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Class: M.B.A
Subject: Production Management
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Unit – III

Plant location – factors influencing plant location, Plant layout-classification of layout with advantages, layout design procedures, Production planning and control – aggregate planning-nature, Strategies, methods, Master production Plan.

PLANT LOCATION:

DEFINITION:

"The function of determining where the plant should be located for maximum operating economy and effectiveness"

- Prof.R.C.Davis

According to Bethel Smith & Alwater,"Plant location stands for that spot where in consideration of business as a whole, the total cost of production and delivering goods to all the consumers is the lowest"

FACTORS THAT INFLUENCE THE SELECTION OF PLANT LOCATION

(i) Availability of Raw Materials

(ii) Proximity to Market

(iii) Infrastructural Facilities

(iv) Government Policy

(v) Availability of Manpower

(vi) Local Laws, Regulations and Taxation

(vii) Ecological and Environmental Factors

(viii) Competition

(ix) Incentives, Land costs. Subsidies for Backward Areas

(x) Climatic Conditions

(xi) Political conditions.

(i) Availability of Raw Materials:

One of the most important considerations involved in selection of industrial location has been the availability of raw materials required. The biggest

advantage of availability of raw material at the location of industry is that it involves less cost in terms of 'transportation cost.

If the raw materials are perishable and to be consumed as such, then the industries always tend to locate nearer to raw material source. Steel and cement industries can be such examples. In the case of small- scale industries, these could be food and fruit processing, meat and fish canning, jams, juices and ketchups, etc.

(ii) Proximity to Market:

If the proof of pudding lies in eating, the proof of production lies in consumption. Production has no value without consumption. Consumption involves market that is, selling goods and products to the consumers. Thus, an industry cannot be thought of without market.

Therefore, while considering the market an entrepreneur has not only to assess the existing segment and the region but also the potential growth, newer regions and the location of competitors. For example, if one's products are fragile and susceptible to spoilage, then the proximity to market condition assumes added importance in selecting the location of the enterprise.

(iii) Infrastructural Facilities:

Of course, the degree of dependency upon infrastructural facilities may vary from industry to industry, yet there is no denying of the fact that availability of infrastructural facilities plays a deciding role in the location selection of an industry. The infrastructural facilities include power, transport and communication, water, banking, etc.

Yes, depending upon the types of industry these could assume disproportionate priorities. Power situation should be studied with reference to its reliability, adequacy, rates (concessional, if any), own requirements, subsidy for standby arrangements etc. If power contributes substantially to your inputs costs and it is difficult to break even partly using your own standby source, entrepreneur may essentially have to locate his/her enterprise in lower surplus areas such as Maharashtra or Rajasthan.

(iv) Government Policy:

In order to promote the balanced regional development, the Government also offers several incentives, concessions, tax holidays for number of years, cheaper power supply, factory shed, etc., to attract the entrepreneurs to set up industries in less developed and backward areas. Then, other factors

being comparative, these factors become the most significant in deciding the location of an industry.

(v) Availability of Manpower:
Availability of required manpower skilled in specific trades may be yet another deciding factor for the location of skill- intensive industries. As regards the availability of skilled labour, the existence of technical training institutes in the area proves useful. Besides, an entrepreneur should also study labour relations through turnover rates, absenteeism and liveliness of trade unionism in the particular area.

Such information can be obtained from existing industries working in the area. Whether the labour should be rural or urban; also assumes significance in selecting the location for one's industry. Similarly, the wage rates prevalent in the area also have an important bearing on selection of location decision.

(vi) Local Laws, Regulations and Taxes:
Laws prohibit the setting up of polluting industries in prone areas particularly which are environmentally sensitive. Air (Prevention and Control of Pollution) Act, 1981 is a classical example of such laws prohibiting putting up polluting industries in prone areas. Therefore, in order to control industrial growth, laws are enforced to decongest some areas while simultaneously encourage certain other areas.

For example, while taxation on a higher rate may discourage some industries from setting up in an area, the same in terms of tax holidays for some years may become the dominant decisional factor for establishing some other industries in other areas. Taxation is a Centre as well as State Subject. In some highly competitive consumer products, its high quantum may turn out to be the negative factor while its relief may become the final deciding factor for some other industry.

(vii) Ecological and Environmental Factors:
In case of certain industries, the ecological and environmental factors like water and air pollution may turn out to be negative factor in deciding enterprise location. For example, manufacturing plants apart from producing solid waste can also pollute water and air. Moreover, stringent waste disposal laws, in case of such industries, add to the manufacturing cost to exorbitant limits.

In view of this, the industries which are likely to damage the ecology and environment of an area will not be established in such areas. The

Government will not grant permission to the entrepreneurs to establish such industries in such ecologically and environmentally sensitive areas.

(viii) Competition:
In case of some enterprises like retail stores where the revenue of a particular site depends on the degree of competition from other competitors' location nearby plays a crucial role in selecting the location of an enterprise. The areas where there is more competition among industries, the new units will not be established in these areas. On the other hand, the areas where there is either no or very less competition, new enterprises will tend to be established in such areas.

(ix) Incentives, Land Costs, Subsidies for Backward Areas:
With an objective to foster balanced economic development in the country, the Government decentralizes industries to less developed and backward areas in the country. This is because the progress made in islands only cannot sustain for long. The reason is not difficult to seek.

"Poverty anywhere is dangerous for prosperity everywhere." That many have-not's will not tolerate a few haves is evidently clear from ongoing protests leading to problems like terrorism. Therefore, the Government offers several incentives, concessions, tax holidays, cheaper lands, assured and cheaper power supply, price concessions for departmental (state) purchases, etc. to make the backward areas also conducive for setting up industries.

It is seen that good number of entrepreneurs considers these facilities as decisive factor to establish industries in these locations. However, it has also been observed that these facilities can attract entrepreneurs to establish industries in backward areas provided other required facilities do also exist there.

(x) Climatic Conditions:
Climatic conditions vary from place to place in any country including India. And, climatic conditions affect both people and manufacturing activity. It affects human efficiency and behaviour to a great extent. Wild and cold climate is conducive to higher productivity. Likewise, certain industries require specific type of climatic conditions to produce their goods. For example, jute and textiles manufacturing industries require high humidity.

As such, these can be established in Kashmir experiencing humidity-less climate. On the other hand, industrial units manufacturing precision goods

like watches require cold climate and hence, will be established in the locations having cold climate like Kashmir and Himachal Pradesh.

(xi) Political Conditions:
Political stability is essential for industrial growth. That political stability fosters industrial activity and political upheaval derails industrial initiates is duly confirmed by political situations across the countries and regions within the same country. The reason is not difficult to seek.

The political stability builds confidence and political instability causes lack of confidence among the prospective and present entrepreneurs to venture into industry which is filled with risks. Community attitudes such as the "Sons of the Soil Feeling" also affect entrepreneurial spirits and may not be viable in every case.

PLANT LAYOUT:

DEFINITION:

According to Keith and Gubellini, **"**Plant layout deals with the arrangement of the physical facilities and the manpower which are required to manufacture a product or perform a service."

According to J. Lundy, "Plant layout ideally involves the allocation of space and the arrangement of equipment in such a manner that overall operations costs be minimised."

OBJECTIVES OF PLANT LAYOUT:

1. To achieve economies in handling of raw materials, work in- progress and finished goods.

2. To reduce the quantum of work-in-progress.

3. To have most effective and optimum utilisation of available floor space.

4. To minimise bottlenecks and obstacles in various production processes thereby avoiding the accumulation of work at important points.

5. To introduce system of production control.

6. To ensure means of safety and provision of amenities to the workers.

7. To provide better quality products at lesser costs to the consumers.

8. To ensure loyalty of workers and improving their morale.

9. To minimise the possibility of accidents.

10. To provide for adequate storage and packing facilities.

11. To workout possibilities of future expansion of the plant.

PRINCIPLES OF PLANT LAYOUT:

(i) Principle of Minimum Movement:
Materials and labour should be moved over minimum distances; saving cost and time of transportation and material handling.

(ii) Principle of Space Utilization:
All available cubic space should be effectively utilized – both horizontally and vertically.

(iii) Principle of Flexibility:
Layout should be flexible enough to be adaptable to changes required by expansion or technological development.

(iv) Principle of Interdependence:
Interdependent operations and processes should be located in close proximity to each other; to minimize product travel.

(v) Principle of Overall Integration:
All the plant facilities and services should be fully integrated into a single operating unit; to minimize cost of production.

(vi) Principle of Safety:
There should be in-built provision in the design of layout, to provide for comfort and safety of workers.

(vii) Principle of Smooth Flow:
The layout should be so designed as to reduce work bottlenecks and facilitate uninterrupted flow of work throughout the plant.

(viii) Principle of Economy:
The layout should aim at effecting economy in terms of investment in fixed assets.

(ix) Principle of Supervision:
A good layout should facilitate effective supervision over workers.

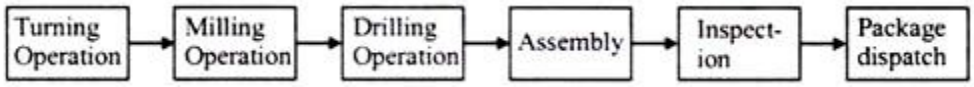
(x) Principle of Satisfaction:
A good layout should boost up employee morale, by providing them with maximum work satisfaction.

TYPES OF PLANT LAYOUT:

(a) Product Layout (or Line Layout):
In this type of layout, all the machines are arranged in the sequence, as required to produce a specific product. It is called line layout because machines are arrange in a straight line. The raw materials are fed at one end and taken out as finished product to the other end.

Special purpose machines are used which perform the required jobs (i.e. functions) quickly and reliably.

Product layout is depicted below:



Advantages:
1. Reduced material handling cost due to mechanized handling systems and straight flow

2. Perfect line balancing which eliminates bottlenecks and idle capacity.

3. Short manufacturing cycle due to uninterrupted flow of materials

4. Simplified production planning and control; and simple and effective inspection of work.

5. Small amount of work-in-progress inventory

6. Lesser wage cost, as unskilled workers can learn and manage production.

Disadvantages:

1. Lack of flexibility of operations, as layout cannot be adapted to the manufacture of any other type of product.

2. Large capital investment, because of special purpose machines.

3. Dependence of whole activity on each part; any breakdown of one machine in the sequence may result in stoppage of production.

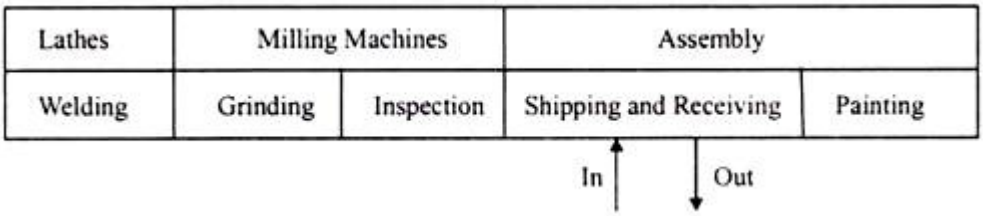
4. Same machines duplicated for manufacture of different products; leading to high overall operational costs.

5. Delicate special purpose machines require costly maintenance / repairs.

(b) Process Layout (or Functional Layout):

In this type of layout, all machines performing similar type of operations are grouped at one location i.e. all lathes, milling machines etc. are grouped in the shop and they will be clustered in like groups.

A typical process layout is depicted below:



Advantages:

1. Greater flexibility with regard to work distribution to machinery and personnel. Adapted to frequent changes in sequence of operations.

2. Lower investment due to general purpose machines; which usually are less costly than special purpose machines.

3. Higher utilisation of production facilities; which can be adapted to a variety of products.

4. Variety of jobs makes the work challenging and interesting.

5. Breakdown of one machine does not result in complete stoppage of work.

Disadvantages:

1. Backtracking and long movements occur in handling of materials. As such, material handling costs are higher.

2. Mechanisation of material handling is not possible.

3. Production planning and control is difficult

4. More space requirement; as work-in-progress inventory is high-requiring greater storage space.

5. As the work has to pass through different departments; it is quite difficult to trace the responsibility for the finished product.

(c) Combination Layout:

In practice, plants are rarely laid out either in product or process layout form. Generally a combination of the two basic layouts is employed; to derive the advantages of both systems of layout. For example, refrigerator manufacturing uses a combination layout.

Process layout is used to produce various operations like stamping, welding, heat treatment being carried out in different work centres as per requirement. The final assembly of the product is done in a product type layout.

(d) Fixed Position Layout:

It is also called stationary layout. In this type of layout men, materials and machines are brought to a product that remains in one place owing to its size. Ship-building, air-craft manufacturing, wagon building, heavy construction of dams, bridges, buildings etc. are typical examples of such layout.

PRODUCTION PLANNING AND CONTROL

Goldon B. Carson:
"Production planning and control involves generally the organization and planning of the manufacturing process. Specifically, it consists of the planning of the routing, scheduling, dispatching and inspection, co-ordination and the control of materials, methods, machines, tooling and operating times. The ultimate objective is the organization of the supply and movement of materials and labour, machine utilization and related activities, in order to bring about the desired manufacturing results in terms of quantity, time and place."

Charles A. Koepke:
"Production planning and control is the coordination of a series of functions according to a plan which will economically utilize the plant facilities and regulate the orderly movement of goods through the entire manufacturing cycle, from the procurement of all materials to the shipping of finished goods at a predetermined rate."

OBJECTIVES OF PRODUCTION PLANNING & CONTROL

1. To ensure safe and economical production process
2. To effectively utilize plant to maximize productivity
3. To maximize efficiency by proper coordination in production process
4. To ensure proper delivery of goods
5. To place the right man for the right job, at right time for right wages.
6. To minimize labor turnover
7. To reduce the waiting time

TYPES (OR) MAIN ELEMENTS OF PRODUCTION PLANNING & CONTROL

1. Routing
2. Loading
3. Scheduling
4. Dispatching
5. Follow up
6. Inspection
7. Corrective

1. **Routing**: It is about selection of path or route through which raw materials pass in order to make it into a finished product. The points to be noted while routing process are – full capacity of machines, economical and short route and availability of alternate routing. Setting up time for the process for each stage of route is to be fixed. Once overall sequence are fixed, then the standard time of operations are noted using work measurement technique.

2. **Loading and scheduling**: Loading and Scheduling are concerned with preparation of workloads and fixing of starting and completing date of each operation. On the basis of the performance of each machine, loading and scheduling tasks are completed.

3. **Dispatching**: Dispatching is the routine of setting productive activities in motion through the release of orders and instructions, in accordance with previously planned time and sequence, embodied in route sheet and schedule charts. It is here the orders are released.

4. **Expediting / Follow-up**: It is a control tool which brings an idea on breaking up, delay, rectifying error etc., during the progress of work.

5. **Inspection**: Inspection is to find out the quality of executed work process.

6. **Corrective**: At evaluation process, a thorough analysis is done and corrective measures are taken in the weaker spots.

STAGES OF PRODUCTION PLANNING & CONTROL

1. Pre-planning
2. Planning
3. Control.

Stage 1: Pre-Planning

Under this phase of production planning, basic ground work on the product design, layout design and work flow are prepared. The operations relating to the availability scope and capacity of men, money materials, machines, time are estimated.

Stage 2: Planning
This is a phase where a complete analysis on routing, estimating and scheduling is done. It also tries to find out the areas of concern for short time and long time so that prominent planning can be prepared.

Stage 3: Control
Under this phase, the functions included are dispatching, follow up, inspection and evaluation. It tries to analyze the expedition of work in progress. This is one of the important phases of the Production Planning and Control.

AGGREGATE PLANNING

DEFINITION :

Aggregate planning is an intermediate term planning decision. It is the process of planning the quantity and timing of output over the intermediate time horizon (3 months to one year). Within this range, the physical facilities are assumed to –10 be fixed for the planning period. Therefore, fluctuations in demand must be met by varying labor and inventory schedule. Aggregate planning seeks the best combination to minimize costs.

NATURE OF AGGREGATE PLANNING

- Minimize costs / maximize profits.
- Maximize customer service.
- Minimize inventory investment.
- Minimize changes in production rates.
- Minimize changes in workforce levels.
- Maximize utilization of plant and equipment.

AGGREGATE PLANNING STRATEGIES

1. **Level Strategy**

   As the name suggests, level strategy looks to maintain a steady production rate and workforce level. In this strategy, organization requires a robust forecast demand as to increase or decrease production in anticipation of lower or higher customer demand. Advantage of level strategy is steady workforce. Disadvantage of level strategy is high inventory and increase back logs.

2. **Chase Strategy**

   As the name suggests, chase strategy looks to dynamically match demand with production. Advantage of chase strategy is lower inventory levels and back logs. Disadvantage is lower productivity, quality and depressed work force.

3. **Hybrid Strategy**

   As the name suggests, hybrid strategy looks to balance between level strategy and chase strategy.

METHODS OF AGGREGATE PLANNING

Trial & Error Method

Procedure:

- Determine demand for each period.
- Determine capacities (regular time, O/T, Subcontracting) for each period.
- Identify company policies
- Determine unit costs for regular time, O/T, subcontracting, inventories, back orders, layoffs and other relevant costs.
- Develop alternative plans and compute the costs for each.

Select the one that best satisfies the objectives.

Linear Programming

- E.H. BOWMAN - proposed formulating the problem in terms of transportation type programming model as a way to obtain aggregate plans that would match capacities with demand requirements and minimize cost.

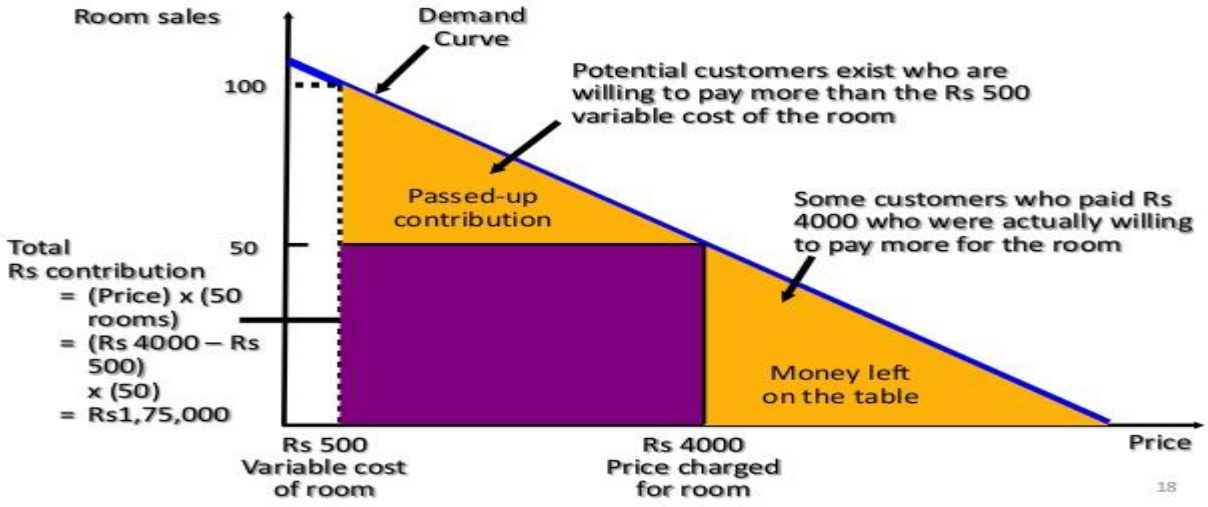
- In order to use this approach, planners must identify capacity (supply) of regular labor time, over time, subcontracting and inventory on a period by period basis as well as related costs of each variable.

LINEAR DECISION RULE

- Linear decision rule is another optimizing technique. It seeks to minimize total production costs (labor, overtime, hiring/lay off, inventory carrying cost) using a set of cost-approximating functions to obtain a single quadratic equation.

- Then, by using calculus, two linear equations can be derived from the quadratic equation, one to be used to plan the output for each period and the other for planning the workforce for each period.

YIELD MANAGEMENT



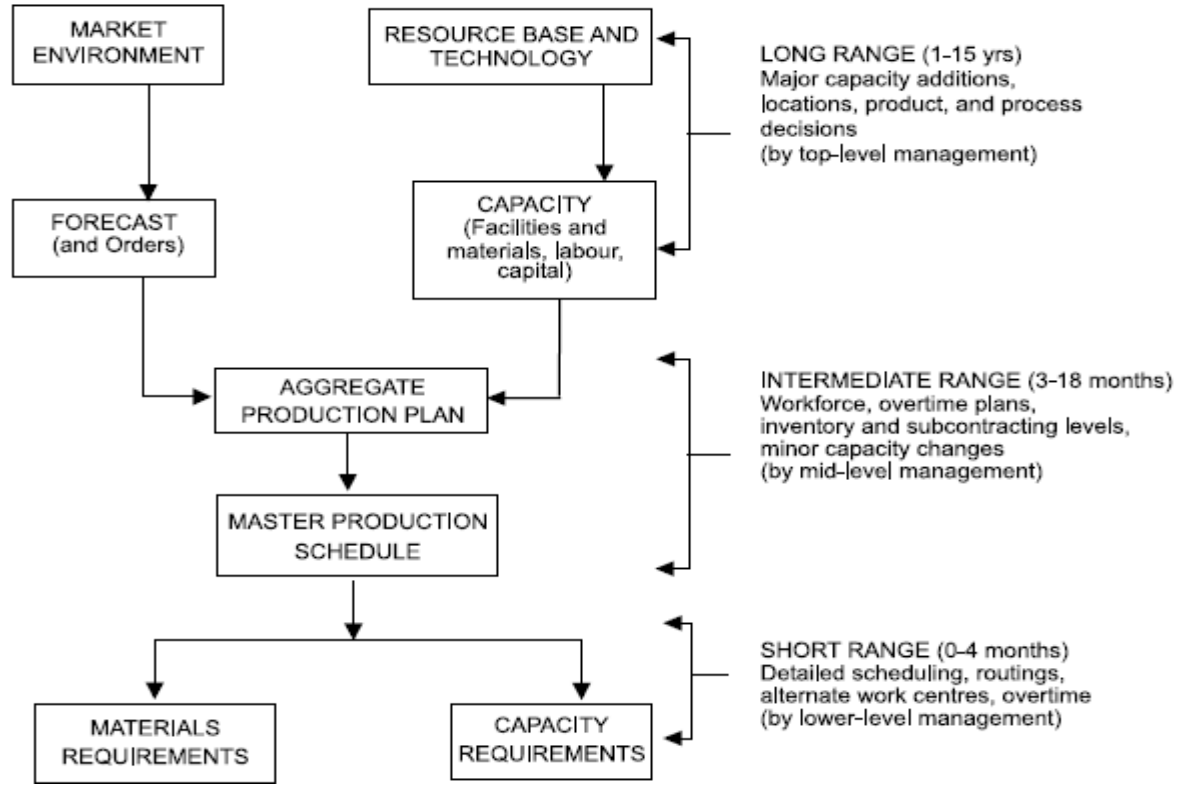
MASTER PRODUCTION PLAN

A master production schedule (MPS) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. ... The MPS translates the customer demand (sales orders, PIR's), into a build plan using planned orders in a true component scheduling environment

FUNCTIONS OF MASTER PRODUCTION PLAN

1. ***To translate aggregate plans into specific end items*:** Aggregate plan determines level of operations that tentatively balances the market demands with the material, labor and equipment capabilities of the company. A master schedule translates this plan into specific number of end items to be produced in specific time period.

Flowchart of aggregate plan and master schedule



2. Evaluate alternative schedules*: Master schedule is prepared by trial and error. Many computer simulation models are available to evaluate the alternate schedules.*

3. Generate material requirement*:* *It forms the basic input for material requirement planning (MRP).*

4. Generate capacity requirements*:* *Capacity requirements are directly derived from MPS. Master scheduling is thus a prerequisite for capacity planning.*

5. Facilitate information processing*:* *By controlling the load on the plant. Master schedule determines when the delivery should be made. It coordinates with other management information systems such as, marketing, finance and personnel.*

6. Effective utilization of capacity*:* *By specifying end item requirements schedule establishes the load and utilization requirements for machines and equipment.*

Unit – IV

Quality control-Definition, need, Quality control techniques, control charts, acceptance sampling, six sigma, quality circles. TQM-scope, benefits.JIT.

Quality control:

Definition:

According to Dr. W.K. Spriegel "The quality of a product may be defined as the sum of a number of related characteristics such as shape, dimension, composition, strength, workmanship, adjustment, finish and colour".

In the words of John D. McIIellan, "Quality is the degree to which a product conforms to specifications and workmanship standards".

Objectives of quality control:

1. To establish the desired quality standards which are acceptable to the customers?

2. To discover flaws or variations in the raw materials and the manufacturing processes in order to ensure smooth and uninterrupted production.

3. To evaluate the methods and processes of production and suggest further improvements in their functioning.

4. To study and determine the extent of quality deviation in a product during the manufacturing process.

5. To analyse in detail the causes responsible for such deviation.

6. To undertake such steps which are helpful in achieving the desired quality of the product.

Steps in the process of quality control:

(i) Establishing quality standards; in terms of size, design, durability, appearance etc., on the basis of customers' preferences and cost of production.

(ii) Selecting the manufacturing process; this permits output of the required specifications.

(iii) Developing measurement techniques; to ensure whether production conforms to set specifications or not.

(iv) Monitoring product quality; which requires designing a system of periodical checks of the end product to find out deviations from set standards of a quality; and locating causes of such deviations.

(v) Taking corrective action; to remove the causes of deviations

Techniques of Quality Control:

(I) Inspection

(II) Statistical quality control (SQC)

(I) Inspection:

Inspection is that component of quality control programme which is concerned with checking on the performance of items to the specifications set for it. It involves periodic checking and measuring – before, during and after the production process. Because of the numerous variables that enter into manufacturing, inspection is a never ending process.

Inspection may be 'Centralised' or 'Floor Inspection.':

Under centralized inspection, all the work from a department is sent to the Inspection Department, before passing on to the next operation. Floor inspection, on the other hand, follows the practice of sending inspectors to the floor and inspects work at the machines of operatives. It is also called patrolling or travelling inspection.

Advantages of centralized inspection:
(i) Centralized inspection ensures impartial supervision; because the inspector is not under the strain of not rejecting the work of a person with him he has good personal relations.

(ii) Under centralized inspection, it is easier to keep records of items/parts which are approved or rejected.

(iii) Production work is liable to less interruption, under centralized inspection.

Advantages of floor inspection:
(i) Since work is inspected on the floor; delay in sending work to next station is avoided.

(ii) Inspector can immediately locate the fault and suggest rectification.

(iii) It involves minimum material handling.

(II) Statistical Quality Control (SQC):
SQC is based upon the laws of probability. It is a system for controlling the quality of production within specified limits (tolerance limits) by means of a sample procedure and continuing analysis of inspection results.

Grant defines SQC as follows:
"SQC is a simple statistic method for determining the extent to which quality goods are being met without necessarily checking every item produced and for indicating whether or not the variations which occur are exceeding normal expectations. It enables us to decide whether to reject or accept a particular product."

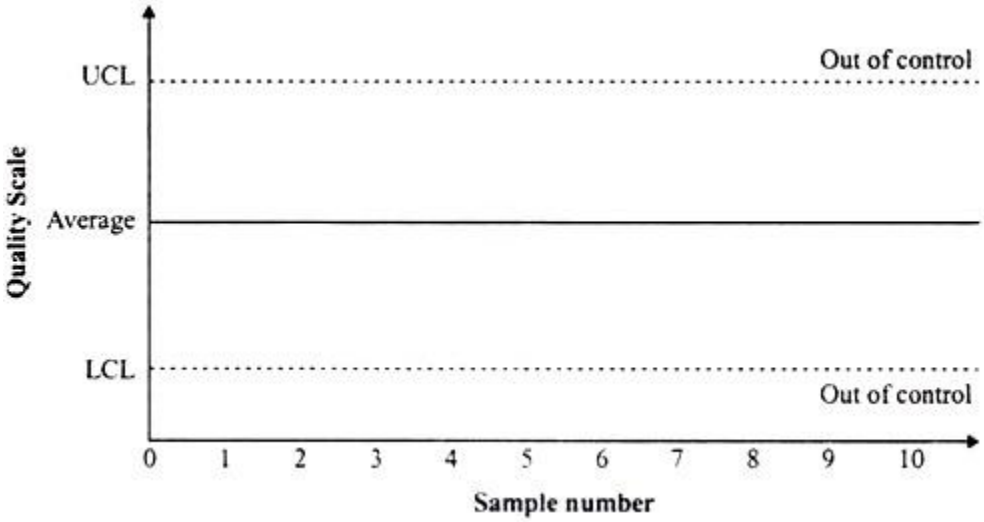
Techniques of SQC:
Techniques of SQC can be divided into two parts:
(1) Process control

(2) Acceptance sampling

Following is a brief account of these techniques of SQC:

(1) Process Control:
The checking up of quality characteristics under process control is done with the help of charts. There may be many types of charts like 'X-Chart', 'R-Chart', 'C-Chart' and 'P-Chart'. All types of charts are similar in composition and structure. All of them represent how quality- characteristic is changing from one sample to another.

A control chart when prepared would appear as follows:



Note: UCL = Upper Control Limit

LCL = lower control Limit

A process is considered out of control and an action to check and correct the process is taken; when a plotted point falls outside the control limits.

Advantages of control charts:
1. They provide visual aids

2. They are easy to prepare.

3. They give early warning of trouble

(2) Acceptance Sampling:

Control charts are useful for process control. In case of receipt of materials and dispatch of finished goods; a different method is used, that of acceptance sampling. Acceptance sampling plans are of utmost value when the nature of the process used to manufacture products remains unchanged.

In acceptance sampling, decisions [e.g. whether acceptable/not acceptable (rejection)] about the quality of batches or lots are made after inspection of only a portion i.e. a sample. If the sample of items conforms to requisite quality levels; then the whole batch from which the sample is taken is accepted. If the sample does not conform to the requisite quality level; then the whole batch is rejected.

An acceptance sampling is defined as:

Lot size (N)

Sample size (n)

Acceptance number (C)

Suppose N = 9000; n = 300 and C = 7; then this sampling plan means that a lot of 9000 items has 300 units (sample size) inspected. If seven or less defectives are found in 300 units sample; the lot is accepted. If eight or more defectives are found in the sample; the lot is rejected.

A close study of acceptance sampling technique would reveal that there is likelihood that a lot of satisfactory quality is rejected on the basis of sample result. This is technically called producer's risk. Similarly, the consumer (or buyer) has the risk of accepting a lot of unsatisfactory quality, on the basis of sample results. This risk is called consumer's risk.

Advantages of acceptance sampling:

(i) Less expensive than 100% inspection

(ii) Used where 100% inspection is not possible.

(iii) Useful when inspection may cause damage or complete destruction.

Advantages of SQC:

(i) Reduced Cost:
Since only a fraction of output is inspected; costs of inspection are greatly reduced.

(ii) Early Warning of Defects:
SQC gives an early warning of defects in the production process; so that these defects can be detected and corrected at inception.

(iii) Simple Technique:
SQC techniques are simple and can be operated by semi-skilled operators.

(iv) Continuous Inspection:
SQC is a technique which provides a continuous inspection of the product at various stages of the manufacturing process.

(v) Adherence to Specifications:
SQC enables a process to be held in a state of statistical control i.e. a state in which variability is the result of chance causes alone.

Advantages (or) Benefits of quality control:

1. Encourages quality consciousness:
The most important advantage derived by introducing quality control is that it develops and encourages quality consciousness among the workers in the factory which is greatly helpful in achieving desired level of quality in the product.

2. Satisfaction of consumers:
Consumers are greatly benefited as they get better quality products on account of quality control. It gives them satisfaction.

3. Reduction in production cost:
y undertaking effective inspection and control over production processes and operations, production costs are considerably reduced.

Quality control further checks the production of inferior products and wastages thereby bringing down the cost of production considerably.

4. Most effective utilization of resources:
Quality control ensures maximum utilisation of available resources thereby minimising wastage and inefficiency of every kind.

5. Reduction in inspection costs:
Quality control brings about economies in inspection and considerably reduces cost of inspection.

6. Increased goodwill:
By producing better quality products and satisfying customer's needs, quality control raises the goodwill of the concern in the minds of people. A reputed concern can easily raise finances from the market.

7. Higher morale of employees:
An effective system of quality control is greatly helpful in increasing the morale of employees, and they feel that they are working in the concern producing better and higher quality products.

8. Improved employer-employee relations:
Quality control develops to better industrial atmosphere by increasing morale of employees which ensures cordial employer-employee relations leading to better understanding and closeness between them.

9. Improved techniques and methods of production:
By supplying technical and engineering data for the product and manufacturing processes, improved methods and designs of production are ensured by quality control.

10. Effective advertisement:
Organizations producing quality products have effective advertisement. They win the public confidence by supplying those better quality products.

11. Facilitates price fixation:
By introducing quality control measures, uniform products of same quality are produced. This greatly facilitates the problem of price fixation. One price of standard products becomes prevalent in the market.

Six Sigma

Definition

Six Sigma is a disciplined, statistical-based, data-driven approach and continuous improvement methodology for eliminating defects in a product, process or service.

Six Sigma Process (Or) procedure

1. RECOGNISE: Identify where output variation is hurting the customer

2. DEFINE: Form the project team and scope the opportunity

3. MEASURE: Identify the potential causes of variation in the process and collect data on them

4. ANALYSE: Evaluate the data to identify the true root causes of variation

5. IMPROVE: Address those root causes by creating and implementing suitable solutions

6. CONTROL: Establish the necessary ongoing control actions to sustain the improvement

7. TRANSFER: Share lessons learnt across the organization to maximize the benefits

Benefits of Six Sigma

1. Time Management:
Implementing Six Sigma in a business helps employees to manage their time effectively. This results in a efficient business and productive employees. They are asked to set smart goals and then principles of six sigma to them. The key areas involved are Learning, Performance and Fulfillment.
In the area of learning a practitioner of six sigma asks how often the interruptions deviate him from the task and how many interruptions require his attention.

2. Improved Customer Loyalty:

Any business wants to retain its customers. It is a significant factor to measure the success of business. Customer loyalty and retention will show the the levels of Customer Satisfaction.

Most of the surveys says that the reason of customers for not returning to a business are dissatisfaction and employee attitude. The company may or may not know that they have a dissatisfied customer. By implementing six sigma in a business reduces the risk of having dissatisfied customers. To achieve this you should consider a running voice through customers to understand the products which are critical to customer perception of satisfaction.

3. Employee Motivation:

In every business the employees need to act in a right way, if it is destined to success. For this they must have a sufficient motivation. The organizations which are fully engaged with the employees, had 25-50 % increases in the productivity.

4. Reduced Cycle time:

We do observe that most of the firms extend their deadlines often because of changes in project scope or shift in management policy.

By using Six Sigma, a business can develop a team of experienced employees from all levels of the organization and from every functional department. These teams work on identifying the factors that leads the project to long cycles.

5. Strategic Planning:

Six Sigma plays a key role in any strategic vision. Once the business has used a created mission statement and carried out a SWOT analysis**,** then six sigma helps you to focus on the areas of improvement.

6. Supply chain management:

The aim of six sigma is having a defect rate less than 3.4 per million and your suppliers have influence on whether the target is met or not. One of the best ways to reduce the defect rate is to implement six sigma to decrease the number of suppliers your business has.It is also very important to know whether the supplier is planning for a change. For example, the change in machinery can have an effect like ripples from a pond when a rock is thrown.

Disadvantages of Six Sigma

1. Some believe six sigma is another packaged form of continuous improvement invented by Toyota. So lacks identity of its own.

2. There is an argument by setting standard of 3.4 defects per million opportunities, we may waste time in unproductive areas of defect identification. Instead quality standard should be defined as per the specific task or process.

3. It might suppress company's growth if Sig Sigma is given more freedom in an organization as more and more new and creative processes would be developed.

4. To implement and reap benefits of six sigma, substantial amount of time is required which is often impractical in many situations.

5. To implement six sigma, considerable amount of training of employees need to be done. Certified six sigma practioners need to be developed which in some environments may not be practical.

6. Lots of bottlenecks need to be overcome while converting theoretical concepts into practical applications

QUALITY CIRCLE

What is quality circle? It is a work group of employees who meet regularly to discuss their quality problems, investigate causes, recommend solutions, and take corrective actions. Generally, QC is a small group of employees belonging to the same similar work area.

Functions (Or) Steps for Setting up Quality Circles:

(i) First of all Managers, Supervisors and Foremen must be made to understand the concepts and activities of Q.C.

(ii) Management's total support and commitment should be made known to everyone in the organisation.

(iii) Steering committee is formed with the top management personnel to give direction to Quality Circle activities.

(iv) A facilitator (or sometimes known as promoter) is selected from the senior management level, who will serve as coordinator and advisor to the circle.

(v) Supervisor and foreman are then trained to act as Q.C. leaders.

(vi) Members of each circle must be selected from the persons who are doing similar type of work or belong to the same department or section.

(vii) Membership to the circle is voluntary.

(viii) First few meetings of the circle are held with a view to train them.

(ix) To start with, only one to two circles should be formed in an organisation, and then increase the number gradually as more and more experience is gained.

(x) Meetings must be held regularly, may be once in a week initially and once in a month on completion of basic training of members.

(xi) Everyone's suggestion or problem matching with the circle's objectives is discussed.

(xii) Total participation of team members must be encouraged.

(xiii) Recommendations of the circle must be considered and decisions should be taken without delay.

Advantages of Quality Circles

1. Through the forum of Q.C. the chronic problems-of organisations which really create hurdles in work get resolved by the grass root employees of organisation, whose knowledge and experience otherwise is not fully utilized.

2. With such a capable work force, any organisation can easily undertake more difficult and challenging assignments for its growth and profit.

3. As the employees gain experience they take more challenging projects, in due course they undertake projects on cost reduction, material handling, quality improvement, preventing wastage, improving delivery schedule, improving customer service, improving inspection and test methods, preventing accidents improving design and process etc.

4. Cost reduction.

5. Increased productivity.

6. Improved quality.

7. Better communication.

8. Better house-keeping.

9. Increased team work.

10. Smooth working.

11. Better mutual trust.

12. Greater sense of belongingness.

13. Increased safety.

14. Better human relations.

Problems of Quality Circles

1. As the circle membership is voluntary, a member can drop out when he/she wishes so. This option may be even be exercised to force other members to come to his/her terms.

2. The selection of a problem to be tackled first may generate more heat among the circle members. A strong-willed member may bulldoze his/her ideas straining the relationship.

3. The quality circle takes up a problem which is difficult to solve, thus, wasting their time and energy.

4. The departmental managers often prove less supportive, as the members of quality circle come to limelight often.

5. Fixing-up meeting time becomes difficult due to fluctuating working demand.

6. The circle may form an impression that the management is not implementing its suggestions whole heatedly and is dilly-dallying the idea which may have a dampening effect on the circle, demoralizing them.

7. The quality circle may feel after some time that it has run out of problems which in effect implies that it is not brainstorming according to the rules.

Total Quality Management

Definition:

"Total Quality Management is a combination of socio-technical process towards doing the right things (externally), everything right (interally), first time and all the time with economic viability considered at each stage of each process."

—Zaire and Simintiras

"TQM is a strategic approach to produce the best product and service possible through constant innovation."

—Atkinson

Principles of Total Quality Management

A. Commitment from the management:

- Plan (drive, direct)
- Do (deploy, support, and participate)
- Check (review)
- Act (recognize, communicate, revise)

B.Employee Empowerment

- Training
- Excellence team
- Measurement and recognition
- Suggestion scheme

C.Continuous Improvement

- Systematic measurement
- Excellence teams
- Cross-functional process management
- Attain, maintain, improve standards

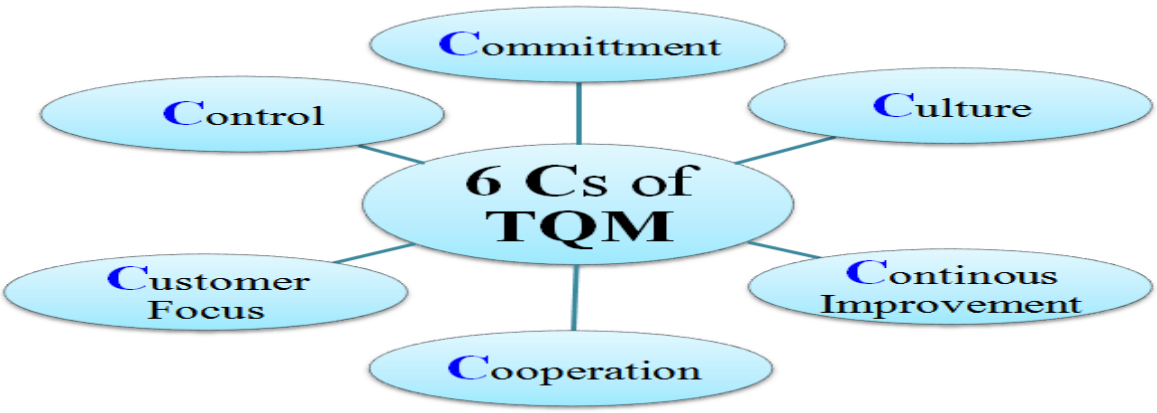
D.Customer Focus

- Partnership with Suppliers
- Service relationship with internal customers
- Customer-driven standards
- Never compromise quality

Scope of TQM

- Commitment by senior management and all employees
- Meeting customer requirements
- Reducing development cycle times
- Just In Time/ Flow Manufacturing
- Improvement teams
- Reducing product and service costs
- Systems to facilitate improvement
- Employee involvement and empowerment
- Recognition and celebration
- Challenging quantified goals and benchmarking
- Focus on processes / improvement plans

6C TQM



ADVANTAGES OF TQM

1) Emphasizing the needs of the market:

TQM helps in highlighting the needs of the market. Its application is universal and helps the organization to identify and meet the needs the market in a better way.

2) Assures better quality performance in every sphere of activity:

Adverse and non-participative attitudes of the employees are the biggest obstacles in the organizational ™s success, growth and advancement.

TQM stresses on bringing attitudinal changes and improvements in the performance of employees by promoting proper work culture and effective team work

3) Helps in checking non-productive activities and waste:

Every organization aims at improving productivity as well as reduction in cost so as to result in increase in profitability.

Under TQM, quality improvement teams are constituted to reduce waste and inefficiency of every king by introducing systematic approach.

4) Helpful in meeting the competition:

TQM techniques are greatly helpful in understanding the competition and also developing an effective combating strategy. Due to the cut throat competition, the very survival of many organizations has become very vital issue.

5) It helps in developing an adequate system of communication:

Faulty and inadequate communication and improper procedures act as stumbling blocks in the way of proper development of an organization.

DISADVANTAGES OF TQM

1) Production Disruption

Implementing a Total Quality Management system in a company requires extensive training of employees and these requires them to take some time of their day to day work duties.
While the improvements do reduce lead time, eliminate waste and improve productivity, the beginning stages of implementing Total Quality Management in an organization can reduce worker output.

2) Employee Resistance

Total Quality Management requires change in mindset, attitude and methods for performing their jobs. When management does not effectively communicate the team approach of Total Quality Management, workers may become fearful, which leads to employee resistance. When workers resist the program, it can lower employee morale and productivity for the business.

3) Quality is Expensive

TQM is expensive to implement. Implementation often comes with additional training costs, team-development costs, infrastructural improvement costs, consultant fees and the like.

4) Discourages Creativity

TQM focus on task standardization to ensure consistency discourages creativity and innovation. It also discourages new ideas that can possibly improve productivity

Just-in-Time System

Definition: The **Just-in-Time or JIT** is an inventory management system wherein the material or the products are produced and acquired just a few hours before they are put to use. The Just-in-time system is adopted by the firms, to reduce the unnecessary burden of inventory management, in case the demand is less than the inventory raised.

Advantages of just in time

1. Less space needed: With a faster turnaround of stock, you don't need as much warehouse or storage space to store goods. This reduces the amount of storage an organisation needs to rent or buy, freeing up funds for other parts of the business.

2. Waste reduction: A faster turnaround of stock prevents goods becoming damaged or obsolete while sitting in storage, reducing waste. This again saves money by preventing investment in unnecessary stock, and reducing the need to replace old stock.

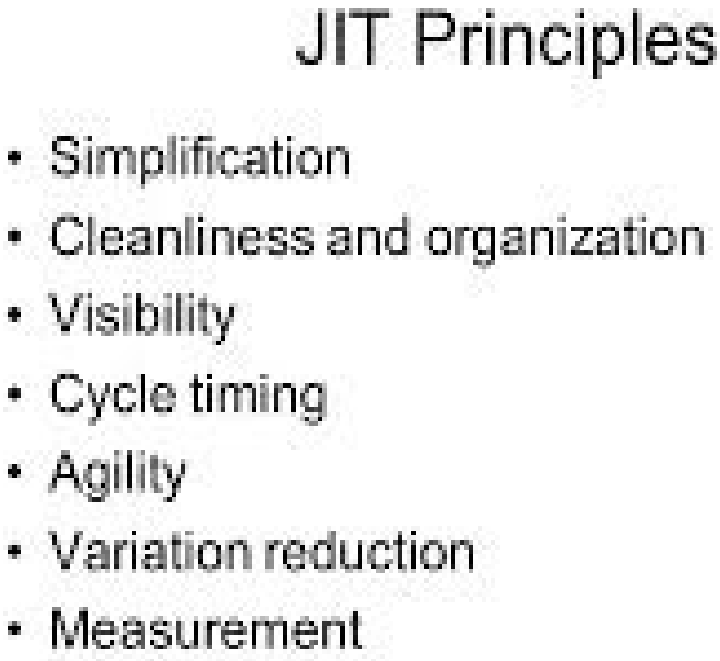
3. Smaller investments: JIT inventory management is ideal for smaller companies that don't have the funds available to purchase huge amounts of stock at once. Ordering stock as and when it's needed helps to maintain a healthy cash flow.

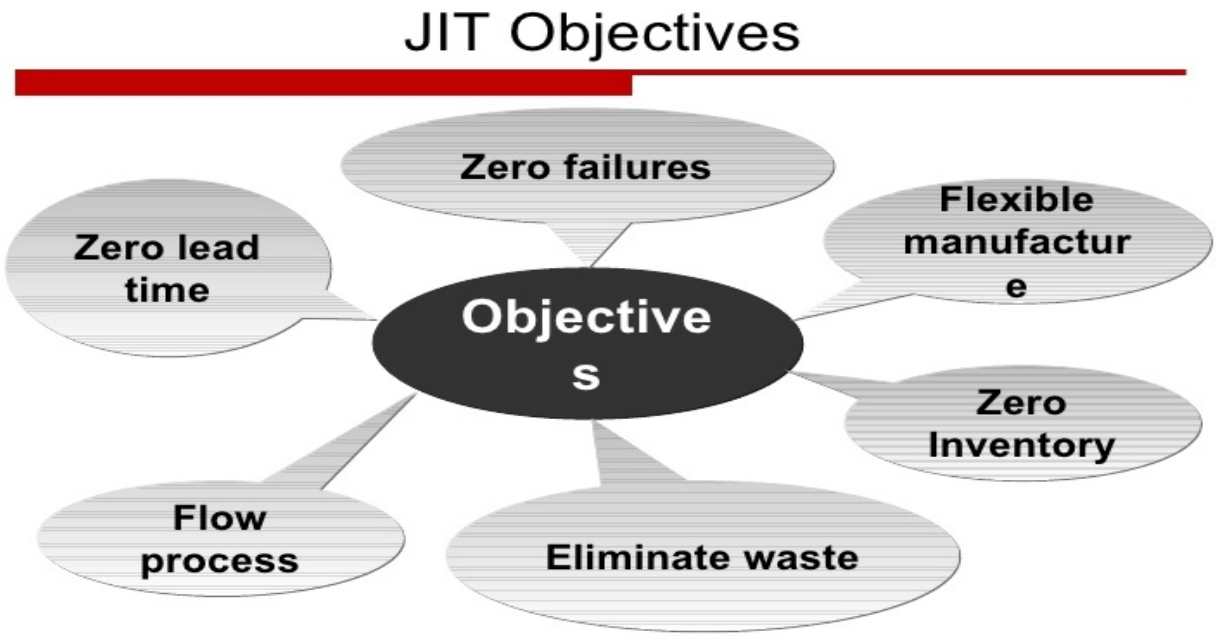
Disadvantages of just in time

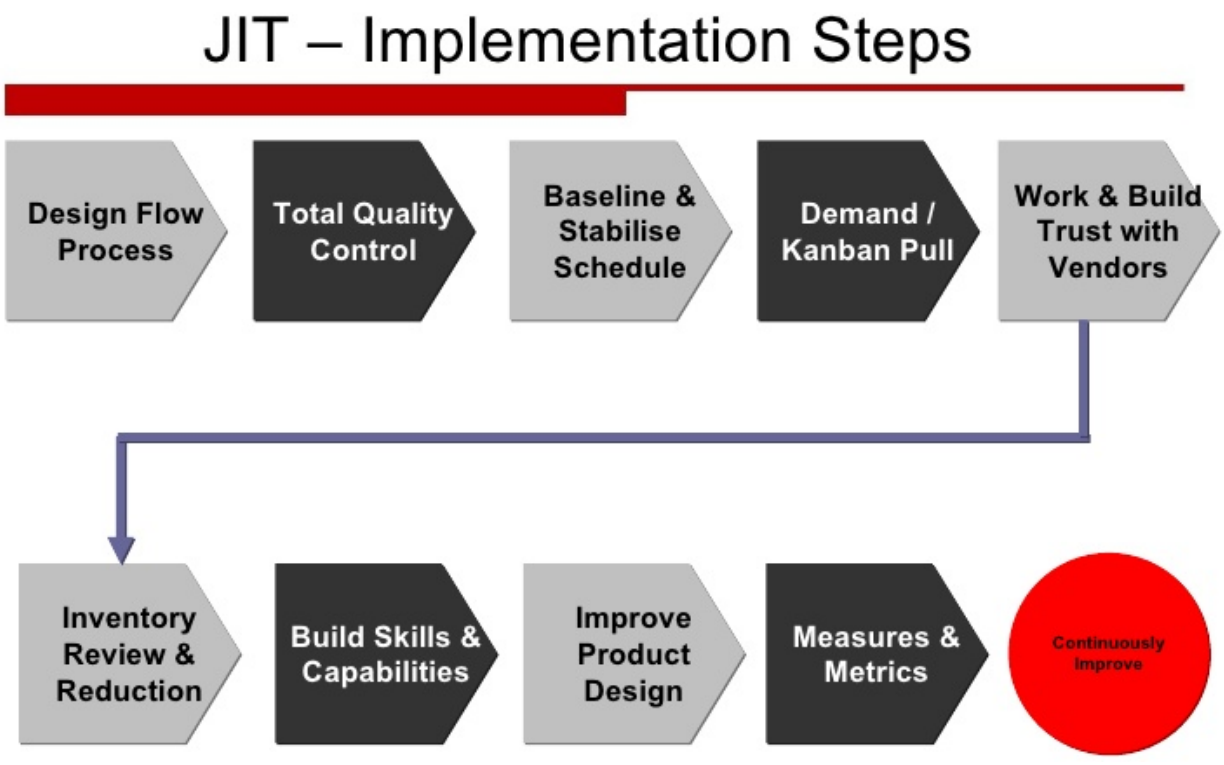
1. Retrofitting Facilities: If your factory or warehouse was not originally built with JIT systems in mind, there might be a lot of work involved to meet the change in production method. New wire shelving and industrial storage may have to be set up right by the loading docks to compensate for the differences in part shipments, and your on-hand equipment and staffing levels may have to be modified to meet the new short-term manufacturing standards.

2. Too Little Inventory: As a counterpoint to one of the advantages listed above, JIT manufacturing does bring the risk of being caught short-handed. If initial orders are too small and demand ramps up unexpectedly, you might be left scrambling to keep up with the influx of demand which could lead to unhappy customers.

3. Unexpected Problems: By only maintaining enough inventory to meet each individual order, any sort of disruption in the supply chain could cause much bigger problems than if you had more on-hand inventory. Any sort of delay from the supplier, weather-related issues, or even unexpected massive orders could greatly compromise your ability to keep up with demand and supply the products your customers need.




JIT Objectives
Zero failures
Zero lead time
Flexible manufactur e
Objective s
Zero Inventory
Flow process
Eliminate waste


JIT – Implementation Steps
Design Flow Process
Total Quality Control
Baseline & Stabilise Schedule
Demand / Kanban Pull
Work & Build Trust with Vendors
Inventory Review & Reduction
Build Skills & Capabilities
Improve Product Design
Measures & Metrics
Continuously Improve

Unit – V

Flexible Manufacturing Systems. Poka yoke-Characteristics, levels, classification, principles, device. Kaizen-Elements, classification, steps in implementing kaizen.

Flexible Manufacturing Systems:

A flexible manufacturing system (FMS) is a method for producing goods that is readily adaptable to changes in the product being manufactured, both in type and quantity. Machines and computerized systems are configured to manufacture different parts and handle varying levels of production. A flexible manufacturing system (FMS) gives manufacturing firms an advantage to quickly change a manufacturing environment to improve process efficiency and thus lower production cost.

ADVANTAGES OF FMS

1. Increased labor productivity,
2. Increased machine efficiency,
3. Improved product quality,
4. Increased system reliability,
5. Reduced parts inventory,
6. Shorter lead times, and increased production rate.

DISADVANTAGES OF FMS

1. High initial set up cost,
2. Increased difficult in pre-planning,
3. Requirements of skilled workers,
4. More complicated system.

NEED FOR FLEXIBLE MANUFACTURING SYSTEM

- Metal-cutting machining
- Metal forming
- Assembly
- Joining-welding (arc , spot), glueing
- Surface treatment
- Inspection
- Testing

POKA YOKE

What is a Poka- yoke?

- Shigeo shingo defined poka-yoke as POKA- 'Inadvertent mistake that anyone can make' and YOKE- 'To prevent or proof'
- Poka-yoke is a tool to have "zero defects" and even reduce or eliminate quality control.
- Poka-yoke is a Japanese name for "fool-proofing".
- Poke-yoke represents the intelligence of the operator by excluding repetitive actions that require a thinking process.

Characteristics of Poka-Yoke

- Simple and cheap
- Part of the process, permitting 100% inspection
- Placed close to where the mistakes occur, providing quick feedback
- Designed to stop a particular mistake
- It will catch the errors before a defective part is manufactured 100% of the time.

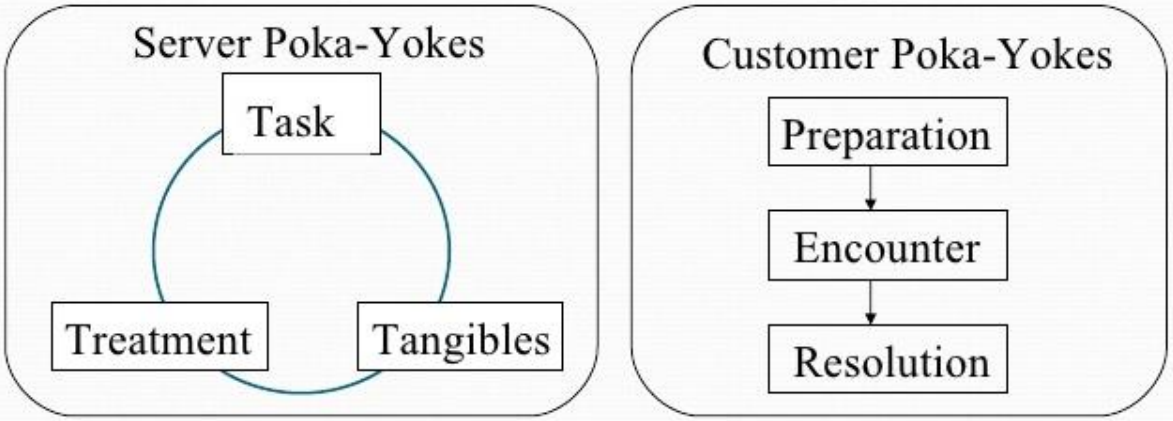
THE THREE LEVELS OF POKA-YOKE:

There are three levels at which your company can effect poka-yoke:

- Eliminating errors defects and losses at the source or prevention of a mistake from being committed..
- Detection of a loss or mistakes it occurs,allowing correction before it becomes a problem.
- Detection of a loss or mistakes after it has occurred,just in time before it blows up into a major issue(least effective).

POKA-YOKE CLASSIFICATION

Poka-yoke is classified into the following types:



PRINCIPLES OF PAKA-YOKE

- **Elimination** seeks to eliminate the possibility of error by redesigning the product or process so that the task or part is no longer necessary.
- **Replacement** substitutes a more reliable process to improve consistency.
- **Prevention** engineers the product or process so that it is impossible to make a mistake at all.
- **Facilitation** employs techniques and combining steps to make work easier to perform.
- **Detection** involves identifying an error before further processing occurs so that the user can quickly correct the problem.
- **Mitigation** seeks to minimize the effects of errors.

Kaizen

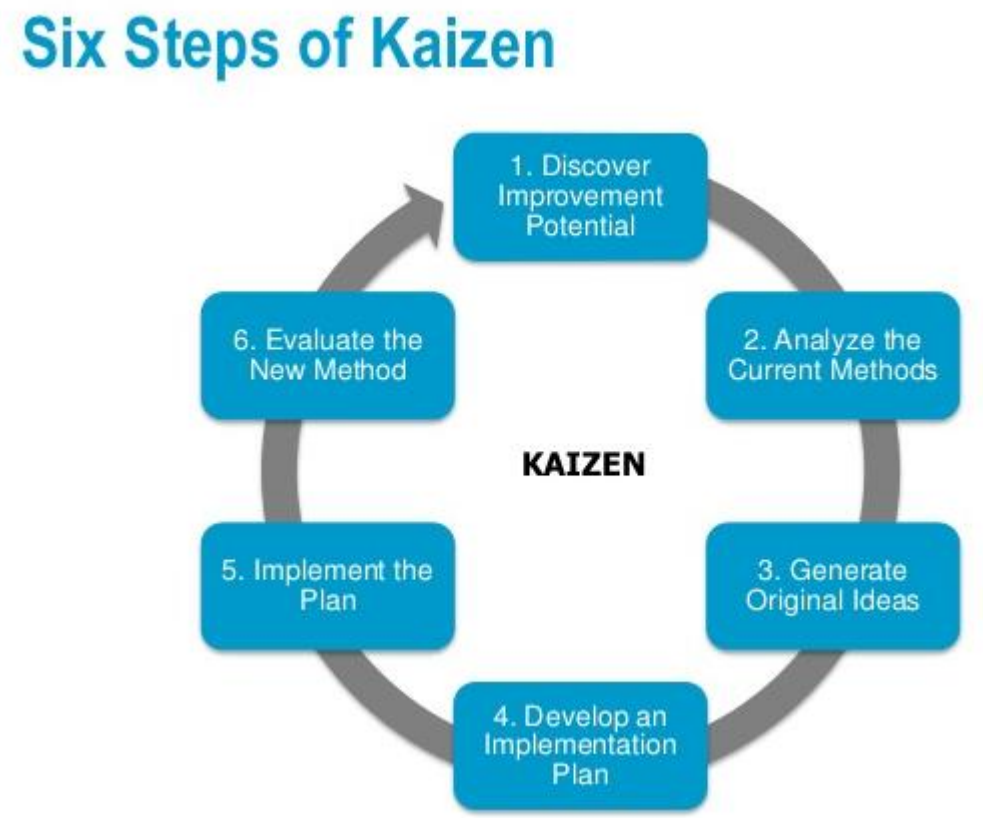
"Kaizen" refers to a Japanese word which means "improvement" or "change for the better". **Kaizen is defined as a continuous effort by each and every employee (from the CEO to field staff) to ensure improvement of all processes and systems of a particular organization**.

Kaizen means "continuous improvement of processes and functions of an organization through change". In a layman's language, Kaizen brings continuous small improvements in the overall processes and eventually aims towards organization's success. Japanese feel that many small continuous changes in the systems and policies bring effective results than few major changes.

ELEMENTS OF KAIZEN

- Teamwork
- Personal Discipline
- Improved Morale
- Quality Circles
- Suggestions for Improvement

STEPS IN IMPLEMENTING KAIZEN

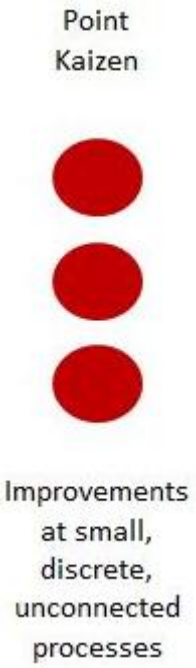


CLASSIFICATION OF KAIZEN

1. Point Kaizen

The term "Point Kaizen" is often associated with discrete events in a department or company. These are continuous improvement activities, where the principles of Lean Manufacturing are applied. "Point" is descriptive because the areas in which Lean is applied are unrelated and discrete. For example, Lean might be applied in the Finance Department as well as in Marketing. But those two Lean Deployments are unrelated with each other.

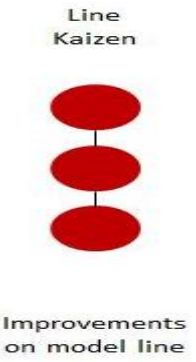
You might visualize Point Kaizen as the following, taken from Hirano



2. Line Kaizen

The next step in an organized Lean Deployment is what we know as Line Kaizen. “Line”, within this context, refers to an organized spreading of Lean from Point or Discrete, to the Line. For example, Kaizen might be applied to a process (point), but also to the downstream process. Those two points constitute a Line Kaizen.

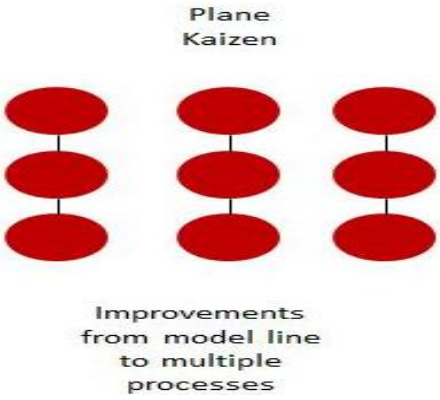
An example of this might be found in Lean implemented in Procurement, but also implemented in the Planning Department. In this case, Planning is upstream from Procurement and Kaizen is done at those two points; in which case, this would be a Line.



3. Plane Kaizen

The next step in maturity would be connecting several lines together. This we call "Plane Kaizen". In more modern terms, this might be described as a Value Stream, where instead of traditional departments; the company is organized into product families and value streams.

This might be visualized by diagram below:



4. Cube Kaizen

Finally, at least according to this model, we have Cube Kaizen. Cube Kaizen describes the situation where all the points are connected and no point is disjointed from each other. This would be a situation where Lean has spread across the entire enterprise. That picture might look like the image below: