BA4204	OPERATIONS MANAGEMENT	L T P C 3 0 0 3

COURSE OBJECTIVE:

- To provide a broad introduction to the field of operations management and explain the concepts, strategies, tools and techniques for managing the transformation process that can lead to competitive advantage.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities,recent trends. Operations Strategy – Strategic fit , framework. Productivity; World-class manufacturing practices

UNIT II OPERATIONS AND THE VALUE CHAIN 9

Capacity Planning – Long range, Types, Developing capacity alternatives, tools for capacity planning. Facility Location – Theories, Steps in Selection, Location Models. Sourcing and procurement - Strategicsourcing, make or buy decision, procurement process, managing vendors.

UNIT III DESIGNING OPERATIONS 9

Product Design - Criteria, Approaches. Product development process - stage-gate approach - tools for efficient development. Process - design, strategy, types, analysis. Facility Layout – Principles, Types, Planning tools and techniques.

UNIT IV PLANNING AND CONTROL OF OPERATIONS 9

Demand Forecasting – Need, Types, Objectives and Steps - Overview of Qualitative and Quantitative methods. Operations planning - Resource planning - Inventory Planning and Control. Operations Scheduling - Theory of constraints - bottlenecks, capacity constrained resources, synchronous manufacturing

UNIT V QUALITY MANAGEMENT 9

Definitions of quality, The Quality revolution, quality gurus; TQM philosophies; Quality management tools, certification and awards. Lean Management - philosophy, elements of JIT manufacturing, continuous improvement. Six sigma.

TOTAL: 45 PERIODS

Unit – I Operations Management

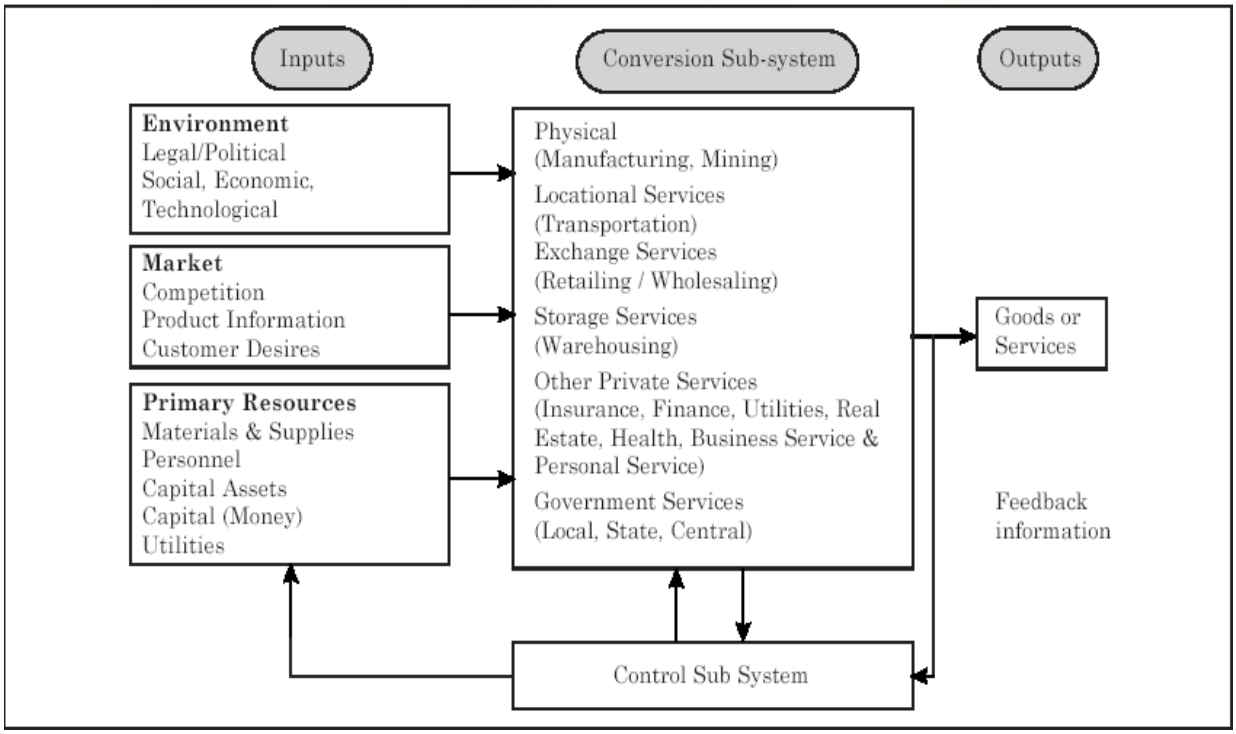
Definition: Production/operations management is the process, which combines and transforms various resources used in the Production/operations subsystem of theorganization into value added product/services in a controlled manner as per the policies of the organization.

Concept of Production: Production function is that part of an organization with the transformation of a range of inputs into the required outputs (products) having the requisite quality level.

- The set of interrelated management activities, which are involved in manufacturing certain products, is called as production management.
- If the same concept is extended to services management, then the corresponding set of management activities is called as operations

Nature of Production

- Production system-A System whose function is to convert a set of inputs into a set of inputs into a set of desired outputs.
- Conversion sub-system- A sub-system of the larger production system where inputs are converted into outputs.
- Control sub-system-A sub-system of the larger production system where a portion of the output is monitored for feedback signals to provide corrective action if required.



Importance of Production/Operation **Function**

Production function can offer competitive advantage to a firm in the following areas:

- Shorter new-product-lead time
- More inventory turns
- Shorter manufacturing lead time
- Higher quality
- Greater flexibility
- Better customer service
- Reduced wastage

HISTORICAL MILESTONES IN OPERATIONS MANAGEMENT

Date	Initiator	Event

1875	James Watt	Steam Engine was commercially manufactured
1899	Eli Whitney	Introduced mass production and the concept of standard interchangeable parts.
1900	Frederick.W.Taylor	Scientific Management
1900	Frank & Lillian Gilberth	Time and motion study
1901	Henry.H.Gantt	Scheduling, Gantt chart
1905	Henry Ford	Assembly Line
1905	Alfred P.Sloan	Organizational management
1927	Elton Mayo	Assembly Line
1931	Walter.A Sherwart	Quality Control charts
1935	H.F.Dodge & H.G.Romig	Statistical sampling applied to quality control
1940	P.M.S. Blacket et.al	Operations Research Application
1947	George.B.Dantzig.et.al	Linear programming
1950	A. Charnes, W.W. cooper & H. Raiffa	Non-linear and stochastic processes programming
1970	J.Orlicky &O.Wright	Computer applications to manufacturing – material requirement planning (MRF)
1980	W.E.deming ,Philip Gosly & J.Juran GM &IBM	Quality & productivity, applications from Japan, CAD/CAM, Robotics
1990	Netscape, US Dept of Defence Michael Hammer, James champy	Internet, electronic enterprise Business process Reengineering

2000	Amozon,ebay,yahoo,America online Dr. Daniel Whitney & Prof charles fine, MIT	E-commerce ,Agile Manufacturing High performance work systems.

CURRENT CHALLENGES OF POM

Mark Davis, Nicolas Aquilano and Richard Chase (1999) have suggested that the major issues for operations management today are:

- reducing the development and manufacturing time for new goods and services
- achieving and sustaining high quality while controlling cost
- integrating new technologies and control systems into existing processes
- obtaining, training, and keeping qualified workers and managers
- working effectively with other functions of the business to accomplish the goals of the firm
- integrating production and service activities at multiple sites in decentralized organizations
- working effectively with suppliers at being user-friendly for customers
- working effectively with new partners formed by strategic alliances

Importance and Organizational function / Functions of Production manager

1. **Production planning**:

Planning is a preoperational activity. It aims at anticipating the probable difficulties sothat they can be eliminated before they materialize. Production planning aims setting the goals (or) targets and allocating existing resources (4m's).

2. Production Control:

Control is a managing technique which aims to see that the activities are carried out inline with the predetermined standards. PC is a process of planning production in advance of operations, establishing the exact boot of each individual item, setting starting and finishing datas for each important items and releasing the necessary orders and initiating the required follow-up to affect the smooth functioning of employees. Thus it involves the following elements.

- Routing

- Scheduling
- Dispatching
- Expediting
- Follow-up

Routing- Sequence of operation

Dispatching- Giving orders, to carry out the

jobExpediting- monitoring the process

Follow-up- Feedback

3.Factory Building:

Basic consideration falling within the scope of production management. The primary purpose of factory building is to protect the machines, plant services and manufacturing process. It involves the following:

- Type of constructing to own the building.
- Get it on lease whether single storing.
- Multi-storey.

4. Provision of plant services

Two categories,

- Production services.
- Employee services.

A production service includes storeroom, power room, tool room, material handling, repairservices etc.

An employee service includes canteen, recreation room, parking, and toilet.

5. Plant layout:

Arranging various facilities and arrangement in plant.

Deals with the arrangements of machines and plant facilities inside the factory area. The machine should be arranged in such a way, the production plant arranged smoothly. Basic layouts are,

- Production layout

- Process
- Combination
- Fixed- position

6. **Physical environment:**
   - Lighting: should be sufficient in terms of general lighting and lighting required for aparticular process. If possible the use of natural light should be made and the building be constructed according. Otherwise artificial lighting should be used.
   - Fresh air: provision should be made with the help of exhaust fans. The smoke dust,fumes and odour should be removed.
   - Humidity: The moisture content of air is known as humidity. Certain specific degreeof moisture is required for production process like spinning and textile industry.
   - Noise: Noise arises due to fast movement of machines. It affects the efficiency of workers. Noise can be eliminated by regular replacement of parts, covering the machines (or) locate such processes at a distant place.
   - Vibration: Vibration arises due to fast movement of giant machines. It affects the precision in processing. Vibration can be reduced by mounting the machines n springs, rubber (or) other shock absorbers.
7. **Method study:**

Direct function of production management. The standard methods should be devisedfor performing the repetitive functions efficiently. The unnecessary elements should be

eliminated by suitable positioning of workers for different process is developed.

i. Motion Study

ii. Time study

8. **Inventory Control:**

Inventory control deals with control over raw material, WIP, finished products,store suppliers, tools etc. The management of these items are closely related with

the production. The raw material should be purchased at right quantity/ quality/ source/time/ place.

9. Quality Control:

* QC is easy in manufacturing and in service it is very difficult.

* QC is everyone's business. The long-run success of the business largely depends on its ability to maintain the quality standards as decided by the management andaccepted by customers.

* QC is maintained by testing the methodology.

10. Product Development:

Standardization, simplification,

It is not likely that the product which is accepted today by the customers will be accepted by them forever, in the form same quality. Product development basically considers following aspects,

- Diversification
- Improvement in existing product
- Simplification

Standardization

Duties and Responsibilities of production Managers

- Planning the geographical location of the factory
- Purchasing production Equipment
- Layout of equipment within the factory
- Designing production processes and equipments
- Product Design
- Designing Production work and establishing work standards
- Capacity planning
- Production Planning & Scheduling

- Production control
- Inventory Management
- Supply Chain Management
- Quality Control
- Production Equipment Maintenance and Repair
- Measurement and Monitoring Of Productivity
- Industrial Relations
- Health and Safety
- Staff Selection and Liasoning
- Budgeting and Capacity Planning

Differences between Goods & Services

S. No.	Particulars	Goods	Service
1	Nature	Tangible Eg: automobile	Intangible Eg: hospital
2	Consumption of output	Consumed over a time	Consumed immediately
3	Nature of work	Jobs use less labour and more equipments	More labour and less equipment
4	Degree of customer contract	Little customer contract(customer is not used as a resource)	Direct customer contract and customer is used as one among the resources

5	Customer participation conversion	No participation	Frequent customer participation
6	Measurement of performance	Sophisticated methods for measuring production activity	Elementary methods
7	Holding stock	It is possible	Impossible to hold stock
8	Measurement of customer requirement	Simple	Difficult
9	Resource planning	Simple	Difficult due to unpredictability
10	Defining the authority of production management	Easier	Difficult because the role of operation manager merges into marketing and there is some overlap

FUNCTIONS OF PRODUCTION MANAGEMENT

- **PRE-PLANNING ACTIVITIES**

Strategic level planning and it deals with the analysis of data fromfeedback received from both operations and external environment such as competitors, political, economical, social and culturalenvironment. It is concerned with the decision making regarding products, processes, machineries,plant location and layouts with respect to availability, scope and capacity.

- **Demand Forecasting**

"Estimating the different activities level of the future in the organization is known as Forecasting." Ithelps the managers in making continuous decisions regarding employment levels, carrying inventories, purchasing new equipments, developing new products, scheduling

production, quality
control, plant maintenance etc

- **Product Design**

Product design is defined as the determination and specification of parts of a product and their interrelationships so that they become unified as the whole. It is the process of transferring thecustomers' expectations into technical specifications. The components of the products must bedesigned in such a way that it meets the specification of the whole product.

Process Design

The physical processes for producing goods and services have to be designed to ensure optimum production in the organization. Some decisions have to be taken at top level management regardingthe selection of process, choice of technology, process low and layout facilities.

PRODUCTION PLANNING

Production planning is the function of deciding the manufacturing requirements such as raw materials, facilities, manpower, and manufacturing process. Based on the results from demand forecasting and other facilities forecasting of the organization, the planning function establishes theprogrammes to meet the demands using the various resources.

STRATEGIC MANAGEMENT

Strategic management is the process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these objectives and then allocating resources to implement the policies, andplans, projects and programs.Strategic management provides overall direction to the enterprise isclosely related to the field of Organization Studies.

Importance of Strategic Management

- Strategic management provide direction and momentum for the business
- It encourages new ideas and result in innovation and creativity

- It helps the management in developing a sustainable competitive advantage for the business
- Helps in achieving the organizational goals in an effective and efficient manner.
- Gives the organization direction, a sense of identity and unity towards what the business goal

Functions of strategic management

- Evolve business goals, by formulating its future mission and vision in terms of theexpectations of the stake-holders
- Set objectives that are achievable in light of changing external factors that includeregulation, competition, technology, and customers
- Evolve and develop a competitive strategy to achieve the mission
- Create an effective organizational structure and arrange the resources to successfully carryout the strategy
- Evaluate the performance so that necessary corrective measures can be taken to keep it ontrack to achieve the vision

Role of Operations in Strategic Management

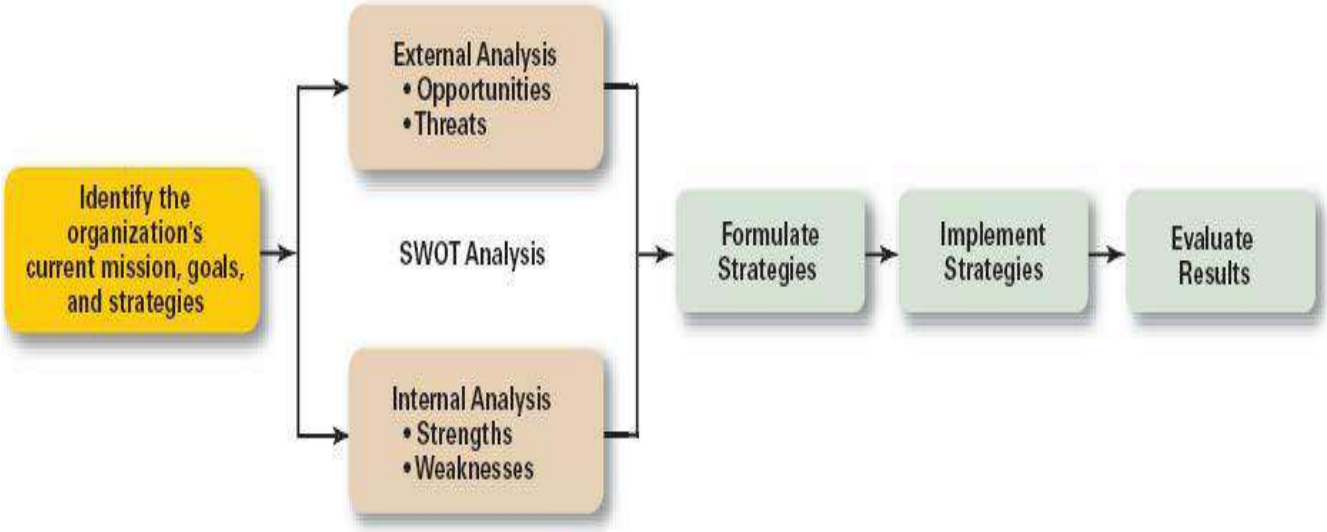
- A strategy is a way of doing something. It usually includes the formulation of a goal and aset of action plans for accomplishing of the goal.
- Strategic Management: the process of formulating, implementing and evaluating businessstrategies to achieve organizational objectives.
- A comprehensive definition is "that set of managerial decisions and actions that determines the long-term performance of a corporation. It involves environmental scanning, strategy formulation, strategy implementation, evaluation and control".

STRATEGIC MANAGEMENT

It involves five steps:

1. Select the corporate mission and major corporate goals.

2. Analyse the opportunities and threats or constraints that exist in the external environment. Also analyse the strengths and weaknesses that exist in internal environment.
3. Formulate strategies that will match the organization's strengths and weaknesses thatexist in internal environment.
4. Implement the strategies.
5. Strategy evaluation



STEP-1 Identify the organisation's current mission, goals and strategies

- □ It begins with selecting corporate mission and corporate goals and ends with monitoringthe activities of the organization.
- □ The first step in strategic management process is selecting or crafting corporate missionand corporate goal.
- □ A mission statement is description or declaration of why a company is in operation(exists), which provides the framework within which strategies are formulated.
- □ A typical mission statement contains

threecomponents:

*a statement, its reason for existence.

*a statement of the key values or guiding standards on which the operations takes place.

*a statement of major goals or objectives.

STEP-2 SWOT Analysis

- The environment of an organization comprises both external and internal factors.
- Environment needs to be scanned in order to determine trends and projections of factorsthat will affect fortunes of the organization.
- Scanning must focus on task environment. Scanning helps identify threats andopportunities prevailing in the environment.
- In formulating a strategy, a company seeks to take advantage of the opportunities whileminimizing the threats

STEP-3 Formulate Strategies

Strategies are formulated at four levels:

1. Corporate level: It is formulated by top management to oversee the interests and operations ofan organization made up of more than one line of business.

2.Global level: Companies may be able to increase their profitability.

3.Business unit level: A Business unit is an organizational subsystem that has a market, a set ofcompetitors, and a goal distinct from those of the other subsystem in the group and

4. Functional level: Functional strategies identify the basic courses of action that each of thedepartment must pursue in order to help the business unit to attain its goals.

STEP-4 Strategy Implementation

- Is positioning forces before

action. Is managing forces during the action. Focuses on effectiveness.

- Focuses on efficiency.
- Requires special motivation and leadership skills. Requires co-ordination among many persons.

STEP-5 Strategy Evaluation

- Strategy evaluation helps determine the extent to which the company's strategies aresuccessful in attaining its objectives.
- Basic activities in strategy evaluation:
- Establishing performance targets, standards and tolerance limits for the objectives,strategies and implementation plans.
- Measuring the performance in relation to the targets at a given time. If outcomes areoutside the limits, inform managers to take action.
- Analyze deviations from acceptable tolerance limits.

Production and Operations strategy:

Operations strategy is the tool that helps to define the methods of producing goods or aservice offered to the customer.

ELEMENTS OF PRODUCTION/OPERATIONS STRATEGY

Operations strategy comprises six components:

1. Positioning the production system
2. Focus of factories and service facilities 3.Product/service design and development.
4. Allocation of resources to strategic alternatives, and 5.Facility planning, Capacity, location and layout
6. Technology selection and process development

SUPPLY CHAIN MANAGEMENT

- A Supply chain is a sequence of an organization's facilities, functions and activitiesthat are involved in producing and delivering a product / service.
- The sequence begins with basic raw materials supplies and extends all the way to thefinal customers.
- The elements are

Customer service requirements.

- Plant and distribution centre network design
- Inventory management
- Outsourcing
- Key customer and supplier relationships
- Business processes
- Information systems
- Organizational designs and training Programmes
- Performance metrics
- Performance goals.

INTERNATIONAL QUALITY STANDARDS:

- Quality refers to the ability of a product / service to consistently meet or exceedcustomer expectations.
- Quality should first and foremost be perceived from the customer point of view.

Dimensions of quality are:

- Reliability
- Serviceability
- Durability

- Appearance
- Customer service and
- Safety.

Any company that distinguishes its product based on any one of the dimensions ofquality or group, helps in gaining competitive advantage.

INTERNATIONALISATION OF R&D:

- Research and development (R&D) refers to an organized efforts, which are directedtowards increasing scientific knowledge and product/ process innovation.
- Basic Research has the objective of enriching knowledge, without any short-termexpectation of commercial applications.
- Applied research has the objective of achieving consumed applications. It has aproblem solving emphasis i.e.,it is conducted to reveal answers to specific problems.
- Development is the conversion of the results applied research into useful commercialapplications.
- R&D benefits helps of firms in gaining competitive advantage by bringing new productor service to the market that is different from competitors.

RECENT TRENDS IN PRODUCTION AND OPERATIONS MANAGEMENT

In the light of global competition many recent trends in operations management have evolved thathave impact on manufacturing firms. Some of the Recent Trends In Operations Management are:

- Global Market Place
- Flexibility
- Total Quality Management (TQM)
- Time Reduction
- Re-engineering
- Production/Operations Strategy
- Lean Production

- JIT
- Computer Aided Design
- Computer Aided Manufacturing
- Supply-Chain Management
- Enterprise Recourse Planning (ERP)
- Environmental Issues

GLOBAL MARKET PLACE Globalization of business has compelled many manufacturing firms togave operations in many countries where they have certain economic advantage. This has resulted ina steep increase in the level of competition among manufacturing firms throughout the world.

FLEXIBILITY The ability to adapt quickly to changes in volumes of demand, in the product mix demanded, and in product design or delivery schedules, has become a major competitive strategy anda competitive advantage to the firms. This is sometimes called as agile manufacturing.

TOTAL QUALITY MANAGEMENT TQM approach has been adopted by many firms to achievecustomer satisfaction by a never ending quest for improving the quality of goods and services.

TIME REDUCTION

Reduction of manufacturing cycle time and speed to marker for a new product provide a competitiveedge to a firm over other firms. When companies can provide products at the same price and quality,quicker delivery (short lead time) provide one firm competitive edge over the other.

BUSINESS PROCESS RE-ENGINEERING

BPR involves drastic measures or break-through improvements to improve the performance of a firm.It involves the concept of clean-state approach or starting from a scratch in redesigning in business processes.

OPERATIONS STRATEGY

More and more firms are recognizing the importance of operations strategy for the overall success oftheir business and the necessity for relating it to their overall business strategy.

LEAN PRODUCTION

Production system have become lean production systems which have minimal amount of

resources toproduce a high volume of high quality goods with some variety. These systems use flexible manufacturing systems and multi-skilled workforce to have advantages of both mass production and job production.

JUST IN TIME (JIT) PRODUCTION

JIT is a 'pull' system of production, so actual orders provide a signal for when a product should be manufactured. Demand-pull enables a firm to produce only what is required, in the correct quantity and at the correct time. This means that stock levels of raw materials, components, work in progressand finished goods can be kept to a minimum. For example, a car manufacturing plant might receiveexactly the right number and type of tyres for one day's production, and the supplier would be
expected to deliver them to the correct loading bay on the production line within a very narrow timeslot

COMPUTER AIDED DESIGN (CAD)

Computer-aided design (CAD) is the use of computer technology to aid in the design and particularlythe drafting (technical drawing and engineering drawing) of a part or product, including entire buildings. It is both a visual (or drawing) and symbol-based method of communication whose
conventions are particular to a specific technical field.

COMPUTER AIDED MANUFACTURING (CAM)

Computer-aided manufacturing (CAM) is the use of computer-based software tools that assist engineers and machinists in manufacturing or prototyping product components. CAM is a programming tool that makes it possible to manufacture physical models using computer-aided
design (CAD) programs. CAM creates real life versions of components designed within a softwarepackage. CAM was first used in 1971 for car body design and tooling.

SUPPLY CHAIN MANAGEMENT

Supply chain management is the management of supply chain from suppliers to final customers reduces the cost of transportation, warehousing and distribution throughout the supply chain. The recent advancement of Internet technology has brought more powerful support to improving supplychain performance.

ENTERPRISE RESOURCE PLANNING Enterprise resource planning (ERP) is an enterprise-wideinformation system designed to coordinate all the resources, information, and activities needed to
complete business processes such as order fulfilment or billing.

ENVIRONMENTAL ISSUES Today's production managers are concerned more and more with pollution control and waste disposal which are key issues in protection of environment and socialresponsibility. There is increasing emphasis on reducing waste, recycling waste, using less-toxic chemicals and using biodegradable materials for packaging.

Unit II

CAPACITY PLANNING:

- **Meaning:**

Capacity is the rate of productive capacity of a facility. Capacity is expressed as volume of output per time period. Capacity affects cost efficiency of operations, the ease or difficulty of scheduling output and the costs of maintaining the facility.

Capacity Planning is the process used to determine how much capacity is needed in order to manufacture greater product or begin production of a new product.

Definition of Capacity planning

According to APICS, "Capacity planning or capacity requirements' planning is the function of establishing, measuring and adjusting limits or levels of capacity."

OBJECTIVES OF CAPACITY PLANNING

Costs: capacity levels in excess of demand could mean under-utilization of capacity and therefore high unit cost.

Revenues: It is also affected by the balance between capacity and demand.

Dependability:- how close demand levels are to capacity.

Flexibility:-volume flexibility will be enhanced by surplus capacity

Working Capital: It will be affected if an operation decides to build up finished goods inventory prior to demand.

Quality: By hiring temporary staff.-disruption to the routine working of the operation.

Speed: By the deliberate provision of surplus capacity to avoid queuing.

LEVEL OF CAPACITY PLAN

LONG RANGE CAPACITY PLANNING

1. Over the long term, capacity planning relates primarily to strategic issues involving the firm's major production facilities.

2. Technology and transferability of the process to other products is also intertwined with the long term capacity planning.

3. Long term capacity planning may evolve when short term changes in capacity are insufficient.

SHORT RANGE CAPACITY PLANNING:

1. In short term, capacity planning concerns issues of scheduling, labor shifts and balancing resource capabilities.

2. The goal of short-term capacity planning is to handle unexpected shifts in demand in an efficient economic manner.

3. The time frame for short-term capacity planning is frequently only a few days but may run as long as six months.

Types of capacity planning

Rough-cut capacity Planning (RCCP):

- It takes capacity planning to the next level of detail.
- RCCP is a medium-range planning aid and is used to verify whether enough available capacity exists at critical resources to accomplish a projected master production schedule.
- The purpose of RCCP is to check the feasibility of the MPS, provide warnings of any bottlenecks, ensure utilization of work centers, and advise vendors of capacity requirements.

Capacity Requirements Planning (CRP):

- Capacity Requirements Planning (CRP) occurs at the level of the material requirements plan.
- It is the process of determining in detail the amount of labor and machine resources needed to achieve the required production.
- Planned orders from the MRP and open shop orders (scheduled receipts) are converted into demand for the time in each work centres accordingly.
- CRP is the last level of capacity analysis. it is planning and control of the resources needed to produce the requirements generated by the MRP system.

Facility location

It is the function of determining where the plant should be located for maximum operating

economy and effectiveness. In other words, plant location is the function of determining location for a plant for maximum operating economy and effectiveness.

Steps in location selection

1. Within the country or outside
2. Selection of the region
3. Selection of the locality or community
4. Selection of exact site

1. Within the country or outside

The first step in plant location is to decide whether the facility should be located domestically or internationally. With increasing internationalisation of business, the issue of home or foreign country is gaining greater relevance.

- Political stability Export & Import
- Currency and exchange rates
- Cultural and Economic peculiarities
- Natural environment

2. Selection of region

The selection of a particular region out of many natural regions of a country is the second step in location selection.

Availability of raw material: A firm that depends on heavy raw materials locates nearer to availability of raw material. Reduced cost of transportation. Savings in the cost of storage of materials.

Nearness to the Market: A company that wants to reduce transportation costs locates near to the market.eg pesticides and insecticides

Availability of Power

Transport Facilities

Suitability of climate: It is very important for setting up of cotton mills.

Government policy: Any firm that is looking for subsidy or incentives has to locate factory in the states which provide them

Competition between states

3. Selection Of Community

Selecting the particular locality or community in a region is the third step in plant location. The

selection of a locality in a particular region is influenced by the following factors.

- Availability of labour
- Civic amenities for workers
- Existence of complementary and competing industries
- Finance and research facilities
- Availability of water and firefighting facilities
- Local taxes and restrictions
- Momentum of an early start
- Personal factors

4. Selection of Site

The selection of an exact site in a chosen locality is the fourth step in plant location. The selection of the site is influenced by the following considerations

- Soil, Size and Topography
- Disposal of waste

Location Models

1. Factor Rating Method
2. Point Rating Method
3. Break-even Analysis
4. Qualitative Factor Analysis

Factor Rating Method

- Factor rating method involves giving rating to each factor based on its importance.
- The steps involved are
- List the most relevant factors in the location decision.
- Rate each factor according to its relative importance.
- Rate each location according to its merits on each factor
- Compute the product of ratings by multiplying the factor rating by the location rating for each factor.
- Compute the sum of the product of ratings for each location.

Factor	Factor rating	Location Rating		Product Rating	
		Location A	Location B	Location A	Location B
1.Tax advantage	4	8	6	32	24

2.Suitability of labour skill	3	2	3	6	9
3.Proximity to customer	3	6	5	18	15
4.Proximity to suppliers	5	2	4	10	20
5.Adequacy of water	1	3	3	3	3
		Total Score		69	71

Point Rating Method

- The relative weight a company assigns to each objective or to each location factor may be represented by the number pf points a perfect site would receive in each category.
- The site with the highest total number of points is considered superior to other sites.
- Point-rating system is the relative importance of tangible cost factors compared to intangible factors.
- Points are usually assigned only to intangible factors and an evaluation is to determine whether the difference between the intangible scores is worth.
- The drawback of this method is that high score in any factor can overcome a low score in any other factor.

Factor related	**Maximum possible points**	**Points assigned to Locations**	
		Location A	**Location B**
1.Future availability of fuel	300	200	250
2. Labour availability	250	220	200
3.Site topography	50	40	30
4.Living conditions	150	100	125
5.Pollution Regulations	30	20	20
Total		**580**	**625**

Locational breakeven analysis

- This graphical method can easily identify the range of annual production volume over which a location is preferable.

- The steps involved in this method
- Determine all relevant cost that vary with each location.
- Categorise the costs for each location into annual fixed costs (FC) and variable costs per unit and calculate the total costs (TC) for the desired volume of production per annum, for each location.
- Plot the total costs associated with each location on a single chart or graph of annual cost versus annual production volume.
- Select the location with the lowest total annual cost(TC) at the expected production volume per annum (Q)

EgPotential locations A,B &C have the cost structures shown for producing a product expected to sell at Rs100 per unit. Find the most economical location for an expected volume of 2,000 units/ year. Also determine the range of annual volume of production for each of the locations A,B and C would be most economical

Location	**Fixed Cost**	**Variable cost (per Unit)**
A	25,000	50
B	50,000	25
C	80,000	15

To determine the most economical location

Q= 2,000 nos

Total cost = fixed cost per annum + Variable Cost Per unit x quantity produced

Location A

$TC_A = (FC)_A + (T.C)_A x\ Q$

= 25,000+50x 2000

= 25000+100000 = Rs1,25,000

Location B

TC B = (FC)B + (T.C)B x Q

= 50,000+25x 2000

= 50000+50,000 = Rs1,00,000

Location C

$TC_c = (FC)_C + (T.C)_C \times Q$

$= 80,000+15x\ 2000$

$= 80000+30,000 = Rs1,\ 10,000$

Analytical method

To determine the break even volume between location A and location B

Q_{AB} at each location A and B are equated ie

$25000 + 50Q_{AB} = 50000 + 25Q_{AB}$

$50Q_{AB} - 25Q_{AB} = 50000-25000$

$25Q_{AB} = \frac{25000}{25}$

$= 1,000$ units

Similarly for location B and C and Location C and A

Qualitative Factor Analysis Method

- Develop a list of relevant factors
- Assign a weight to each factor to indicate its relative importance
- Assign a common scale to each factor and designate any minimum point to be scored by any location
- Score each potential location according to the designated scale and multiply the scores by the weights to arrive at the weighted scores
- Total the points for each location and choose the location with the maximum points.

Relevant Factors	**Assigned Weight**	**Scores for location**			
		A	**B**	**C**	**D**
Production cost	0.35	50	40	60	30
Raw material supply	0.25	70	80	80	60
Labour availability	0.20	60	70	60	50
Cost of living	0.05	80	70	40	80

Environment	0.05	50	60	70	90
Markets	0.10	70	90	80	50
Total	1.00				

Relevant Factors	**Weighted Scores for location**			
	A	**B**	**C**	**D**
Production cost	17.5	14.0	21.0	10.5
Raw material supply	17.5	20.0	20.0	15.0
Labour availability	12.0	14.0	12.0	10.0
Cost of living	4.0	03.5	02.0	04.0
Environment	2.5	03.0	03.0	04.5
Markets	7.0	09.0	08.0	05.0
Total	**z**	**63.5**	**66.5**	**49.0**

SOURCING AND PROCUREMENT

SOURCING

Sourcing is the process of vetting, selecting, and managing suppliers who can provide the inputs an organization needs for day-today running. Sourcing is tasked with carrying out research, creating and executing strategy, defining quality and quantity metrics, and choosing suppliers that meet these criteria.

PROCUREMENT

- **Procurement** is a set of processes related to acquiring goods and services to satisfy a company's needs.
- For instance, if your company requires raw materials to manufacture its products, you first choose where to procure these materials, send a purchase order to the selected supplier, and pay for delivered items.

What Is Sourcing Process?

- **Sourcing in procurement** is a process of assessing, selecting, and managing suppliers to acquire the desired goods and services from them.
- As the name suggests, sourcing focuses on creating *sources* through which an organization can obtain its supplies.
- Thus, it enables procurement and helps ensure the availability of necessary goods and services for a company.
- Another term that you will hear a lot when purchasing products from vendors or suppliers is **strategic sourcing**.
- Strategic sourcing refers to adopting various sourcing strategies and models to minimize the risks and costs while increasing the purchase value.

The Role of Strategic Sourcing in Business

- Strategic sourcing is crucial to a company's development. It allows to negotiate the best price and quality of the purchase and thus directly influences the company's profit margin and net income.
- Besides, the sourcing team helps ensure that chosen suppliers maintain a high level of performance.
- Since potential vendors undergo an extensive vetting process, the sourcing team can choose the most reliable and qualified providers.
- Selecting suitable suppliers is essential, as the further you go down the supply chain, the harder it will be to detect and correct mistakes.
- Moreover, sourcing specialists ensure that if the primary suppliers face problems and cannot fulfill the contract requirements, alternative providers can replace the main ones.
- This, in turn, helps mitigate supplier risk and prevent supply chain disruption. So,

sourcing starts the supply chain and guarantees its stability and resilience in the long run.

Sourcing Process Steps

Step 1. Analyzing internal needs and understanding the spend category

- First, the sourcing team has to identify the company's needs — what goods or services must be purchased — and define specifications for these products.
- Employees also have to analyze the spend and define the spend category: are you buying food and beverages for the office or computer software or maintenance services?
- Who uses these goods or services? How much is used? Who's involved in the supply chain?

Step 2. Researching the market

- Upon determining internal needs, the sourcing specialists search for suppliers, review the market offerings, and evaluate the market for risks and opportunities.
- They also break down the cost components of the product and assess them along with raw materials, transportation, and labor costs.

Step 3. Developing a sourcing strategy

- The third step is choosing the right strategy — deciding where to buy necessary goods to minimize costs and ensure the stability of the supply chain. In this step, a company also devises the set of criteria for potential suppliers.

Step 4. Issuing RFQs or RFPs and vetting suppliers

- Next, employees start the process of soliciting bids and evaluating vendors. An organization can send potential suppliers a request for quote (*RFQ*) or a request for proposal (*RFP*).

- Both are business documents that announce a project and ask for bids to assess each vendor's ability to complete this project.
- A r*equest for proposal* is usually more complex than a *request for quote* and contains project details, pricing analysis, product specifications, and delivery terms.

Step 5. Negotiating and selecting suppliers

- Upon receiving quotations from vendors, a sourcing team evaluates responses, asks for clarifications if needed, and begins negotiating with shortlisted suppliers for lower prices, better payment terms, benefits, etc.
- At the end of the negotiation process, a responsible person chooses the most suitable suppliers based on quality and pricing, reputation, recognition on the market, and possible risks.

Step 6. Arranging supplier integration process

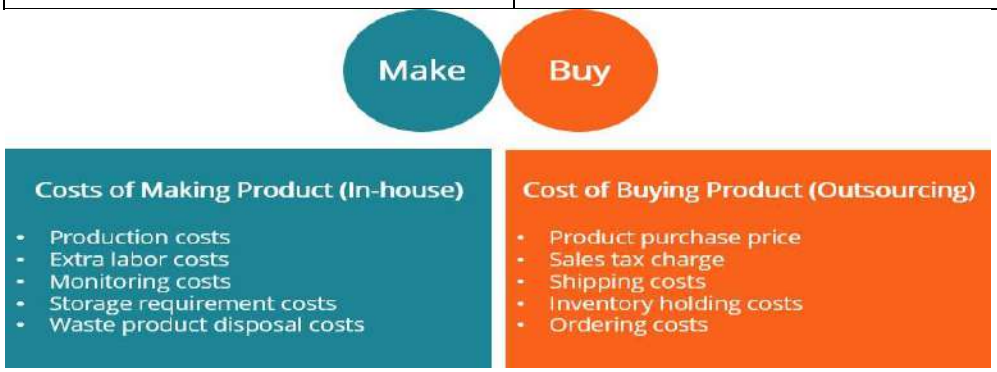
- Once the selected vendor was notified, the implementation process begins. A buyer and a supplier sign a contract.
- The sourcing team also has to develop a communication plan and a system for measuring supplier performance.

Step 7. Benchmarking and assessing results

- The final step takes place after the purchase is made. The sourcing team benchmarks the status of the spend category and analyzes the suppliers' performance based on established KPIs

SOURCING	**PROCUREMENT**
Tasked with choosing suitable suppliers and negotiating the most favorable contract terms	Tasked with acquiring the high-quality goods at the right time to meet company needs
Contains fewer steps	Involves multiple processes and numerous steps

Involves defining the need, researching the market, running sourcing events, vetting suppliers, and negotiating contracts	Comprises sourcing, requisitioning, purchase ordering,making a payment, examining data, and managing contracts
Focuses on who provides the supplies	Focuses on what and how is supplied
Takes a strategic approach	Includes both strategic and tactical components
Aims at minimizing costs and building a robust supply chain	Aims at fulfilling internal needs and gaining a competitive advantage
Creates vendor and supplier relations	Managing Supplier Relationship to procure goods
Builds supply channels and systems	Uses supply systems developed by sourcing
Makes the flow of supplies possible	Emphasizes streamlining the flow of supplies



Sourcing Decisions: The Make-or-Buy Decision (Cont.)

Reasons for Buying or Outsourcing

Cost advantage: Especially for components that are non-vital to the organization's operations, suppliers may have economies of scale.

Insufficient capacity: A firm may be at or near capacity and subcontracting from a supplier may make better sense.

Lack of expertise: Firm may not have the necessary technology and expertise.

Quality: Suppliers have better technology, process, skilled labor, and the advantage of economy of scale.

 17

What Is Procurement?

- Procurement encompasses a range of activities involved in obtaining goods or services. Many companies consider that procurement encompasses all the stages, from gathering business requirements and sourcing suppliers to tracking the receipt of goods and updating payment terms, while others define procurement as a narrower range of activities, such as issuing purchase orders and making payments.

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Types of Procurement	Direct Procurement	Indirect Procurement	Goods Procurement	Services Procurement
What is it?	Any good or service required to produce an end product	All non-production-related goods or services	Physical items typically held as inventory, whether for direct or indirect procurement purposes	All people-based services procured, whether for direct or indirect procurement purposes
Examples	Raw materials, components and parts, machinery, items purchased for resale	Office supplies, marketing services, utilities	Raw materials, wholesale items, office supplies	Law firms, contractors, contingent labor, on-site security services

Types of Procurement

- Procurement can be categorized in several ways. It can be classified as direct or indirect procurement, depending on how the company will use the items being procured. It can also be categorized as goods or services procurement depending on the items that are being procured.
- **Direct procurement** refers to obtaining anything that's required to produce an end-product. For a manufacturing company, this includes raw materials and components. For a retailer, it includes any items purchased from a wholesaler for resale to customers.

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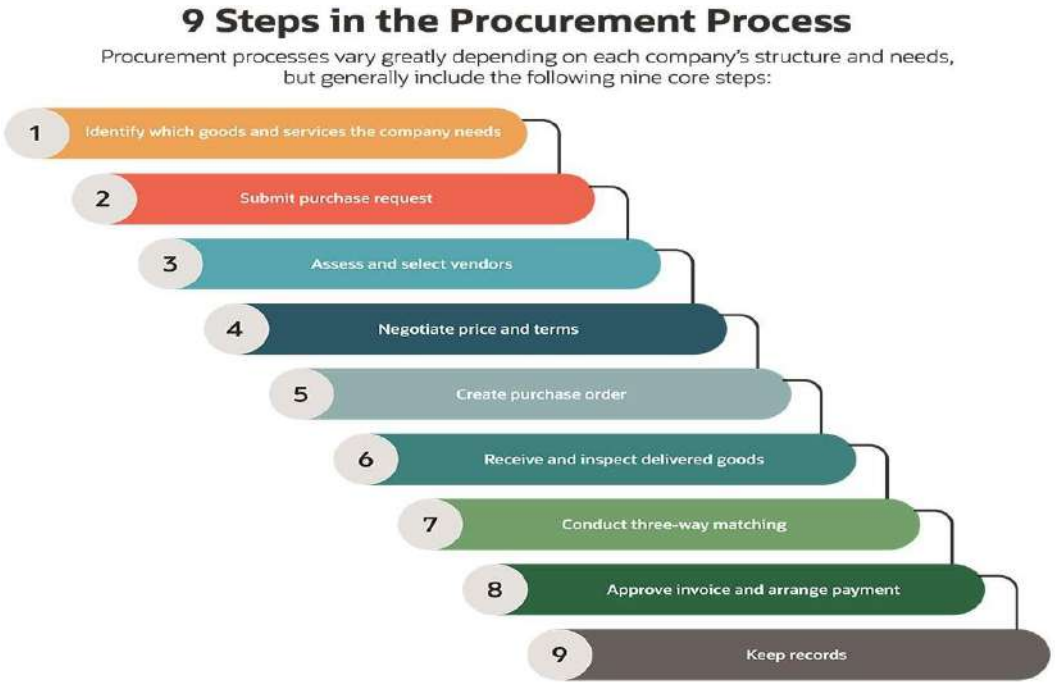
- **Indirect procurement** typically involves purchases of items that are essential for day-to- day operations but don't directly contribute to the company's bottom line. This can include anything from office supplies and furniture to advertising campaigns, consulting services and equipment maintenance.
- **Goods procurement** largely refers to the procurement of physical items, but it can also include items like software subscriptions. Effective goods procurement generally relies on good supply chain management practices. It may include both direct and indirect procurement.
- **Services procurement** focuses on procuring people-based services. Depending on the company, this may include hiring individual contractors, contingent labor, law firms or on-site security services. It may include both direct and indirect procurement.



9 Steps in the Procurement Process

- Procurement processes vary greatly depending on each company's structure and

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needs, but generally include the following nine core steps:

- **1. Identify which goods and services the company needs.** First, a business must identify its requirements for a specific item or a service. This may be a new item that the company hasn't previously purchased, a restock of existing goods or a subscription renewal. This step typically involves delving into the nitty-gritty details of what the business needs, such as the precise technical specifications, materials, part numbers or service characteristics. At this stage, it's a good idea to consult all business departments affected by the purchasing decision to ensure the procured items accurately reflect the needs of each department.

- **2. Submit purchase request.** When an employee or business group needs to procure a significant quantity of new supplies or services, they make a formal purchase request (also known as a purchase requisition). A purchase request notifies the company that a need exists, usually via department managers, purchasing staff or the financial team, as well as specifications such as price, time frame needed, quantity and other important things for the purchasing team to keep in mind. The department overseeing the purchase can then approve or deny the purchase request. If approved, the procurement team can proceed with selecting a vendor and making the purchase.

3. Assess and select vendors. With a clear list of requirements and an approved purchase request, now is the time to find the best vendor and submit a request for quote (RFQ) – this is what the purchasing team sends to potential suppliers in order to receive a quote – it is important to be as detailed as possible so you can compare apples to apples. Vendor assessment should focus not only on cost but also on reputation, speed, quality and reliability. Many companies consider ethics and social responsibility as well, since procurement is often intertwined with corporate identity. A retailer that prides itself on sustainability would stand to benefit from partnering with environmentally responsible suppliers, for instance.

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4. Negotiate price and terms. A common best practice is to get at least three quotes from suppliers before making a decision. Examine each quote carefully and negotiate where possible. If you need to walk away from a deal, be sure that you have concrete alternative options. Once you've agreed on final terms, be sure to get them in writing

- **5. Create a purchase order.** Fill out a purchase order (PO) and send it to the supplier. The PO should be sufficiently detailed to identify the exact services or goods needed and to enable the supplier to fill the order.

5. Receive and inspect the delivered goods.

Carefully examine deliveries for any errors or damage. Make sure everything is delivered as specified in the PO and that the quality meets or exceeds expectations.

7. Conduct three-way matching.

Accounts payable should conduct three-way matching by comparing the purchase order, order receipt or packing list and invoice. The goal is to ensure the goods or services received match the purchase order and to prevent payment for unauthorized or inaccurate invoices. Highlight any discrepancies between the three documents and resolve issues before arranging payment**.**

8. Approve the invoice and arrange payment. If the three-way match is accurate, approve and pay the invoice. Businesses should strive to have a consistent invoice payment process through accounts payable that checks that payments match the invoice amount and due date. A standardized process can help make sure invoices are always paid on time, which can prevent late fees and build good relationships with suppliers.

9. Recordkeeping. It's important to maintain records for the entire procurement process, from purchase requests to price negotiations, invoices, receipts and everything in between. These records may be useful for multiple reasons. They help the company reorder goods at the right price in the future, as well as assist with

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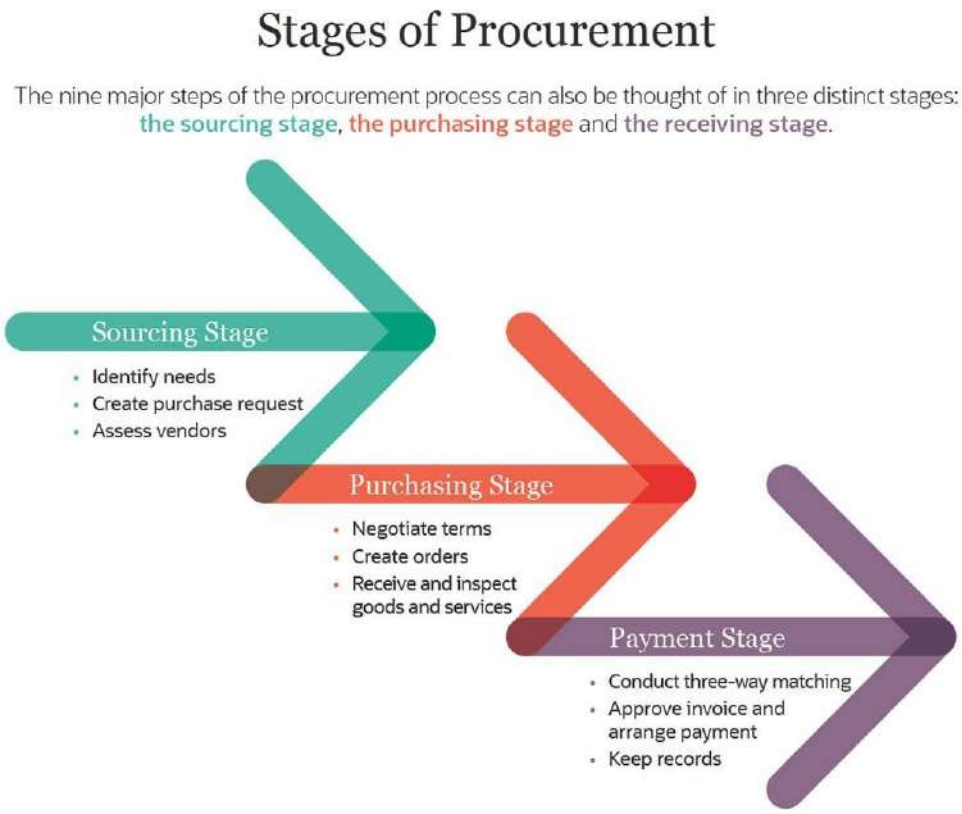
auditing processes and calculating taxes. Clear, accurate records can also help resolve any potential disputes.



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UNIT –III Designing Operations

Product design

It is concerned with form and function of a product. It refers to the arrangement of elements or parts that collectively form a product i.e. the shape and appearance of the product.

Importance of product design

- Detailed characteristics of each product.
- Process design and process technology.
- Design of the production system.

Objectives of product design

- The overall objective is profit generation in the long run.
- To achieve the desired product quality.
- To reduce the development time and cost to the minimum.
- To reduce the cost of the product.
- To ensure producibility or manufacturability.
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Factors influencing product design

1. **Customer Requirements**

- The designers must find out the exact requirements of the customers to ensure that the products suit the convenience for use.
- The product must be designed to be used in all kind of conditions

2. **Convenience of the operator or user**

The industrial products such as machines and tools should be designed that they are convenient and comfortable to operate or use.

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3. Trade-off between function and form

The design should combine should combine both performance and aesthetics or appearance with a proper balance between the two.

4. Types of material used.

Discovery of new and better materials can improve the product design.

Designers should keep in touch with the latest developments taking place in the field of materials and components.

5. Work methods and equipment.

Designers must keep moving with improvements in work methods, processes and utensils and can design the products to make use of the technology and manufacturing processes to achieve reduction in costs.

6. Cost /Price ratio

In competitive market, there is a lot of pressure on designers to design the products which are cost effective because cost and quality are inbuilt in the design.

7. Product quality

The product design partly depends on quality of design and partly on quality of conformance. The quality policy of the firm provides the necessary guidelines for the designers.

8. Process capability.

The product design should take into consideration the quality of conformance i.e., the degree to which the quality of design is achieved in manufacturing. This depends on the process capability of the machines and equipments**.**

9. Effect on existing products

New product designs while replacing existing product designs, must take into consideration the use of standard parts and components, existing manufacturing and distribution strategies and blending of new manufacturing technology with the existing one**.**

10. Packaging

Packaging is an essential part of a product

Packaging design and product design go hand in hand with equal importance.

Packaging design must take into account the objectives of packaging such as protection and promotion of the product**.**

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Approaches to product design

- **Designing for the customer**

- Designing for aesthetics and for the user is generally termed as industrial design.
- One approach is the voice of the customer into a design specification of a product is *quality function deployment.*
- The customer's requirements and the technical characteristics of the product are related to each other in a matrix called *house of quality.*
- The technical characteristics and the data are used to evaluate the strengths and weaknesses of the product in terms of technical characteristics.

Designing for manufacturing and Assembly (DFMA)

- The attitude of designers has been "We design it, you build it" which is termed as over the wall approach , where the designer is sitting on one side of the wall and throwing the design over the wall of manufacturing engineers. Concurrent engineering approach is used by manufacturing engineers.
- Concurrent engineering means bringing design engineers and manufacturing people together early in the design phase to simultaneously develop the product and processes.
- DFM is used to indicate the designing of products.
- DFA focuses on reducing the number of parts in a product or on assembly methods and sequence.

Designing for ease of production

- It is key way for manufacturers to be competitive in the world market.
- Three concepts which are closely associated to designing for ease of production are specification, standardisation and simplification.
- Specification is a detailed description of a material part or product, including physical measures such as dimensions, volume, weigh etc.
- Standardisation refers to design activity that reduces variety among a group of products or parts.
- Simplification of product design is the elimination of complex features so that the intended function is performed with reduced costs, higher quality and better customer satisfaction.

Designing forquality

- Building product quality into the product design is the first step in producing products of superior quality. This is known as quality of design and quality of conformance.
- Quality of design refers to the quality specifications incorporated in the design.
- Quality of conformance is the degree to which the product actually conforms to the design

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specification.

- Designing products for quality consists of three aspects of design.
- (a) robust design (b)design for production (c) design for reliability.

- **Design for robustness.**

Customers expect products to perform satisfactorily when used in all kinds of field conditions. A robust design is one that will perform as intended even if undesirable conditions occur either in production or in the field.

- **Designing for production**

This can reduce the sources of error and improve overall product quality. Modular design and designing for automation are two aspects of designing for ease of production.

- **Designing for reliability**

Reliability is the measure of the ability of a product, part or system to perform its intended function under a prescribed set of conditions. It is the probability that an item will function as planned over a given a time period.

Designing for ergonomics

- Ergonomics or Human Factor Engineering applies knowledge of human capabilities and limitations to the design of products and processes.
- Poorly designed products may cause work related accidents resulting in injuries to users.
- Hence, comfort, safety and use for the users are becoming more important.

Designing for environmental protection

- It includes designing for products which are environmental friendly known as **green designs**.
- A new approach called **universal design** is an example of product design in which an attempt made to design products that are easily operable by disabled persons.

Designing for recycling

- Recycling means recovering materials for further use.
- Recycling is done to achieve cost savings, and also to meet environmental concerns and regulations.
- Designing for recycling facilitates the recovery of materials and components in used products for reuse.

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Designing for disassembly

- This involves designing products which can be easily taken apart or disassembled.
- It includes fewer parts and less material and using snap-fits where possible instead of screws, bolts and nuts.

Designing for mass customisation

- It is a strategy of designing standardized products but incorporating some degree of customisation in the final product.
- Delayed differentiation and modular design are two tactics used to make mass customisation.
- Delayed differentiation is the process of producing but not quite completing, a product, postponing completion until customer preferences or specifications are known.
- Modular design is a form of standardization in which component parts are grouped into modules that are easily replaced or interchanged to produce varieties of same basic products.

Computer aided design and value engineering

- Computer aided design are used for computer graphics for designing the products that helps to generate a number of alternative designs and identify the best alternative which meets the designer's criteria.
- Value engineering concerned with the improvement design and specifications at various stages of product planning and development. It is otherwise known as value analysis.

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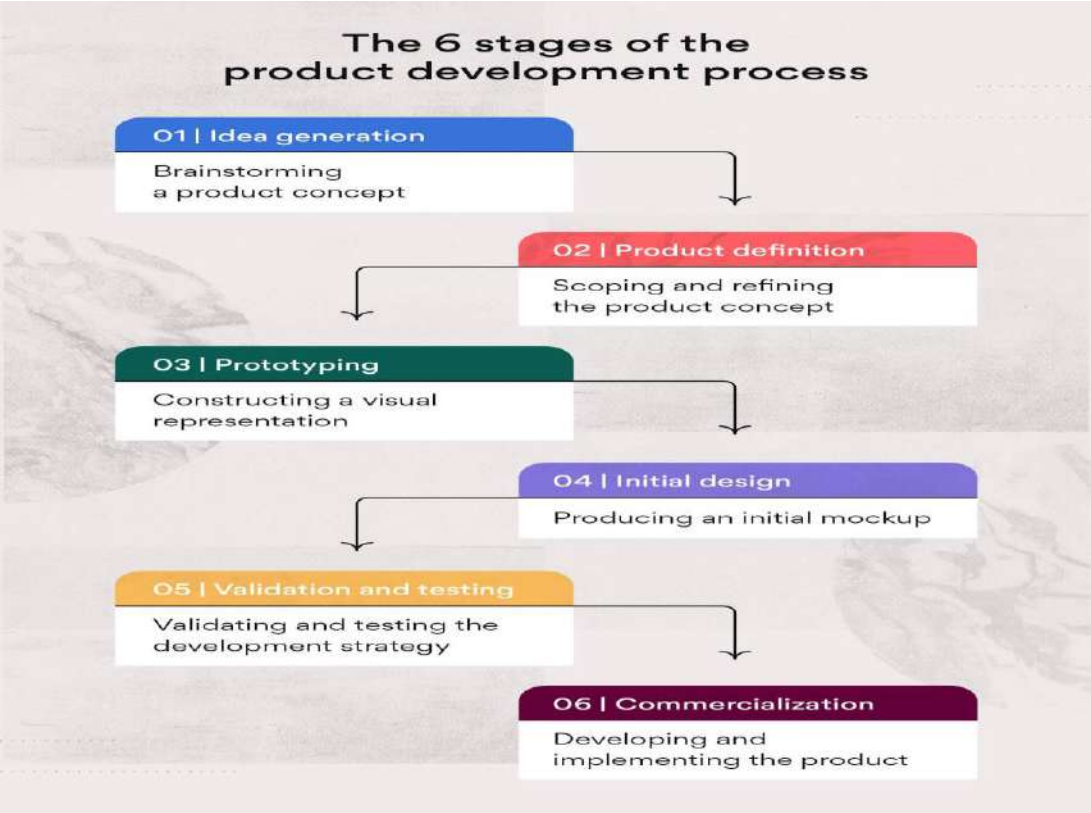

1. Idea generation (Ideation)

- The initial stage of the product development process begins by generating new product ideas. This is the product innovation stage, where you brainstorm product concepts based on customer needs, concept testing, and market research.
- It's a good idea to consider the following factors when initiating a new product concept:
- ***Target market*:** Your target market is the consumer profile you're building your product for. These are your potential customers. This is important to identify in the beginning so you can build your product concept around your target market from the start.
- ***Existing products*:** When you have a new product concept, it's a good idea to evaluate your existing product portfolio. Are there existing products that solve a similar problem? Or does a competitor offer a product that doesn't allow for market share? And if yes, is your new concept different enough to be viable? Answering these questions can ensure

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the success of your new concept.

- ***Functionality***: While you don't need a detailed report of the product functionality just yet, you should have a general idea of what functions it will serve. Consider the look and feel of your product and why someone would be interested in purchasing it.

- ***SWOT analysis***: Analyzing your product strengths, weaknesses, opportunities, and threats early in the process can help you build the best version of your new concept. This will ensure your product is different from competitors and solves a market gap.

- ***SCAMPER method***: To refine your idea, use brainstorming methods like SCAMPER, which involves substituting, combining, adapting, modifying, putting to another use, eliminating, or rearranging your product concept?

Product definition

- Once you've completed the business case and discussed your target market and product functionality, it's time to define the product. This is also referred to as scoping or concept development, and focuses on refining the product strategy.

- During this stage, it's important to define specifics including:

- ***Business analysis***: A business analysis consists of mapping out distribution strategy, ecommerce strategy, and a more in-depth competitor analysis. The purpose of this step is to begin building a clearly defined product roadmap.

- ***Value proposition***: The value proposition is what problem the product is solving. Consider how it differs from other products in the market. This value can be useful for market research and for developing your marketing strategy.

- ***Success metrics*:** It's essential to clarify success metrics early so you can evaluate and measure success once the product is launched. Are there key metrics you want to look out for? These could be basic KPIs like average order value, or something more specific like custom set goals relevant to your organization.

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- ***Marketing strategy***: Once you've identified your value proposition and success metrics, begin brainstorming a marketing strategy that fits your needs. Consider which channels you want to promote your product on—such as social media or a blog post. While this strategy may need to be revised depending on the finished product, it's a good idea to think about this when defining your product to begin planning ahead of time.

Prototyping

- During the prototyping stage, your team will intensively research and document the product by creating a more detailed business plan and constructing the product.
- These early-stage prototypes might be as simple as a drawing or a more complex computer render of the initial design. These prototypes help you identify areas of risk before you create the product.
- During the prototyping phase, you will work on specifics like:
- ***Feasibility analysis:*** The next step in the process is to evaluate your product strategy based on feasibility. Determine if the workload and estimated timeline are possible to achieve. If not, adjust your dates accordingly and request help from additional stakeholders.
- ***Market risk research*****:** It's important to analyze any potential risks associated with the production of your product before it's physically created. This will prevent the product launch from being derailed later on. It will also ensure you communicate risks to the team by documenting them in a risk register.
- ***Development strategy:*** Next, you can begin working through your development plan. In other words, know how you'll be assigning tasks and the timeline of these tasks. One way you can plan tasks and estimate timeline is by using the critical path method.
- ***MVP:*** The final outcome of the prototyping stage is a minimum viable product. Think of your MVP as a product that has the features necessary to go to launch with and nothing above what's necessary for it to function. For example, an MVP bike would include a

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frame, wheels, and a seat, but wouldn't contain a basket or bell. Creating an MVP can help your team execute the product launch quicker than building all the desired features, which can drag launch timelines out. Desired features can be added down the road when bandwidth is available.

- **Initial design**

- During the initial design phase, project stakeholders work together to produce a mockup of the product based on the MVP prototype. The design should be created with the target audience in mind and complement the key functions of your product.

- A successful product design may take several iterations to get just right, and may involve communicating with distributors in order to source necessary materials.

- To produce the initial design, you will:

- ***Source materials:*** Sourcing materials plays an important role in designing the initial mockup. This may entail working with various vendors and ordering materials or creating your own. Since materials can come from various places, you should document material use in a shared space to reference later if needed during the design phase to verify your initial design is on the right track. Share weekly or daily progress reports to share updates and get approvals as needed.

- ***Receive initial feedback:*** When the design is complete, ask senior management and project with stakeholders: It's important to keep tight communication ct stakeholders for initial feedback. You can then revise the product design as needed until the final design is ready to be developed and implemented.

- **Validation and testing**

- To go live with a new product, you first need to validate and test it. This ensures that every part of the product—from development to marketing—is working effectively before it's released to the public.

- To ensure the quality of your product, complete the following:

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- ***Concept development and testing***: You may have successfully designed your prototype, but you'll still need to work through any issues that arise while developing the concept. This could involve software development or the physical production of the initial prototype. Test functionality by enlisting the help of team members and beta testers to quality assure the development.
- ***Front-end testing***: During this stage, test the front-end functionality for risks with development code or consumer-facing errors. This includes checking the ecommerce functionality and ensuring it's stable for launch.
- ***Test marketing:*** Before you begin producing your final product, test your marketing plan for functionality and errors. This is also a time to ensure that all campaigns are set up correctly and ready to launch.
- **Commercialization**
- Now it's time to commercialize your concept, which involves launching your product and implementing it on your website.
- By now, you've finalized the design and quality tested your development and marketing strategy. You should feel confident in your final iteration and be ready to produce your final product.
- In this stage you should be working on:
- ***Product development:*** This is the physical creation of your product that will be released to your customers. This may require production or additional development for software concepts. Give your team the final prototype and MVP iterations to produce the product to the correct specifications.

Process

- A process is a sequence of activities that is intended to achieve some result, typically create added value for customers. A process converts inputs into output in a production system.

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- **Types of processes**

✓ Conversion processes

✓ Manufacturing processes

✓ Testing processes

➢ **Conversion processes**

Converting the raw materials into finished goods. The conversion process could be metallurgical or chemical or manufacturing or construction processes.

➢ **Manufacturing processes**

It can be categorised into three (1) forming processes (2) Machining processes.(3)Assembly processes

➢ **Testing processes**

It involve inspection and testing of products.

Process planning

- Processes planning is concerned with planning the conversion processes needed to convert the raw material into finished products. It consists of two parts.

1. Process design
2. Operations design

- **Process design**

➢ It is concerned with the overall sequence of the operations required to achieve the product specifications.

➢ It specifies the type of work station to be used, the machines and equipments necessary to carry out the operations.

➢ The sequence of operations are

✓ Nature of the product.

✓ Materials used

✓ Quantities to be produced

✓ Existing physical layout of the product.

- **Operations design**

➢ It is concerned with the design of the individual manufacturing operation.

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- It examines the man machine relationship in the manufacturing process.
- Operations design must specify how much labour and machine time is required to produce each unit of the product.

Process selection

- It refers to the way production of goods or services is organised.
- It is the basis for decisions regarding capacity planning, facilities layout, equipments and design of work systems.
- Process selection is necessary when a firm takes up production of new products or services to be offered to the customers.

Three primary questions

1. How much variety of products or services will the system need to handle?
2. What degree of equipment flexibility will be needed
3. What is the expected volume of output?

Process strategy

- It is organisation's approach to process selection for the purpose of transforming resource inputs into goods and services.
- The objective of a process strategy is to find a way to produce goods and services that meet customer requirement and product specification within the constraints of cost and managerial limitations
- Key aspects in process strategy
- Make or buy decisions
- Capital intensity
- Process flexibility

Make or buy decisions

It refer to the extent to which a firm will produce goods or provide services in-house or go for outsourcing (buying or subcontracting).

Capital intensity

It refers to the mix of equipment and labour which will be used by the firm.

Process flexibility

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It refers to the degree to which the system can be adjusted to changes in processing requirements due to such factors as changes in product or service design, changes in volume of products produced and changes in technology.

Three process strategies:

1. Process focus
2. Repetitive focus
3. Product focus

1. Process focus.

- Majority of global production is devoted to low volume, high variety products in manufacturing facilities called job shops. Such facilities are organised around performing processes.
- Process focused in terms of equipment, machines, layout and supervision. They provide a high degree of product flexibility as products move intermittently between processes.
- Each process is designed to perform a wide variety of activities and handle frequent changes. Such processes are called ***intermittent processes.***
- These facilities have high variable costs and low utilisation of facilities.

2. Repetitive focus.

A repetitive process is a product oriented production process that uses modules. It falls between product focus. It uses modules which are parts components prepared often in a continuous or mass production process.

3. Product focus

- It is facility organised around products, a product oriented, and high volume low variety process. It is also referred as continuous processes. Because it has very long continuous production run.
- The specialised nature of the facility requires high fixed cost, but low variable cost reward high facility utilisation

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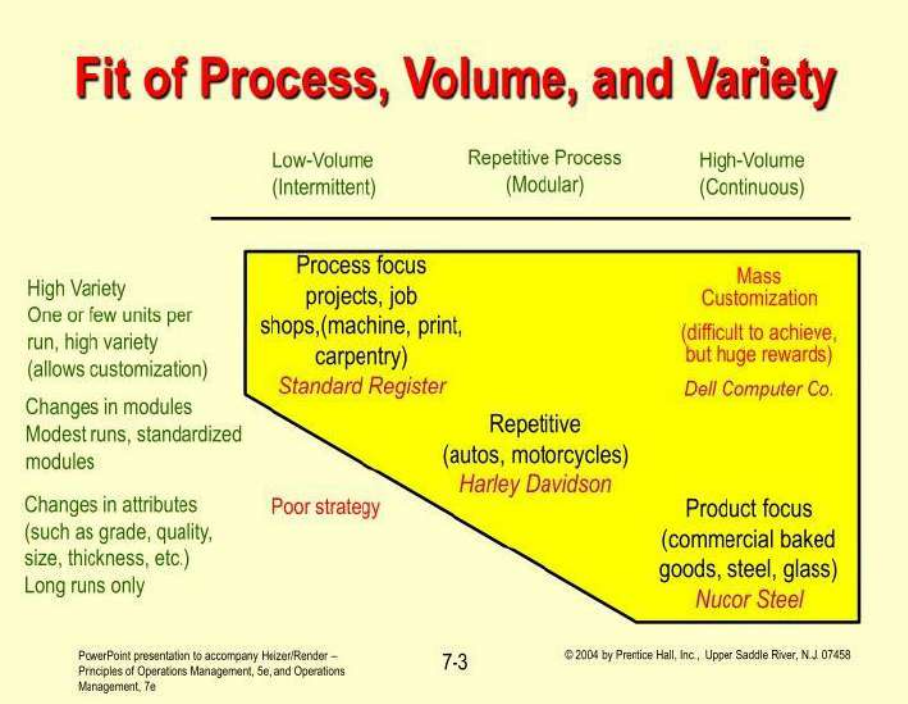

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Five common process decisions

(i) Process choice
(ii) Vertical integration
(iii) Resource flexibility
(iv) Customer involvement
(v) Capital intensity

Process choice

- It determines whether resources are organised around product or processes in order to implement the flow strategy.
- It depends on the volumes and degree of customisation to be provided.
- The production manager has to choose from five basic process types such as job shop process, batch process, repetitive or assembly line, continuous and project.

Vertical integration.

It is the degree to which a firm's own production system handles the entire supply chain starting from procurement of raw materials to distribution of finished goods.

Backward integrationwhich represent moving upstream toward the sources of raw material and parts.

Forward integrationin which the firm acquires the channel of distribution.

Resource flexibility

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It is the ease with which equipment and workers can handle a wide variety of products, levels of output, duties and functions. It means the flexibility of resources such as employee, facilities and equipment.

Customer involvement

It refers to the ways in which customers become part of the production process and the extent of their participation. The extent to which customer interact with the process.

Capital intensity.

It is the mix of equipment and human skills in a production process. Capital intensity will be high if the relative cost of equipment is high when compared to the cost of human labour.

It means the predominant resources used in manufacturing consist of machines and equipment rather than human labour.

Facility layout or Plant

Layout Meaning

Plant layout refers to the arrangement of machinery, equipment and other industrial facilities- such as receiving and shipping departments, tool rooms, maintenance rooms and employee amenities – for the purpose of achieving quickest and smooth production.

Definition

Planning and arranging manufacturing machinery, equipment, and services for the first time in completely new plants.

Objectives of Good Layout

1. Provide enough production capacity
2. Reduce material handling costs
3. Reduce congestion
4. Reduce hazards to personnel
5. Utilise labour efficiently

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6. Increase employee morale
7. Reduce Accidents
8. Use Available space efficiently and effectively
9. Provide for volume and product flexibility
10. Provide ease of supervision
11. Provide for employee safety and health
12. Allow ease of maintenance.
13. Allow high machine/ equipment utilisation
14. Improve productivity

Factors affecting Plant layout

1) **Building & Structure** :

Depend on type of production system(Intermittent / Continuous)

Intermittent System : Building & Shades are constructed & layouts done in shades with best possible options & then machinery will be brought inside.

Continuous System : Arrange machines first then construction around . It should withstand & offer support to cranes / hoists / trolleys etc.

2) **Men** : •

Number of people. • Unskilled (More space) / Skilled (Less space i.e. Computer operator).

Physic of workers (ex. height).

3) Machinery :

Type of machine:

• General purpose machines: Compact in size & requires less space.

• Special Purpose machines (SPM): Large in size , complicated, high level of automation.

• Number of machines:

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• Level of automation (Semi / fully automated)

• Higher complexity wider space.

4) Material

• Nature of material (Flammable / inflammable / Hazardous & Non

Hazardous, Corrosive, Methylene , mercury , oils , fuels)

• Form of material (Solid / Liquid / Powder etc)

• Quantity of material to be handled.

• Cycle Time: Consumption of material.

5) Movement :

• Movement of people / machines / cranes (length & frequency)

• Purpose of movement (With load / without load / Quantity of load)

6) Waiting Time:

• Cycle time for completing each activity.

• Intermittent –

• Uncertain & High.

• More storage places between machines & facilities.

Continuous –

• Defined & low.

7) Services and changes

Changes:

• Production Volume

• Product type & design

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• Process type

• Varieties

• Frequency of change (Ex 5 years)

Services:

• Electrical supply

• Pneumatic supply (Air supply)

• Water supply

• Chilling process – Cooling Tower

• Air ventilation –Ducting

• Fire extinguishers – Water sprinklers

Types of Plant layout

Functional Layout (Process Layout)

Line Layout (Product Layout)

Static Product Layout (Fixed Position)

Group Layout (Cellular Layout)

Combination layout (Hybrid Layout)

1) Functional Layout (Process Layout)

• Also called as process layout.

• Its best suited for intermittent type of operation.

• Machines on layout are called as general purpose machines.

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• It involves a grouping together of like machines in one section / dept.

Example: • Machines performing grinding operation are installed in grinding dept.

• Machines performing drilling operation are installed in drilling dept.
Heat Treatment / Painting etc.

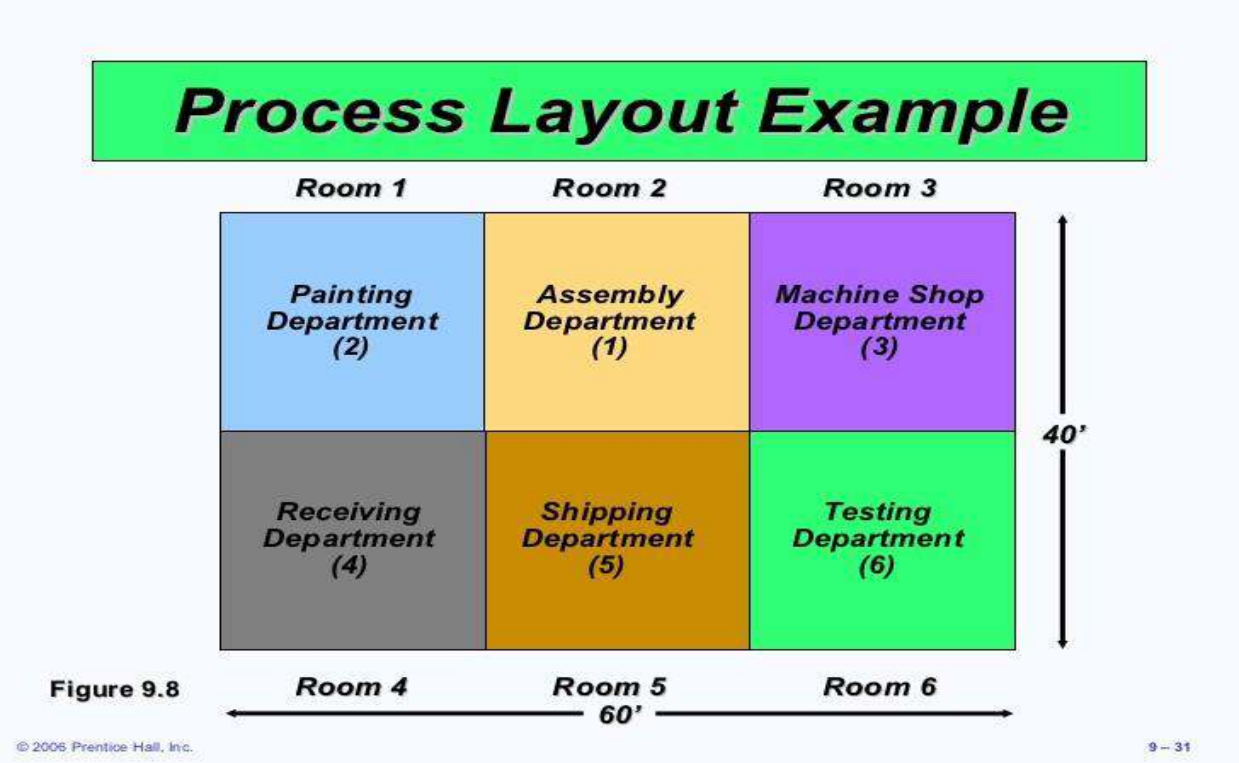

Figure 9.8

Advantages :

• Easy to handle machine breakdown by transfer of to another machine.

• Greater Scope for expansion.

• Investment on equipment will be comparatively low .

• Full utilization of equipment.

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Disadvantages :

• Requires more floor space.

• Difficulty in movement of material.
• Production control is difficult.

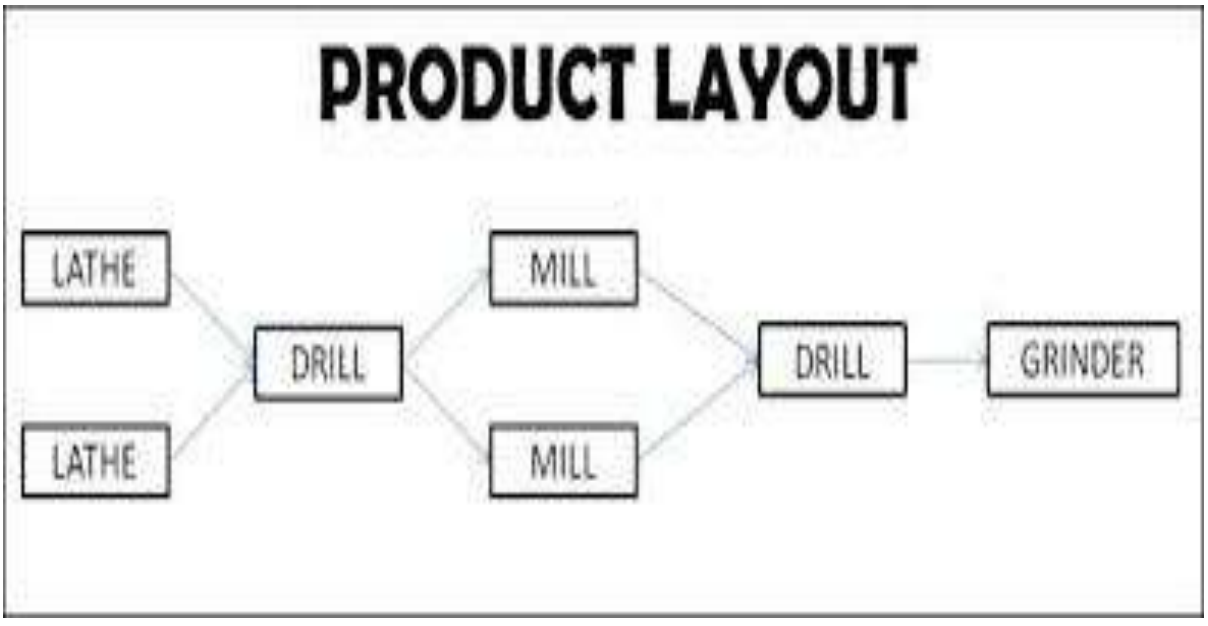
• High production time as material has to travel from place to place.

2. Line Layout (Product Layout)

It involves the arrangement of machines in one line , depending on operation sequence.

Raw material will be fed in first machine & final product will come out of last machine.

Output of one machine becomes input to next machine.



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Example :

Sugar refineries / Paper mills / Cement plants / Rolling mills.

Advantages :

• Smooth & regular flow of finished goods.

• Shorter processing time due to less travel , storage & inspection frequency.

• Reduced material handling.

• Low cost labors & lesser training requirement.

• Use of special purpose machines (SPM) ,automatic or semi automatic.

• Easy production control.

Disadvantages :

• Heavy capital investment.

• Non flexible layout.

Risk of total production line shutdown.

3) Static Product Layout (Fixed Position)

This type of layout involves the movement of men & machines to the product which remains stationary

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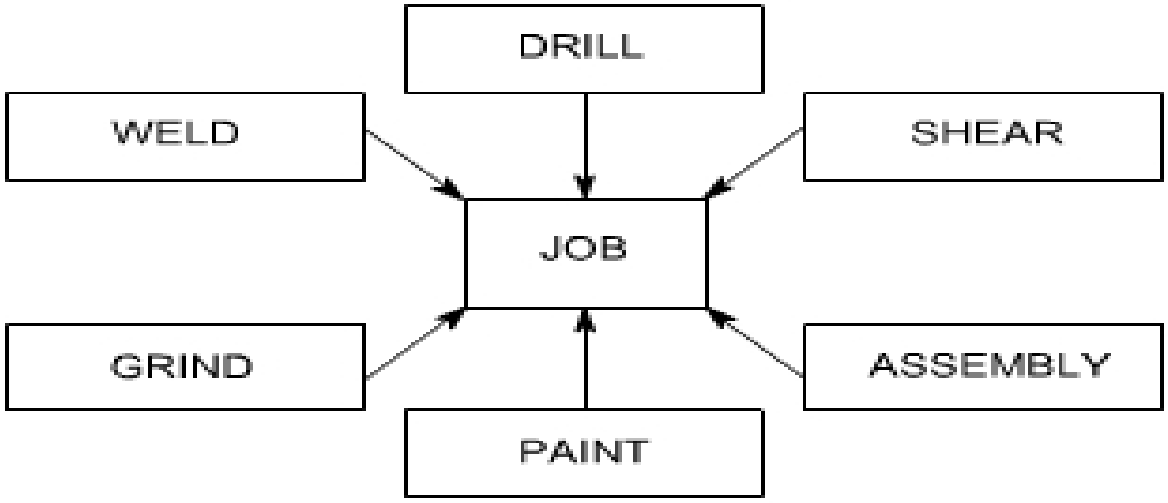

Advantages :

- The investment on layout is very small.
- The high cost & difficulty in transporting a bulky product are avoided.

Disadvantages :

- High cost of operation.
- Very high duration of project.
- Rework will be very costly.

4) Group Layout (Cellular Layout)

In cellular manufacturing layout the arrangement of a facility so that equipment used to make similar parts or families of parts is grouped together.

The group of equipment is called "cell "

The arrangement of cells is called a "cellular Layout "

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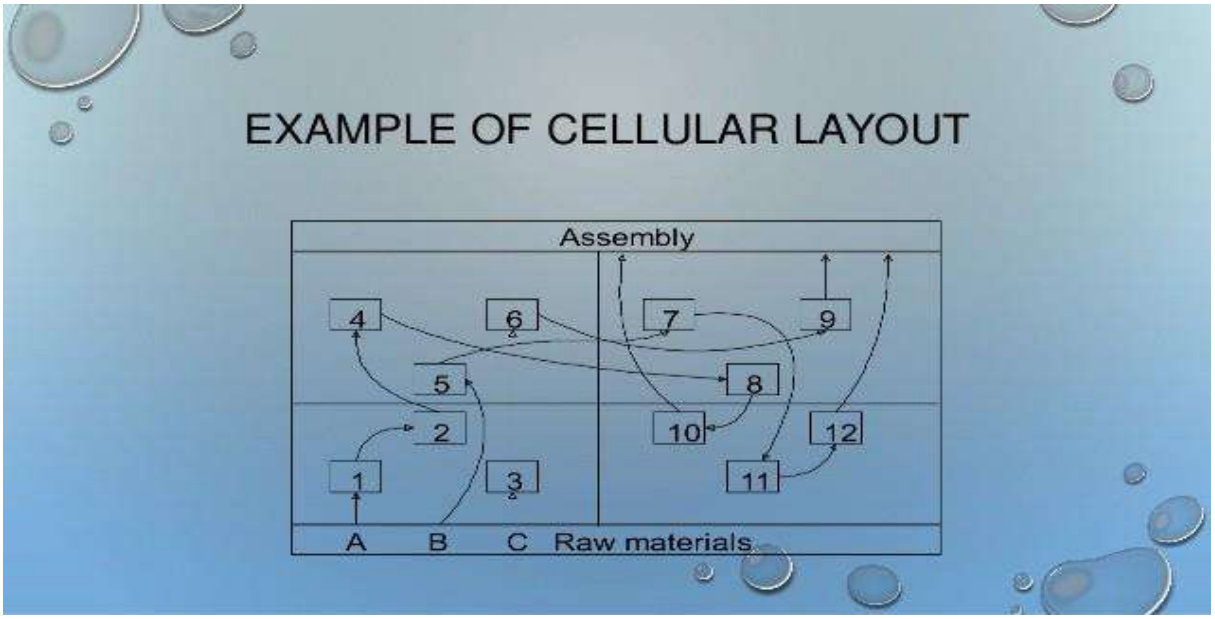

5) Combination layout (Hybrid Layout)

It is a combination of product & process layout with an emphasis on either .

In industries plants are never laid out in either pure form.

It is possible to have both types of layouts in an efficient combine form if the products are somewhat similar & not complex.

Fabrication of parts ----Process Layout Assembly of parts ----Product layout

Ex : Soap Manufacturing Machines ----Product line Process Layout ---------- Functional basis--- Ancillary services ---Heating / Manu of glycerine / power house / water treatment plant.

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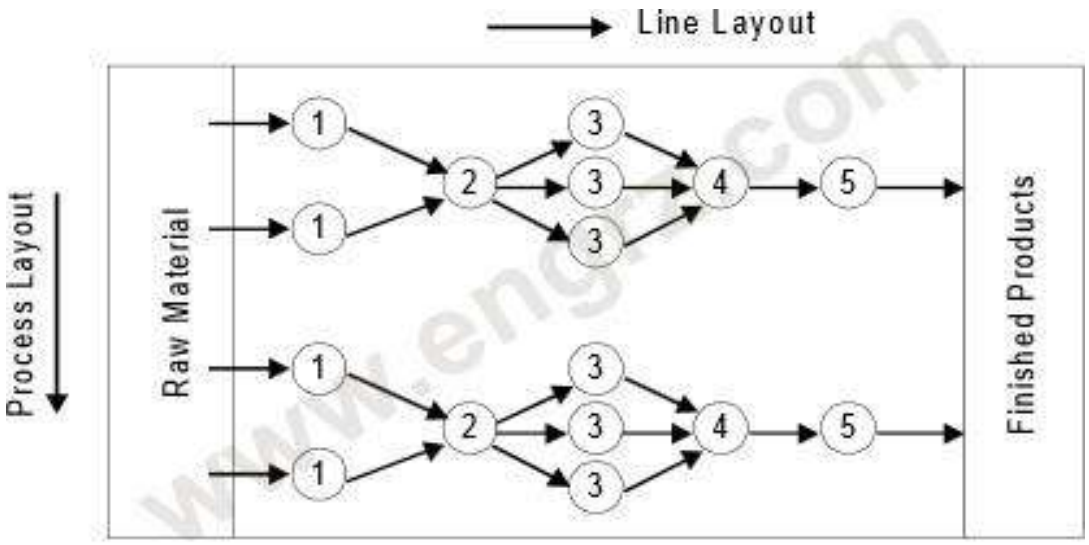

Fig. 2.4 Typical combination layout

Principles of facility layout

The principle of Minimum Travel

Men and materials should travel the shortest distance between operations so as to avoid waste of labour and time and minimise the cost of material handling.

Principle of Sequence

Machinery and operations should be arranged in a Sequential order. This principle is best achieved in product layout, and efforts should be made to have it adopted in the process layout.

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Principle of usage

Every foot of available space should be effectively utilised. This principle should receive top consideration in towns and cities where land is costly.

Principle of compactness

There should be a harmonious fusion of all the relevant factors so that the final layout looks well integrated and compact.

Principle of safety and satisfaction

The layout should contain built in provisions for safety for the workmen. It should also be planned on the basis of the comfort and convenience of the workmen so that they feel satisfied.

Principle of flexibility

The layout should permit revisions with the least difficulty and at minimum cost.

Principle of minimum investment.

The layout should result in savings in fixed capital investment, not by avoiding installation of the necessary facilities but by an intensive use of available facilities.

Layout tools and techniques

Templates

Plant layout template is a scaled representation of a physical object in a layout.

Templates are patterns which consist of a thin plate of wood or metal, which serves as a gauge or a guide in mechanical work.

Operations sequence analysis.

Operations Sequence analysis helps arrange departments graphically analysing the layout problems.

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Line balancing Line balancing is the study that nearly equally divides the work to be done among the workers and minimizes the number of employees required to complete a project.

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Unit – IV

Materials Management

Materials Management

Materials management involves organising, and co coordinating all management functions that are responsible for every aspect of materials, storage, and transformation.

Definition

Ammer defines it as the process by which an organisation is supplied with goods and services that it needs to achieve its objectives. The materials management begins with the supplier and ends when the material is either consumed or incorporated into some product.

Objectives of Materials Management

Optimum investment in inventory is the prime objective of materials management.

The main objective is to contribute to the achievement of organisation.

If, the contribution is direct, the objective may be called primary. If, the contribution is indirect the objectives may be called secondary. The ***primary objectives*** are

1. **Low Prices**: If the purchasing department reduces the prices of the items it buys, Operating costs are reduced and profits are enhanced. This objective is important for all Purchases of materials and services including transportation.
2. **High Inventory Turnover**: When inventories are low in relation to sales, less capital is tied up in inventories. This in turn, increases the efficiency with which, the company's capital is utilized, so that, return on investments is higher. Also, storage and carrying costs of inventories are lower when turnover is high.
3. **Low cost Acquisition and Possession**: Acquisition and possession costs are low when the receiving and stores departments operate efficiently.
4. **Continuity of supply**: It is particularly important for highly automated processes, where, costs are rigid and must be incurred even when production stops because of unavailability of material.
5. **Consistency of quality**: When materials purchased are homogenous and in a primitive stage (e.g. sand, gravel), quality is a problem for purchasing personnel. When a variety of items of different qualities are needed and meeting rigid specifications becomes a challenge to

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suppliers. Quality may become the single most important materials management objective.

6. **Low Payroll Costs**: The lower the payroll the higher the profits-all other factors being equal. The objective of low payroll costs is common to every organization.
7. **Favourable Supplier Relations**: Maintaining cordial relations with suppliers' benefits buying company in more than one way.
8. **Development of Personnel:** Each department head should spot the potential leaders among the men and women employed in his department and encourage them to develop into future executives, and the company's future profits will depend on the talents of its managers.
9. **Good Records:** Good records are considered a primary objective of materials management.

The ***secondary objectives*** of materials management. Since they represent the materials management's contribution to the achievement of primary objectives of some other departments, they can vary widely from industry to industry.

1. **Reciprocal Relations:** When a company deliberately buys as much as possible from its own customers, it is said to practice reciprocity

2. **New Materials and products:** Engineering and manufacturing managers are always interested in new products and materials that will help them more efficiently and achieve one of their primary objectives.

3. **Economic Make-or-buy:** Make-or-buy decisions are generally made by committees consisting of departmental heads. The purchasing manager should spot the need for a make-or-buy decision and refer it to the committee for action.

4. **Product Improvement:** The engineering department can supplement the technical skills of the engineers on Programs to boost the profits through product development.

5. **Interdepartmental Harmony:** Most materials managers are aware of the need for good inter-departmental relations

6. **Forecasts:** In large companies, professional economists make forecasts that are used for both sales and purchase planning. Purchasing managers translate these general forecasts into specific forecasts for purchased materials.

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7. **Acquisitions:** Business acquisitions and mergers are common. Acquisition is taken as one of the ways of business expansion.

MATERIAL PLANNING

Materials planning is the scientific way of determining the requirements of raw Materials, components, spares and the other items that go into meeting the production needs Within economic investment policies. Material planning is one part of overall production planning.

FACTORS INFLUENCING MATERIAL PLANNING

MACRO FACTORS

1. Price trends
2. Credit policies
3. Government policies
4. Technology
5. Business cycle

MICRO FACTORS

Corporate policies
Availability
Working capital
Corporate capabilities
Plant location
Demand forecasting accuracy
Seasonal factors
Availability of substitute materials
Delegation of powers

IMPORTANCE OF MATERIAL PLANNING

- Improper planning leads to over ordering or under ordering of materials.
- Poor planning leads to rush order or create emergency.
- Planning enables firm to spend money optimally.

- Good planning aims at motivating people and increases the effective utilization of materials.

BENEFITS OF PLANNING

- Helps in effective material budgeting.
- Helps in proper purchase planning.
- It adds value to material management.
- Results in effective utilization of materials.

Guidelines for a good material planning:

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- Computerization of the materials is advisable. So it can handle various difficult situations.
- Computerized results in savings in time and cost, gives accurate forecast.

  Quarterly plans are advisable.
- Planning should cover longest lead time anticipated.

MATERIAL BUDGETING

- Material budgeting is an estimate of expenses to be incurred in the procurement of materials and it helps in effective execution and control of material plans.
- Process of preparing purchase budget or material budget in terms of quantity, quality and money value of materials to be procured for a given period of time is called "Material budgeting".

FACTORS/BENEFITS OF BUDGET

FACTORS

1. Inventory in order
2. Inventory in transit
3. Material required
4. Inventory Norms
5. Forecasted price of materials.
6. Fund allotted for material purchase
7. Logistics available
8. Inventory in hand

BENEFITS

- Budget helps to reduce risk involved in inventory management.
- It improves maximum purchasing lead time.
- It helps in proper and good overall firm's budget.

Benefits of Material Budgets

1. When a material budget is to be expressed in terms of rupees, the purchase manager has to provide the budget department with two types of information
   (i) Estimate of material prices during to coming year.
   (ii) Plans for the specific timing of purchases.

2. In purchasing, reasonably precise knowledge of materials requirements over an extended period of time facilitates forward buying and permits the advantageous use of contract purchasing and blanket order purchasing techniques.

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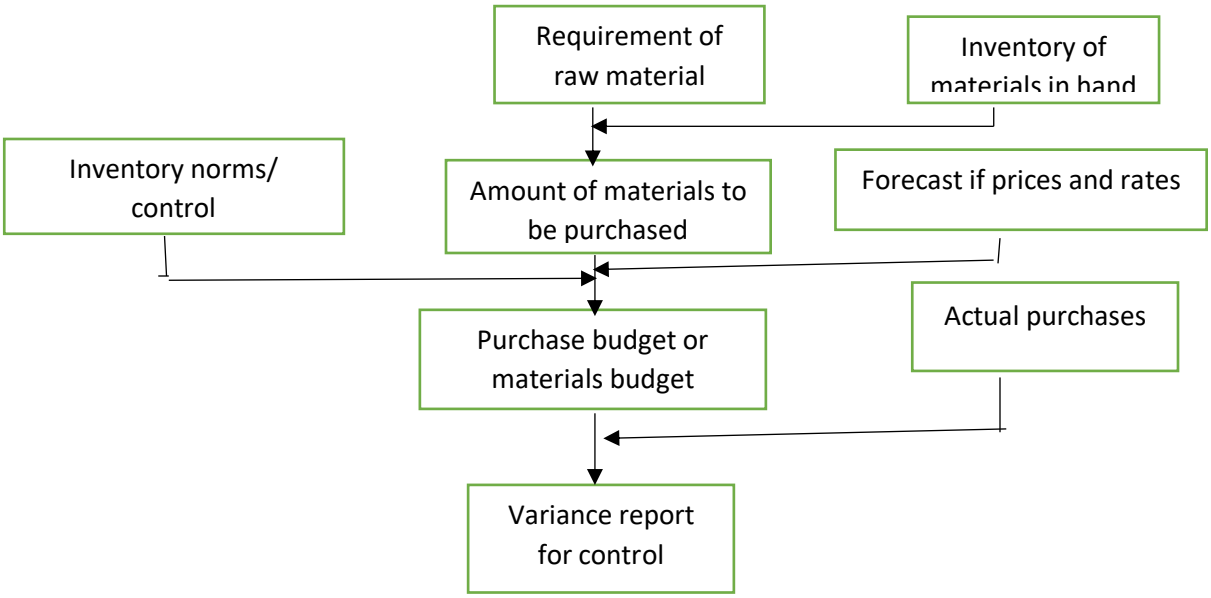
3. Inventory investment and its associated risks can be reduced by advance planning of material requirements.

4. It also provides maximum purchasing lead time.

5. Supplier relationships can be improved and costs can be reduced because of availability of time to most purchasing requirements with the supplier's production schedule more effectively.

Process of preparing Material Budget



MATERIAL CONTROL

The function of maintaining constantly available supply of raw materials purchased Parts and supplies that are required for the manufacture of products is called "material Control".

Material control includes requisition of materials for purchase for economic cost and quality in right time, and its receipt, storage and production, issuing of materials to production upon authorized request and maintaining and verifying inventory records.

Materials Control Cycle

Material Control cycle comprises all procedures which are necessary for the provision of materials for the manufacturing process with minimum investment and lowest possible costs.

A knowledge of this cycle is fundamental to an understanding of the principles and practice of material control.

The steps of material cycle are as follows.

1. Determining material needs.

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2. Preparing requisitions for purchase items and requests for work orders for parts made in the shops.
3. Receiving materials purchased and finished parts into the plant.
4. Inspecting purchased material and parts and inspection of finished shop made parts.
5. Delivering all parts and materials to the stores for storage.
6. Entering receipts in stores records.
7. Issuing of parts and materials to the shop for production and assembly.
8. Recording the issue in store record.
9. Entry of receiving and issuing transactions to cost and accounting records
10. Determination of necessity for replacement of stores which leads to step number one and the cycle repeats.

PURCHASING:

Definition: The term 'purchasing' refers to the act of buying an item at a price.

Purchasing makes it a managerial activity, which goes beyond the simple act of buying and includes the planning and policy activities covering a wide range of related and complementary activities.

According to LEVIS, "Purchasing is the acquisition of the manufacture of any necessary primary material suppliers, equipment by any method whatsoever."

"The objective of the purchasing function is to ensure continuity of supply of raw materials,

Sub-contracted items and spare parts and at the same time reduce the ultimate cost of the finished goods."

The different objectives of purchasing are:

1. Purchasing items with right price
2. Purchasing items with right quantity
3. Purchasing items at right time so that the items are available when needed
4. Purchasing items from right source
5. Purchasing items of right quantity

Purchasing Objectives are:

- Buying raw materials of the right quality, in the right quantity, at the right time, at the right price, and the form the right source.

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The **specific objectives** of purchasing are:

- To pay reasonably low prices for the best values obtainable, negotiating and executing all company commitments.
- To keep inventories as low as possible to be consistent with maintaining production.
- To develop satisfactory sources of supply and maintain good relations with them.
- To secure good vendor performance including prompt deliveries and acceptable quality.
- To locate new materials or products as required.
- To develop good procedures, together with adequate controls and purchasing policy.
- To implement programs as value analysis, cost analysis, and make-or-buy to reduce cost of purchases.
- To achieve a high degree of co-operation and co-ordination with other departments in the organization.

Importance of purchasing

- All production firms have the need of supplies of materials and services from external sources. This makes purchasing, one of the most significant functions of any Production Manager. Purchasing function may include the purchase of Raw Materials.
- In simple words, Purchasing is the act of exchange of goods is the act of exchange of goods and services for money or money's worth.
- Purchasing function provides materials to the factory without which of Machines cannot move.
- A 1% saving in materials cost is equivalent to a 10% increase in turnover. Efficient buying can achieve this.
- Increasing proportion of one's requirements is now bought instead of being made as was the practice in the earlier days. Buying assumes significance.
- Purchasing can contribute to import substitution and save foreign exchange. •Purchasing is the main factor in timely execution of industrial projects.
- Materials management organizations that exist now have evolved out of purchasing department.

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- The stream of salesmen and direct mail advertisement entering the purchasing department day-in and day-out brings information about new products, materials and new ways of doing old jobs.

- Other factors are: cyclical swings of surpluses and shortages and the fast rising materials cost, heavy competition and growing world-wide markets have contributed to the importance of purchasing.

PURCHASING: FUNCTIONS The functions of purchasing are:

1. Evaluating and rating suppliers 2. Selection of suppliers
3. Finalization of terms of purchase 4. Placement of purchase orders
5. Follow-up 6.Approval of payments to suppliers.

1. **Responsibilities often fully delegated to the purchasing function:**

- Obtaining prices. •
  Selecting vendors.
- Awarding purchase orders.
- Following up on delivery promises.
- Adjusting and settling complaints.
- Selecting and training of purchasing personnel. •
  Vendor relations.

2. **Responsibilities often shared with functions other than purchasing function:**

•Obtaining technical information and advice.

•Receiving sales presentations and arranging for sales opportunities with interested personnel.

- Accounting
- Purchasing and market research.

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3. Responsibilities often divorced from purchasing:

•Receiving and warehousing

•Payment of invoices.

•Other functions.

PURCHASING: POLICIES

1. **Forward buying**: The purchasing decision for a period (say 1 year) will be taken in advance and the organization will commit accordingly in terms of order quantity, rate and delivery schedule, by taking into consideration the availability of funds and the requirements.

2. **Tender buying**: The steps are preparing bidder's list, advertising tenders, receiving bids, evaluating bids and placing order with the bidder with the lowest cost.

3. **Blanket ordering system**: The organization will enter into an agreement with its suppliers to receive items for a required quantity at a particular rate over a period of time. Buyer issues an order covering the requirement of a small item for one year. The order is relevant for one year.

Blanket orders are useful because:

- Paper work is reduced.
- Time of buyers is saved
- Facilitate price negotiation because one order covering a year's requirement is placed once and
- Facilitate inventory contract of small items

Stockless Buying

- It also called 'systems contracting'; stockless buying is a special type of blanket order.
- In stockless buying stock of items are kept in buyer's plant, ownership of the stock being with the supplier.

4. **Zero Stock**: This purchase system is in-line with using the just-in-time manufacturing system. The main idea of this system is to operate the plant with near zero inventories. If the suppliers are situated nearer to the company, they are more reliable in terms of making supply in time. The company can place orders with such suppliers.

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5. **Rate Contract:** Is very much used in public sectors and government departments. The suppliers are on 'rate contract' with DGS&D for a specific period. The organizations can place orders straightaway with such firms without going through the lengthy procedure of purchasing.

6. **Ancillarisation:** When a company decides to buy a component from outside suppliers, it is usually sub-contracted. Sub-contracting is the work of obtaining the prime manufacturer's requirements, mostly of fabricated parts and components, from outside sources in order to manufacture a certain product in the manufacturer plant. Ancillarisation results in spread of entrepreneurial base. It promotes industrial development.

7. **Make-or-buy decision**: It is deciding whether a part should be purchased or manufactured. There are three types of make-buy problems:

1. Making or buying something which it never before procured. 2.
   Making something which it is now buying.
3. Buying something which it is now making.

8**. Speculative buying**: Speculative buying is done with the hope of making profit out of price changes. Two types of Speculative buying may be distinguished:

Purchasing department buys certain items at low prices and sells the same when their prices shoot up, thus making profit in the bargain.

It is conducted by some purchasing departments- it involves the purchases of material in excess of foreseeable requirements in anticipation that a need will arise for the material and that firm will profit by making the purchase at the current price.

Vendor rating

Vendor rating is a process of rating a supplier based on some rating techniques. The Hallmark of an effective purchase department is the quality of suppliers selected. The purchaser's prime interest lies in getting the best value from his suppliers. This implies that he should be in a position to assess and rate their performance against what is expected from

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an ideal supplier. The absolute standard is difficult to define with exactness but there should be some method for evaluating suppliers and grading them. An objective and accurate vendor rating can become an asset and valuable tool in the hands of a buyer in making his purchase decisions as also providing feedback to suppliers with low rating to encourage improvement in their performance.

There are various rating criteria such as

1. Discounts received
2. Price
3. Compliance with other specifications
4. Installation cost
5. Market information
6. Credit terms
7. Maintenance of Specifications
8. Promptness of delivery.
9. Service
10. Co-operation
11. Management Competence
12. Disposition of rejects,

Employee training, Adjustment Policies, Cost reduction suggestions, Inventory Plans, Financial Position.

There are different methods in evaluation of suppliers such as

1. **Categorical method**: Personnel maintain informal evaluation records
2. **Weighted point method**: The performance factors to be evaluated by giving weights.
3. **Cost ratio method**
4. **Critical Incidents method**: It is based on buyer-vendor relationship
5. **Checklist system**: Buyers checklist for evaluating vendors are:

1. Reliability.
2. Technical Capabilities.
3. After-sale Service.
4. Availability
5. Buying Convenience.
6. Sales Assistance

Value Analysis

- Also called as value engineering.
- Value analysis is an important activity that typically occurs jointly between purchasing and methods engineering.
- This activity is aimed at modifying the specifications of materials, parts and products to reduce its costs while reducing their final function.

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- Focus is placed on the value of the product – what function is to be performed by the product and how that value can be achieved at the lowest cost.
- Although value analysis is applied to all phases of the production process, primary attention is devoted to the materials and components going into the product.
- Value Analysis has wide acceptance as it offers increased value of a product without increasing its cost or reducing the usefulness of the product. It is applicable in manufacturing processes; organizations have been focusing on finding alternative materials in the place of the present materials.

STORES MANAGEMENT – NATURE

- Store as building is a place, where inventories are kept.
- Store is defined as a place for goods. Storage/storekeeping is defined as the act of storing the goods.
- The store is used to cover all aspects of preservation of goods i.e. building, supplies and the act of storing.
- Stores or Storage is the function of receiving, storing and issuing materials. It involves supervision or the clearance of incoming supplies, to ensure that they are maintained in good condition, safely and in readiness for use when required while they are in storage and issuing them against authorized requisitions.
- In short, it is connected with the physical handling and well-being of the stocks.

Importance / Functions of Stores Management

Stores ensure ready accessibility of major materials, there-by efficient service to users.

Efficient storage of stores yields the following benefits:

1. Ready accessibility of major materials permitting efficient service to users.
2. Efficient space utilization and flexibility of arrangement.
3. A reduced need for materials handling equipment.
4. A minimization of materials deterioration and pilferage.
5. Ease of physical counting.

Functions:

Minimization of stores cost, and continuous supply is the prime function of stores.

Stores Layout - Principles of Store Layout:

Stores layout is proper placement of materials and storeroom equipment. It may broadly include the stores, the shelves, racks or other appropriate equipment and proper placement of materials with sufficient space for material handling and labour movement. An efficient layout of the store should serve the following objectives:

- Reduced investment in shelves, racks or other equipment.

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- Reduced operating expenses by minimizing the movements of materials and thereby
- Reducing the internal transportation cost.
- Increased flexibility
- Increased safety of workers and materials
- Easy accessibility and good house keeping
- Convenience of traceability
- Suitability to the nature and the volume of materials.
- Maximum utilization of floor space.

Stores Layout is a fundamental factor in determining the efficient performance of the stores department. Two aspects of Stores Layout are significant:

1. Storage System.

2. Type of stores layout.

Storage System: A Satisfactory storage system compromises between the use of space and the use of time. There are three ways of locating stock: Fixed location, random location and Zoned location.

- **Fixed location:** means that, goods of a particular type have a position in the store assigned to them exclusively. It means while stock can be found immediately without a complex searching process, there can be considerable waste of space, because when stocks of any one item are low the space left vacant cannot be filled.

- **Random location:** Means that item can be stored in any storage position which is available.

- **Zoned location**: Means those goods of a particular product group are kept in a given area. They may be randomly stored in a zoned location or stored according to the fixed location.

Types of Stores Layout

- Whatever the location followed, stock may be kept on one side of the aisle in which case it is called comb type layout.
- Or goods may be placed on either side of the aisle in which case the method is called tree layout.
- Selecting a particular type depends on the availability of space and the layout of the building.

Comb type Layout

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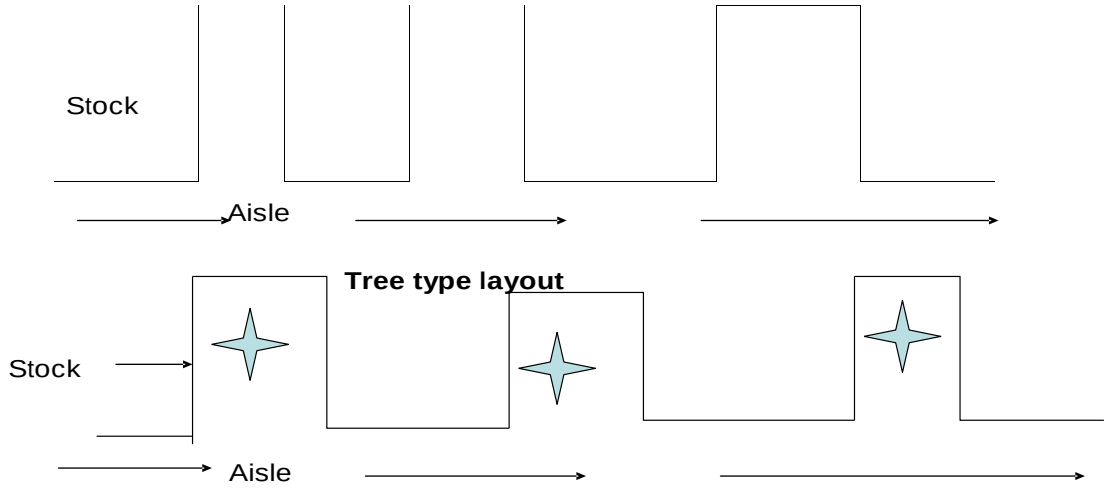

Stores-Manual, Stores Efficiency

Manual is a written statement of policies and procedures.

Stores are the repository of inventory worth crores of rupees.

The store-keeper's performance can be measured objectively through quantitative techniques.

(i) **Stores efficiency index**=

No. of requisitions delivered on time

total number of requirements.

(ii**) Storage loss index** =

Value of inventory lost due to deterioration, obsolescence's and pilferage.

Average value of inventory

(iii) Obsolescence index =

Value of non-moving items

Total inventory value

(iv**) Space Utilization Index** =

Area used for storage

Total storage area available

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Classification and Coding

Classification: Classification will be of great value in material and component standardization. Classification aims at systematically grouping together items, based on their common features and subdividing them by their special features. A system of classification and codification is necessary for the design of new products within the defined range. Classification and codification enables reduction in sizes and varieties

Such systems should readily

- Identify and locate identical items.
- Facilitate the use of standard items in new designs. •

  Identify substitutes in case of stock outs.
- Help to develop group technology which will be of more use in designing layout facilities.
- Aid to improve parts location in the store

Advantages of Classification and Codification

Good store-keeping requires proper classification and codification of various items stored in the stock. The advantages of proper classification and codification are:

1. Systematic grouping of similar items for correct identification of each and every item
2. Long descriptions are simplified and confusions avoided
3. Avoids duplication of stocks of the same item
4. Enables reduction in size and varieties
5. Helps in standardization of materials
6. Used as a basis for setting up different stores
7. To arrange bin cards, stores record, accounts and inventory ledger in an uniform manner
8. Ensure accuracy in correspondence

Principles of Classification and Codification

- Consistency in classification and codification
- **Comprehensive**: cover all items and allow reasonable scope for extension
- **Mutual exclusiveness**: One code for one item **Simple**: Understood by a layman and be self-explanatory

Methods of Classification and Codification

Stores are classified based on its nature or usage. Based on nature, stores are classified into:

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- Raw materials
- Components
- Consumable stores
- Spare parts
- Tools
- Packing materials
- Work-in-process
- Finished goods
- Hardware

  Motors
- Gear box
- CKD – Completely Knocked Down items

Inventory Management

The term 'inventory' includes raw material, work-in- progress, finished goods, stores and spares.

DEFINITION: The term includes following categories of items:

- **Production Inventories**: Raw materials, parts, and components which enter the firm's product. These may consist of two general types- (a) Special items manufactured to company specifications. (b) standard industrial items purchased 'off the shelf'

- **MRO Inventories:** Maintenance, Repair, and Operating supplies which are consumed in the production process but which do not become part of the product. (e.g., lubricating oil, soap, machine repair parts).

- **In-process Inventories**: Semi-finished products found at various stages in the production operation.

- **Finished goods Inventories**: Completed Products ready for shipment

Objectives of inventories

- The primary Objective of inventory management is to ensure continuous supply of raw materials and facilitate uninterrupted production.
- Inventory facilitates transit and handling.
- Inventories serve to isolate the supplier, the producer and the consumer.
- It permits the procurement of raw materials in economic lot sizes as well as processing of these raw materials into finished goods in the most economical quantities.

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- Isolating- also called decoupling, of producer from supplier, one production department from another, and consumer from producer is necessary for two reasons viz.
- Is to reduce dependencies of one another.
- To enable each organization to schedule its operations independently of another.

Inventory-costs

- Inventory costs includes ordering cost and carrying costs.
- Inventories cost money.
- Inventory cost includes ordering cost, carrying cost, out of stock or shortage cost, and capacity cost.

1. Ordering cost:

(**a)Cost of placing an order with a vendor of materials**:-
(i) Preparing a purchase order.-
(ii) Processing payments.-
(iii) Receiving and inspecting the material.

(b)Ordering from the plant:
(i) Machine set-up.
(ii) Start-up scrap generated from getting a production run started

2. Carrying costs:
A. Costs connected directly with materials:

(i) Obsolescence-(A loss in the utility of an asset due to the development of improved or superior equipment, but not due to physical deterioration).

(ii) Deterioration-(The process of growing worse, or the state of having grown worse).

(iii) Pilferage- (the act of stealing small amounts or small articles).

B. Financial Costs:

- Taxes
- Insurance
- Storage
- Interest (as the cost of capital borrowed to acquire and maintain the inventories).

C. Capital costs:

➢Interest on money invested in inventory.

➢Interest on money invested in land and building to hold inventory.

➢Interest on money invested in inventory holding and control equipment. ➢Storage Space costs

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- Inventory Service Costs.
- Handling- equipment Costs.
- Inventory Risk Costs

3. Out-of-Stock Costs:

A. Back Ordering

B. Lost Sales.

4. Capacity Costs:

A. Overtime Payments when capacity is too large.

B. Lay-offs and idle time when capacity is too low.

PROCESS OF INVENTORY MANAGEMENT AND CONTROL

It refers to the planning for optimum quantities of materials at all stages in the production cycle and evolving techniques which would ensure the availability of planned inventories.

Four steps are involved:

1. Determination of optimum inventory levels and procedures of their review and adjustment.
2. Determination of the degree of control i.e. required for the best results.
3. Planning and design of the inventory control system.
4. Planning of the inventory control organization.

1. Determination of optimum inventory levels

- Too much of inventory results in locking up of working capital accompanied by Increased carrying costs (but reduced ordering costs).
- Too less of inventory releases working capital for alternative uses and reduces carrying costs and increases ordering costs.
- To overcome this problem-The trend of sales must be watched closely and inventories adjusted in advance of the change in rate of production as determined by actual sales.
- The actual level of the inventory may also be improved by a close study of the manufacturing cycle.

2. Determination of the degree of control

The second aspect of inventory management is to decide just how much control is needed to realize the objectives of inventory management.

- ABC classification approach is useful in deciding the degree of control.

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- 'A' class items are 'high' in value but 'low' in quantity, 'C' class inventories are the opposite of 'A' group, i.e., 'high' in quantity and 'low' in value.
- In between 'B' group stock which are more or less equal in quantity and value proportion to the total inventory.

3. Planning and design of the inventory system

- An inventory system provides the organizational structure and the operating policies for maintaining and controlling goods to be stocked.
- The system is responsible for ordering and receipt of goods, timing the order placement, and keeping track of what has been ordered, how much, and from whom.

INVENTORY CONTROL TECHNIQUES

Inventory control techniques are employed by the inventory control department within the framework of one of the basic inventory models:

- Fixed Order quantity system or Fixed order period system.
- Inventory control techniques represent the operational aspect of inventory management and help to realize the objectives of inventory management and control.
- Several Techniques of inventory control are in use and it depends on the convenience of the firm to adopt any of the techniques
- Commonly used techniques

Always Better Control (ABC) classification.
High, Medium and Low (HML) classification.
Vital, Essential and Desirable (VED) classification.
Scarce, Difficult and Easy to obtain (SDE)
Fast moving, Slow moving and Non-moving (FSN).
Economic Order quantity (EOQ)
Max-minimum system
Two bin system.

ABC analysis

- The objective of ABC control is to vary the expenses associated with maintaining appropriate control according to the potential savings associated with a proper level of such control.
- ABC inventory control technique divides inventory into three categories A,B and C based on their annual consumption value. (acc. to the potential amount to be controlled.)
- ABC analysis is often called the Selective Inventory Control Method (SIM).

HML CLASSIFICATION

In this classification, Unit value is the criterion and not the annual consumption value. The items of inventory should be listed in descending order of unit value and it is up to management to fix the limits for three categories:
Rs.2000 and above-H items.

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Rs.1000 to 2,000 – M items.
Less than Rs.1,000- L items.
The HML analysis is useful for keeping control over consumption at departmental levels, for deciding frequency of physical verification, and for controlling purchases.

VED classification

- On the basis of Vital, Essential and Desirable categorization.
- For 'V' items, a large stock of inventory is maintained.
- 'E' items are stocked in moderate quantity
- 'D' items minimum stock is enough

SDE CLASSIFICATION

- 'S' Refers to 'scarce' items, generally imported, and those which are in short supply.
- 'D' refers to difficult items which are available indigenously but are difficult items to
- procure, items which have to come from distant places.
- 'E' refers to items which are easy to acquire and are available in the local markets. The SDE Classification is based on problems faced in procurement and is vital to lead time analysis and in deciding on purchasing strategies

FSN CLASSIFICATION

- FSN stand for Fast moving, Slow moving and non-moving.
- The Classification is based on the pattern of issues from stores and is useful in controlling obsolescence.
- It is useful in identifying active items which need to be reviewed regularly, Surplus items which have to be examined and Non-moving items may be examined further and their disposal can be considered.

SOS CLASSIFICATION

- 'S' stands for seasonal items and 'OS' stands for Off-Seasonal items.
- It may be advantageous to buy seasonal items at low prices and keep inventory or buy at high price during off seasons.
- Based on the fluctuation in prices and availability, suitable decision has to be taken regarding how much to purchase and at what prices.

GOLF CLASSIFICATION

- This stands for Government, Open market, Local or Foreign source of supply.
- For many items, imports are canalized through government agencies such as state Trading Corporations, Mineral And Metals Trading Corporations, Indian Drugs and Pharmaceuticals Association etc.For such items, the buying firms cannot apply any inventory control techniques and have to accept the quota allotted by the government.
- Open Market are those who form bulk of suppliers and procurement is rather easy.

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- 'L' category includes those local suppliers from whom items can be purchased off -the-shelf on cash purchase basis.
- 'F' category indicates foreign suppliers, since elaborate import procedure is involved, it is better to have lots that cover annual requirements.

ECONOMIC ORDER QUANTITY

- EOQ is the level of inventory order at which inventory cost is minimum
- It is the order size at which the total cost, comprising ordering cost and plus carrying
- costs, is the least.
- Graphically, the two costs, carrying costs and ordering costs cut exactly, where the total cost curve is at its lowest point.
- The more the inventory held in any period, greater will be the cost of holding it.

- Ordering in small quantities means more acquisition and higher ordering costs. The ordering costs decreases with increase in order sizes.
- A point where the carrying cost curve and the ordering cost curve meet represent the least total cost which incidentally is the economic order quantity or optimum quantity.

MINIMUM-MAXIMUM TECHNIQUE

- The Minimum-maximum system is used in connection with manual inventory control systems.
- The minimum quantity is established in the same way as any re-order point.
- The maximum is the minimum quantity plus the optimum lot size

TWO-BIN TECHNIQUE

- In the two-bin system, stock of each item is separated into two bins.
- One bin contains stock, just enough to last from the date a new order is placed until it is received in inventory. The other bin contains a quantity of stock enough to satisfy probable demand during the period of replenishment.
- Two bin Technique: order is placed when one bin inventory is used.

JUST-IN-TIME SYSTEMS

- JIT is defined as "a philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity".

- It encompasses the execution of all manufacturing activities required to produce a final product, from design engineering to delivery and including all stages of conversion from raw materials onward.

- The primary elements of JIT are to have only the required inventory when needed, to improve quality to zero defects, to reduce lead times by reducing set-up times, queue

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lengths and lot sizes, to incrementally revise the operations themselves and to accomplish these things at minimum cost.

- In the broad sense, "it applies to all forms of manufacturing, job-shop, process as well as repetitive tasks".

CONCEPT OF JIT

The Three fundamental concepts of JIT

are:

(i) Elimination of waste and variability.

(ii) "pull" versus "push" system and

(iii) Manufacturing cycle time (or "throughput" time).

OVERVIEW OF JIT MANUFACTURING

JIT manufacturing includes activities:

(i)Inventory reduction.

(ii)Quality improvement.

(iii)Lead time reduction.

(iv)Vendor Control/performance improvement.

(v)Continuous Improvement.

(vi)Total Preventive Maintenance.

(vii)Strategic Gain.

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UNIT-V QUALITY MANAGEMENT

Definitions of quality, The Quality revolution, quality gurus; TQM philosophies; Quality management tools, certification and awards. Lean Management - philosophy, elements of JIT manufacturing, continuous improvement. Six sigma.

Definitions:

Quality:

Quality can be quantified as

Q = P/E

Where Q=Quality

P=Performance

E=Expectations

If Q is greater than 1.0, then the customer has a good feeling about the product or service.

Total Quality Management

"TQM is the management approach of the organization ,centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society"- **ISO**

Meaning:

Total-Made up of the whole

Quality- Degree of excellence a product or service provides.

Management-Act, art or manner of handling, controlling, directing.

TQM FRAMEWORK

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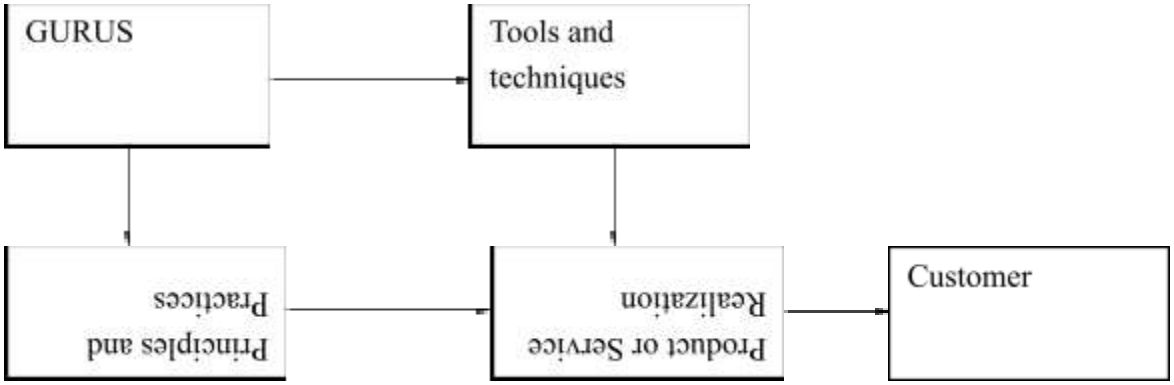
- TQM framework gives the overall structure of the organization.
- It consist of



Gurus:

- Shewhart
- Deming
- Juran
- Figenbaum
- Ishikawa
- Crosby
- Taguchi

Tools and Techniques:

- Benchmarking
- Information Technology
- Quality Management Systems
- Environmental Management Systems
- Quality Function Deployment
- Quality by Design
- Failure Mode and Effect Analysis
- Product and Service Liability

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- Total Productive Maintenance
- Management tools
- Statistical Process Control
- Experimental Design
- Taguchi's Quality Engineering

PHILOSOPHIES OF TQM

Deming has given 14 points

1. Create and Publish the Aims and Purposes of the Organization:

- Management must create and publish the aims and purposes of the organization to investors, customers, suppliers, employees, the community and a quality philosophy.
- Organization should develop a long term view of business and set goals according to that.
- In order to achieve these goals resources must be allocated to research, training and continuing education.
- Innovation must be promoted to ensure that the product or service does not become obsolete.

2. Learn the New Philosophy:

- Top management and everyone in the organization must learn the new philosophy.
- Organization must concentrate on defect prevention rather than defect detection.
- Organizations must give importance to never ending improvement and refuse to accept nonconformance.
- Customer satisfaction is the number one priority because dissatisfied customers will not continue to purchase nonconforming products or services.
- Everyone in the organization including the union must be involved in the quality journey and change his or her attitude about quality.

3. Understand the Purpose of Inspection:

- Management must understand that the purpose of inspection is to improve the process and reduce its cost.
- For the most part of the organization, mass inspection is costly and unreliable.
- Where ever the inspection is required it should be applied and replaced by never ending improvement process.
- It should be clearly understood that mass inspection is for managing failure and defect prevention is for managing success.

4. Stop Awarding Business Based on Price Alone:

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- The organization must stop awarding business based on the low bid because price has no meaning without quality.
- The goal is to have single suppliers for each item and to develop a long term relationship of trust and loyalty, thereby providing improved products and services.
- They must follow the materials throughout the life cycle in order to examine how customer expectations are affected and provide feedback to the supplier regarding the quality.

5. Improve Constantly and Forever the System:

- Management must take more responsibility in actively finding and correcting problems, so that quality and productivity are continually and permanently improved and costs are reduced.
- The focus is on preventing problems before they happen.
- Responsibilities are assigned to the teams to remove the causes of the problems and continually improve the process.

6. Institute Training:

- Each employee must be oriented to the organizations philosophy of never ending improvements.
- Management must allocate resources to train their employees to perform their jobs in the better manner.

7. Teach and Institute Leadership:

- Improving Supervision in the organization is the management's responsibility.
- Management must appoint supervisors with training, so that the new philosophy can be implemented.
- Supervisors should create a positive and supportive work environment instead of focusing on negative and fault finding atmosphere.
- All communication must be clear from top management to supervisors to operators.

8. Drive out Fear, Create trust and Create a Climate for Innovation:

- Management must encourage open, effective communication and team work.
- Fear is caused because of lack of job security, possible physical harm, performance appraisals, and ignorance of organization goals, poor supervision and not knowing the job.
- Driving out fear will lead to success, for this management must concentrate on workers with adequate training, good supervision, and proper tools to do the job as well removing physical dangers.
- When people are treated with dignity fear can be eliminated and they will

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work for the general well being of the organization.

9. Optimize the efforts of teams, groups and staff areas:

- Management must optimize the efforts of teams, groups and staff areas to achieve the aims and purposes of the organization.
- Internally the barriers exist among levels of management, among departments, within departments and among shifts.
- Externally it exists between the organization and its customers and suppliers.
- The barriers exist because of poor communication, ignorance of organization mission and it can be overcome by multifunctional team.

10. Eliminate Exhortations for the Workforce:

- Exhortations that ask for increased productivity without providing specific improvement methods can handicap an organization.
- They do not produce better product or service because the workers are limited by the system.
- Improvements in the process cannot be made unless the tools and methods are available.

11. a. Eliminate Numerical Quotas for the Workforce:

- Quotas and work standards focus on quantity rather than quality.
- Instead of quotas, management must concentrate on methods of improvement.
- They encourage poor workmanship in order to meet their quotas.

b. Eliminate Management by Objective:

- Instead of management by objective, management must learn the capabilities of the processes and how to improve them.
- Management by numerical goal is an attempt to manage without knowledge of what to do.

12. Remove Barriers that Rob People of Pride of Workmanship:

- Loss of pride in workmanship exists throughout the organization because
  - ✔ Workers do not know how to relate to organizations mission
  - ✔ They are being blamed for system problems.
  - ✔ Poor designs lead to the production of junk.
  - ✔ Inadequate training is provided.
  - ✔ Punitive supervision exists.
  - ✔ Inadequate or ineffective equipment is provided for performing the required work.

13. Encourage Education and Self Improvement for Everyone:

- When an organization needs is people who are improving with education, a long term commitment to continuously train and educate people must be made by management.

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14. Take Action to Accomplish the Transformation:

- Management has to accept the primary responsibility for the never ending improvement of the process.
- A cultural change is required from the previous "business as usual" attitude.
- Management must be committed, involved and accessible if the organization is to succeed in implementing the new philosophy.

CROSBY'S CONTRIBUTIONS

Philip Crosby, author of ***Quality is Free.*** Crosby emphasized meeting customer requirements by focusing on prevention rather than correction.

His "Absolutes" are:

(1) Quality is defined as conformance to requirements, not *goodness;*
(2) The system for achieving quality is prevention, not appraisal;
(3) The performance standard is zero defects, not *that's close enough;* and
(4) The measure of quality is the price of non-conformance, not indexes.

- Crosby's method does not dwell on statistical process control and problem solving techniques that the Deming method uses. He stated that quality is free because prevention will always be lower than the costs of detection, correction and failure
- Manage commitment, that is, top level management must be convinced and committed and communicated to the entire company.

14 Principles

1. Manage commitment, that is, top level management must be convinced and committed and communicated to the entire company.
2. Quality improvement team composed of department heads, oversee improvements.
3. Quality measurement is established for every activity.
4. Cost of quality is estimated to identify areas of improvement.
5. Quality awareness is raised among all employees.
6. Corrective action is taken.
7. Zero defects are planned for.
8. Supervisor training in quality implementation.
9. Zero defects day is scheduled.
10. Goal setting for individuals.
11. Error causes are removed by having employees inform management of problems.
12. Recognition is given, but it is non-financial, to those who meet quality goals.
13. Quality councils meet regularly.
14. Do it all over again (i.e., repeat steps one through thirteen).

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CONTRIBUTION OF JURAN

Juran's Triology

- Quality Planning
- Quality Control
- Quality Improvement

Quality Planning:

- The planning component begins with external customers.Once the quality goals are established, marketing determines the external customers and all organizational personnel (managers, members of multifunctional teams or work groups) determine the internal customer.
- Once the customers are determined, their needs are discovered.
- Customer needs has to be stated in their own words, however real needs may differ from stated needs.
- Internal customers may not wish to voice real needs out of fear of the consequences.
- The customer needs which are stated in their view point should be translated to requirements that are understandable to the organization and its suppliers.
- The next step is to develop the product/service features that respond to customer needs, meet the needs of organization and its suppliers.
- The fourth step is to develop the processes able to produce the product or service features.
- Transferring plans to operations is the final step of the planning process.

Quality Control:

- Control is used by operating forces to help meet the product, process and service requirements.

Steps:

✔ Determine items/subjects to be controlled and their units of measure.

✔ Set goals for control and determine what sensors need to be put in place to measure the product, process or service.

✔ Measure actual performance.

✔ Compare actual performance to goals.

✔ Act on the difference.

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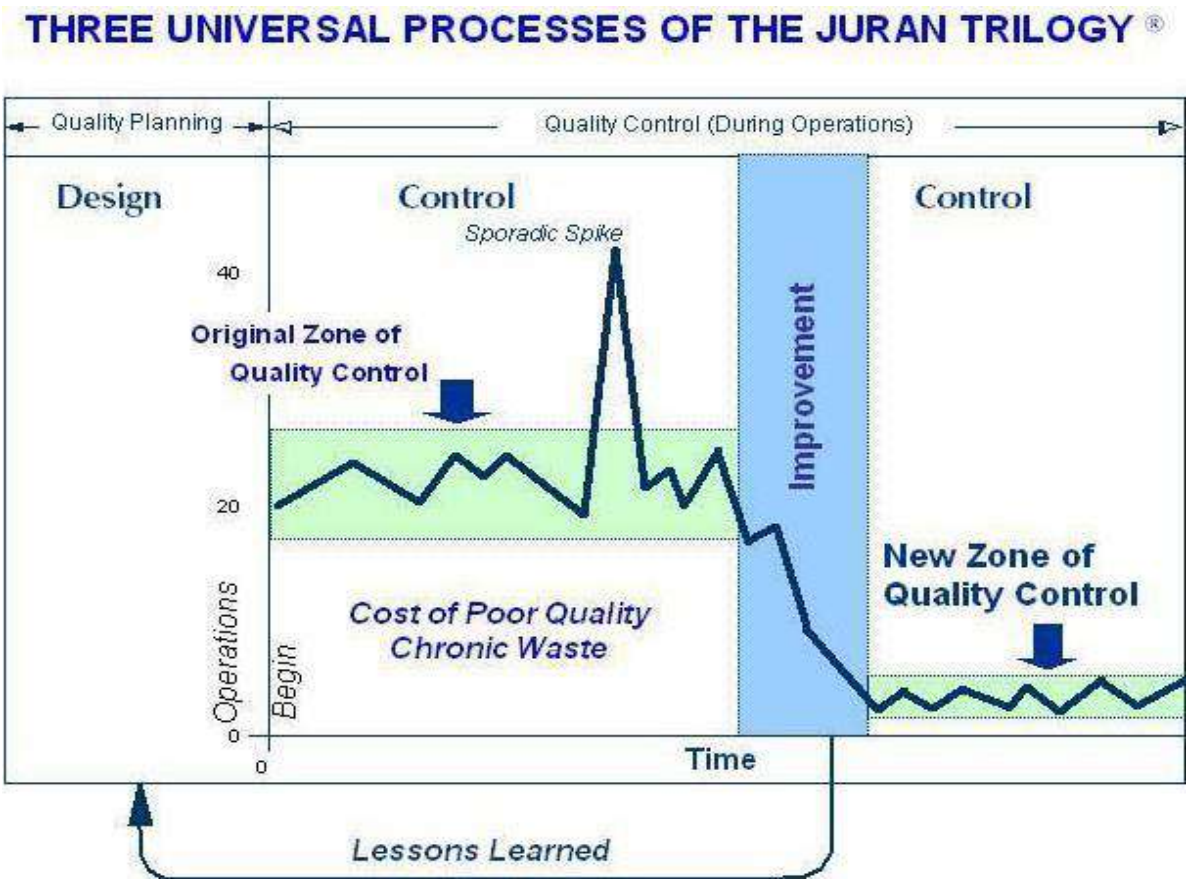

Quality Improvement:

- Aim is to attain the levels of performance that are significantly higher than current levels.
- Process improvements begin with the establishment of quality council.
- Two duties of quality council
  - ✔ Identify the improvement projects
  - ✔ Establish the project teams with a project owner.
- Quality council needs to provide the teams with resources to determine the causes, create solutions and establish controls to hold the gains.
- In the figure juran provides a distinction between sporadic waste and chronic waste
  - ✔ Sporadic waste can be identified and corrected through quality control.
  - ✔ Chronic waste requires an improvement process.
- As solution is found through the improvement process, lessons learned are brought back to the quality planning process, so that new goals may be established for organization.

Improvement Strategies:

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- Repair
- Refinement
- Renovation
- Reinvention

Repair:

- This strategy is simple; if anything is broken it must be fixed so that it functions as designed.
- If a customer receives a damaged product, a quick fix is required.
- The second level is to identify and eliminate the root causes of the problem and effects a permanent solution.
- Repair strategy does not make the process better than the original design.

Refinement:

- Improvements to processes, products and services are accomplished on an incremental basis.
- Refinement improves efficiency and effectiveness.
- The change may be so gradual that there is no appearance of change.
- The primary benefit of gradual change is that it produces little resistance from employees.

Renovation:

- This strategy results in major or breakthrough improvements.
- Innovation and technological advancements are key factors in this approach.
- Eg: Rechargeable batteries

Reinvention:

- Renovation is the most demanding improvement strategy.
- It is preceded by the feeling that the current approach will never satisfy customer requirements.
- A new product, service, process or activity is developed using teams based on a complete understanding of the customer requirements and expectations.

Types of Problems:

✔ Compliance
✔ Unstructured
✔ Efficiency
✔ Process design

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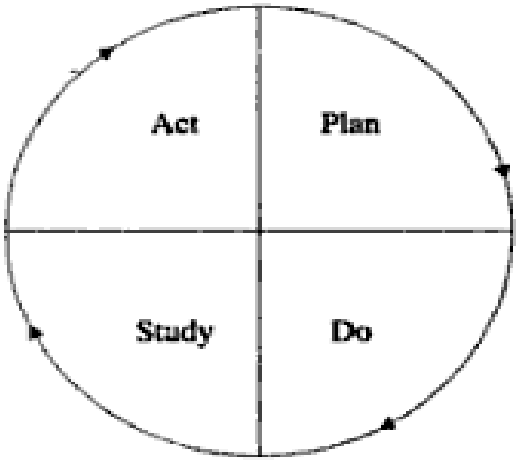
✔ Product design

CONTIBUTION OF SHEWHART

- The concept was first given by Deming and later it was developed by Shewhart.
- It is also known as **Deming cycle** or **PDCA cycle.**

PDSA Cycle:



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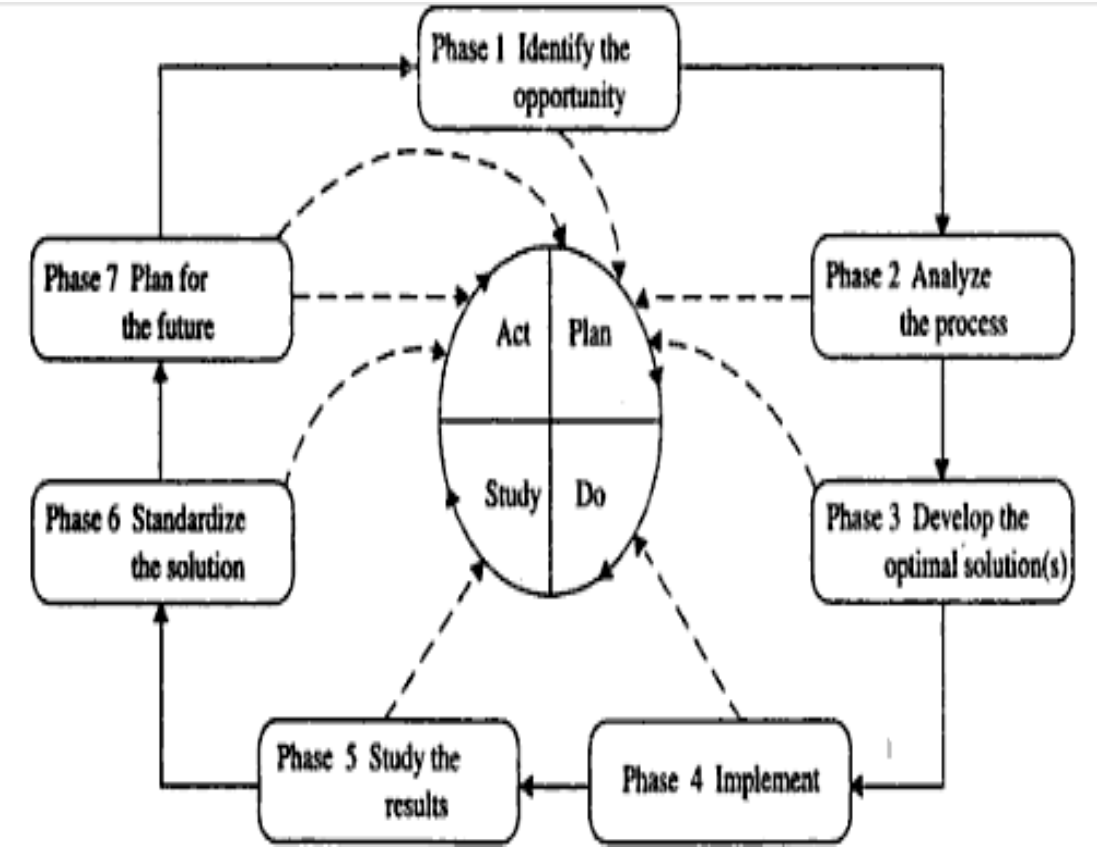

Identify the opportunity:

- The objective of this phase is to identify and prioritize opportunities for improvement.
- It has three parts
  - ✔ Identify the problem
  - ✔ Form the team
  - ✔ Define the scope.

Analyze the current process:

- The objective of this phase is to understand the process and how it is currently performed.
- Key activities are to define process boundaries outputs and customers, inputs and suppliers and process flow, determine levels of customer satisfaction and measurements needed, gather data and identify root causes.
- With the help of process flow diagram the team will
  - ✔ Establish performance measures with respect to customer requirements.
  - ✔ Determine data needed to manage the process
  - ✔ Establish regular feedback with customers and suppliers.
  - ✔ Establish measures for quality/cost/time of inputs and outputs.

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- Once the target performance measures are established, the team can collect all available data and information.
- Gathering data by the team
  - ✔ Helps confirm that a problem exists
  - ✔ Enables the team to work with facts
  - ✔ Makes it possible to establish measurement criteria for baseline
  - ✔ Enables the team to measure the effectiveness of an implemented solution.
- The team should develop a plan that includes input from internal and external customers and answers the following questions
  - ✔ What problem or operation do we want to learn about?
  - ✔ What are the data used for?
  - ✔ How many data are needed?
  - ✔ What conclusions can be drawn from the collected data?
  - ✔ What action should be taken as a result of the conclusion?

Develop the optimal solution:

- The objective of this phase is to establish potential and feasible solution and recommend the best solution to improve the process.
- Once all the information is available the project team begins it search for possible solutions.
- In this phase creativity plays the major role and brainstorming is the principle technique.
- There are three types of creativity
  - ✔ Create new processes
  - ✔ Combine different processes
  - ✔ Modify the existing processes

Implement Changes:

- Once the best solution is selected it should be implemented.
- This phase has the objective of preparing the implementation plan, obtaining approval and implementing the process improvements.
- Although the team has the authority in implementing the solution but it has to get approval from the quality council.
- If such approval is needed from the quality council, the team has to give a written or oral report.
- The report should fully describe about
  - ✔ Why will it be done?
  - ✔ How will it be done?
  - ✔ When will it be done?

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- ✔Who will do it?
- ✔Where will it be done?

- The length of the report is determined by the complexity of the change.
- Simple changes may require only an oral report, whereas other changes require a detailed written report.

Study the Results:

- This phase has the objective of monitoring and evaluating the change by tracking and studying the effectiveness of the improvement efforts through data collection and review of progress.
- The team should meet periodically during this phase to evaluate the results to see that the problem has been solved or if fine tuning is required.
- If the team is not satisfied, then some of the phases will need to be repeated.

Standardize the solution:

- Once the team is satisfied with the change, it must be institutionalized by positive control of process, process certification and operator certification.
- Positrol (positive control) assures that the important variables are kept under control.
- It specifies that what, who, how, where and when of the process and is an updating of the monitoring activity.

Plan for the future:

- This phase has the objective of achieving improved levels of process performance.
- Everyone in the organization is involved in a systematic, long term endeavor to constantly improve quality by developing processes that are customer oriented, flexible and responsible.

CONTIBUTION OF ISHIKAWA

Principles of Customer Supplier Relations

Ten Principles:

- Both the customer and the supplier are fully responsible for the control of quality.
- Both the customer and the supplier should be independent of each other and respect each other's independence.
- The customer is responsible for providing the supplier with clear and

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sufficient requirements, so that the supplier can know precisely what to produce.

- Both the customer and the supplier should enter in to a non-adversarial contract with respect to quality, quantity, price, delivery method and terms of payments.
- The supplier is responsible for providing the quality that will satisfy the customer and submitting necessary data upon the customer's request.
- Both the customer and the supplier should decide the method to evaluate the quality of product or service to the satisfaction of both parties.
- Both the customer and the supplier should establish in the contract the method by which they can reach an amicable settlement of any disputes that may arise.
- Both the customer and the supplier should continually exchange information sometimes using multi functional teams in order to improve the product or service quality.
- Both the customer and the supplier should perform business activities such as procurement, production and inventory planning, clerical work and systems so that an amicable and satisfactory relationship is maintained.
- When dealing with business transactions, both the customer and the supplier should always have the interest of the end user in mind.

Cause and effect diagram:

- A Cause and Effect diagram is a picture composed of lines and symbols designed to represent a meaningful relationship between a effect and its causes.
- It is also referred to as fishbone diagram because of its shape.
- C&E diagrams are used to investigate either a bad effect and to take action to correct the causes or a good effect and to learn those causes that are responsible.
- For every effect there are likely to be numerous causes.

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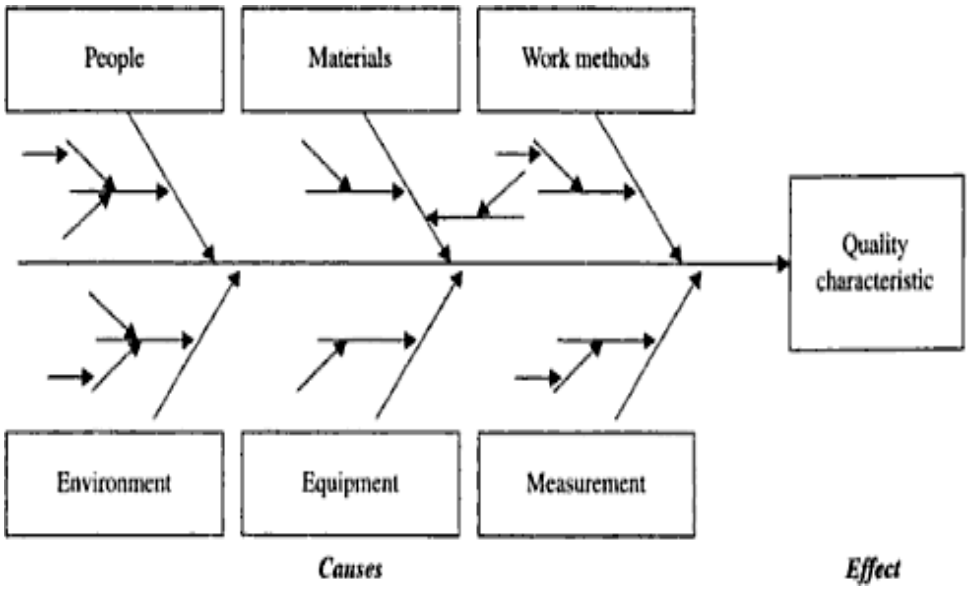

CONTRIBUTION OF MASAAKI IMAI

Kaizen Concept:

- Value added and non-value added work activities.
- Muda: which refers to seven classes of waste-overproduction, delay, transportation, processing, inventory, wasted motion and defective parts
- Principles of motion study and the use of cell technology.
- Documentation of standard operating procedures.
- The five S's for workplace organization.
- Visual management by means of virtual displays that everyone in the plant can use for better communication.
- Just in time principles to produce only the units in the right quantities at the right time and with the right resources.
- POKA-YOKE to prevent or detect errors.
- Team dynamics, which includes problem solving, communication skills and conflict resolution.

CONTRIBUTION OF SHINGEO

- Zero defects
- Statistical Quality Control
- Statistical Process Control
- SMED(Single Minute Exchange of Dies)

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- POKA YOKE (Mistake Proofing)
- Defining processes and operations in two dimensions of VA (value addition) and non VA.

CONTRIBUTION OF FEIGENBAUM

❖ He devised the concept of Total Quality Control, later known as Total Quality Management (TQM).

His contributions to the quality body of knowledge include:

- "Total quality control is an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow full customer satisfaction."
- The concept of a "hidden" plant—the idea that so much extra work is performed in correcting mistakes that there is effectively a hidden plant within any factory.
- Accountability for quality: Because quality is everybody's job, it may become nobody's job—the idea that quality must be actively managed and have visibility at the highest levels of management.
- The concept of quality costs.

CONTRIBUTION OF TAGUCHI

- Taguchi has defined quality as the loss imparted to society from the time a product is shipped.
- Societal losses include failure to meet customer requirements, failure to meet ideal performance and harmful side effects.

Loss to society:

Loss Function: - Cost + Target + Variation into one metric

Total Loss = Producer's loss + Customer's loss

Robustness: - Noise factors taken into account to ensure that the systems function properly

SEVEN NEW MANAGEMENT TOOLS

The seven new management tools are:

1. Affinity Diagram

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2. Interrelationship Digraph
3. Tree Diagram
4. Matrix Diagram
5. Prioritization Matrices
6. Process Decision Program Chart(PDPC)
7. Activity Network Diagram

1. Affinity Diagram:

- This tool takes large amounts of disorganized data and information and enables one to organize it into groupings based on natural relationships
- This diagram allows the team to creatively generate a large number of issues/ideas and then logically group them for problem understanding and possible break through solution.
- The procedure is to state the issue in a sentence, brainstorming using short sentences on self-adhesive notes, post them for the team to see, sort ideas in to logical groups and create concise descriptive headings for each group.
- Large groups should be divided in to smaller groups with appropriate headings.
- Notes, that stand alone could become headers or placed in a miscellaneous category.
- Affinity diagrams encourage team creativity, break down barriers, facilitate breakthroughs and stimulate ownership of the process.

Figure 1

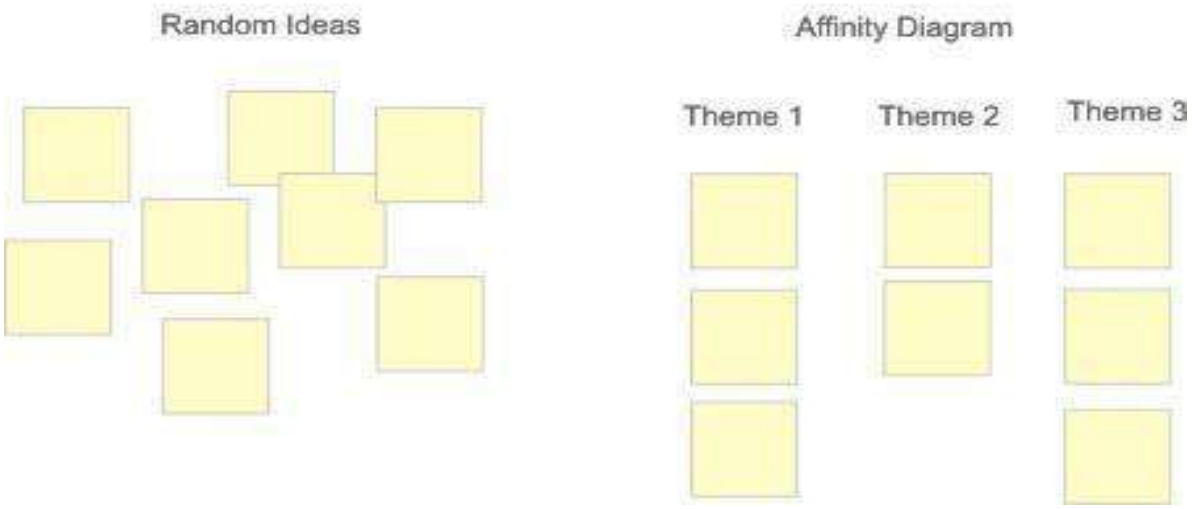

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Figure 3

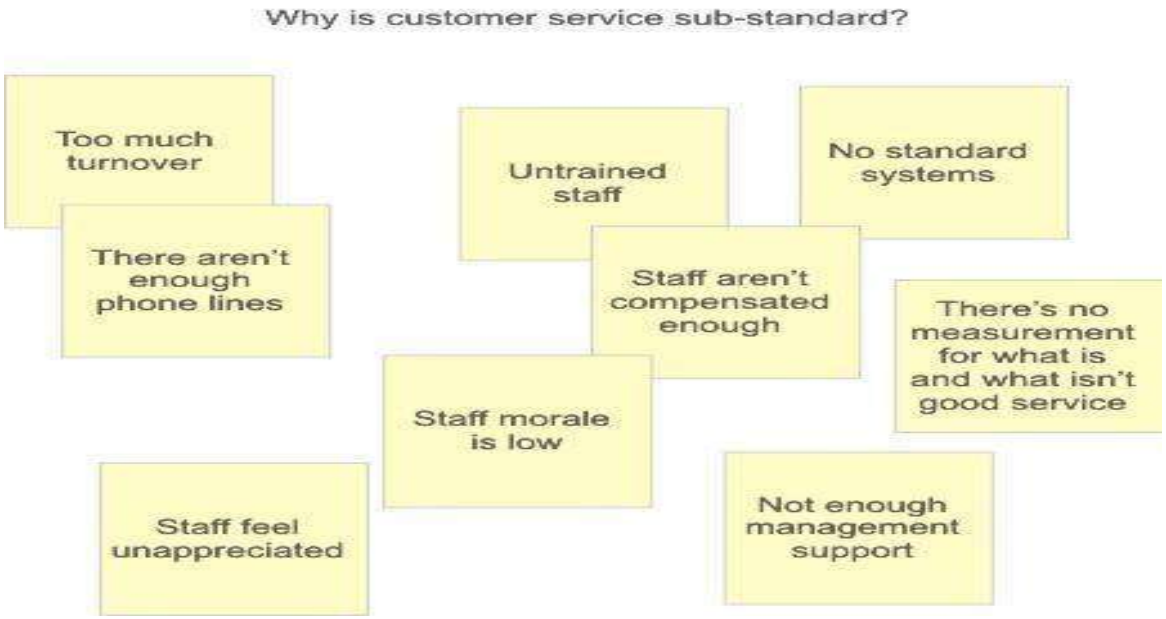

Figure 4

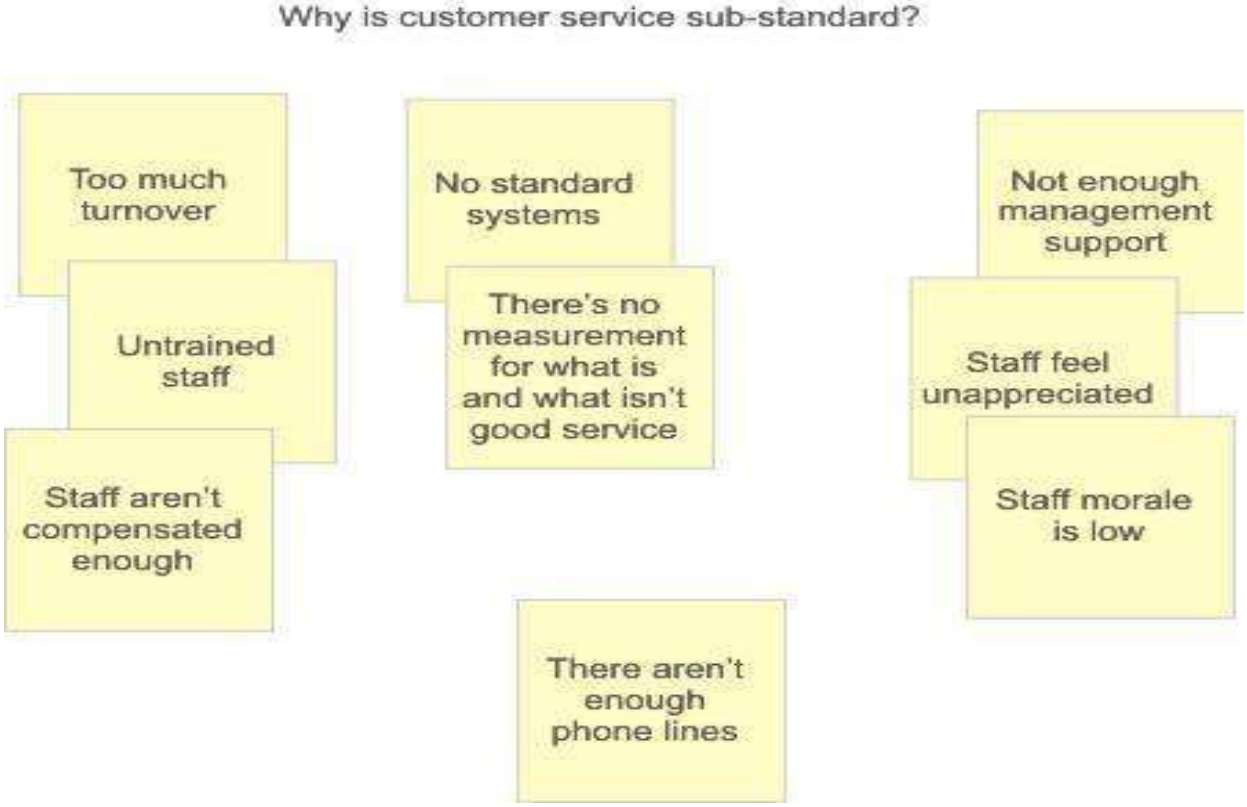

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Figure 5

2. Interrelationship Digraph:

- This tool displays all the interrelated cause-and-effect relationships and a factor involved in a complex problem and describes desired outcomes.
- The process of creating an interrelationship digraph helps a group analyze the natural links between different aspects of a complex situation.
- The interrelationship diagraph clarifies the interrelationship of many factors of a complex situation.
- It allows the team to classify the cause and effect relationships among all the factors so that the key drivers and outcomes can be used to solve the problem.
- A relationship diagram allows a team to identify root causes from subjective data , systematically explores cause and effect relationship, encourages member to think multi directionally and develops team harmony and effectiveness

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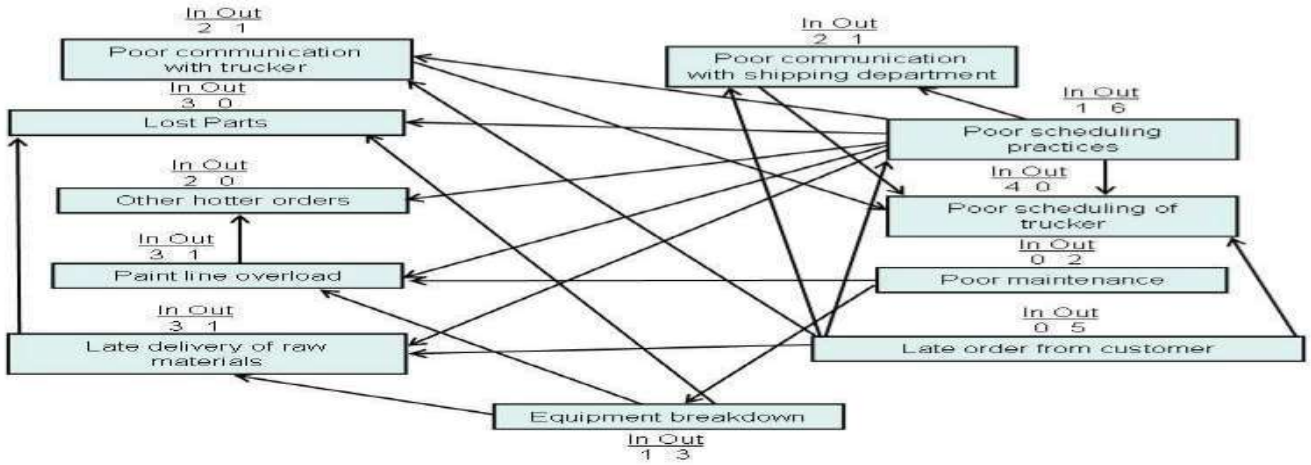

A concern with a high number of output arrows is a driver or key cause. A key cause affects a large number of other items. The above diagram shows the following key causes:

- Poor scheduling practices' (6 outgoing arrows),
- Late order from customer' (5 outgoing arrows), and
- Equipment breakdown (3 outgoing arrows).

A concern with a large number of input arrows is affected by a large number of other concerns. Thus, it could be a source of a quality or performance metric. 'Poor scheduling of the trucker' has 4 input arrows.

3. Tree Diagram:

- This tool is used to break down broad categories into finer and finer levels of detail
- This tool is used to reduce any broad objective in to increasing levels of detail in order to achieve the objective.
- The procedure is to first choose an action oriented objective statement from the interrelationship diagraph, affinity diagram, and brainstorming.
- Second using brainstorming chooses the major headings.
- The third step is to generate the next level by analyzing the major headings.
- Ask "What needs to be addressed to achieve the objective?" , repeat this question at each level.
- Three levels below the objective are usually sufficient to complete the diagram and make appropriate assignments.
- The diagram should be reviewed to determine if these actions will give the results anticipated or if something has been missed.
- The tree diagram encourages team members to think creatively, makes large

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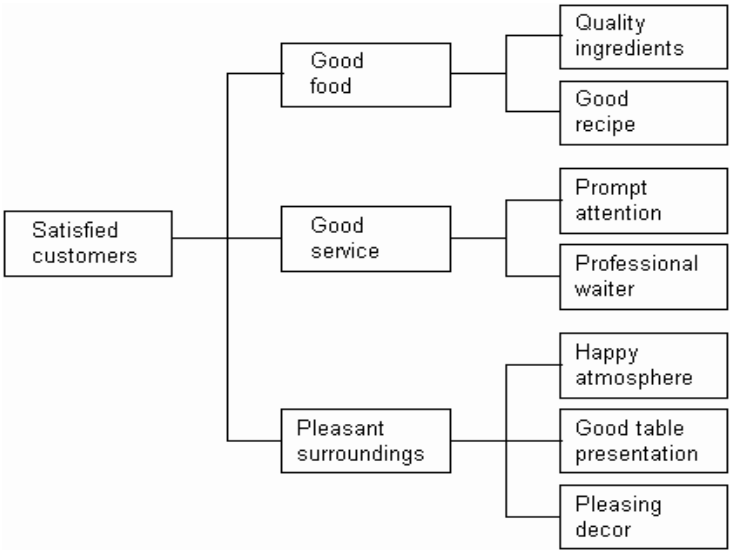
projects manageable and generates a problem solving atmosphere.



1. Matrix Diagram:

- The matrix diagram allows individuals or teams to identify, analyze and rate the relationship among two or more variables.
- QFD is the best example of the use of matrix diagram.
- There are 5 standard formats
  - ❖ L-Shaped(2 Variables)
  - ❖ T-Shaped(3Variables)
  - ❖ Y-Shaped(3Variables)
  - ❖ C-Shaped(3 Variables)
  - ❖ X-Shaped(4 Variables)
- The procedure for the diagram is to first select the factors affecting a successful plan.
- Select the appropriate format Eg: L-Shaped
- Next step is to determine the relationship symbols
- Any symbols can be adopted provided the diagram contains a legend.
- Numerical values are sometimes associated with the symbol as we have seen in QFD.
- The last step is to complete the matrix by analyzing each cell and inserting the appropriate symbol.
- The matrix diagram clearly shows the relationship of the two variables.
- It encourages the team to think in terms of relationships, their strength and any patterns.

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Legend	
Soft-skills training	
√	Course attended
Social club attendance	
◎	More than 70%
○	30% to 70%
△	Less than 30%

Measures are over past three years

Soft-skills courses							Social clubs					
Assertiveness	Team building	Negotiation	Listening skills	Group working	People in Purchasing dept.	Yrs. of service	Chess	Football	Photography	Pool	Swimming	Tennis
√	√				Michael Jordan	2		◎		△	△	
√		√	√		Richie Valens	5	○		○	△		
	√				Dawn Simmons	10	△				◎	△
					Eleri Mair	4						△
		√			Dave Morgan	3	△					
	√		√		Cynthia Place	5			◎			
√					Geraint Morgan	3		○				
√	√		√	√	Heledd Eluned	11	◎		○	△		◎
					Gwen Uki	9		○				
	√				Bella Bumpps	5			◎		○	

5. Prioritization Matrices:

- This tool is used to prioritize items and describe them in terms of weighted criteria.
- It uses a combination of tree and matrix diagramming techniques to do a pair-wise evaluation of items and to narrow down options to the most desired or most effective.
- This tool prioritizes issues, tasks and characteristics based on weighted criteria.
- Once prioritized effective decisions can be made.

Prioritization Matrix				
Issue	*Frequency*	*Importance*	*Feasibility*	*Total*
No appointments for the afternoon	5	0	0	5
Delays in registration	6	1	5	12
Incomplete laboratory	9	11	6	26
Not enough materials for the lab	3	0	0	3
Broken down ambulance	0	3	0	3
Long waiting time	7	14	15	36
Disrespect of patients	4	6	10	20

6. Process Decision Program Chart (PDPC):

- PDPC helps to avoid surprises and identifies possible counter measures.
- The procedure starts with the team stating the objective.
- The objective here is to plan a successful conference.

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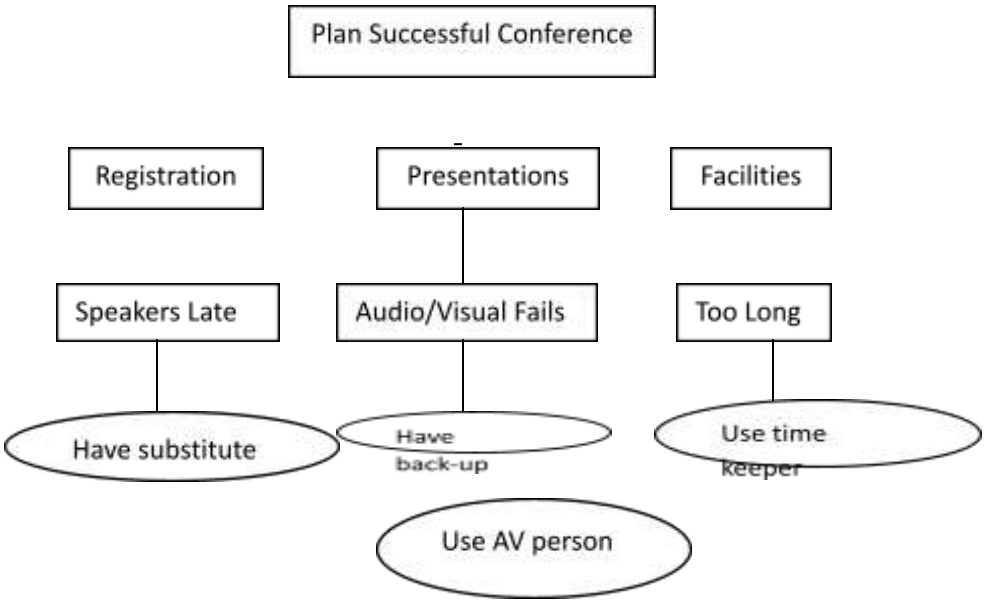
- This activity is followed by the first level which has the conference activities of registration, presentation and facilities.
- Only the presentation activity is discussed here.
- In some cases a second level of detailed activities may be used.
- Next the team brainstorms to determine what could go wrong with the conference and these are shown in "What if" level.
- Countermeasures are brainstormed and placed in a balloon in the last level.
- The last step is to evaluate the counter measures and select the optimal ones by placing an O underneath.
- Place an X under those that are rejected.
- PDPC should be used when the task is new or unique, complex or potential failure has great risks.
- This tool encourages team members to think about what can happen to a process and how counter measures can be taken.

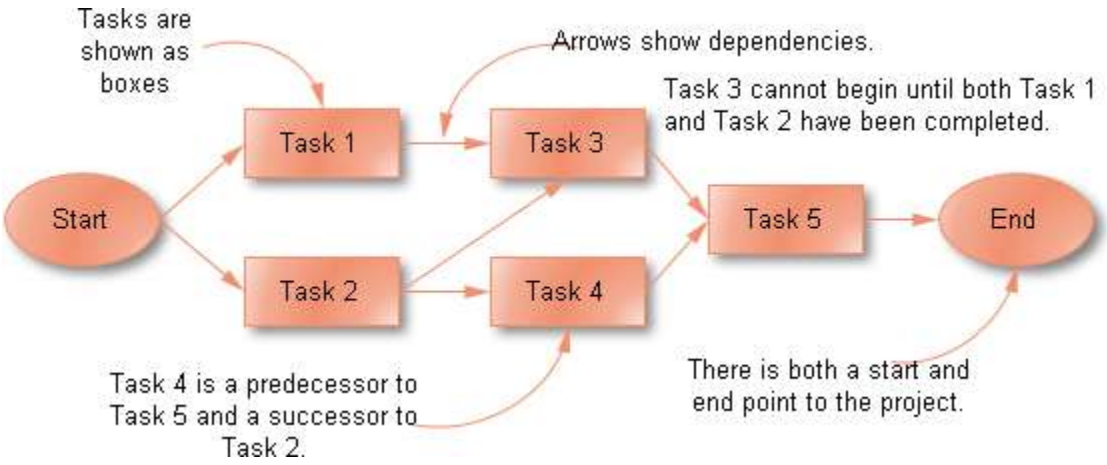


7. Activity Network Diagram:

- A project network is a graph (flow chart) depicting the sequence in which a project's terminal elements are to be completed by showing terminal elements and their dependencies.
- The work breakdown structure or the product breakdown structure show the "part-whole" relations. In contrast, the project network shows the "before-after" relations.
- The most popular form of project network is activity on node, the other one is activity

on arrow.

- The condition for a valid project network is that it doesn't contain any circular references.
- Project dependencies can also be depicted by a predecessor table. Although such a form is very inconvenient for human analysis, project management software often offers such a view for data entry.
  - An alternative way of showing and analyzing the sequence of project work is the design structure matrix.



SIX SIGMA

- **Six Sigma** is a business management strategy originally developed by Motorola, USA in 1986. Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes.

- It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization ("Black Belts", "Green Belts",

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etc.) who are experts in these methods.

- Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified financial targets (cost reduction and/or profit increase).
- A six sigma process is one in which 99.99966% of the products manufactured are statistically expected to be free of defects (3.4 defects per million).

SIX SIGMA IS SEVERAL THINGS:

• A statistical basis of measurement: 3.4 defects per million opportunities

• A philosophy and a goal: as perfect as practically possible

• A methodology

• A symbol of quality

SIGMA VALUES

Sigma Level	% Good	PPM/DPMO
2	95.45	45500
3	99.73	2700
4	99.9937	63
5	99.999943	0.57
6	99.9999998	0.002

METHODS:

- Six Sigma projects follow two project methodologies inspired by Deming's Plan-Do-Check-Act Cycle.
- These methodologies, composed of five phases each, bear the acronyms DMAIC and DMADV.

- **DMAIC** is used for projects aimed at improving an existing business process.
- **DMADV** is used for projects aimed at creating new product or process designs. DMAIC

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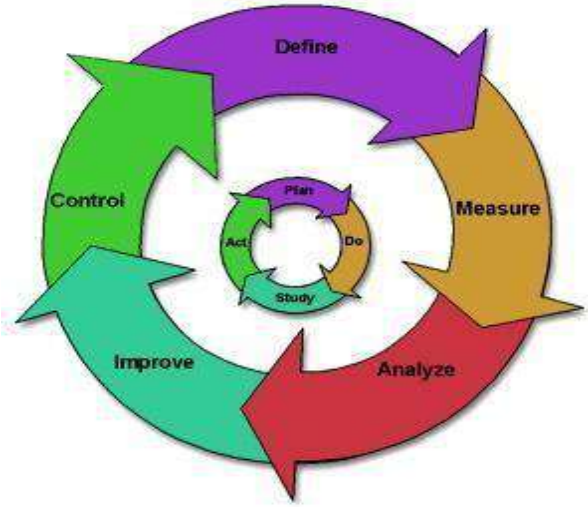
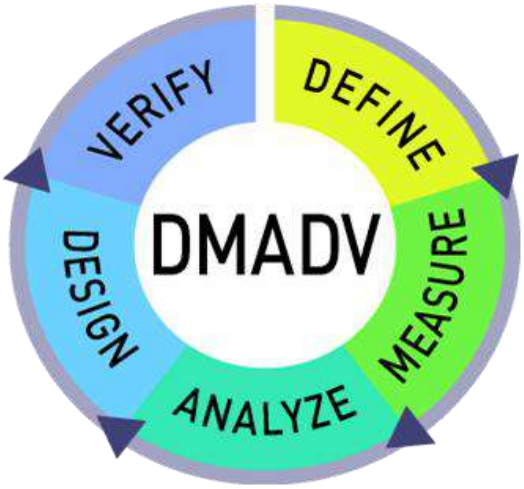
The DMAIC project methodology has five phases:



- **Define** the problem, the voice of the customer, and the project goals, specifically.
- **Measure** key aspects of the current process and collect relevant data.
- **Analyze t**he data to investigate and verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation.
- **Improve** or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- **Control** the future state process to ensure that any deviations from target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process.

DMADV or DFSS



The DMADV project methodology, also known as DFSS ("**D**esign **F**or **S**ix **S**igma"), features five phases:

- **Define** design goals that are consistent with customer demands and the enterprise strategy.
- **Measure** and identify CTQs (characteristics that are **C**ritical **T**o **Q**uality), product capabilities, production process capability, and risks.
- **Analyze** to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
- **Design** details, optimize the design, and plan for design verification. This phase may require simulations.
- **Verify** the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

IMPLEMENTATION:

Six Sigma identifies several key roles for its successful implementation.

- ***Executive Leadership*** includes the CEO and other members of top management. They are responsible for setting up a vision for Six Sigma implementation. They also empower the

other role holders with the freedom and resources to explore new ideas for breakthrough improvements.

- ***Champions*** take responsibility for Six Sigma implementation across the organization in an integrated manner. The Executive Leadership draws them from upper management. Champions also act as mentors to Black Belts.

- ***Master Black Belts***, identified by champions, act as in-house coaches on Six Sigma. They devote 100% of their time to Six Sigma. They assist champions and guide Black Belts and Green Belts. Apart from statistical tasks, they spend their time on ensuring consistent application of Six Sigma across various functions and departments.

- ***Black Belts*** operate under Master Black Belts to apply Six Sigma methodology to specific projects. They devote 100% of their time to Six Sigma. They primarily focus on Six Sigma project execution, whereas Champions and Master Black Belts focus on identifying projects/functions for Six Sigma.

- ***Green Belts*** are the employees who take up Six Sigma implementation along with their other job responsibilities, operating under the guidance of Black Belts.

Some organizations use additional belt colours, such as *Yellow Belts*, for employees that have basic training in Six Sigma tools and generally participate in projects and 'white belts' for those locally trained in the concepts but do not participate in the project team.

JUST-IN-TIME SYSTEMS

- JIT is defined as“ a philosophy ofmanufacturingbasedonplannedeliminationofall waste and continuous improvement of productivity”.

- Itencompassestheexecutionofallmanufacturingactivitiesrequiredtoproducea finalproduct,fromdesignengineeringtodeliveryandincludingallstagesofconversion from raw materials onward.

- The primary elementsof JITaretohaveonlytherequiredinventory whenneeded,to improvequalitytozerodefects,toreduceleadtimesbyreducingset-uptimes,queue lengthsandlotsizes,toincrementallyrevisetheoperationsthemselvesandtoaccomplish thesethings at minimum cost.

In the broad sense, "it applies to all formsof manufacturing,job-shop,processaswell as repetitive tasks".CONCEPT OFJIT

TheThree fundamental concepts of JITare:

(i) Elimination of waste and variability.

(ii) "pull" versus "push"system and

(iii) Manufacturing cycletime (or "throughput" time).

OVERVIEW OFJIT MANUFACTURING

JIT manufacturingincludes activities:

(i)Inventoryreduction.

(ii)Qualityimprovement.

(iii)Lead time reduction.

(iv)VendorControl/performanceimprovement.

(v)ContinuousImprovement.

(vi)Total Preventive Maintenance.

(vii)StrategicGain.