

TECHNOLOGY AND OPERATIONAL MANAGEMENT

Purbanchal University: BCA IV Semester

S@R0Z

TECHNOLOGY AND OPERATIONAL MANAGEMENT

BCA 256MS

Year: II

Semester: II

Teaching schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
3	1	2	Theory	Practical *	Theory **	Practical	100
			20	-	80	-	

* Continuous

** Duration: 3 Hrs

Objective:

The basic objective of this course is to provide students with the fundamental Knowledge of Technology and operation function of an organization.

1. Nature and Concept of Operation Management:

- What is operation management
- Difference and similarities between manufacturing and services.
- Operation management and organization
- A case study of successful Japanese owned facilities in United States.

2. Operation Strategy

- Corporate strategy
- Market analysis
- Competitive priorities
- Flow strategy
- Flow strategy and competitive priorities
- Breakeven analysis
- Preference matrix

3. *Process Management*

- Major process decision: Process choice, Vertical integration, resource flexibility, capital intensity
- Relationship between decisions

4. *Management of Technology*

- Meaning and Role of Technology
- Information Technology

5. *Total Quality Management*

- Quality as a management philosophy
- Employee involvement
- Continuous improvement
- The cost of poor quality
- Improving quality through TQM
- A case study of Cranston Nissan

6. *Capacity*

- Measures of capacity

7. *Location*

- Factor affecting location decisions

8. *Layout*

- Layout types

9. *Forecasting*

- Concepts
- Judgment methods

- Casual method: Linear regression
- Time series methods.

10. Material requirement planning

- Inputs to material requirement planning
- Planning factors
- Outputs from material requirement planning

11. Just in time system

- Characteristic of just in time system
- The KANBAN system

Test Books

1. Krajewski, Ritzman, Operation Management, Strategy and Analysis, Addison- Wesley Publishing Company

Reference Books

1. Elwood, S. Buffa, Rakesh Sarin, Modern Production/ Operation Management, John Wiley and Sons
2. James B. Dilworth, Production and Operations Management. McGraw Hill Publishing Company
3. Everett E. Adam Jr., Ronald J. Fbert, Production and Operation Management, Prentice – Hall of India Pvt. Ltd.

Chapter 1: Nature and Concept of Operation Management



Operation Management

At one time, the term “Operation Management” referred primarily to manufacturing production. The growing economic importance of a wide range of non-manufacturing business activities, however broadened the scope of the operations management function.

Today, the term operation management refers to the direction & control of the processes that transform inputs into finished goods & services. This function is essential to systems producing goods & services in both profit & non-profit organization.



Difference between Manufacturing and Services

Manufacturing	Services
1.) Manufactured goods are physical, durable products.	1) Services are intangible, perishable products.
2.) Manufactured goods are outputs that can be produced, stored, & transported in anticipation of future demand. Inventories allow coping with fluctuations in demand by smoothing output levels.	2.) Services cannot be pre-produced. Service operations don't have the luxury of using finished goods inventories as a cushion against erratic customer demand.
3.) Most customers for manufactured products have little or no contact with the production system.	3.) In service organization the customer themselves are inputs & active participants in the process.
4.) Manufacturers generally have days or weeks to meet customer demand.	4.) The many services must be offered within minutes of customer arrival.
5.) Manufacturing facilities often serve regional, national or even international markets & therefore requires larger facilities, more automation & greater capital investment.	5.) In general services can't be shipped to distant locations. Thus service organizations requiring direct customer contact must locate relatively near their customers.

6.) As manufacturing systems tends to have tangible products & less customer contact, quality is relatively easy to measure.	6.) The quality of service systems, which generally produce intangibles, is harder to measure. Moreover individual preferences affect assessments of services quality making objective measurements is difficult.
--	---



Similarities between Manufacturing & Services

Despite of distinctions, the similarities between manufacturing & service operations are compelling. Every organization is concerned about quality, productivity & the timely response to customers. A service provider like a manufacturer must make choices about the capacity, location & layout of its facilities.

The similarities between manufacturing & services are listed below:

- Manufacturers do not just offer products, & service organization does not just offer services. Both types of organization normally provide a package of goods & services. Manufacturing firms offer many customer services, & a decreasing proportion of the value added by them directly involves the transportation of materials.
- Despite the fact that service providers can't inventory their outputs, they must inventory the inputs for their products. These inputs must undergo further transformations during provision of the services. Hospital, for example, must maintain an adequate supply of medications. Manufacturing firms that make customized products or limited-shelf-line products can't inventory their outputs.
- As for customer contact, many service operations have little outside customer contact, such as the back-room operations of a bank or the luggage handling area at an airport. However, everyone in an organization has some customers-outside customers or inside customers, whether in service or in manufacturing,

Clearly, operations management is relatively to both manufacturing and service operations.



Operation Management and Organization



Operation Management as an Inter-functional Imperative:

Operations managers need to build & maintain solid relationship both inter-organizationally & intra-organizationally. Too often managers allow artificial barriers to be erected between functional areas & departments. In these situations jobs or tasks move sequentially from marketing to engineering to operations. This result is often slow or poor decision making because each department bases its decisions solely on its own limited perspective, not the organization's overall perspective.

A new approach being tried by many organizations is to replace sequential decisions making with the cross-functional co-ordination & flatter organizational structure.

● **Cross-functional Co-ordination**

Cross-functional co-ordination is essential to effective operations management. The strongest connection is with the marketing function, which determines the need for new products & services & the demand for existing ones. Operations Manager must bring together human & capital resources to handle demand effectively. Marketing & sales makes delivery promises to customers, which must be related to current operations capabilities. Marketing's demand forecasts guide the operations manager in planning output rates & capabilities.

The operations manager also needs feedback from the accounting function to understand current performance. Accounting can help the operations manager monitor the production system's vital signs by developing multiple tracking methods.

The engineering function also can have a big impact on operations. In beginning new products, engineering needs to consider technical trade offs. It must ensure that product designs do not create costly specifications or exceed operations capabilities.

● **Achieving Cross-functional Co-ordination**

Several approaches may be used to achieve cross-functional co-ordination. Each organization should select some blend of them to get everyone pulling in the same direction.

- A unified strategy should be developed as a starting point, giving each department a vision of what it must do to help to fulfill the overall organizational strategy.
- The organizational structure & management hierarchy can be re-designed to promote cross-functional co-ordination.
- The goal setting process & reward systems can encourage cross-functional co-ordination. So, can bringing people or committees to make decisions & solve problems.
- Improvements to information systems also can boost co-ordination. Sharing information helps harmonize the efforts of managers from different parts of the organization & enables them to make decisions consistent with organizational goals.
- Informal social systems are another device that can be used to encourage better understanding across functional lines.
- Employee selection & promotion also can help foster more cross-functional co-ordination by encouraging broad perspectives & common goals.

✦ **Operations Management as a Competitive Weapon**

Business & government leaders increasingly are recognizing the importance of involving the whole organization in making strategic decisions in order to compete globally. Because the organization usually commits the bulk of its human & financial assets to operations, operations is an important function in meeting global competition.

Largely, because of foreign competition & the explosion of new technologies, recognition is growing that a firm competes not only by offering new products & services, creative marketing, & skillful finance, but also with unique competencies in operations. The organization that offers superior products & services at lower prices is a formidable.

Chapter 2: Operation Strategy

Operation strategy specifies how operations can help implement the firm's corporate strategy. Basically, operation strategy links long & short term operates decisions to corporate strategy. Continuous cross-functional interaction must occur in implementing operation strategy or any other functional strategy.

Corporate Strategy

Corporate Strategy defines the business that the company will pursue, new opportunities & threats in the environment & the growth objectives that it should achieve. Corporate Strategy provides an overall direction that serves as the framework for carrying out all the organization's functions.

Strategic Choices:

Corporate Strategy defines the direction of the organization over the long term & determines the goals that must be achieved for the firm to be successful. Management sets corporate strategy by making three strategic choices: determining the firm's mission, monitoring & adjusting to changes in the environment & identifying & developing the firm's core competencies.

Contd. ...

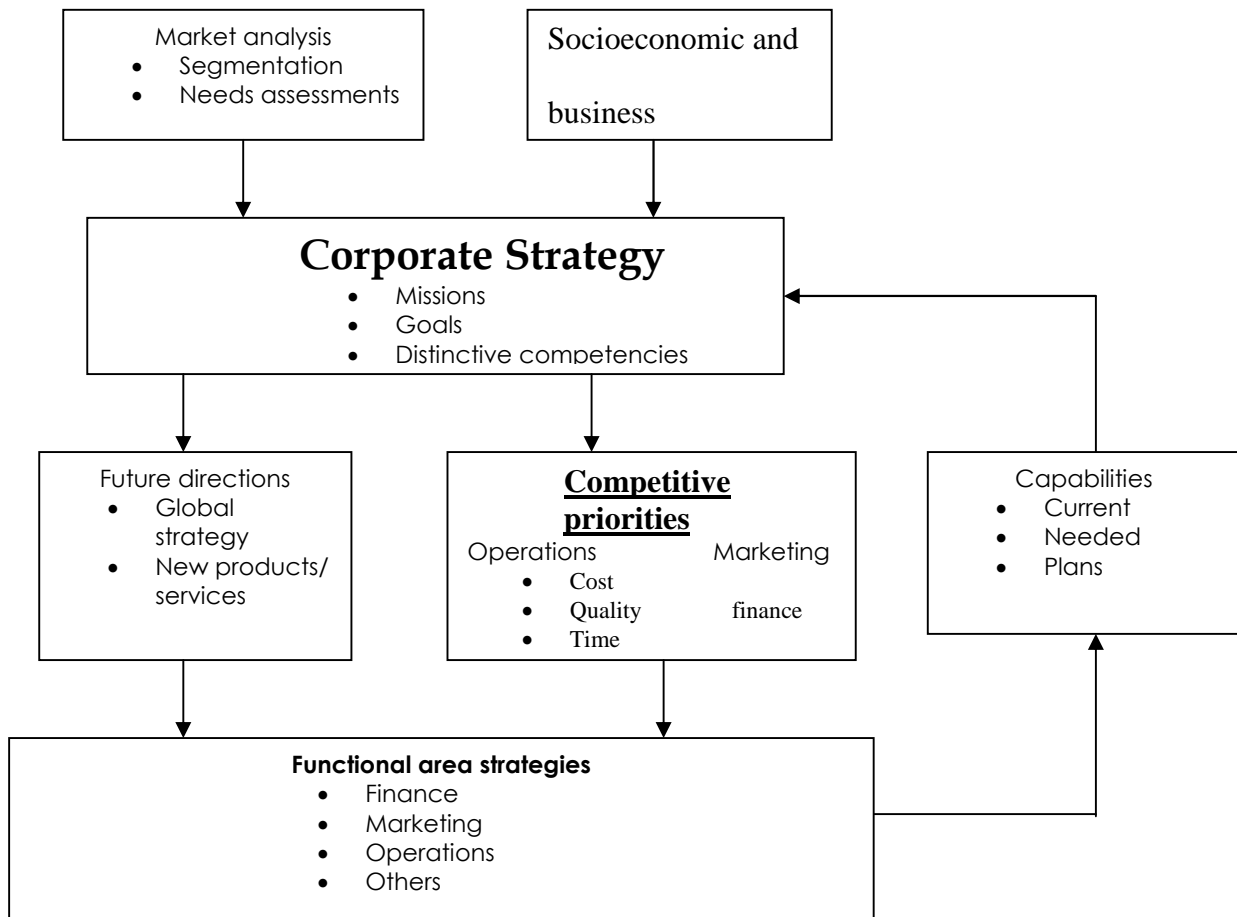


Fig: Link between Corporate Strategy & Functional Strategies

A firm's mission statement answers several fundamental questions:

- What business are we in ?
- Who are our customers (or clients) ?
- What are our basic beliefs ?
- What are the key performance, objectives, such as profits, growth, or market-share, by which we measure success ?

An understanding of the firm's mission helps managers generate ideas & design new products & services. If its mission is too broadly defined, the firm could enter areas in which it has no expertise. If the mission is too narrowly defined, the firm could miss promising growth opportunities.

➡ Environment

The external business environment in which a firm competes changes continually & an organization needs to adapt to those changes. Adaptation begins with environmental scanning, the process by which managers monitor trends within the socioeconomic environment, including the industry, the marketplace, and the society, for potential opportunities or threats. A crucial reason for environmental scanning is to stay ahead of the competition. Important environmental concerns include economic trends, technological changes, political conditions, social changes (such as attitudes towards work), the availability of vital resources, & the collective power of customers & suppliers.

➡ Core competencies

Core competencies are an organization's unique resources & strengths that management considers when formulating strategy. They reflect the collective learning of the organization, especially in how to co-ordinate diverse processes & integrate multiple technologies. These competencies include the following:

- **Work force :-** A well-trained & flexible work-force is an advantage that allows organizations to respond to market needs in a timely fashion.
- **Facilities :-** Having well-located facilities – offices, stores and plants – is a primary advantage because of the long lead time needed to build new ones. Expansion into new products or services may be accomplished quickly.
- **Market & Financial know-how :-** An organization that can easily attract capital from stock sales, market & distribute its products, or differentiate its products from similar products on the market has a competitive edge.
- **System & Technology :-** Organizations within expertise in information systems will have an edge in industries that are data & information intensive, such as banking. Having the patents on a new technology is also a big advantage.

✦ **Global Strategies**

A global strategy may include buying foreign parts or services, combating threats from foreign competitors, or planning ways to enter markets beyond traditional national boundaries. One way for a firm to open foreign markets is to create a strategic alliance. A strategic alliance is an agreement with another firm that may take the form of a:

- **Collaborative effort,**
- **Joint venture, or**
- **Licensing of technology**

A collaborative effort often arises when one firm has core competencies that another needs but is unwilling (or unable) to duplicate. The two companies agree to work together to the mutual benefit of both.

In a joint venture two firms agree to jointly produce a product or service. This approach often is used by firms to gain access to foreign markets.

Licensing technology is a form of strategic alliance in which one company licenses its production or service methods to another firm. Licenses may be used to gain access to foreign markets.

Another way to enter in the foreign market is to locate operations in foreign country. However, manager must recognize that what work well in their home country might not work well elsewhere.

✦ **Market Analysis**

One key to success in formulating a customer-driven operations strategy for both manufacturing & service firms understands what the customer wants & how to provide it better than the competition does. Market analysis first divides the firm's customers into market segments & then identifies the needs of each segment.

✦ **Market segmentation**

Market Segmentation is a process of identifying groups of customers with enough in common to warrant the design & provision of products or services that the larger groups wants & needs. In general, to identify market segment the analyst must determine the characteristics that clearly differentiate each segment. A sound marketing program can then be devised & an effective operating system developed to support the marketing plan.

Once the firm has identified the market segment, it can incorporate the needs of customers into the design of the product or service & the operations system for its production. The following characteristics are among those that can be used to determine market segments:

- **Demographic factors :-** Age, income, educational level, occupation, & location are example of facts that differentiate the markets.
- **Psychological factors :-** Factors such as pleasure, fear, innovativeness, & boredom can serve to segment to markets.
- **Industry factors :-** Customers may utilize specific technologies (e.g. electronics, or microwave telecommunications), use certain materials (e.g. rubber, oil, or wood), or participate in a particular industry (e.g. banking, health-care, or automotive). These factors are used for market segmentation when the firm's customers use its goods or services to produce other goods or services for sale.

✦ Needs Assessments

The second step in Market Analysis is to make a need assessment, which identifies the needs of each segment & assesses how well competitors are addressing those needs. The needs assessment should include both the tangible & the intangible product attributes & features a customer desires.

Each market segment has market needs that can be related to product/service, process, or demand attributes. Markets needs may be grouped as follows:

- **Product/Service needs :-** Attributes of the product or service, such as price, quality, & degree of customization desired.
- **Delivery system needs:-** Attributes of the process & the supporting systems & resources needed to deliver the product or service, such as availability, convenience, courtesy, safety, delivery speed, & delivery dependability.
- **Volume needs:-** Attributes of the demand for the product or service, such as high or low volume, degree of variability in volume, & degree of predictability in volume.

- **Other needs:-** Other attributes not directly relating to operations, such as reputation & number of years in business, technical after sale support, accurate & reliable billing & accounting systems, ability to invest in international financial markets, competent legal services, & product/service design capability.

Competitive Priorities

Market analysis identifies the market needs that a firm can exploit to gain competitive advantage in each market segment. Translating these needs into desirable capabilities for each of the functional areas of the firm is followed by developing the selected capabilities. There are eight possible competitive priorities for operation, which fall into four groups:

- | | |
|--------------------|-----------------------------|
| Cost | 1) Low-cost operations. |
| Quality | 2) High-performance design. |
| | 3) Consistent quality. |
| Time | 4) Fast delivery time. |
| | 5) On-time delivery. |
| | 6) Development speed. |
| Flexibility | 7) Customization. |
| | 8) Volume flexibility. |

Cost

Lowering prices can increase demand for products or services, but it also reduces profit margins if the product or service cannot be produced at lower cost. Often, lowering costs requires additional investment in automated facilities & equipment

Quality

Two competitive priorities deal with quality. The first, **High-performance design**, may include superior features, close tolerances, & greater durability, helpfulness, courteousness, & availability of service employees, convenience if access to service locations, & safety of products or services. High-performance design determines the level of operations performance required in making a product or performing a service.

The second quality priority, **consistent quality**, measures the frequency with which the product or service meets design specifications. Customers want products or services that consistently meet the specifications they contracted for, have come to expect, or saw advertised. A firm that doesn't have consistent quality doesn't last long in a competitive global marketplace.

✦ Time

Three competitive priorities deal with time:

- **Fast delivery time:-** is the elapsed time between receiving a customer's order & filling it. Industrial buyers often call it **lead-time**. Manufacturers can shorten the delivery times by storing inventory, manufacturers & service providers can do so having excess capacity.
- **On-time delivery:-** measures the frequency with which delivery-time promises are met. Manufacturers measure on-time delivery as the percentage of customer orders shipped when promised.
- **Development speed:-** measures how quickly a new product or service is introduced, covering the elapsed time from idea generation through final design & production. Development speed is important in the fashion apparel industry.

Many companies focus on the competitive priorities of development speed and fast delivery time with a time based competition managers carefully define the steps & time needed to deliver a product or services & then critically analyze each step to determine whether time can be saved without hurting quality.

✦ Flexibility

Some firms give top priority to two types of flexibility:

- **Customization:-** is the ability to satisfy the unique needs of each customer by changing product or service designs. However, products or services tailored to individual preferences may not have long lives. Customization typically implies that the operating system must be flexible to handle specific customer needs & changes in designs.
- **Volume flexibility:-** is the ability to accelerate or decelerate the rate of production. Quickly to handle large fluctuations in demand. Volume

flexibility is an important operating capability that often supports the achievement of other competitive priorities (e.g. fast delivery times).



Flow Strategy

Flow Strategy determines how the operations system is organized to handle the volume & variety of products or services for a specific market segment. With a flexible flow strategy the system is organized around the processes used to produce the product or service. With a line flow strategy the system is organized around the product or service itself.

✦ Flexible Flow Strategy

Firms use a flexible flow strategy to produce a wide range of low-volume products or services. Different types of machines or employees with different sets of skills are grouped to handle all products or services requiring a specific function to be performed, & various products or services move from one process to another. Although the flexible flow strategy enables the production of a wide variety of products or services with low volume, it creates a jumbled flow through the facility. Machine shop that takes many small jobs utilizes a flexible flow strategy because each product can require a different sequence of resources.

✦ Line Flow Strategy

In line-flow strategy, equipment & employees are organized around the product or service. A line flow strategy fits high-volume production of a few products or services, & lends itself to highly automated facilities. With a line-flow strategy, all products or customer follow a linear pattern in the facility. The firms which follow the line flow strategy are fast-food restaurant, car washes, appliance manufactures etc.

✦ Strategies Based On Flows

Five fundamentals manufacturing & service strategies based on flows are **made-to-stock, standardized services, assemble-to-order, make-to-order, & customized services.**

- **Make-to-Stock :-** Manufacturing firms with line flows tends to use a make-to-stock strategy, in which the firms hold items in stock for immediate delivery, thereby minimizing customer delivery times. This strategy is also applicable to situations in which the firm is producing a unique product for a specific customer if the volumes are high enough. The example of products produced with a make-to-stock strategy includes garden tools, electronic components, soft drinks, & chemicals.
- **Standardized Services Strategy:-** Service firms with line flows tend to use a standardized services strategy, in which the firms provide services with little variety in high volumes. This strategy is analogous to make-to-stock strategy of manufacturing firms.
- **Assemble-to-Order Strategy:-** In manufacturing, the assemble-to-order strategy is an approach to producing products with many options from relatively few assemblies & components, after customer orders are received. The assemble-to-order strategy typically addresses two competitive priorities, customization & fast delivery time.

In services, the assemble-to-order strategy involves packaging a variety of standardized services for specific customer needs.

- **Make-to-Order Strategy:-** Manufacturers with flexible flows tends to use a make-to-order strategy, whereby they make products to customer specification in low volumes. This strategy provides a high degree of customization, which is a major competitive priority of these firms.
- **Customization Services Strategy:-** Service providers with flexible flows can utilize a customized services strategy, whereby they provide highly individualized services, often in low volumes. Sometimes service providers utilize the customized services. Strategy in high-volume situations such as the case in large facilities that service electronic equipment needing periodic maintenance or repair.



Flow Strategy & Competitive Priorities

Operations managers use flow strategy to translate product or service plans & competitive priorities for each market segment the firm serves into decisions throughout the operations functions that support those market segments.

Contd. ...

Flow Strategy

Flexible Flows	Line Flows
Tendency for customized products and services, with low volume.	Tendency for standardized products and services, with high volume.
High performance design quality.	Consistent quality.
More emphasis on customization and volume flexibility.	More emphasis on low cost.
Long delivery time.	Short delivery time.

Fig: - Linking flow strategy with competitive priorities



Break-Even Analysis

Break-even analysis helps the manager identify how much change in volume or demand is necessary before a second alternative becomes better than the first one. The **break-even point** is the volume at which total revenues equal total costs. Use of this technique is known as break-even analysis. Break-even analysis can also be used to compare production methods by finding the volume at which two different processes have equal total costs.

Evaluating Products or Services

This technique helps the manager answer questions such as the following:

- Is the predicted sales volume of the product or service sufficient to break-even?
- How low must the variable cost per unit to be break even, based on current prices & sales processes?

- How low must the fixed cost to be break-even ?
- How do price levels affect the break-even volume ?

Break-even analysis is based on the assumption that all costs related to the production of a specific product or service can be divided into two categories: variable costs & fixed costs.

The variable costs, c , is the portion of a total costs that varies directly with the volume of outputs. If Q be the number of units produced & sold per year, total variable cost = cQ . The fixed costs, f , is the portion of the total cost that remains constant regardless of changes in levels of output. Thus,

$$\text{Total cost} = f + cQ$$

$$\text{Total revenue} = pQ \quad p = \text{revenue per unit sold}$$

If we set total revenue equal to total costs, we get break-even point as:

$$pQ = f + cQ$$

$$(p - c) Q = f$$

$$Q = f / (p - c)$$

$$\boxed{Q = f / (p - c)}$$

We can also find this break-even quantity graphically. Because both costs and revenues are linear relationships, the break-even point is where the total revenue line crosses the total cost line.

Example:

A hospital is considering a new procedure to be offered at \$ 200 per patient. Fixed cost per year would be \$ 100,000, with total variable cost of \$ 100 per patient. What is the break-even quantity for this service? Use both algebraic and graphic approach to get the answer.

Solution:

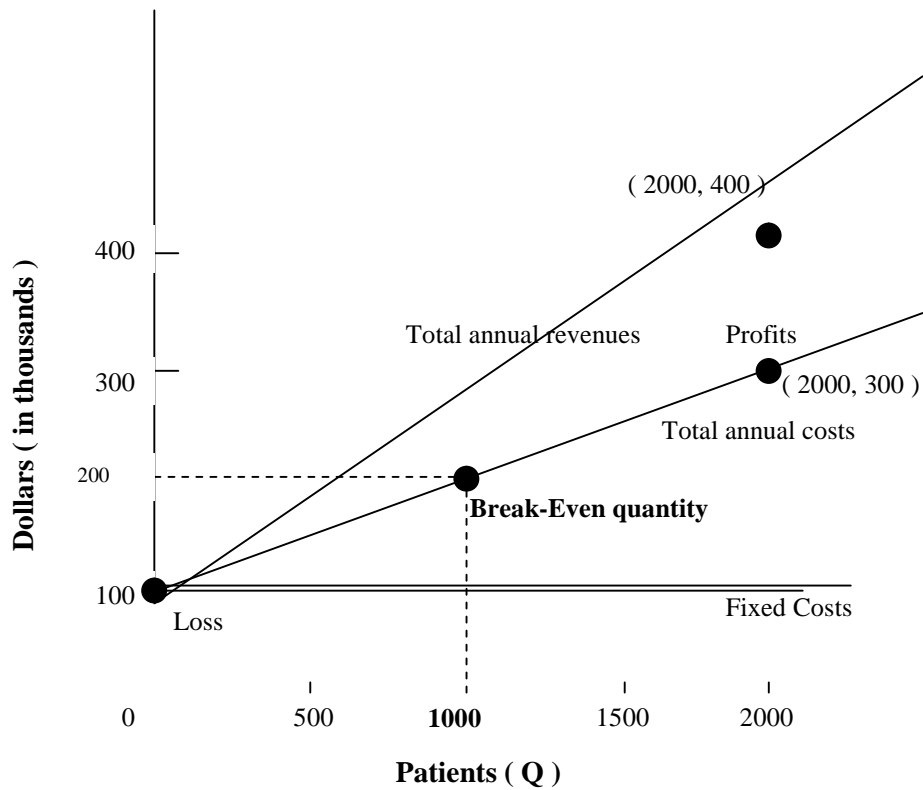
Algebraic approach:

The formula for break-even quantity yields

$$\begin{aligned} Q &= f / (p - c) \\ &= 100,000 / 200 - 100 \\ &= 1000 \text{ patients} \end{aligned}$$

Graphic approach:

Quantity (Patients) (Q)	Total Annual Costs (\$) (100,000 + 100 * Q)	Total Annual Revenue (\$) (200 * Q)
0	100,000	0
2000	300,000	400,000



Break-even analysis can't tell a manager whether to pursue a new product or service idea to drop an existing line. The technique can only show what is likely to happen for various forecasts of costs & sales volumes. To evaluate a variety of " what if " questions, we use an approach called sensitivity analysis, a technique for systematically changing parameters in a model to determine the effects of which changes.



Preference Matrix

A preference matrix is a table that allows the manager to rate an alternative according to several performance criteria. The preference matrix helps a manager deal with multiple criteria that cannot be evaluated with a single measure of merit, such as total profit or cost.

Not all managers are comfortable with preference matrix technique. It requires the manager to state criteria weights before examining the alternatives, although the proper weights may not be readily apparent.

Example:-

The following table shows the preference criteria, weights, & scores (1 = worst, 10 = best) for a new product: a thermal storage air conditioner. If the management wants to introduce just one new product & the highest total score of any of the other products ideas is 800, should the firm pursue making the air conditioner?

Performance Criterion	Weight (A)	Score (B)	Weighted Score (A * B)
Market potential	30	8	240
Unit profit margin	20	10	200
Operations compatibility	10	6	120
Competitive advantage	15	10	150
Investment requirement	10	2	20
Profit risk	5	4	20
			Weighted Score =750

Solution:-

Because the sum of the weighted scores is 750, it falls short of the score of 800 for another product. So management would not pursue the thermal storage air conditioner idea at this time.

Chapter 3: Process Management

✦ *What is Process Management?*

A process involves the use of an organization's resources to provide something of value. No product can be made and no service provided without a process, and no process can exist without a product or service.

Process Management is the selection of the inputs operations, workflows, and methods that transform inputs into outputs. Input Selection begins by deciding which processes are to be done in-house and which processes are done outside and purchased as materials and services. Process decisions also deal with the proper mix of human skills and equipment and which parts of the process are to be performed by each.

Process decisions must be made when:

- A new or substantially modified product or service is being offered,
- Quality must be improved,
- Competitive priorities have changed,
- Demand for a product or service is changing,
- Current performance is inadequate,
- Competitors are gaining by using a new process or technology, or
- The cost or availability of inputs has changed.

✦ *Major Process Decisions*

Whether dealing with processes for offices, service providers, or manufacturers, operations managers must consider five common process decisions. The common 5 process decisions are listed below:

✦ **Process Choice**

Process Choice determines whether resources are organized around products or processes in order to implement flow strategy. The process choice

decision depends on the volume and degree of customization to be provided. The manager has five process types, which form a continuum, to choose from:

- **Project Process**

A project process is characterized by a high degree of job customization, the large scope of each project, and the release of substantial resources once a project is completed. A project process lies at the high-customization, low-volume end of the process-choice continuum. Although some projects may look similar, each is unique. A project process is based on a flexible flow strategy, with work flows redefined with each new project. **E.g.** building a shopping center, running a political campaign, developing a new technology or product etc.

- **Job Process**

A job process creates the flexibility needed to produce a variety of products or services in significant quantities. Customization is relatively high and volume for any one product or service is low. A job process primarily involves the use of a flexible flow strategy, with resources organized around the process. **E.g.** machining a metal casting for a customized order, providing emergency room care, handling special-delivery mail, or making customized cabinets.

- **Batch Process**

A batch process differs from the job process with respect to volume, variety and quality. The primary difference is that volumes are higher because the same or similar products or services are provided repeatedly. Another difference is that a narrower range of products and services is provided. A third difference is that production lots or customer groups are handled in larger quantities than they are with job processes. A batch process implements an intermediate flow strategy. It has average or moderate volumes, but variety is still too great to warrant dedicating

substantial resources to each product or service. The flow pattern is jumbled, with no standard sequence of operations throughout the facility.

- **Line Process**

A line process lies between the batch and continuous processes on the continuum, volumes are high, and products or services are standardized, which allows resources to be organized around a product or service. Manufacturers with line processes often follow a make-to-stock strategy, with standard products held in inventory so that they are ready when customer places an order. This use of a line process is sometimes called mass production. A line process fits primarily with the line flow strategy, although it can overlap into the intermediate flow strategy. When mass customization or assemble-to-order strategies are pursued. Products created by a line process include automobiles, appliances, and toys.

Difference between Line Process and Job Process:

Line Process	Job Process
1.) Customization is low.	1.) Customization is high.
2.) Little variety of products.	2.) More variety of products.
3.) Line flow strategy is also called make to stock strategy.	3.) Flexible flow strategy.
E.g. Cement plant, TV assembling plant etc.	4.) E.g. Machine shop, Emergency units in the hospital etc.

- **Continuous Process**

A continuous process is the extreme end of high volume, standardized production with rigid line flows. The process often is capital intensive and operated round the clock to maximize utilization and to avoid expensive shutdowns and start-ups. Continuous processes are used almost exclusively

in manufacturing and fit perfectly a line flow strategy. **E.g.** petroleum refineries, chemical plant etc.



Vertical Integration

Vertical Integration is a degree to which a firm own production system or service facility handles the entire supply chain. Management decides the level of vertical integration by looking at all the activities performed by between acquisition of raw materials or outside services and delivery of finished products or services. The more processes in the supply chain that the organization performs itself, the more vertically integrated it is. Vertical Integration can be in two directions.

- ***Backward Integration***

Backward Integration represents movement upstream towards sources of raw materials and parts, such as a major grocery chain having its own plants to produce house brands of ice cream, peanut butter etc.

- ***Forward Integration***

Forward Integration means that the firm acquires more channels of distribution, such as its own distribution centers (warehouses) and retail stores. It can also mean that the firm goes even further, acquiring its industrial customers.

Contd. ...

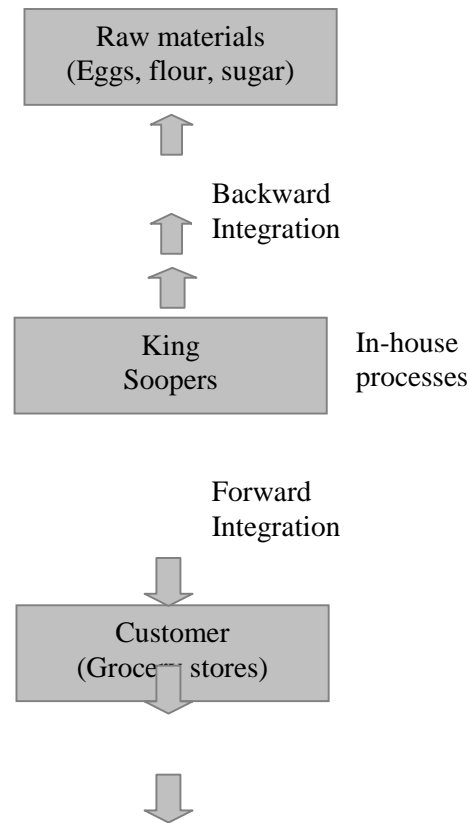


Fig:- Vertical Integration at King Soopers.

✦ **Advantages of Vertical Integration**

- A firm can achieve savings if it has the skills, volume, and resources to perform the processes at lower cost and produce higher quality goods and services than outsiders can.
- Extensive vertical integration is generally attractive when input volumes are high because high values allow task specialization and greater efficiency.

- It is also attractive if the firm has the relevant skills and views the processes into which it is integrity as particularly important to its future success.

✦ **Resource Flexibility**

Resource Flexibility is the ease with which employees and equipment can handle a wide variety of products, output levels, duties, and functions. The choice that management makes concerning competitive priorities determine the degree of flexibility required a company's resources- its employees, facilities and equipment.

● **Work Force**

Operations manager must decide whether to have a flexible work force. Members of a flexible work force are capable of doing many tasks, either at their own workstations or as they move one workstation to another. The type of work force required depends on the need for volume flexibility. When conditions allows for a smooth, steady rate of outputs, the likely choice is a permanent work force that expects regular full time employment. If the process is subject to hourly, daily, or seasonal peaks and valleys in demand, the use of part-time or temporary employees to supplement a smaller core of full-time employees may be the best solution. However, this approach may not be practical if knowledge and skill requirements are too high for a temporary worker to group quickly.

● **Equipment**

When a firm's product or service has a short life cycle and a high degree of customization, low production volumes mean that a firm should select flexible, general-purpose equipment.

✦ **Customer Involvement**

The fourth significant process decision is the extent to which customers interact with the process. Customer Involvement reflects the ways in which customers become part of the production process and the extent to their participation. The amount of customer involvement may range from self-service to customization of product to deciding the time and place that the service is to be provided.

● **Self Service**

Self Service is the process decision of many retailers, particularly when price is a competitive priority. To save money, some customers prefer to do part of the process formerly performed by the manufacturer or dealer.

● **Product Selection**

A business that competes on customization frequently allows customers to come up with their own product specifications or even become involved in designing the product.

● **Time and Location**

When services can't be provided in the customer's absence, customers may determine the time and location that the service is to be provided. If the service is delivered to the customer, client, or patient by appointment, decisions involving the location become part of process design.

✦ **Capital Intensity**

Capital intensity is the mix of equipment and human skills in the process; the greater the relative cost of equipment, the greater is the capital intensity. Adding capital intensity can significantly increase productivity and improve quality. One big disadvantage of capital intensity can be the prohibitive investment cost for low-volume operations.

❖ Relationship between Decisions

Each of the 5 process decisions has an underlying relationship with volume. High volume occurs when demand for a product or service is heavy, when each unit made or served requires significant work content, and when parts or tasks are standard and therefore used often. The figure below shows how process choice and the other key process decisions are tied to volume:

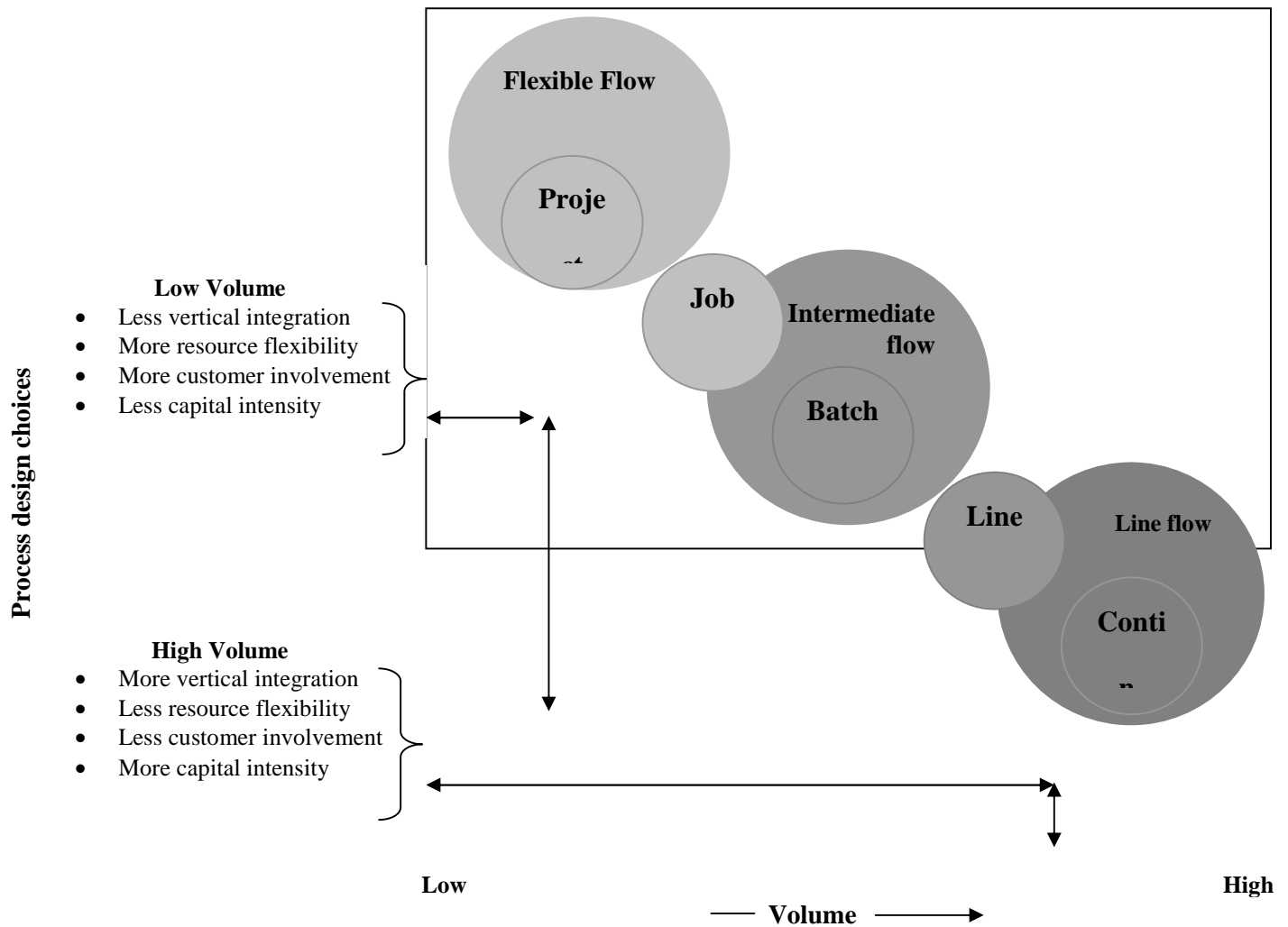


Fig:- Volume and major process decisions

The vertical arrows reflect the link between volume and the process choice, and the horizontal arrow represents the subsequent link between process choice and the other process decisions.

High volumes typically mean:

- *A line or continuous process.*
- *More vertical integration.* High volumes create more opportunities for vertical integration.
- *Less resource flexibility.* When volumes are high, there is no need for flexibility to utilize resources effectively, and specialization can lead to more efficient processes.
- *Less customer involvement.* At high volumes, firms cannot meet the unpredictable demands required by customized orders.
- *More capital intensity.* High volumes justify the large fixed costs of an efficient operation.

Low volumes typically mean:

- *A project or job process.*
- *Less vertical integration.* Low volumes eliminate most opportunities for backward or forward vertical integration.
- *More resource flexibility.* When volumes are low, as in the custom cake process, workers are trained to handle all types of customer requests.
- *More customer involvement.*
- *Less capital intensity.* The custom cake line is very labor intensive and requires little investment to equip the workers.

Chapter 4: Management Technology



The meaning and Role of Technology

Technology is defined to be the know-how, physical things, and procedures used to produce products and services. Know-how is the knowledge and judgment of how, when and why to employ equipment and procedures. Physical things are the equipment and tools. Procedures are the rules and techniques for operating the equipment and performing the work.



Primary Areas of Technology

Within an organization, technologies reflect what people are working on and what they are using to do that work. The most widespread view of technology is that of product technology, process technology, and information technology. Operations managers are interested in all three aspects of technologies.

Product technology is important because the production system must be designed to produce products and services. *Process technology* is important because it can improve the methods currently used in production system. *Information technology* is important because it can improve how information is used to operate the production system.



Product technology

Developed within the organization, **product technology** translates ideas into new products and services for the firm's customers. Primarily engineers and researchers develop product technology. Developing new product technologies requires close co-operation with marketing, to find out what customers really want, and with operations to determine how the goods or services can be produced effectively.

✦ **Process Technology**

The methods by which an organization does the things rely on the application of **process technology**. Some of the large number of process technologies used by an organization is unique to a functional area; others are used more universally.

✦ **Information Technology**

Managers use **information technology** to acquire, process, and transmit information so that they can make more effective decisions. Information technology pervades every functional area in the workplace. Nowhere is it more revolutionary than in offices, be they main offices, branch offices, back offices, front offices, sales offices, or functional area offices.



Information Technology

Information technology is crucial to operations everywhere along the supply chain and to every functional area. Computer-based information technology, in particular, has greatly influenced how operations are managed and how offices work.

✦ **Components of Information Technology**

Information technology is made up of four sub-technologies:

- ❖ Hardware
- ❖ Software
- ❖ Database, and
- ❖ Telecommunications

- **Hardware:** A computer and the devices connected to it, which can include Intel's semiconductor or Pixel Version's flat-panel computer monitors, are called

hardware. Scientists and engineers at computer and telecommunications companies and academies are the primary sources of these advances.

- **Software:** The computer programs written to make the hardware work and to carry out different application tasks are called **software**. Software is essential to many manufacturing capabilities, such as computer-aided design and manufacturing, robots, automated materials handling etc. Software also provides various executive support systems, including management information system and decision support systems.
- **Databases:** A **database** is a collection of interrelated data or information stored on a data storage device such as a computer hard drive, a floppy disk, or tape. A database can be a firm's inventory records, time standards for different kinds of processes, customer demand information.
- **Telecommunications:** The final component of information technology, which many believe might be the most important, is telecommunications. Fiber optics, telephones, modems, are their related components make electronic networks possible. Such networks, and the use of compatible software, allow computer users at one location to communicate directly with computer users at another location and can pay big dividends.

Chapter 5: Total Quality Management

Total quality management (TQM) stresses three principles: customer satisfaction, employee involvement, and continuous improvements in quality. TQM also involves benchmarking, product and service design, process design, purchasing, and problem solving tools



Quality: A Management Philosophy

The global economy of the 1990's and beyond dictates that companies provide the customer with an ever-widening array of products and services having high levels of quality.

The two competitive priorities that deal with quality are: high-performance design and consistent quality. These priorities characterize an organization's competitive thrusts. Strategic plans that recognize quality as an essential competitive priority must be based on some operational definition of quality. Some various definitions of quality are:



Customer-Driven Definition of Quality

Customers define **quality** in various ways. In general sense, quality may be defined as meeting or exceeding the expectations of the customer. For practical purposes, it is necessary to be more specific. Quality has multiple dimensions in the mind of the customer, and one or more of the following definitions may apply at any one time.

- ❑ **Conformance to Specifications:-** Customers expect the products or services they buy to meet or exceed certain advertised levels of performance. In service systems also, conformance to specifications is important, even though tangible outputs are not produced. Specifications for a service operation may relate to on-time delivery or response time.
- ❑ **Value:-** Another way customers define quality is through value, or how well the product or service serves its intended purpose at a price customers are willing to pay.

- **Fitness for Use:-** In assessing fitness for use, or how well the product or service performs its intended purpose, the customer may consider the mechanical features of a product or the convenience of a service. Other aspects of fitness for use include appearance, style, durability, reliability, and serviceability.

- **Support:-** Often the product or service support provided by the company is as important to customers as the quality of the product or service itself. Customers get upset with a company if financial statements are incorrect, responses to warranty claims are delayed, or advertising is misleading.

- **Psychological Impressions:-** People often evaluate the quality of a product or service on the basis of psychological impressions: atmosphere, image, or aesthetics. In the provision of services, where the customer is in close contact with the provider the appearance and actions of the provider are very important.

★ **Quality as a Competitive Weapon**

Attaining quality in all areas of business is a difficult task. To make the things more difficult, consumers change their perceptions of quality. For instance, changes in life-style and economic conditions have drastically altered consumer perceptions of automobile quality.

In general, a business's success depends on the accuracy of its perceptions of consumer expectations and its ability to bridge the gap between those expectations and operating capabilities. Moreover, perception plays as important a role as performance: A product or service that is perceived by customers to be of higher quality stands a much better chance of gaining market share than does one perceived to be of low quality, even if the actual levels of quality are the same. Good quality can also pay off in higher than comparable lower quality ones and yield a greater return for the same sales dollar.



Employee Involvement

One of the important elements of TQM is employee involvement. A complete program in employee involvement includes changing organizational culture, forecasting individual development through training, establishing awards and incentives, and encouraging teamwork. The three aspects of employee involvement in quality programs are:



Cultural Change

The challenge of quality management is to instill an awareness of the importance of quality in all employees and to motivate them to improve product quality. TQM involves all the functions that relate to a product or service. One of the main challenges in developing the proper culture for TQM is to define customer for each employee. In general, customers are internal and external. **External customers** are the people or firms who buy the product or service. In this sense the entire firm is a single unit that must do its best to satisfy external customers. Internal customers are employees in the firms who rely on the output of other employees. For example, a machinist who drills holes in a component and passes it on to a welder has the welder as her customer. All employees must do a good job of serving their internal customer if external customers ultimately are to be satisfied.

In TQM, everyone in the organization must share the view that quality control is an end in itself. Errors or defects should be caught and corrected at the source, not passed along to an internal customer. This philosophy is called *quality at the source*. However, in TQM, quality consistency has a higher priority than the level of output.



Individual Development

On-the-job training programs can help improve quality. Teaching new work methods to experienced workers or training new employees in current practices can increase the productivity and reduce the number of product defects. Managers too need to develop new skills- not only those directly relating to their own duties, but also those needed to teach their subordinates. Many companies are putting their managers through “train-the-trainer” programs that give managers the skills to train others in quality improvement practices.

✦ Awards and Incentives

The prospective of merit pay and bonuses can give employees some incentive for improving quality. Companies may tie monetary incentives directly to quality improvements. Non-monetary awards, such as recognition in front of co-workers, also can motivate quality improvements. Each month some companies select an employee who has demonstrated quality workmanship and give that person special recognition, such as a privileged parking spot, a dinner at a fine restaurant, or a plaque. Typically the event is reported in the company newsletter.



Continuous Improvement

Continuous improvement, based on a Japanese concept called **kaizen**, is the philosophy of continually seeking ways to improve operations. Continuous improvement involves identifying benchmarks of excellent practice and instilling a sense of employee ownership in the process. The focus can be on reducing the length of time required to process requests for loans at a bank, the amount of scrap generated at a milling machine, or the number of employee injuries at a construction site. Continuous improvement also can focus on problems with customers or suppliers, such as customer who request frequent changes in shipping quantities and suppliers that fail to maintain high quality.

✦ Getting Started with Continuous Improvement

Instilling a philosophy of continuous improvement in an organization may be a lengthy process, and several steps are essential to its eventual success.

- ❑ Train employees in the methods of statistical process control (SPC) and other tools for improving quality and performance.
- ❑ Make SPC methods a normal aspect of daily operations.
- ❑ Build work teams and employee involvement.
- ❑ Utilize problem-solving tools within the work teams.
- ❑ Develop a sense of operator ownership in the process.

Employee involvement is central to the philosophy of continuous improvements. However, the last two steps are crucial if the philosophy is to become part of everyday operations.

★ **Problem-Solving Process**

Most firms actively engaged in continuous improvement train their work teams to use the plan-to-check-act cycle for problem solving. Another name for this approach is the Deming Wheel. The cycle comprises the following steps:

- ❑ **Plan:-** The team selects a process that needs improvement. The team then documents the selected process, usually by analyzing data; sets qualitative goals for improvement; and discuss various ways to achieve the goals.
- ❑ **Do:-** The team implements the plan and monitors progress. Data are collected continuously to measure the improvements in the process. Any changes in the process are documented, and further revisions are made as needed.
- ❑ **Check:-** The team analyzes the data collected during the *do* step to find out how closely the results correspond to the goals set in the *plan* step. If major shortcomings exist, the team may have to reevaluate the plan or stop the project.
- ❑ **Act:-** If the results are successful, the team documents the revised process so that it becomes the standard procedure for all who may use it. The team then instructs other employees in use of the revised process.

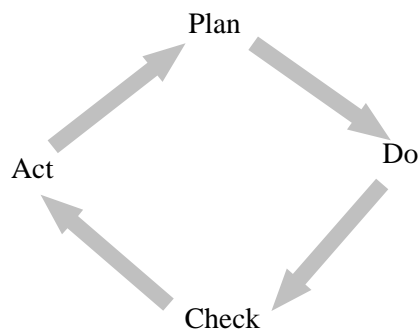


Fig:- Plan-Do-Check-Act cycle



The Costs of Poor Quality

Most experts on the costs of poor quality estimate losses in the range of 20 to 30 percent of gross sales for defective or unsatisfactory products. Four major categories of costs are associated with quality management: prevention, appraisal, internal failure, and external failure.

✦ Prevention Costs

Prevention costs are associated with preventing defects before they happen. They include the cost of redesigning the process to remove the causes of poor quality, redesigning the product to make it simpler to produce, training employees in the methods of continuous improvement, and working with suppliers to increase the quality of purchased items or contracted services.

✦ Appraisal Cost

Appraisal costs are incurred in assessing the level of quality attained by the operating system. Appraisal helps management identify quality problems.

✦ Internal Failure Costs

Internal failure costs result from defects that are discovered during the production of a product or service. They fall into two major cost categories: **yield losses**, which are incurred if a defective item must be scrapped, and **rework cost**, which are incurred if the item is rerouted to some previous operation to correct the defect or if the service must be performed again. The additional time spent correcting such a mistake results in lower productivity for the sanding and painting departments.

✦ External Failure Costs

External failure costs arise when a defect is discovered after the customer has received the product or service. External failure costs also include warranty service and litigation costs. A warranty is a written guarantee that the producer will replace or repair defective parts or perform the service to the customer's satisfaction. Usually, the warranty is given for a specific

period of time. Encountering defects and correcting them after the product is in the customer hands is costly. Defective products can injure and even kill consumers who purchase them.

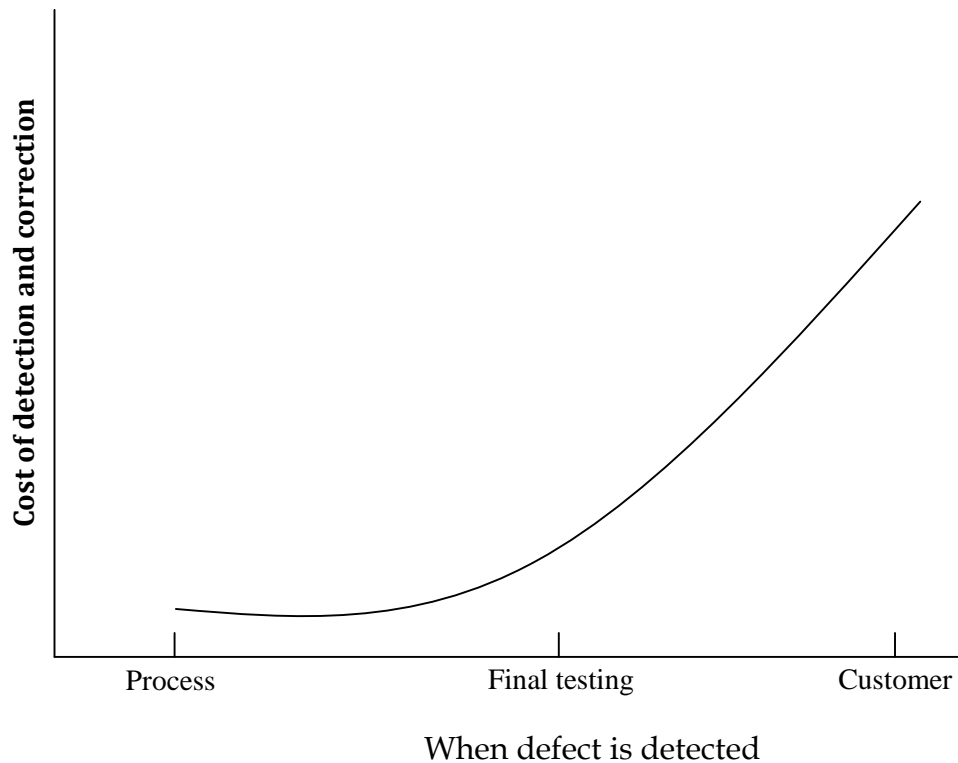


Fig:- The cost of Detecting and Fixing a Defect



Improving Quality through TQM

Programs of employee involvement and continuous improvement are aimed at improving quality in a general sense. However, TQM often focuses on benchmarking, product and service design, process design, and purchasing.



Benchmarking

Benchmarking is a continuous, systematic procedure that measures a firm's products, services, and processes against those of industry leaders. Companies use benchmarking to understand better how outstanding companies do things so that they can improve their own operations. Typically measures used in benchmarking include cost per unit, service upsets per customer, processing time per unit, customer retention rates, revenue per unit,

return on investment, and customer satisfaction levels. Benchmarking consists of four basic steps:

- **Planning:-** Identify the product, service, or process to be benchmarked and the firms to be used for comparison, determine the measure of performance for analysis, and collect the data.
- **Analysis:-** Determine the gap between the firm's current performance and that of the benchmark firms and identify the causes of significant gaps.
- **Integration:-** Establish goals and obtain the support of managers who must provide the resources for accomplishing the goals.
- **Action:-** Develop cross-functional teams of those most affected by the changes, develop action plans and team assignments, implement the plans, monitor progress, and recalibrate benchmarks as improvements are made.

The benchmarking is similar to the plan-do-check-act cycle in continuous improvement, but benchmarking focuses on setting quantitative goals for continuous improvement.

✦ **Product and Service Design**

Because design changes often require changes in methods, material, or specifications, they can increase defect rates. Stable designs may not be possible when a product or service is sold in markets globally. If a firm needs to make design changes to remain competitive, it should carefully test new designs and redesign the product or service and/or the process with a focus on the market.

Another dimension of quality related to product design is **reliability**, which refers to the probability that the product will be functional when used. Sometimes product can be designed with extra components so that if one component fails another can be activated.

✦ **Process Design**

The design of the process used to produce a product or service greatly affects in quality. One of the keys to obtaining high quality is concurrent engineering, in which operations managers and designers work closely together in the initial phases of product or service design to ensure that production requirements and process capabilities are synchronized. The result is better quality and shorter development time.

✦ **Quality Function Deployment**

Quality function deployment (QFD) is a means of translating customer requirements into the appropriate technical requirements for each stage of product or service development and production. This approach seeks to answers to the following six questions:

- ❑ *Voice of customer.* What do our customers need and want?
- ❑ *Competitive analysis.* In terms of our customers, how well are we doing relative to our competition?
- ❑ *Voice of the engineer.* What technical measures relate to our customer needs?
- ❑ *Correlations.* What are the relationships between the voice of the customer and the voice of the engineer?
- ❑ *Technical comparison.* How does our product or service performance compare to that of our competition?
- ❑ *Trade-offs.* What are the potential technical trades-offs?

A QFD approach provides a way to set targets and debate their effects on product quality. QFD encourages inter-functional communication for the purpose of improving the quality of products and services.

✦ **Purchasing Considerations**

Most businesses depend on outside suppliers for some of the materials, services, or equipment used in producing their products and services. Large companies have hundreds and even thousands of suppliers, some of which supply same types of parts. The quality of these inputs can affect the quality of the firm's work, and purchased parts of poor quality can have a devastating effect.

The specifications for purchased parts and materials must be clear and realistic. As a check on specifications, buyers in some companies initiate process capability studies for important products. Management needs a sufficient time for purchasing department to identify several low-cost, qualified suppliers and to analyze the information they submit. An unrealistic deadline can lead to poor selection based on incomplete information about supplier qualifications.

Chapter 6: Capacity

Capacity is the maximum rate of output for a process. The operations manager must provide the capacity to meet current and future demand; otherwise, the organization will miss opportunities for growth and profits.

Capacity plans are made at two levels, long-term capacity plans: deals with investments in new facilities and equipment. These plans covers at least 2 years into the future, but construction lead times alone can force much longer time horizons. Short-term capacity plans focus on workforce size, overtime budgets, inventories, and other types of decisions.

Some terminologies:

- ❑ **Peak capacity**:- The maximum output that a process or facility can achieve under ideal conditions is called peak capacity. It can be sustained for only a short time, such as a few hours in a day or a few days in a month.
- ❑ **Effective capacity**:- The maximum output that a process or firm can economically sustain under normal conditions is its effective capacity.
- ❑ **Rated capacity**:- When capacity is measured relative to equipment alone, the appropriate measure is rated capacity: an engineering assessment of maximum annual output, assuming continuous operation except for an allowance for normal maintenance and repair downtime.

Capacity planning:

Capacity planning is central to the long-term success of an organization. When choosing a capacity strategy, managers have to consider questions such as following:

- ❑ How much of a cushion is needed to handle variable, uncertain demand?
- ❑ Should we expand capacity before the demand is there or wait until demand is more certain?

A systematic approach is needed to answer these and similar questions and to develop a capacity strategy appropriate for each situation.

- 1) **Estimate Capacity Requirements:-** For estimating long-term capacity needs is forecasts of demand, productivity, competition, and technological changes that extend well into the future. The farther ahead we look, the more chance we have of making an inaccurate forecast.
- 2) **Identify Capacity Gaps:-** A capacity gap is any difference (positive or negative) between projected demand and current capacity. Identifying gaps requires use of the correct capacity measure.
- 3) **Develop Alternatives:-** The next step is to develop alternative plans to cope with projected gaps. One alternative, called the base case is to do nothing and simply lose orders from any demand that exceeds capacity.
- 4) **Evaluate the Alternatives:-** In this final step, the manager evaluates each alternative, both *quantitatively* and *qualitatively*.
 - a) **Qualitative concerns:-** Qualitatively, the manager has to look at how each alternative fits the overall capacity strategy and other aspects of the business not covered by the financial analysis. Some factors cannot be quantified, and have to be assessed on the basis of judgment and experience. " what if " analysis allows the manager to get an idea of each alternative's implications before making a final choice.
 - b) **Quantitative concerns:-** Quantitatively, the manager estimates the change in cash flows for each alternative over the forecast time horizon compared to the base case. Cash flow is the difference between the flows of funds into and out of an organization over a period of time, including revenues, costs, and changes in assets and

liabilities. The manager is concerned here only with calculating the cash flows attributable to the project.

Economies of Scale

Historically, organizations have accepted a concept known as economies of scale, which states that the average unit cost of a goods and services can be reduced by increasing its output rate. There are 4 principal reasons why economies of scale can drive costs down when output increases: fixed costs are spread over more units, construction costs are reduced, costs of purchased materials are cut, and process advantages are found.

- ❑ **Spreading fixed costs:** - In short-term, certain costs do not vary with changes in the output rate. These fixed costs include heating costs, debt services, and management salaries. As increments of capacity often are rather large, a firm initially might have to buy more capacity than it needs. However, demand increases in subsequent years can then be absorbed without additional fixed costs.
- ❑ **Reducing construction cost:** - Certain activities and expenses are required in building small and large facilities alike: building permits, architects' fees, rental of building equipment. Doubling the size of the facility usually does not double construction costs. The construction cost of equipment or a facility often increases relative to its surface area, whereas its capacity increases in proportion to its cubic volume.
- ❑ **Cutting costs of purchased materials:** - Higher volumes can reduce the costs of purchased materials and services. They give the purchaser a better bargaining position and the opportunity to take advantage of quantity discounts.
- ❑ **Finding process advantage:** - High-volume production provides many opportunities for cost reduction. At a higher output rate, the process shifts towards a line process, with resources dedicated to individual's products. The benefits from dedicating resources to individual products or services may include speeding up the learning effect, lowering inventory, improving process and job designs, and reducing the number of changeover.

Chapter 7: Location



Factors Affecting Location Decisions

Facility location is the process of determining a geographic site for a firm's operations. Managers of both service and manufacturing organizations must weigh many factors when assessing the desirability of a particular site, including proximity to customers and suppliers, labor costs, and transportation costs. Managers can disregard factors that fail to meet at least one of the following two conditions:

- The factor must be sensitive to location. That is, managers shouldn't consider a factor that isn't affected by the location decision. For example, if community attitudes are uniformly good at all the locations under consideration, community attitudes shouldn't be considered as a factor.
- The factor must have a high impact on the company's ability to meet its goals. For example, although different locations will be at different distances from suppliers, if shipments and communication can take place by overnight delivery, faxing, and other means, distance to suppliers shouldn't be considered as a factor.

Managers can divide location factors into dominant and secondary factors. Dominant factors are those derived from competitive priorities (cost, quality, time and flexibility) and have a particularly strong impact on sales or costs. Secondary factors are also important, but management may downplay or even ignore some of them if other factors also are important.



Dominant factors in Manufacturing:

Six groups of factors dominate location decisions for few manufacturing plants. They are:

- **Favorable labor climate:** A favorable labor climate may be the most important factor in location decisions for labor-intensive firms in industries such as textiles, furniture, and consumer electronics. Labor climate is a function of wage rates, training requirements, attitudes toward work, worker productivity, and union strength.

- ❑ **Proximity to Markets:** After determining where the demand for goods and services is greatest, management must select a location for the facility that will supply that demand. Locating near markets is particularly important when the final goods are bulky or heavy and outbound transportation rates are high.
- ❑ **Quality of Life:** Good schools, recreational facilities, cultural events, and an attractive life-style contribute to quality of life. This factor is relatively unimportant on its own, but it can make the difference in location decisions.
- ❑ **Proximity to Suppliers and Resources:** Firms dependent on inputs of bulky, perishable, or heavy raw materials emphasize proximity to suppliers and resources. In such cases inbound transportation costs become a dominant factor, encouraging such firms to locate facilities near suppliers.
- ❑ **Proximity to the Parent Company's Facilities:** In many companies, plants supply parts to other facilities or rely on other facilities for management and staff support. These ties require frequent coordination and communication, which can become more difficult as distance increases.
- ❑ **Utilities, Taxes, and Real Estate Costs :** Other important factors that may emerge include utility costs (telephone, energy, and water), local and state taxes, financing incentives offered by local or state governments, relocation costs, and land costs.

★ **Reasons for Globalization**

Four developments have spurred the trend toward globalization: improved transportation and communication technologies, loosened regulations on financial instruction, increased demand for imported goods, and lowered international trade barriers.

- ❑ **Improved Transportation & communication technologies:** Improvements in communications technology and transportation are breaking down the barriers of time and space between countries. Telecommunications (voice and data) technology- including electronic mail, Internet allows facilities to serve larger market areas and allows firms to centralize some operations and provide support to branches located near their customers.
- ❑ **Opened Financial Systems:** The world's financial systems have become more open, making it easier for firms to locate where capital, supplies, and resources are cheapest.
- ❑ **Increased Demand for Imports:** Import penetration of the major economies is increasing, as political barriers to international trade have crumbled. Penetration has been increased by locating production facilities in foreign countries because a local presence reduces customer aversion to buying imports.
- ❑ **Reduced Import Quotas and Other Trade Barriers:** Producing goods or service in the country where the customers live also circumvents import quotas and other trade barriers. Japanese markets also are far more open to foreign entrants than in the past, creating an explosion of partnership opportunities that were unthinkable just 5 years ago.

✦ **Disadvantages of Globalization**

The disadvantages of globalization are listed below:

- ❑ A firm may have to relinquish proprietary technology if it turns over some of its component manufacturing to offshore suppliers or if suppliers need the firm's technology to achieve desired quantity and cost goals.
- ❑ There may be political risks. Each nation can exercise its sovereignty over the people and property within its borders. The extreme case is nationalization, in which a government may take over a firm's assets without paying compensation.

- Employee skills may be lower in foreign countries, requiring additional training time.
- When a firm's operation are scattered, customer response times can be longer. Effective cross-functional connections also may be more difficult if face-to-face discussions are needed.

Chapter 8: Layout



What is Layout Planning?

Layout planning involves decisions about the physical arrangement of economic activity centers within a facility. The goal of layout planning is to allow workers and equipment to operate more effectively. Before manager can make decisions regarding physical arrangement, four questions must be addressed. They are:

- ❑ **What centers should the layout include?** Centers should reflect process decisions and maximize productivity. For example, a central storage area for tools of tools is most efficient for certain processes, but keeping tools at individual workstations makes more sense for other processes.
- ❑ **How much space and capacity does each center need?** Inadequate space can reduce productivity, deprive employees of privacy, and even create health and safety hazards.
- ❑ **How should each center's space be configured?** The amount of space, its shape, and the elements in a center are interrelated. Providing a pleasing atmosphere also should be considered as part of the layout configuration decisions, especially in retail outlets and offices.
- ❑ **Where should each center be located?** Location can significantly affect productivity. For example, employee who must frequently interact with one another face to face should be placed in central location rather than in separate, remote locations to reduce time lost traveling back and forth.



Layout Types

The choice of layout type depends largely on the firm's flow strategy. There are four basic types of layout:

✦ Process Layout:

- ❑ With a flexible flow strategy, which is best for low-volume, high variety production, the operations manager must organize resources (employees and equipment) around the process.
- ❑ A process layout, which groups workstations or departments according to function, accomplishes this purpose.
- ❑ Is most common when the same operation must intermittently produce many different products or serve many customers.
- ❑ Demand levels are too low or unpredictable for management to set aside human and capital resources exclusively for a particular product line or type of customer.

➡ Advantages of process layout over product layout are:

- ❑ Resources are relatively general purpose and less capital intensive.
- ❑ Is less vulnerable to changes in product mix or new marketing strategies and is therefore more flexible.
- ❑ Equipment utilization is higher.
- ❑ Employee supervision can be more specialized, an important factor when job content requires a good deal of technical knowledge.

➡ Disadvantages of process layout over product layout are:

- ❑ Processing rates tend to be slower.
- ❑ Productive time is lost in changing from one product or services to another.
- ❑ More space and capital are tied up in inventory, which helps workstations to work independently despite their variable output rates.
- ❑ The time lags between job starts and end points are relatively long.
- ❑ Materials handling tends to be costly.



Product Layout:

- ❑ With a line flow strategy, which is best for repetitive or continuous production, the operations manager dedicates resources to individual products or tasks.
- ❑ This strategy is achieved by a product layout.
- ❑ Are common in high-volume types of operations.
- ❑ Often follow a straight line, a straight line isn't always best, and layouts may take an **L**, **O**, **S**, or **U** shape.
- ❑ Often is called a production line or an assembly line. The difference is that, an assembly line is limited to assembly processes, whereas a production line can be used to perform other processes such as machining.
- ❑ Often rely heavily on specialized, capital-intensive resources.

➡ Advantages of product layout over process layout are:

- ❑ Faster processing rates,
- ❑ Lower inventories, and
- ❑ Less unproductive time lost to changeovers and materials handling.

➡ Disadvantages of product layout are:

- ❑ Greater risk of layout redesign for products or services with short or uncertain lives,
- ❑ Less flexibility, and
- ❑ Low resource utilization for low-volume products or services.



Hybrid layout:

- ❑ More often, a flow strategy combines elements of both a product and a process focus.
- ❑ This intermediate flow strategy calls for a hybrid layout, in which some portions of the facility are arranged in a process layout and others are arranged in a product layout.

- ❑ Are used in facilities having both fabrication and assembly operations.
- ❑ Managers create this layout when introducing cells and flexible automation, such as a flexible manufacturing system.
- ❑ Retail store is an example of a hybrid layout in non-manufacturing setting.

✦ **Fixed-Position layout:**

- ❑ In this arrangement, the product is fixed in place; workers, along with their tools and equipment, come to the product to work on it.
- ❑ Makes sense when the product is particularly massive or difficult to move.
- ❑ Minimizes the number of times that the product must be moved and often is the only feasible solution.

Chapter: 9 Forecasting



Why is forecasting needed?

A forecast is a prediction of future events used for planning purposes. Changing business conditions resulting from global competition, rapid technological change, & increasing environmental concerns exert pressure on firm's capability to generate accurate forecasts. Forecasts are needed to aid in determining what resources are needed, scheduling existing resources, and acquiring additional resources. Managers may need forecast to anticipate changes in prices or costs or to prepare for new laws or regulations, competitors, resource storages, or technologies.

Forecasting methods may be based on mathematical models using historical data available, qualitative methods, drawing on managerial experience, or a combination of both.



Patterns of Demand

The repeated observation of demand for a product or service in their order of occurrence from a pattern is known as time series. The 5 basic patterns of most demand time series are:

- ❑ **Horizontal**, or the fluctuation of data around a constant mean,
- ❑ **Trend**, or systematic increase or decrease in the mean of the series over time,
- ❑ **Seasonal** or a repeatable pattern of increases or decreases in demand, depending on the time of day, week, month, or season.
- ❑ **Cyclic**, or less predictable gradual increases or decreases in demand over periods of time (years or decades); &
- ❑ **Random** or un-forecast able, variation in demand.



Factors Affecting Demand

What factors cause changes in the demand for a particular product or service over time? Generally, such factors can be divided into two main categories: **external** and **internal**.

External factors: External factors that affect demand for a firm's products or services are beyond management's control. A booming economy may positively influence demand,

although the effect may not be the same for all products and services. Certain government agencies and private firms compile statistics on general economic time series to help organizations predict the direction of change in demand of their products or services.

Leading indicators, such as the rate of business failures, are external factors with turning points that typically precede the peaks and troughs of the general business cycle. **Coincident indicators**, such as unemployment figures, are time series with turning points that generally match those of the general business cycle. **Lagging indicators**, such as retail sales, follow those turning points, typically by several weeks or months. Knowing that a series is a lagging indicator can be useful. For example, a firm needing a business loan for expansion should realize that interest rates will drop to a low point several weeks after the business cycle reaches its trough.

Internal factors: Internal decisions about product or service design, price and advertising promotions, packaging design, salesperson quotas or incentives, and expansion or contraction of geographic market target areas all contribute to changes in demand volume. The term **demand management** describes the process of influencing the timing and volume of demand or adapting to the undesirable effects of unchangeable demand patterns. For example, automobile manufacturers use rebates to boost car sales.

Management must carefully consider the timing of demand, an extremely important factor in efficiently utilizing resources and production capacity. Trying to produce for peak customer demand during the peak demand period can be very costly. To avoid this situation, firms often use price incentives or advertising promotions to encourage customers to make purchases before or after traditional times of peak demand.

Finally, some companies schedule delivery dates for products or services according to the current workload and capacity.

✚ Judgment Methods

When adequate historical data are lacking, as when a new product is introduced or technology is expected to change, firms rely on managerial judgment and experience to generate forecasts. Judgment methods can also be used to modify forecasts generated by quantitative methods. The four successful methods currently in use are:

✦ Sales Force Estimates

Sometimes the best information about future demand comes from the people closer to the customer. Sales force estimates are forecasts compiled from estimates of future demands made periodically by members of a company's sales force.

This approach has several advantages:

- ❑ The sales force is the group most likely to know which products or services customers will be buying in the near future, and in what quantities.
- ❑ Sales territories often are divided by district or region. Information broken down in this manner can be useful for inventory management, distribution, and sales force staffing purposes.
- ❑ The forecasts of individual sales force members can be combined easily to get regional or national sales.

The disadvantages are:

- ❑ Individual biases of the salesperson may taint the forecast; moreover, some people are naturally optimistic, others more cautious.
- ❑ Salesperson may not always be able to detect the difference between what a customer "wants" and what a customer "needs".
- ❑ If the firm uses individual sales as a performance measure, salesperson may underestimate their forecasts so that their performance will look good when they exceed their projections or may work hard only until they reach their projections or may work hard only until they reach their required minimum sales.

✦ **Executive Opinion**

When a new product or service is contemplated, the sales force may be able to make accurate demand estimates. Executive opinion is a forecasting method in which the opinions, experience, & technical knowledge of one or more managers are summarized to arrive at a single forecast. Executive opinion can also be used for technological forecasting. The quick pace of technological change makes keeping abreast of the latest advances difficult.

This method of forecasting has several disadvantages:

- ❑ Is costly, because it takes valuable executive time.
- ❑ If executives are allowed to modify a forecast without collectively agreeing to the changes, the resulting forecast will not be useful.

The key to effective use of executive opinion is to ensure that the forecast reflects not a series of independent modifications but consensus among executives on a single forecast.

✦ **Market Research**

Market research is a systematic approach to determine consumer interest in a product or service by creating and testing hypotheses through data-gathering surveys. Conducting a market research study includes:

1. Designing a questionnaire that requests economic and demographic information from each person interviewed and asks whether the interviewee would be interested in the product or services.
2. Deciding how to administer the survey, whether by telephone polling, mailings, or personal interviews.
3. Selecting a representative sample of households to survey, which should include a random selection within the market area of the proposed product or service; and
4. Analyzing the information using the judgment and statistical tools to interpret the responses, determine their adequacy, make allowance for economic or competitive

factors not included in the questionnaire, and analyze whether the survey represents a random sample of the potential market.

Market research may be used to forecast demand for the short, medium, and long term. Although market research yields important information, one shortcoming is the numerous qualifications and hedges typically included in the findings.

✦ **Delphi Method**

The Delphi method is a process of gaining consensus from a group of experts while maintaining their anonymity. This form of forecasting is useful when there are no historical data from which to develop statistical models and when managers inside the firm have no experience on which to base informed projections. Anonymity is important when some members of the group tend to dominate discussion or command a high degree of respect in their fields.

The Delphi method can be used to develop long-range forecasts of product demand and new products sales projections. It can be used to obtain a consensus from a panel of experts who can devote their attention to following scientific advances, governmental regulations, and the competitive environment.

The Delphi method has some shortcomings, including the following major ones:

- ❑ The process can take a long (sometimes a year or more). During that time the panel of people considered to be experts may change, confounding the results or at least further lengthening the process.
- ❑ Responses may be less meaningful than if experts were accountable for their responses.
- ❑ There is little evidence that Delphi forecasts achieve high degrees of accuracy. However, they are known to be fair good in identifying turning points in new product demand.
- ❑ Poorly designed questionnaires will result in ambiguous or false conclusions.

★ Causal Methods: Linear Regression

Causal methods are used when historical data are available and the relationship between the factor to be forecasted and other external or internal factors can be identified. Casual methods provide the most sophisticated forecasting tools and are very good for predicting turning points in demand and preparing long-range forecasts.

In linear regression, one variable, called a dependent variable, is related to one or more independent variables by linear equation. In simplest linear regression models, the dependent variable is a function of only one dependent variable, and therefore the theoretical relationship is a straight line:

$$Y = a + bX$$

Where

- Y** = dependent variable
- X** = independent variable
- a** = Y-intercept of the line
- b** = slope of the line

The objective of linear regression analysis is to find values of *a* and *b* that minimize the sum of the squared deviations of the actual data points from the graphed line. Two measures commonly reported are the sample correlation coefficient and the sample coefficient of determination.

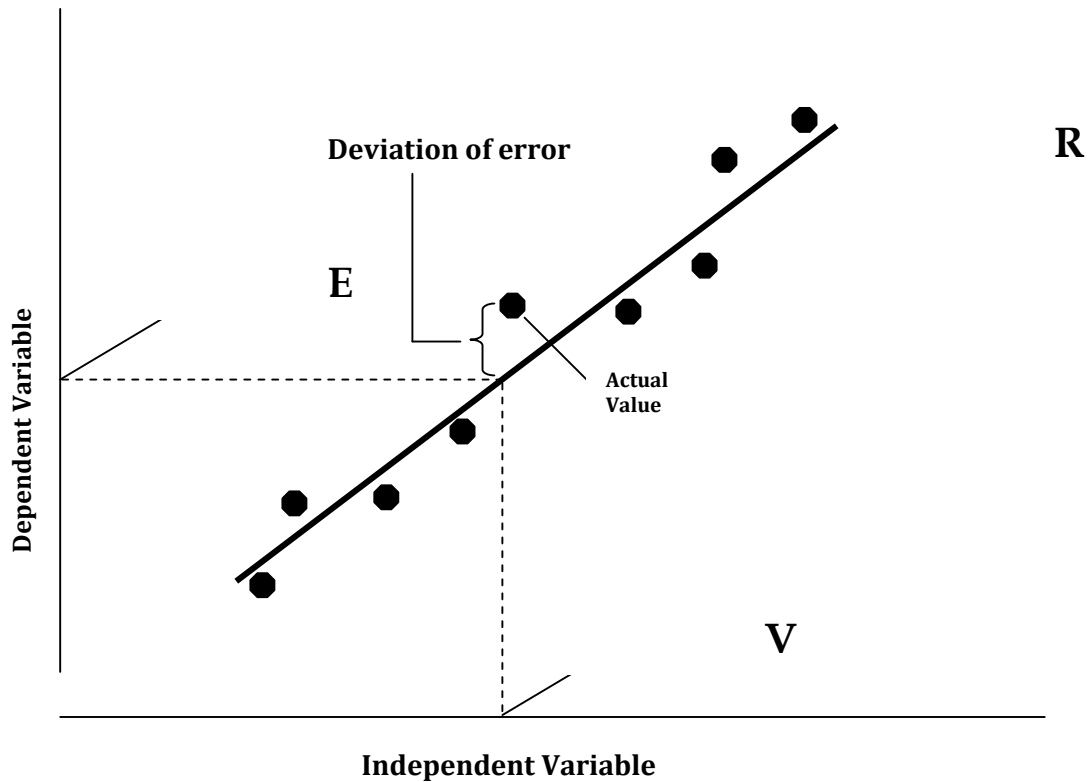


Fig:- Linear Regression Line Relative to Actual Data

✦ Time Series Method

Rather than using independent variables for the forecast as regression modules do, time series methods use historical information regarding only dependent variable. These methods are based on assumption that the dependent variables past pattern will continue in the future. Time series analysis identifies the underlying patterns of demand that combine to produce an observed historical pattern of the dependent variable and then develops a model to replace it. The simplest time series method for addressing all patterns of demand is the naive forecast.

Naive forecast:- A method often used in practice is the naive forecast, whereby the forecast for the next period equals the demand for the current period. The naive forecast method may take into account a demand trend. This increase (or decrease)

in demand observed between the last two periods is used to adjust the current demand to arrive at a forecast.

The advantages of the naïve forecast method is:

- ❑ Simple and low cost.
- ❑ Best when horizontal, trend, or seasonal patterns are stable and random variation is small.
- ❑ Level of accuracy is acceptable.

Chapter 10: Material Requirement Planning

✚ Benefits of Material Requirement Planning

Material requirement planning (MRP)- a computerized information system- was developed specially to aid in managing dependent demand inventory and scheduling replenishment orders. The MRP system enables businesses to reduce inventory levels, utilize labor and facilities better, and improve customer service.

The three advantages of Material requirement planning are:

- ❑ Statistical forecasting for components with lumpy demand results in large forecasting errors. MRP calculates the dependent demand of components from the production schedules of their parents, thereby providing a better forecast of component requirements.
- ❑ MRP systems provide managers with information useful for planning capacities and estimating financial requirements. Planners can use the information on parent item schedules to identify times when needed components may be unavailable because of capacity shortages, supplier delivery delays, and the like.
- ❑ MRP systems automatically update the dependent demand and inventory replenishment schedules of components when the production schedules of parent item change. The MRP system alerts the planners whenever action is needed on any component.

✚ Inputs to Material Requirement Planning

The key inputs of MRP system are bill of materials database, master production schedules, and an inventory record database. Using this information, the MRP system identifies actions that operations must take to stay on schedule, such as releasing new production orders, adjusting order quantities, and expediting later orders.

An MRP system translates the master production schedule and other sources of demand, such as independent demand for replacement parts and maintenance items, into the

requirements for all subassemblies, components, and raw materials needed to produce the required parent items. This process is called an MRP explosion because it converts the requirements of various final products into a material requirements plan that specifies the replacement schedules of all the subassemblies, components, and raw materials needed by the final products.

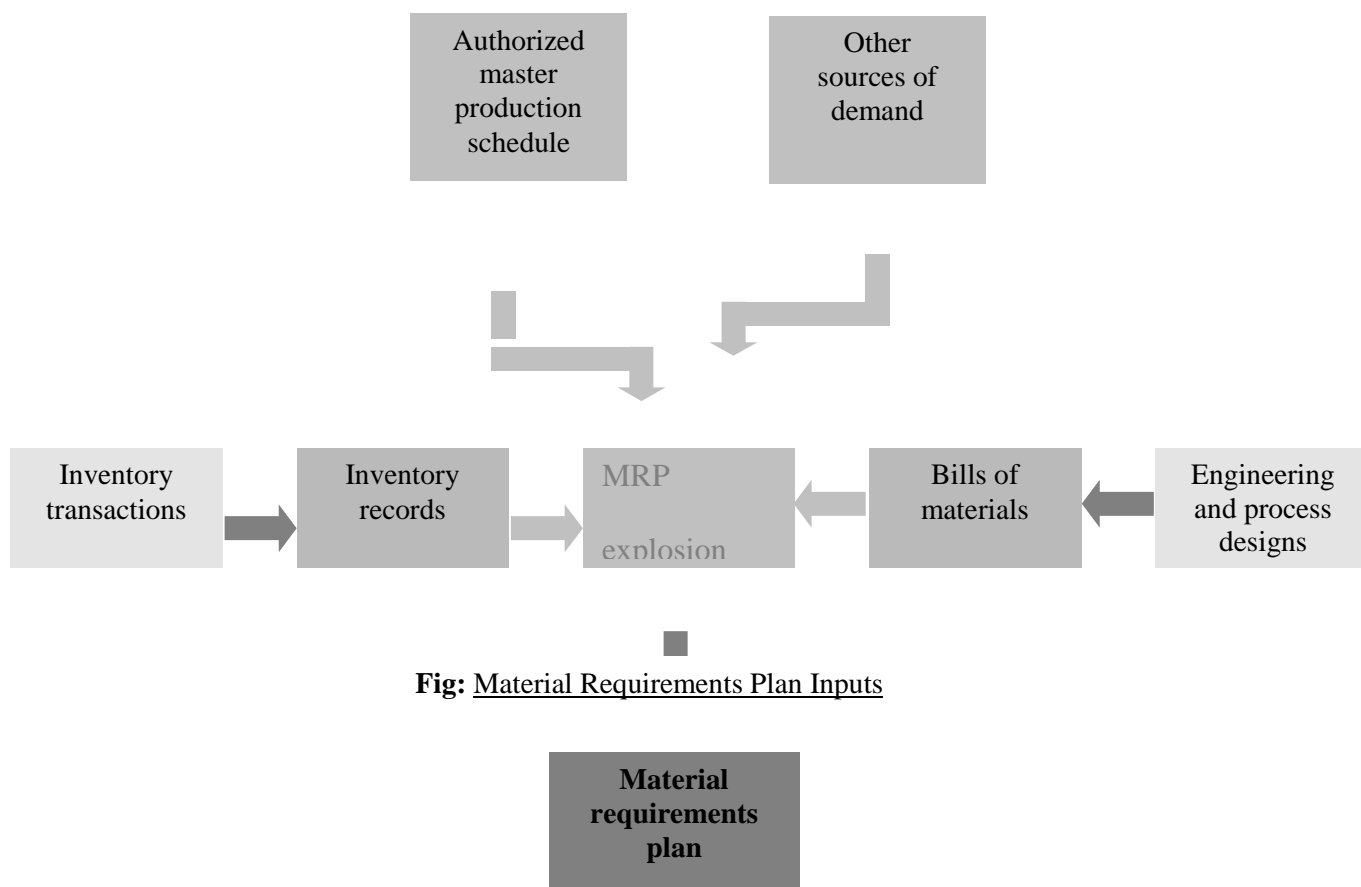


Fig: Material Requirements Plan Inputs

✦ **Bills of Materials**

The replenishment schedule for a component is determined from the production schedules of its parents. Hence the system needs accurate information on parent-component relationship. A bill of materials (BOM) is a record of all the components of an item, the parent-component relationships, and usage quantities derived from engineering and process designs. A component may have more than one parent. **Part commonality**, sometimes called *standardization of parts* or *modularity*, is the degree to which a

component has more than one immediate parent. As a result of commonality, the same item may appear in the bills of materials for several different products.

✦ **Master Production Schedule**

The second input into a material requirement plan is the master production schedule (MPS), which details how many end items will be produced within specified period of time. It breaks the aggregate production plan into specific product schedules. The **figure** below shows how an aggregate plan for a family of chairs breaks down into the weekly master production schedule for each specific chair type (the time period can be hours, day, weeks, or month). The chair example demonstrates the following aspects of master scheduling.

- The sums of the quantity in the MPS must equal those in the aggregate production plan. The consistency between the plans is desirable because of the economic analysis done to arrive at the aggregate plan.
- The aggregate production quantities must be allocated efficiently over time. The specific mix of chair types- the amount of each type as a percentage of the total aggregate quantity- is based on historic demand and marketing and promotional conditions. The planner must select lot sizes for each chair type, taking into consideration economic factors such as production setup costs and inventory carrying costs.
- Capacity limitations, such as machine or labor capacity, storage space, or working capital, may determine the timing and size of MPS quantities.

The MPS start quantities are used in the MRP system to determine the components needed to support the schedule.

	April				May			
	1	2	3	4	5	6	7	8
Ladder-back chair	150					150		
Kitchen chair				120			120	
Desk chair		200	200		200			200
Aggregate production plan for chair family	670				670			

Fig: Master Production for a Family of Chairs

✦ Inventory Record

Inventory records are the final input for MRP, and the basic building blocks of up-to-date records are inventory transactions. Transactions include releasing new orders, receiving scheduled receipts, adjusting due dates for scheduled receipts, withdrawing inventory, canceling orders, correcting inventory errors etc. Recording such transactions is essential for maintaining the accurate records of on-hand inventory balances and scheduled receipts necessary for an effective MRP system.

The inventory record divides the future into time periods called time buckets.

The purpose of the inventory record is to keep track of inventory levels and component replenishment needs. The time-phased information contained in the inventory record consists of:

1. gross requirements,
2. scheduled receipts,
3. projected on-hand inventory,
4. planned receipts, and
5. Planned order releases.

- ❑ **Gross requirements:-** The gross requirements are the total demand derived from all parent production plans. They also include demand not otherwise accounted for, such as demand for replacement parts for units already sold.

- ❑ **Scheduled receipts:-** Recall that scheduled receipts are orders that have been placed but not yet completed. For a purchased item, the scheduled receipt could be in one of several stages: being processed by a supplier, being transported to purchaser, or being inspected by the purchaser's receiving department.

- ❑ **Projected On-Hand Inventory:-** The projected on-hand inventory is an estimate of the amount of inventory available each week after gross requirements have been satisfied. As with scheduled receipts, entries are made for each actual withdrawal and receipt to update the MRP database.

Contd. ...

Item: c	Lot size: 230							
units								
Description: Seat subassembly	lead time: 2							
weeks								
	<u>Week</u>							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	-3	-3	-153	-273	-273
Planned receipts								
Planned order releases								

$$\left(\text{Projected on-hand inventory balance at end of week } t \right) = \left(\text{inventory on hand at end of week } t-1 \right) + \left(\text{Scheduled or planned receipts in week } t-1 \right) - \left(\text{Gross requirements in week } t \right)$$

Week 1: $37 + 230 - 150 = 117$
 Week 2 and 3: $117 + 0 - 0 = 117$
 Week 4: $117 + 0 - 120 = -3$
 Week 5: $-3 + 0 - 0 = -3$
 Week 6: $-3 + 0 - 150 = -153$
 Week 7: $-153 + 0 - 120 = -273$
 Week 8: $-273 + 0 - 0 = -273$

- **Planned Receipts:-** Planning for receipt of new orders will keep the projected on-hand balance from dropping below zero. The planned receipt row is developed as follows:
 1. Weekly on-hand inventory is projected until a shortage appears. The addition of the newly planned receipt should raise the projected on-hand balance so that it equals or exceeds zero.
 2. Projection of on-hand inventory continues until the next shortage occurs. This shortage signals the need for the need for the second planned receipt.

This process is repeated until the end of the planning horizon by proceeding column by column through the MRP record- filling in planned receipts as needed and completing the projected on-hand inventory row.

- **Planned Order Releases:-** A planned order release indicates when an order for a specified quantity of an item is to be issued. We must place the planned order release quantity in the proper time bucket.

Contd. ...

Item: c	Lot size: 230							
units								
Description: Seat subassembly	lead time: 2							
weeks								
	<u>Week</u>							
	1	2	3	4	5	6	7	8
Gross requirements	150	0	0	120	0	150	120	0
Scheduled receipts	230	0	0	0	0	0	0	0
Projected on-hand inventory 37	117	117	117	227	227	77	187	187
Planned receipts				230			230	
Planned order releases		230			230			



Planning Factors

The planning factors in an MRP record play an important role in the overall performance of the MRP system. By manipulating these factors, managers can fine-tune inventory operations. Planning factors are:



Planning Lead Time

Planning lead time is an estimate of the time between placing an order for an item and receiving it in inventory. Accuracy is important in planning lead time. If an item arrives in

inventory sooner than needed, inventory cost increase. If an item arrives too late, stock-outs, excessive expediting costs, or both occur.

For purchased items, the planning lead time is the time allowed for receiving a shipment from the supplier after the order has been sent, including the normal time to place the order. For items manufactured in-house, the planning lead time consists of estimates for

- ❑ Setup time,
- ❑ Process time,
- ❑ Materials handling time between operations, and
- ❑ Waiting time.

✦ ***Lot-Sizing Rules***

A lot-sizing rule determines the timing and size of order quantities. A lot-sizing rule must be assigned to each time before planned receipts and planned order releases can be computed. The choice of lot-sizing rules is important because they determine the number of setups required and recovery holding costs for each time.

✦ ***Fixed Order Quantity***

The fixed order quantity (FOQ) rule maintains the same order quantity each time an order is issued. For example, the lot size might be the size dedicated by equipment capacity limits, as when a full lot must be loaded into a furnace at one time. For purchased items the FOQ could be determined by the quantity discount level, truckload capacity, or minimum purchase quantity. FOQ might be insufficient to avoid shortage. In such unusual cases, the inventory planner must increase the lot size beyond the FOQ, typically to a size large enough to avoid a shortage.

✦ ***Periodic Order Quantity***

The periodic order quantity (POQ) rule allows a different order quantity for each order issued but tends to issue the order at predetermined time interval such as every two weeks. The order quantity equals the amount of the item needed during the predetermined time between orders and must be large enough to prevent shortages.

The POQ rule does not mean that operations must issue a new order every P weeks. Rather, when an order is planned, its lot size must be enough to cover P successive weeks.

✦ **Safety Stock**

An important managerial issue is the quantity of safety stock to require. It is more complex for dependent demand items than for independent demand items. Safety stock for dependent demand items with lumpy demand is valuable only when future gross requirements, the timing or size of scheduled receipts, and the amount of scrap are uncertain. Safety stock should be reduced and ultimately removed as the causes of the uncertainty are eliminated.

✦ **Outputs from Material Requirement Planning**

Material Requirement Planning systems provide many reports, schedules, and notices to help managers control dependent demand inventories. The outputs of MRP systems are:

✦ **Material Requirement Planning Explosion**

MRP translates, or explodes, the master production schedule and other sources of demand into the requirements for all subassemblies, components, and raw materials needed to produce parent items. This process generates the material requirement plan for each component parts. An item's gross requirements are derived from three sources.

1. the MPS for immediate parents that are end items,
2. the planned order releases for parents below the MPS level, and
3. Any other requirements not originating in the MPS, such as the demand for replacement parts.

★ Action Notices

Once computed, inventory records for each item appearing in the bills of materials can be printed in hard copy or displayed on a computer video screen. Inventory planners use a computer-generated memo called an action notice to make decisions about releasing new orders and adjusting the due dates of scheduled receipts. An action list can simply be a list of parts numbers for items needing attention. Or it can be the full record for such items, with a note at the bottom identifying the action needed.

- **Releasing New Orders:-** If there is a nonzero quantity in the first week's entry of the planned order release row, sometimes called the action bucket, the computer issues an action notice. An order in the action bucket is the call to release the planned order.
- **Adjusting Due Dates of Scheduled Receipts:-** If subtracting the scheduled receipt from the projected on-hand inventory for the week in which it is due doesn't cause a shortage, the scheduled receipt is arriving too early. In this case, the inventory planner can delay the scheduled receipt. If the projected on-hand balance for the week prior to the arrival of the scheduled receipt is arriving too late. In this case, the planner should expedite the arrival of the scheduled receipt.
- **Making Decisions:-** Although the computer generates action notices, decisions based on them are made by the inventory planner. The planner reviews the item's complete MRP inventory record, along with those components. When releasing a new order, the planner can also prepare documentation for tool requisition, routings, or parts lists.

★ Capacity Reports

By itself, the MRP system doesn't recognize capacity limitations when computing planned orders. An essential role of managers is to monitor the capacity requirements of material requirements plans, adjusting a plan when it can't be met.

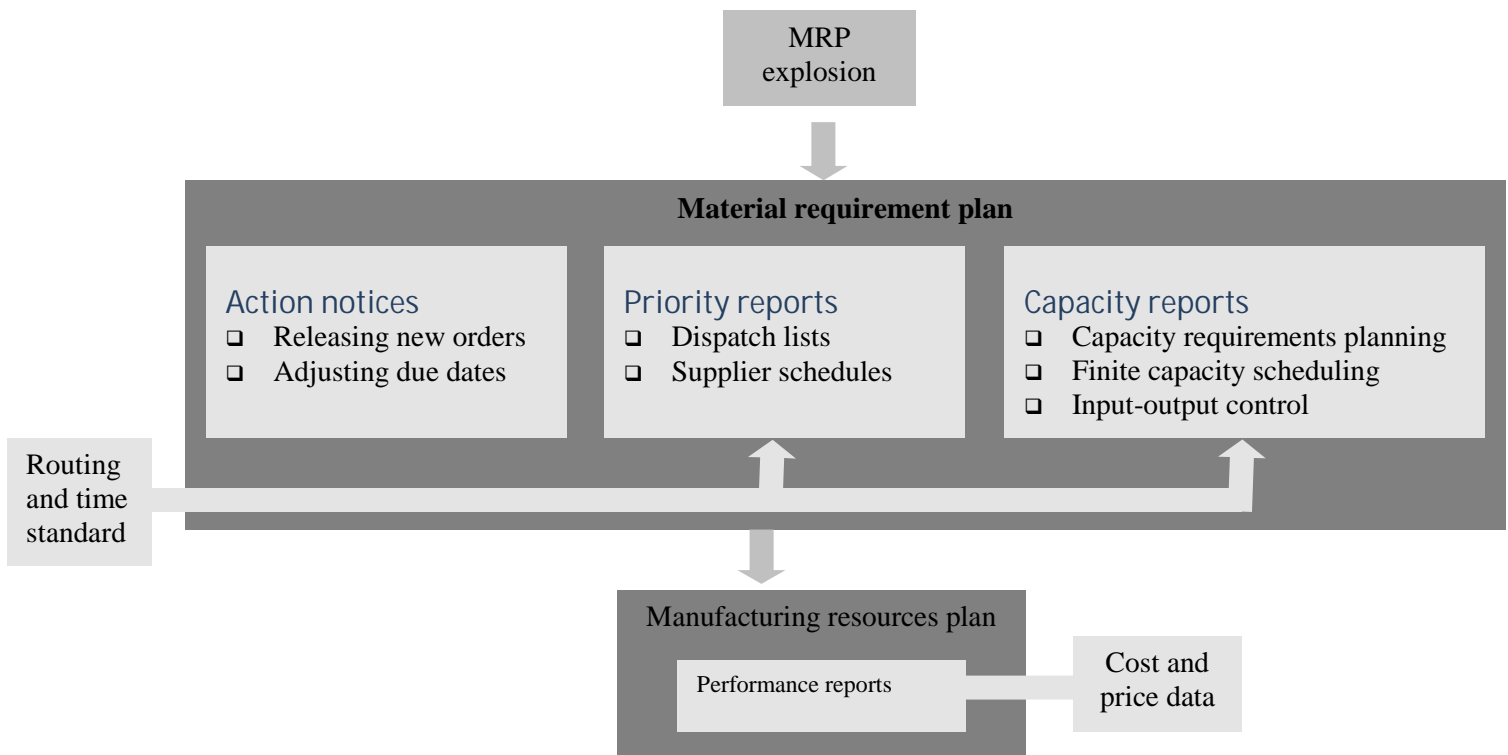


Fig:- Material Requirements Planning Outputs

Chapter 11: Just in Time

To gain and maintain a competitive advantage, firms are using the Just-In-Time (JIT) philosophy, which is to eliminate waste by cutting unnecessary inventory and removing delays in operations. A JIT system is an organization of resources, information flows, and decision rules that can enable an organization to realize the benefits of operations. JIT system is known by many different names including zero inventory, synchronous manufacturing, lean production, stockless production, materials as needed, and continuous flow manufacturing.



Characteristics of Just-In-Time Systems

JIT systems focus on reducing inefficiency and unproductive time in the production process to improve continuously the process and quality of the product or service. Employee involvement and inventory reduction are essential to JIT operations. Some of the characteristics of JIT system are:



Pull Method of Material Flow

JIT systems utilize the pull method of materials flow. Another popular method is the push method. In push method; the customer demand activates the production of the item. Whereas in pull method; the production of the item begins in advance of customer needs.



Consistently High Quality

JIT system seek to eliminate scrap and rework in order to achieve a uniform flow of materials. JIT systems control quality at source, with workers acting as their own quality inspectors. Management must realize the enormous responsibility this method places on the workers and must prepare them properly.



Small Lot Sizes

Rather than building up a cushion of inventory, users of JIT systems maintain inventory with lot sizes that are small as possible. Small lot sizes have three benefits:

- ❑ Reduce cycle inventory, the inventory in excess of the safety stock carried between orders.
- ❑ Help cut lead times. A decline in lead-time in turn cuts pipeline inventory because the total processing time at each workstations is greater for large lots than for small lots.
- ❑ Help to achieve a uniform operating system workload.

✦ **Uniform Workstation Loads**

The JIT system works best if daily load on individual workstations is relatively uniform. Uniform loads can be achieved by assembling the same type and number of units each day, thus creating a uniform daily demand at all workstations.

✦ **Standard Components and Work Methods**

The standardization of components, called part commonality or modularity, increases repeatability. Productivity tends to increase because, with increased repetition, workers learn to do the task more efficiently. Standardization of components and work methods aids in achieving the high-productivity, low-inventory objectives of JIT systems.

✦ **Close Suppliers Ties**

Because JIT system operates with very low levels of inventory, close relationships with suppliers are necessary. Stock shipments must be frequent, have short lead times, arrive on schedule, and be of high quality. A contract might require a supplier to deliver goods to a factory as often as several times per day. Purchasing managers focus on three areas: reducing the number of suppliers, using local suppliers, and improving supplier relations.

✦ **Flexible Work Force**

Workers in flexible work force can be trained to perform more than one job. Flexibility can be very beneficial: workers can be shifted among workstations to help relieve bottlenecks as they arise without resorting to inventory buffers- an important aspect of the uniform flow of JIT system. Assigning workers to tasks they don't usually perform may reduce efficiency; some rotation relieves boredom and refreshes workers.

✦ **Line Flow Strategy**

A line flow strategy can reduce the frequency of setups. If volumes of specific products are large enough, groups of machines and workers can be organized into a product layout to eliminate setups entirely. Another tactic used to reduce or eliminate setups is the one-worker, multiple machines (OWMM) approach, which essentially is a one-person line.

✦ **Automated Production**

Automation plays a big role in JIT systems and is a key to low-cost production. Sakichi Toyoda, the founder of Toyota, once said, "Whenever there is money, invest it into the machinery." Money freed up because of JIT inventory reductions can be invested in automation to reduce the costs.

✦ **Preventive Maintenance**

Because JIT emphasizes finely tuned flows of materials and little buffer inventory between workstations, unplanned machine downtime can be disruptive. Preventive maintenance can reduce the frequency and duration of machine downtime. Another tactic is to make workers responsible for routinely maintaining their own equipment and develop employee pride in keeping their machines in top conditions. Doing even simple maintenance tasks goes a long way toward improving machine performance, though.

✦ ***The KANBAN System***

One of the most publicized aspects of JIT systems is the Kanban system developed by Toyota. Kanban, meaning "card" or "visible card" in Japanese, refers to cards used to control the flow of production through a factory.

✦ **Working of KANBAN system**

- ❑ A card is attached to each container of items that have been produced.
- ❑ The container holds a given percentage of the daily requirements for an item.

- When user of the parts empties the container, the card is removed from the container and put on the receiving post.
- The empty container is taken in the storage area.
- The card signals the need to produce another container of the part.
- When the container has been refilled, the card is put on the container, which is then returned to a storage area.
- The cycle begins again when the user of the parts retrieves the container with the card attached.

✦ **General Operating Rules**

The operating rules for the single-card system are simple and are designed to facilitate the flow of materials, while maintaining control of inventory levels.

- Each container must have a card.
- The assembly line always withdraws materials from the fabrication cell. The fabrication cell never pushes parts to the assembly line because, sooner or later, parts will be supplied that are not yet needed for production.
- Containers of parts must never be removed from a storage area without a kanban first being posted on the receiving post.
- The containers should always contain same number of good parts. The use of nonstandard containers or irregularly filled containers disrupts the production flow of the assembly line.
- Only non-defective parts should be passed along to the assembly line to make the best use of materials and worker's time.
- Total production should not exceed the total amount authorized on the kanban in the system.