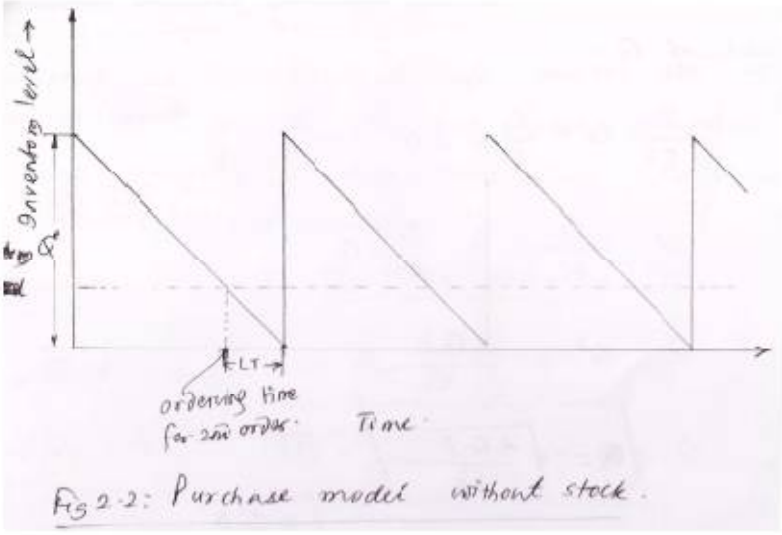


Fig 2.2: Purchase model without stock.

Let Q = order size

Therefore, the number orders/year = $\frac{D}{Q}$ ---------(1)

Average inventory level = $\frac{Q}{2}$

Ordering cost per year = $\frac{D}{Q} \times Co$ ----------(2)

Carrying cost per year = $\frac{Q}{2} \times Cc$ ----------(3)

Purchase cost/year = $D \times P$ ----------(4)

Now, the total inventory cost per year = $TC = \frac{D}{Q} \times Co + \frac{Q}{2}.Cc + D \times P$-----(5)

Differentiating Eq (5) w.r.t. Q it becomes:

$\frac{d(TC)}{dQ} = \frac{-D}{Q^2} Co + \frac{Cc}{2}$ ----------(6)

The 2nd derivative = $\frac{+2D}{Q^3} Co$----(7)

Since the 2nd derivative is +ve, we can equate the value of first derivative to zero to get the optimum value of Q.

i.e., $\frac{-D}{Q^2} Co + \frac{Co}{2} = 0$

$\therefore \frac{Cc}{2} = \frac{D}{Q^2} Co$

$\therefore Q^2 = \frac{2CoD}{Cc}$

$\therefore Q = \sqrt{\frac{2CoD}{Cc}}$ -------(8)

So, optimum $Q = EOQ = \sqrt{\frac{2CoD}{Cc}}$

******THE END******

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