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MORADABAD, INDIA

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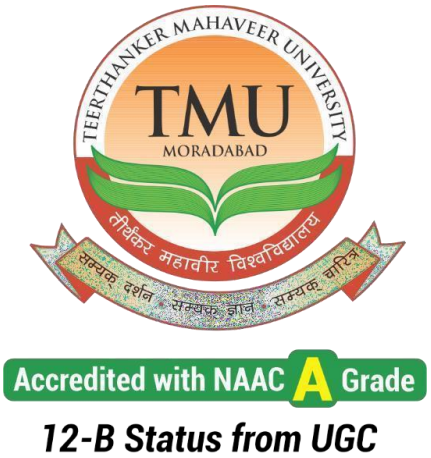

Programme: Bachelor of Commerce

Course: Material & Production Management

Course Code: BCPGE401

Semester-I

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SYLLABUS

Course Name: Material & Production Management

Course Code: BCPGE401

Course Objective- Understanding the concepts of production and material management, maintenance methods of manufacturing functions, location and plant layout.

Block I Introduction and evolution of Material & Production Management in Indian Context

Unit I Nature of Production – Production as a system, organizational function – Decision making in production.

Unit II Recent trends in Production and Operation function-Methods of Manufacturing.

Unit III Comparison of various manufacturing system – Characteristics of Modern Manufacturing

Unit IV Operations in the Service sector- Manufacturing Vs Service operations

Block II Facilities Location and Layout

Unit V Introduction to plant location – Location need analysis

Unit VI Comparison of site location area

Unit VII Introduction to Plant layout –Essentials of good plant Layout

Unit VIII Group and Cell Layout.

Block III Materials Handling System and Design of Work System

Unit IX Introduction -Elements of Material Handling System

Unit X Principles of Material Handling System

Unit XI Unit Load Concept – Selection of Material Handling System

Unit XII Work study & Method study

Block IV Maintenance Management and Statistical Quality Control

Unit XIII Introduction – Areas of Maintenance – Types of Maintenances

Unit XIV Planning and scheduling of Maintenance – Control of Maintenance

Unit XV Introduction to SQC – Inspection and Quality Control

Unit XVI Statistical Quality Control – Types of Control Charts for Variables

Block V Purchase and Stores Management

Unit XVII Objectives, Functions, Purchasing cycle and Purchase Policies

Unit XVIII Vendor rating – Vendor Rating Methods

Unit XIX Introduction to stores management

UNIT 1

1.1 CONCEPT OF PRODUCTION

Production function is 'the part of an organisation, which is concerned with the transformation of a range of inputs into the required outputs (products) having the requisite quality level'.
Production is defined as 'the step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the productto the user'. Thus production is a value addition process. At each stage of processing, there will be value addition.

Edwood Buffa defines production as 'a process by which goods and services are created'. Some examples of production are: manufacturing custom-made products like, boilers with a specific capacity, constructing flats, some structural fabrication works for selected customers,etc., and manufacturing standardized products like, car, bus, motor cycle, radio, television, etc.

1.2 PRODUCTION SYSTEM

The production system is 'that part of an organisation, which produces products of anorganization. It is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with thepolicies communicated by management'.

The production system has the following characteristics:

1. Production is an organised activity, so every production system has an objective.
2. The system transforms the various inputs to useful outputs.
3. It does not operate in isolation from the other organisation system.
4. There exists a feedback about the activities, which is essential to control and improve system performance.

1.3 PRODUCTION MANAGEMENT

Production management is 'a process of planning, organising, directing and controlling the activities of the production function. It combines and transforms various resources used inthe production subsystem of the organization into value added product in a controlled manneras per the policies of the organization'.
E.S.Buffa defines production management as follows: 'Production management deals with decision-making related to production processes so that the resulting goods or services are produced according to specifications, in the amount and by the schedule demanded and outof minimum cost'.

1.4 Objectives of Production Management

The objective of the production management is 'to produce goods and services of RightQuality and Quantity at the Right time and Right manufacturing cost'.

1. **Right Quality:** The quality of product is established based upon the customers need. The right quality is not necessarily being the best quality. It is determined by the cost of the product and the technical characteristics as suited to the specific requirements.
2. **Right Quantity:** The manufacturing organisation should produce the products in right number. If they are produced in excess of demand the capital will block up in the form of inventory and if the quantity is produced in short of demand, leads to shortage of products.
3. **Right Time:** Timeliness of delivery is one of the important parameter to judge the effectiveness of production department. So, the production department has to make theoptimal utilization of input resources to achieve its objective.
4. **Right Manufacturing Cost**: Manufacturing costs are established before the product is actually manufactured. Hence, all attempts should be made to produce the products at pre-established cost, so as to reduce the variation between actual and the standard (pre- established) cost.

1.5 CLASSIFICATION /TYPES OF PRODUCTION SYSTEM

Production systems can be classified as Job-shop, Batch, Mass and Continuous productionsystems.

1.5.1 Job-Shop Production

Job-shop production are characterised by manufacturing one or few quantity of products designed and produced as per the specification of customers within prefixed time and cost. The distinguishing feature of this is low volume and high variety of products. A job-shop comprises of general-purpose machines arranged into different departments. Each job demands unique technological requirements, demands processing on machines in a certain sequence.

Job-shop Production is characterised by

1. High variety of products and low volume.

2. Use of general purpose machines and facilities.

3. Highly skilled operators who can take up each job as a challenge because of uniqueness.

4. Large inventory of materials, tools, parts.

5. Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

Advantages

Following are the advantages of Job-shop Production:

1. Because of general purpose machines and facilities variety of products can be produced.

2. Operators will become more skilled and competent, as each job gives them learning opportunities.

3. Full potential of operators can be utilised.

4. Opportunity exists for Creative methods and innovative ideas.

Limitations

Following are the limitations of Job-shop Production:

1. Higher cost due to frequent set up changes.

2. Higher level of inventory at all levels and hence higher inventory cost.

3. Production planning is complicated.

4. Larger space requirements.

1.5.2 Batch Production

American Production and Inventory Control Society (APICS) defines Batch Production as a form of manufacturing in which the job pass through the functional departments in lots orbatches and each lot may have a different routing. It is characterised by the manufacture of limited number of products produced at regular intervals and stocked awaiting sales.

Batch Production is characterized by

1. Shorter production runs.

2. Plant and machinery are flexible.

3. Plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.

4. Manufacturing lead-time and cost are lower as compared to job order production.

Advantages

Following are the advantages of Batch Production:

1. Better utilization of plant and machinery.

2. Promotes functional specialisation.

3. Cost per unit is lower as compared to job order production.

4. Lower investment in plant and machinery.

5. Flexibility to accommodate and process number of products.

6. Job satisfaction exists for operators.

Limitations

Following are the limitations of Batch Production:

1. Material handling is complex because of irregular and longer flows.

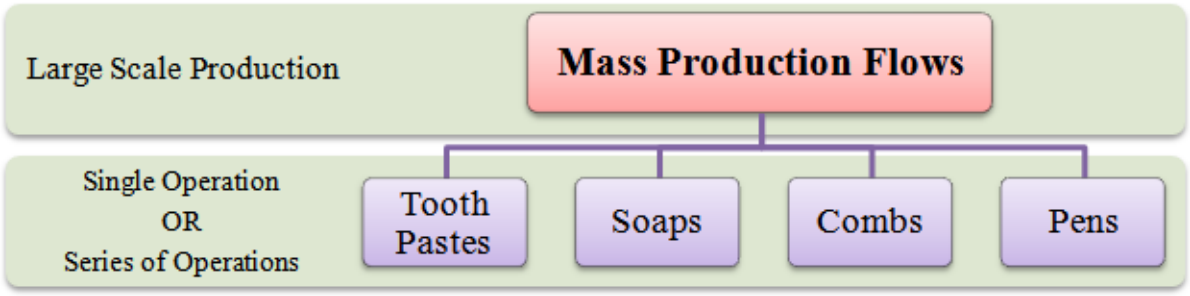
2. Production planning and control is complex.

3. Work in process inventory is higher compared to continuous production.

4. Higher set up costs due to frequent changes in set up.

1.5.3 Mass Production

Manufacture of discrete parts or assemblies using a continuous process are called Mass Production. This production system is justified by very large volume of production. The machines are arranged in a line or product layout. Product and process standardisation exists and all outputs follow the same path.



Mass Production is characterized by

1. Standardization of product and process sequence.

2. Dedicated special purpose machines having higher production capacities and output rates.

3. Large volume of products.

4. Shorter cycle time of production.

5. Lower in process inventory.

6. Perfectly balanced production lines.

7. Flow of materials, components and parts is continuous and without any back tracking.

8. Production planning and control is easy.

9. Material handling can be completely automatic.

Advantages

Following are the advantages of Mass Production:

1. Higher rate of production with reduced cycle time.

2. Higher capacity utilization due to line balancing.

3. Less skilled operators are required.

4. Low process inventory. 5. Manufacturing cost per unit is low.

Limitations

Following are the limitations of Mass Production:

1. Breakdown of one machine will stop an entire production line.

2. Line layout needs major change with the changes in the product design.

3. High investment in production facilities.

4. The cycle time is determined by the slowest operation.

1.5.4 Continuous Production

Production facilities are arranged as per the sequence of production operations from the first operations to the finished product. The items are made to flow through the sequence of operations through material handling devices such as conveyors, transfer devices, etc.

Continuous Production is characterised by

1. Dedicated plant and equipment with zero flexibility.

2. Material handling is fully automated.

3. Process follows a predetermined sequence of operations.

4. Component materials cannot be readily identified with final product.

5. Planning and scheduling is a routine action.

Advantages

Following are the advantages of Continuous Production:

1. Standardization of product and process sequence.

2. Higher rate of production with reduced cycle time.

3. Higher capacity utilization due to line balancing.

4. Manpower is not required for material handling as it is completely automatic.

5. Person with limited skills can be used on the production line.

6. Unit cost is lower due to high volume of production.

Limitations

Following are the limitations of Continuous Production:

1. Flexibility to accommodate and process number of products does not exist.

2. Very high investment for setting flow lines.

3. Product differentiation is limited.

1.6 STRATEGIC MANAGEMENT: An Introduction

Strategic Management is all about identification and description of the strategies that managers can carry so as to achieve better performance and a competitive advantage for their organization. An organization is said to have competitive advantage if its profitability is higher than the average profitability for all companies in its industry.

Strategic management can also be defined as a bundle of decisions and acts which amanager undertakes and which decides the result of the firm's performance. The manager must have a thorough knowledge and analysis of the general and competitive organizational environment so as to take right decisions. They should conduct a SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats), i.e., they should make best possible utilization of strengths, minimize the organizational weaknesses, make use of arising opportunities from the business environment and shouldn't ignore the threats.

Strategic management is nothing but planning for both predictable as well as unfeasible contingencies. It is applicable to both small as well as large organizations as even the smallest organization face competition and, by formulating and implementing appropriate strategies, they can attain sustainable competitive advantage.

It is a way in which strategists set the objectives and proceed about attaining them. It deals with making and implementing decisions about future direction of an organization. It helps us to identify the direction in which an organization is moving.

Strategic management is a continuous process that evaluates and controls the business and the industries in which an organization is involved; evaluates its competitors and sets goals and strategies to meet all existing and potential competitors; and then reevaluates strategies on a regular basis to determine how it has been implemented and whether it was successful or does it needs replacement.

Strategic Management gives a broader perspective to the employees of an organization and they can better understand how their job fits into the entire organizational plan and how it is co- related to other organizational members. It is nothing but the art of managing employees in a manner which maximizes the ability of achieving business objectives. The employees become more trustworthy, more committed and more satisfied as they can co-relate themselves very well with each organizational task. They can understand the reaction of environmental changes on the organization and the probable response of the organization with the help of strategic management. Thus the employees can judge the impact of such changes on their own job and caneffectively face the changes. The managers and employees must do appropriate things in appropriate manner. They need to be both effective as well as efficient.

One of the major role of strategic management is to incorporate various functional areas of the organization completely, as well as, to ensure these functional areas harmonize and get together well. Another role of strategic management is to keep a continuous eye on the goals andobjectives of the organization.

The word “strategy” is derived from the Greek word “stratçgos”; stratus (meaning army) and “ago” (meaning leading/moving).

Strategy is an action that managers take to attain one or more of the organization’s goals.Strategy can also be defined as “A general direction set for the company and its various components to achieve a desired state in the future. Strategy results from the detailed strategic planning process”.

A strategy is all about integrating organizational activities and utilizing and allocating the scarce resources within the organizational environment so as to meet the present objectives. While planning a strategy it is essential to consider that decisions are not taken in a vaccum and thatany act taken by a firm is likely to be met by a reaction from those affected, competitors, customers, employees or suppliers.

Strategy can also be defined as knowledge of the goals, the uncertainty of events and the need to take into consideration the likely or actual behavior of others. Strategy is the blueprint ofdecisions in an organization that shows its objectives and goals, reduces the key policies, and

plans for achieving these goals, and defines the business the company is to carry on, the type of economic and human organization it wants to be, and the contribution it plans to make to its shareholders, customers and society at large.

Features of Strategy

Strategy is Significant because it is not possible to foresee the future. Without a perfect foresight,the firms must be ready to deal with the uncertain events which constitute the business environment.

Strategy deals with long term developments rather than routine operations, i.e. it deals with probability of innovations or new products, new methods of productions, or new markets to be developed in future.

Strategy is created to take into account the probable behavior of customers and competitors. Strategies dealing with employees will predict the employee behavior.

Strategy is a well defined roadmap of an organization. It defines the overall mission, vision and direction of an organization. The objective of a strategy is to maximize an organization'sstrengths and to minimize the strengths of the competitors.

Strategy, in short, bridges the gap between "where we are" and "where we want to be".

Components of a Strategy Statement

The strategy statement of a firm sets the firm's long-term strategic direction and broad policy directions. It gives the firm a clear sense of direction and a blueprint for the firm's activities for the upcoming years. The main constituents of a strategic statement are as follows:

Strategic Intent

An organization's strategic intent is the purpose that it exists and why it will continue to exist, providing it maintains a competitive advantage. Strategic intent gives a picture about what an organization must get into immediately in order to achieve the company's vision. It motivates thepeople. It clarifies the vision of the vision of the company.

Strategic intent helps management to emphasize and concentrate on the priorities. Strategicintent is, nothing but, the influencing of an organization's resource potential and core competencies to achieve what at first may seem to be unachievable goals in the competitive environment. A well expressed strategic intent should guide/steer the development of strategic intent or the setting of goals and objectives that require that all of organization's competencies becontrolled to maximum value.

Strategic intent includes directing organization's attention on the need of winning; inspiring people by telling them that the targets are valuable; encouraging individual and team participation as well as contribution; and utilizing intent to direct allocation of resources.

Strategic intent differs from strategic fit in a way that while strategic fit deals with harmonizing available resources and potentials to the external environment, strategic intent emphasizes on building new resources and potentials so as to create and exploit future opportunities.

Mission Statement

Mission statement is the statement of the role by which an organization intends to serve it's stakeholders. It describes why an organization is operating and thus provides a framework withinwhich strategies are formulated. It describes what the organization does (i.e., present capabilities), who all it serves (i.e., stakeholders) and what makes an organization unique (i.e., reason for existence).

A mission statement differentiates an organization from others by explaining its broad scope of activities, its products, and technologies it uses to achieve its goals and objectives. It talks about an organization's present (i.e., "about where we are"). For instance, Microsoft's mission is tohelp people and businesses throughout the world to realize their full potential. Wal-Mart'smission is "To give ordinary folk the chance to buy the same thing as rich people." Mission statements always exist at top level of an organization, but may also be made for various organizational levels. Chief executive plays a significant role in formulation of mission statement. Once the mission statement is formulated, it serves the organization in long run, but it may become ambiguous with organizational growth and innovations.

In today's dynamic and competitive environment, mission may need to be redefined. However, care must be taken that the redefined mission statement should have originalfundamentals/components. Mission statement has three main components-a statement of missionor vision of the company, a statement of the core values that shape the acts and behaviour of the employees, and a statement of the goals and objectives.

Features of a Mission

Mission must be feasible and attainable. It should be possible to achieve it.Mission should be

clear enough so that any action can be taken.

It should be inspiring for the management, staff and society at large.

It should be precise enough, i.e., it should be neither too broad nor too narrow.It should be

unique and distinctive to leave an impact in everyone's mind.

It should be analytical,i.e., it should analyze the key components of the strategy.

It should be credible, i.e., all stakeholders should be able to believe it.

Vision

A vision statement identifies where the organization wants or intends to be in future or where it should be to best meet the needs of the stakeholders. It describes dreams and aspirations for future. For instance, Microsoft's vision is "to empower people through great software, any time, any place, or any device." Wal-Mart's vision is to become worldwide leader in retailing.

A vision is the potential to view things ahead of themselves. It answers the question "where we want to be". It gives us a reminder about what we attempt to develop. A vision statement is for the organization and it's members, unlike the mission statement which is for the customers/clients. It contributes in effective decision making as well as effective business planning. It incorporates a shared understanding about the nature and aim of the organization andutilizes this understanding to direct and guide the organization towards a better purpose. It describes that on achieving the mission, how the organizational future would appear to be.

An effective vision statement must have following features-

It must be unambiguous.

It must be clear.

It must harmonize with organization's culture and values.The dreams

and aspirations must be rational/realistic.

Vision statements should be shorter so that they are easier to memorize.

In order to realize the vision, it must be deeply instilled in the organization, being owned and shared by everyone involved in the organization.

Goals and Objectives

A goal is a desired future state or objective that an organization tries to achieve. Goals specify in particular what must be done if an organization is to attain mission or vision. Goals makemission more prominent and concrete. They co-ordinate and integrate various functional and departmental areas in an organization. Well made goals have following features-

These are precise and measurable.

These look after critical and significant issues.These

are realistic and challenging.

These must be achieved within a specific time frame.

These include both financial as well as non-financial components.

Objectives are defined as goals that organization wants to achieve over a period of time. These are the foundation of planning. Policies are developed in an organization so as to achieve these objectives. Formulation of objectives is the task of top level management. Effective objectives have following features-

These are not single for an organization, but multiple. Objectives should

be both short-term as well as long-term.

Objectives must respond and react to changes in environment, i.e., they must be flexible.These must be

feasible, realistic and operational.

Strategic Management Process - Meaning, Steps and Components

The strategic management process means defining the organization's strategy. It is also defined as the process by which managers make a choice of a set of strategies for the organization that will enable it to achieve better performance.

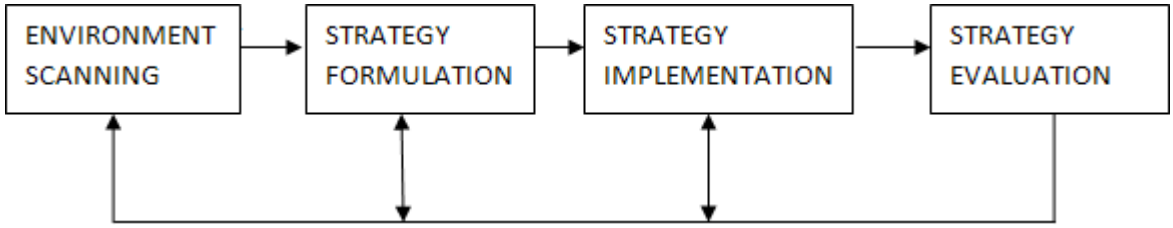
Strategic management is a continuous process that appraises the business and industries in whichthe organization is involved; appraises it's competitors; and fixes goals to meet all the presentand future competitor's and then reassesses each strategy.

Strategic management process has following four steps:

1. **Environmental Scanning-** Environmental scanning refers to a process of collecting, scrutinizing and providing information for strategic purposes. It helps in analyzing the internal and external factors influencing an organization. After executing the environmental analysis process, management should evaluate it on a continuous basis and strive to improve it.
2. **Strategy Formulation-** Strategy formulation is the process of deciding best course of action for accomplishing organizational objectives and hence achieving organizational purpose. After conducting environment scanning, managers formulate corporate, business and functional strategies.
3. **Strategy Implementation-** Strategy implementation implies making the strategy work as intended or putting the organization's chosen strategy into action. Strategy implementation includes designing the organization's structure, distributing resources, developing decision making process, and managing human resources.
4. **Strategy Evaluation-** Strategy evaluation is the final step of strategy management process. The key strategy evaluation activities are: appraising internal and external factors that are the root of present strategies, measuring performance, and taking remedial

/ corrective actions. Evaluation makes sure that the organizational strategy as well as it'simplementation meets the organizational objectives.

These components are steps that are carried, in chronological order, when creating a newstrategic management plan. Present businesses that have already created a strategic management plan will revert to these steps as per the situation's requirement, so as to make essential changes.



Components of Strategic Management Process

Strategic management is an ongoing process. Therefore, it must be realized that each component interacts with the other components and that this interaction often happens in chorus.

Benefits of Strategic Management

There are many benefits of strategic management and they include identification, prioritization, and exploration of opportunities. For instance, newer products, newer markets, and newer forays into business lines are only possible if firms indulge in strategic planning. Next, strategic management allows firms to take an objective view of the activities being done by it and do a cost benefit analysis as to whether the firm is profitable.

Just to differentiate, by this, we do not mean the financial benefits alone (which would be discussed below) but also the assessment of profitability that has to do with evaluating whether the business is strategically aligned to its goals and priorities.

The key point to be noted here is that strategic management allows a firm to orient itself to its market and consumers and ensure that it is actualizing the right strategy.

Financial Benefits

It has been shown in many studies that firms that engage in strategic management are more profitable and successful than those that do not have the benefit of strategic planning andstrategic management.

When firms engage in forward looking planning and careful evaluation of their priorities, they have control over the future, which is necessary in the fast changing business landscape of the 21st century.

It has been estimated that more than 100,000 businesses fail in the US every year and most of these failures are to do with a lack of strategic focus and strategic direction. Further, high performing firms tend to make more informed decisions because they have considered both the short term and long-term consequences and hence, have oriented their strategies accordingly. In contrast, firms that do not engage themselves in meaningful strategic planning are often bogged down by internal problems and lack of focus that leads to failure.

Non-Financial Benefits

The section above discussed some of the tangible benefits of strategic management. Apart from these benefits, firms that engage in strategic management are more aware of the external threats, an improved understanding of competitor strengths and weaknesses and increased employee productivity. They also have lesser resistance to change and a clear understanding of the link between performance and rewards.

The key aspect of strategic management is that the problem solving and problem preventing capabilities of the firms are enhanced through strategic management. Strategic management is essential as it helps firms to rationalize change and actualize change and communicate the needto change better to its employees. Finally, strategic management helps in bringing order and discipline to the activities of the firm in its both internal processes and external activities.

Closing Thoughts

In recent years, virtually all firms have realized the importance of strategic management. However, the key difference between those who succeed and those who fail is that the way in which strategic management is done and strategic planning is carried out makes the difference between success and failure. Of course, there are still firms that do not engage in strategic planning or where the planners do not receive the support from management. These firms ought to realize the benefits of strategic management and ensure their longer-term viability and successin the marketplace.

1.7 WHAT IS CORPORATE STRATEGY?

Definition: Corporate strategy encompasses a firm’s corporate actions with the aim to achieve company objectives while achieving a competitive advantage.

What Does Corporate Strategy Mean?

A corporate strategy entails a clearly defined, long-term vision that organizations set, seeking to create corporate value and motivate the workforce to implement the proper actions to achieve customer satisfaction. In addition, corporate strategy is a continuous process that requires a constant effort to engage investors in trusting the company with their money, thereby increasing the company’s equity. Organizations that manage to deliver customer value unfailingly are those

that revisit their corporate strategy regularly to improve areas that may not deliver the aimedresults.

Let’s look at an example.

Example

Corporate strategies may pertain to different aspects of a firm, yet the strategies that mostorganizations use are cost leadership and product differentiation.

Cost leadership is a strategy that organizations implement by providing their products andservices as low as consumers are willing to pay, thereby being competitive and realizing avolume of sales that allows them to be the leaders in the industry. Typical examples of cost leaders are Wal-Mart in the retail industry, McDonalds in the restaurant industry, and Ikea, the furniture retailer that offers low-priced, yet good quality home equipment by sourcing its products in emerging markets, thereby having a high-profit margin.

Product differentiation refers to the effort of organizations to offer a unique value proposition to consumers. Typically, companies that manage to differentiate their products from thecompetition are gaining a competitive edge, thereby realizing higher profits. Often, competitors employ cost leadership to directly compete with these companies; yet, customer satisfaction and customer loyalty are the factors that eventually make or break a strategy.

Other examples of corporate strategies include the horizontal integration, the vertical integration,

and the global product strategy, i.e. when multinational companies sell a homogenous product around the globe.

Corporate strategies are always growth-oriented, seeking to retain a company’s existing customerbase while attracting new customers.

Why Corporate Strategy?

Strategic management is basically needed for every organization and it offers several benefits.

1.Universal

Strategy refers to a complex web of thoughts, ideas, insights, experiences, goals, expertise, memories, perceptions, and expectations that provides general guidance for specific actions in pursuit of particular ends. Nations have, in the management of their national policies, found it necessary to evolve strategies that adjust and correlate political, economic, technological, and psychological factors, along with military elements. Be it management of national polices,international relations, or even of a game on the playfield, it provides us with the preferred path that we should take for the journey that we actually make.

2. Keeping pace with changing environment

The present day environment is so dynamic and fast changing thus making it very difficult for any modern business enterprise to operate. Because of uncertainties, threats and constraints, the business corporation are under great pressure and are trying to find out the ways and means for their healthy survival. Under such circumstances, the only last resort is to make the best use of strategic management which can help the corporate management to explore the possible opportunities and at the same time to achieve an optimum level of efficiency by minimizing the expected threats.

3. Minimizes competitive disadvantage

It minimizes competitive disadvantage and adds up to competitive advantage. For example, a company like Hindustan Lever Ltd., realized that merely by merging with companies likeLakme, Milk food, Ponds, Brooke bond, Lipton etc which make fast moving consumer goods alone will not make it market leader but venturing into retailing will help it reap heavy profits. Then emerged its retail giant "Margin Free' which is the market leader in states like Kerala. Similarly, the R.P. Goenka Group and the Muruguppa group realized that mere takeovers do nothelp and there is a need to reposition their products and reengineer their brands. The strategy worked.

4. Clear sense of strategic vision and sharper focus on goals and objectives

Every firm competing in an industry has a strategy, because strategy refers to how a given objective will be achieved. 'Strategy' defines what it is we want to achieve and charts our course in the market place; it is the basis for the establishment of a business firm; and it is a basic requirement for a firm to survive and to sustain itself in today's changing environment by providing vision and encouraging to define mission.

5. Motivating employees

One should note that the labor efficiency and loyalty towards management can be expected only in an organization that operates under strategic management. Every guidance as to what to do, when and how to do and by whom etc, is given to every employee. This makes them more confident and free to perform their tasks without any hesitation. Labor efficiency and theirloyalty which results into industrial peace and good returns are the results of broad-based policies adopted by the strategic management

6. Strengthening Decision-Making

Under strategic management, the first step to be taken is to identify the objectives of the businessconcern. Hence a corporation organized under the basic principles of strategic management will find a smooth sailing due to effective decision-making. This points out the need for strategic management.

7. Efficient and effective way of implementing actions for results

Strategy provides a clear understanding of purpose, objectives and standards of performance to employees at all levels and in all functional areas. Thereby it makes implementation very smoothallowing for maximum harmony and synchrony. As a result, the expected results are obtained more efficiently and economically.

8. Improved understanding of internal and external environments of business

Strategy formulation requires continuous observation and understanding of environmental variables and classifying them as opportunities and threats. It also involves knowing whether the threats are serious or casual and opportunities are worthy or marginal. As such strategy provides for a better understanding of environment.

Levels of strategy

A typical business firm should consider three types of strategies, which form a hierarchy as shown in Figure.

Corporate strategy – Which describes a company's overall direction towards growth by managing business and product lines? These include stability, growth and retrenchment. For example, Coco cola, Inc., has followed the growth strategy by acquisition. It has acquired local bottling units to emerge as the market leader.

Business strategy - Usually occurs at business unit or product level emphasizing the improvement of competitive position of a firm's products or services in an industry or market segment served by that business unit. Business strategy falls in the in the realm of corporate strategy. For example, Apple Computers uses a differentiation competitive strategy that

emphasizes innovative product with creative design. In contrast, ANZ Grindlays merged with Standard Chartered Bank to emerge competitively.

Functional strategy – It is the approach taken by a functional area to achieve corporate and business unit objectives and strategies by maximizing resource productivity. It is concerned with developing and nurturing a distinctive competence to provide the firm with a competitive advantage. For example, Procter and Gamble spends huge amounts on advertising to create customer demand.

Operating strategy - These are concerned with how the component parts of an organization deliver effectively the corporate, business and functional -level strategies in terms of resources, processes and people. They are at departmental level and set periodic short-term targets for accomplishment.

As ongoing process

Corporate strategy is a continuous ongoing process and extends companywide over a diversified company's business. It is a boundary spanning planning activity considering all the elements of the micro and macro environments of a firm.

The following are the key tasks of the process of developing and implementing a corporate strategy.

 Exploring and determining the vision of the company in the form of a vision statement.

 Developing a mission statement of the company that should include statement of methodology for achieving the objectives, purposes, and the philosophy of the organization adequately reflected in the vision statement.

 Defining the company profile that includes the internal analysis of culture, strengths and capabilities of an organization.

 Making external environmental analysis to identify factors as threats, opportunities etc. Finding out ways by which a company profile can be matched with its environment to be able to accomplish mission statement

 Deciding on the most desirable courses of actions for accomplishing the mission of an organization

Selecting a set of long-term objectives and also the corresponding strategies to be adopted in line with vision statement.

 Evolving short-term and annual objectives and defining the corresponding strategies that would be compatible with the mission and vision statement.

 Implementing the chosen strategies in a planned way based on budgets and allocation of resource, outlining the action programs and tasks.

Installation of a continuous comparable review system to create a controlling mechanism and also generate data for selecting future course of action

Summary

In the globalized business, companies require strategic thinking and only by evolving good corporate strategies can they become strategically competitive. A strategy of a business organization is a comprehensive master plan stating how the organization will achieve its mission and objectives. Strategy is significant because it is universal. It helps corporate to keep pace with changing environs, provides better understanding of external environment, minimizes competitive disadvantage by forcing to think clearly about mission, vision and objectives of enterprise. It improves motivation of employees and strengthens decision-making. It forms the basis for implementing actions. Strategy can be classified based on hierarchy into four levels: corporate level, strategic business level, functional level and operating level. The approaches to strategy making are: the Chief Architect approach, the delegation approach, the collaborator or team approach and the corporate intrapreneur approach. Strategy making is an ongoing process involving activities like defining vision, mission and goals, analyzing organization and environment and matching them to decide suitable actions and objectives, and implementingwith a review system.

Functional strategy - organizational plans prepared for various functional areas of a company's organizational structure (e.g., marketing strategy, financial strategy, production strategy etc.). Functional strategies can be part of overall corporate strategy or serve as separate plans of strategy cascading/implementation within a functional area.

Some common functional strategies are:

- **Production strategy** ("make or buy") - defines what the company produces itself, and that purchases from suppliers or partners, that is, how far worked out the production chain.
- **Financial Strategy**- to select the main source of funding: the development of their own funds (depreciation, profit, the issue of shares, etc.) or through debt financing (bank loans, bonds, commodity suppliers' credits, etc.).
- **Organizational strategy**- decision on the organization of the staff (choose the typeof organizational structure, compensation system, etc.).
- others, such as: research and development (R & D) strategy, investment strategy, etc.

1.8 PRODUCTION STRATEGIES

What is a production strategy?

The primary mission of production strategies is **planning the production schedule** within budgetary limitations and time constraints. They do this by analyzing the plant's personnel and capital resources to select the best way of meeting the production quota. Production strategies determine (often using mathematical formulas) which machines will be used, whether newmachines need to be purchased, whether overtime or extra shifts are necessary, and what the sequence of production will be. They monitor the production run to make sure that it stays on schedule and correct any problems that may arise.

Because the work of many departments is interrelated, production managers work closely with heads of other departments such as sales, procurement, and logistics to plan and implement company goals, policies, and procedures. For example, the production manager works with the procurement department to ensure that plant inventories are maintained at their optimal level. This is vital to a firm's operation because maintaining the inventory of materials necessary for production ties up the firm's financial resources, yet insufficient quantities cause delays in production. Therefore a major component of a production strategy is **inventory management and control**.

Corporate strategy (company-wide strategy)Business

strategy (competitive strategy)

Functional strategy (production, marketing, technology, etc.)

Why production strategies are important?

A typical medium-sized manufacturing concern keeps an inventory of approximately 10.000 types of raw materials, parts and finished goods. Items produced and held in inventory can differ in many ways. They may be difference is cost, weight, volume, colour or physical shape. Units may be stored in barrels, on pallets in cardboard boxes or loose on shelves. They may be perishable because of deterioration over time, perishable through theft and pilferage or subject to obsolescence because of style or technology.

Demand for items can also vary in many ways. Items may be withdrawn from inventory by the thousands, by the dozen or unit-by-unit. They may be substituted for each other, so that, if one item is out of stock the user is manually willing to accept another. Items can also be complementary; customers will not accept one item unless another is also available. Units could be picked up by a customer or they may have to be delivered by company-owned vehicles or shipped by rail, boat, airplane or truck. Some customers are willing to wait for certain types of products while others expect immediate service on demand. Taking into account all the above

considerations there is no unified model for production strategy as there are many internal and external factors involved in a real production system and most of them uncontrollable.

Constituent of Production Strategy

1）Structural item (hard) Requiring large investment decision, involving determination by top management . It includes -,decision of production capacity, factory net work/design, selection of production technology, vertical integration.

2）Substructural item (soft) Steady buildup of small decisions Gradually formed as actionpattern of all employees Investment in corporate knowledge/information asset (intangible). It includes - personnel/labor management, purchase/supplier management, production plan/control,quality control, costing, IE, improvement, management organization.

Production strategies

Chase strategy

Companies that use the chase strategy, or demand matching strategy, produce only enough goods
to meet or exactly match the demand for goods. Think of this strategy in terms of a restaurant, which produces meals only when a customer orders, therefore matching the actual production with customer demand. The chase strategy has several advantages; it keeps inventories low, which frees up cash that otherwise can be used to buy raw materials or components, and reduces inventory carrying costs that are associated with holding inventory in stock. Cost of capital, warehousing, depreciation, insurance, taxes, obsolescence and shrinkage are all inventory carrying costs.

Level production

In a manufacturing company that uses a level production strategy, the company continuously produces goods equal to the average demand for the goods. Scheduling consistently arranges the same quantity of goods for production based on the total demand for the goods. So, if for three months a company wants to produce 20,000 units of a certain item and there are a total of 56 working days, it can level production to 358 units per day.

Make-to-stock

In the make-to-stock environment, goods are produced before customers place orders. The retail environment is an example of make-to-stock as goods are produced and put into inventory at the retail location. The make-to-stock strategy typically allows manufacturers to produce goods in long production runs, taking advantage of production efficiencies. Because the make-to-stock environment produces goods on a consistent basis, a master production schedule determines the exact number of units to produce for each production run.

Make-to-order

Companies that use a make-to-order strategy produce goods after receiving an order from the customer. Most often a company that uses the make-to-order strategy produces one-of-a-kind goods. Examples include custom-tailored clothing, custom machinery and some fine jewelry.

Assemble-to-order

Certain fast-food restaurants use an assemble-to-order strategy. A customer walks in, places an order for a hamburger and the hamburger gets assembled from a stock selection of ingredients. This strategy forces the restaurant to carry enough ingredients to make every hamburger combination a customer might request. Automobile manufacturers also use the assemble-to-orderstrategy. A customer can pick and choose from many features including interior fabrics, exterior paints, and seat, engine, wheel or tire options. Once the dealer places the customer's order, the manufacturing plant assembles the standard component parts to the customer exact specifications. In this environment the production scheduler uses a final assembly timetable.

1.9 WORLD CLASS MANUFACTURING

Introduction

Manufacturing has evolved considerably since the advent of industrial revolution. In current global and competitive age, it is very important for organization to have manufacturing practicewhich is lean, efficient, cost-effective and flexible.

World class manufacturing is a collection of concepts, which set standard for production and manufacturing for another organization to follow. Japanese manufacturing is credited with pioneer in concept of world-class manufacturing. World class manufacturing was introduced in the automobile, electronic and steel industry.

Characteristics of World Class Organizations:

1. Customer service.2. Quality control and assurance.3. Research and development/ new product development4. Acquiring new technologies5. Innovation6. Team-based approach (adopting and using effectively)7. Best practices (study and use of)8. Manpower planning 9. Environmentally sound practices10. Business partnerships and alliances11. Reengineering of processes12. Mergers and acquisitions13. Outsourcing and contracting14. Reliance on consulting services15. Political lobbying

World class manufacturing is a process driven approach where various techniques andphilosophy are used in one combination or other.

Some of the techniques are as follows:

- Make to order
- Streamlined Flow

- Smaller lot sizes
- Collection of parts
- Doing it right first time
- Cellular or group manufacturing
- Total preventive maintenance
- Quick replacement
- Zero Defects
- Just in Time
- Increased consistency
- Higher employee involvement
- Cross Functional Teams
- Multi-Skilled employees
- Visual Signaling
- Statistical process control

Idea of using above techniques is to focus on operational efficiency, reducing wastage and creating cost efficient organization. This leads to creation of high-productivity organization,which used concurrent production techniques rather than sequential production method.

There are 3 principles behind World Class Manufacturing.

1. The first is what is known as Just in Time or Lean Manufacturing, the step by step elimination of waste. Waste in this sense is defined as any activity that adds cost but not value to the end product such as excess production, stock, idle work in progress, unnecessary movement and scrap.
2. The second is total quality, a culture of intolerance to defects both in the processes and also information such as bills of material and stock records. Total quality is often these days called Six Sigma which uses total quality and lean manufacturing techniques to attempt to reduce rejects to 3.4 or less per million parts produced.
3. The final principle is the principle of total preventative maintenance where, whenever practical, a preventative maintenance programme means that unplanned stoppages due to equipment failure are minimised

World Class Manufacturers

World class manufacturers tend to implement best practices and also invent new practices as to stay above the rest in the manufacturing sector. The main parameters which determine world-class manufacturers are quality, cost effective, flexibility and innovation.

World class manufacturers implement robust control techniques but there are five steps, whichwill make the system efficient. These five steps are as follows:

- **Reduction of set up time and in tuning of machinery:** It is important that organizations are able to cut back time in setting up machinery and also tune machinery before production.
- **Cellular Manufacturing:** It is important that production processes are divided into according to its nature, with similar nature combined together.

- **Reduce WIP material:** It is normal tendency of manufacturing organization to maintain high levels of WIP material. Increased WIP leads to more cost and decreased WIP induces more focus on production and fast movement of goods.
- **Postpone product mutation:** For to achieve a higher degree of customization many changes are made to final product. However, it is important that mutation conceived for the design stage implement only after final operation.
- **Removal the trivial many and focus on vital few:** It is important for organization to focus on production of products which are lined with forecast demand as to match customer expectation.

Principles of World Class Manufacturing

There are three main principles, which drive world-class manufacturing.

- Implementation of just in time and lean management leads to reduction in wastage thereby reduction in cost.
- Implementation of total quality management leads to reduction of defects and encourages zero tolerance towards defects.
- Implementation of total preventive maintenance leads to any stoppage of production through mechanical failure.

Aspects of World Class Manufacturing

The main aspects of the world-class manufacturing are as follows:

- Industrial culture area
- Market/client area
- Product development area
- Operations area
- E-Performance area

1.10 DEMAND FORECASTING

- Forecasts are becoming the lifetime of business in a world, where the tidal waves of change are sweeping the most established of structures, inherited by human society. Commerce just happens to the one of the first casualties. Survival in this age of economicpredators, requires the tact, talent and technique of predicting the future.

- Forecast is becoming the sign of survival and the language of business. All requirements of the business sector need the technique of accurate and practical reading into the future. Forecasts are, therefore, very essential requirement for the survival of business. Management requires forecasting information when making a wide range of decisions.

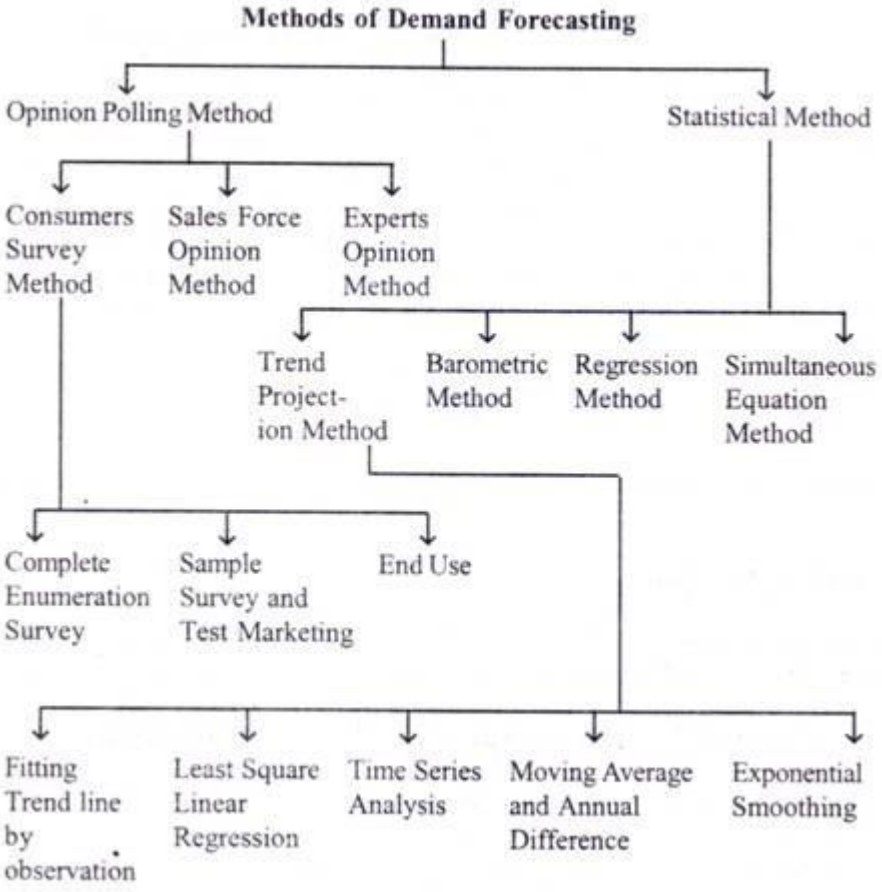
- The sales forecast is particularly important as it is the foundation upon which all company plans are built in terms of markets and revenue. Management would be a simple

matter if business was not in a continual state of change, the pace of which has quickenedin recent years. It is becoming increasingly important and necessary for business to predict their future prospects in terms of sales, cost and profits. The value of future sales is crucial as it affects costs profits, so the prediction of future sales is the logical starting point of all business planning. A forecast is a prediction or estimation of future situation. It is an objective assessment of future course of action. Since future is uncertain, no forecast can be percent correct. Forecasts can be both physical as well as financial in nature. The more realistic the forecasts, the more effective decisions can be taken for tomorrow. In the words of Cundiff and Still, **"Demand forecasting is an estimate of sales during a specified future period which is tied to a proposed marketing planand which assumes a particular set of uncontrollable and competitive forces".** Therefore, demand forecasting is a projection of firm's expected level of sales based on a chosen marketing plan and environment.

The more commonly used methods of demand forecasting are discussed below:

The various methods of demand forecasting can be summarised in the form of a chart as shownin Table 1.

Table 1.



1. Opinion Polling Method:

In this method, the opinion of the buyers, sales force and experts could be gathered to determine the emerging trend in the market.

The opinion polling methods of demand forecasting are of three kinds:

(a) Consumer's Survey Method or Survey of Buyer's Intentions:

In this method, the consumers are directly approached to disclose their future purchase plans. I his is done by interviewing all consumers or a selected group of consumers out of the relevant population. This is the direct method of estimating demand in the short run. Here the burden of forecasting is shifted to the buyer. The firm may go in for complete enumeration or for sample surveys. If the commodity under consideration is an intermediate product then the industries using it as an end product are surveyed.

(i) Complete Enumeration Survey:

Under the Complete Enumeration Survey, the firm has to go for a door to door survey for the forecast period by contacting all the households in the area. This method has an advantage offirst hand, unbiased information, yet it has its share of disadvantages also. The major limitationof this method is that it requires lot of resources, manpower and time.

In this method, consumers may be reluctant to reveal their purchase plans due to personalprivacy or commercial secrecy. Moreover, at times the consumers may not express their opinion properly or may deliberately misguide the investigators.

(ii) Sample Survey and Test Marketing:

Under this method some representative households are selected on random basis as samples and their opinion is taken as the generalised opinion. This method is based on the basic assumption that the sample truly represents the population. If the sample is the true representative, there is likely to be no significant difference in the results obtained by the survey. Apart from that, this method is less tedious and less costly.

A variant of sample survey technique is test marketing. Product testing essentially involves placing the product with a number of users for a set period. Their reactions to the product are noted after a period of time and an estimate of likely demand is made from the result. These are suitable for new products or for radically modified old products for which no prior data exists. It is a more scientific method of estimating likely demand because it stimulates a national launch ina closely defined geographical area.

(iii) End Use Method or Input-Output Method:

This method is quite useful for industries which are mainly producer's goods. In this method, thesale of the product under consideration is projected as the basis of demand survey of the

industries using this product as an intermediate product, that is, the demand for the final product is the end user demand of the intermediate product used in the production of this final product.

The end user demand estimation of an intermediate product may involve many final goodindustries using this product at home and abroad. It helps us to understand inter-industry'relations. In input-output accounting two matrices used are the transaction matrix and the input co-efficient matrix. The major efforts required by this type are not in its operation but in the collection and presentation of data.

(b) Sales Force Opinion Method:

This is also known as collective opinion method. In this method, instead of consumers, the opinion of the salesmen is sought. It is sometimes referred as the "grass roots approach" as it is a bottom-up method that requires each sales person in the company to make an individual forecast for his or her particular sales territory.

These individual forecasts are discussed and agreed with the sales manager. The composite of allforecasts then constitutes the sales forecast for the organisation. The advantages of this method are that it is easy and cheap. It does not involve any elaborate statistical treatment. The main merit of this method lies in the collective wisdom of salesmen. This method is more useful in forecasting sales of new products.

(c) Experts Opinion Method:

This method is also known as "Delphi Technique" of investigation. The Delphi method requiresa panel of experts, who are interrogated through a sequence of questionnaires in which the responses to one questionnaire are used to produce the next questionnaire. Thus any information available to some experts and not to others is passed on, enabling all the experts to have access toall the information for forecasting.

The method is used for long term forecasting to estimate potential sales for new products. This method presumes two conditions: Firstly, the panellists must be rich in their expertise, possess wide range of knowledge and experience. Secondly, its conductors are objective in their job.This method has some exclusive advantages of saving time and other resources.

2. Statistical Method:

Statistical methods have proved to be immensely useful in demand forecasting. In order to main- tain objectivity, that is, by consideration of all implications and viewing the problem from an external point of view, the statistical methods are used.

The important statistical methods are:

(i) Trend Projection Method:

A firm existing for a long time will have its own data regarding sales for past years. Such data when arranged chronologically yield what is referred to as ‘time series’. Time series shows the past sales with effective demand for a particular product under normal conditions. Such data can be given in a tabular or graphic form for further analysis. This is the most popular method amongbusiness firms, partly because it is simple and inexpensive and partly because time series data often exhibit a persistent growth trend.

Time series has got four types of components namely, Secular Trend (T), Secular Variation (S), Cyclical Element (C), and an Irregular or Random Variation (I). These elements are expressed bythe equation O = TSCI. Secular trend refers to the long run changes that occur as a result of general tendency.

Seasonal variations refer to changes in the short run weather pattern or social habits. Cyclical variations refer to the changes that occur in industry during depression and boom. Random variation refers to the factors which are generally able such as wars, strikes, flood, famine and so on.

When a forecast is made the seasonal, cyclical and random variations are removed from the observed data. Thus only the secular trend is left. This trend is then projected. Trend projection fits a trend line to a mathematical equation.

The trend can be estimated by using any one of the following methods:

(a) The Graphical Method,

(b) The Least Square Method.

a) Graphical Method:

This is the most simple technique to determine the trend. All values of output or sale for differentyears are plotted on a graph and a smooth free hand curve is drawn passing through as many points as possible. The direction of this free hand curve—upward or downward— shows the trend. A simple illustration of this method is given in Table 2.

Table 2: Sales of Firm

Year	Sales (Rs. Crore)
1995	40
1996	50
1997	44

1998	60
1999	54
2000	62

In Fig. 1, AB is the trend line which has been drawn as free hand curve passing through the various points representing actual sale values.

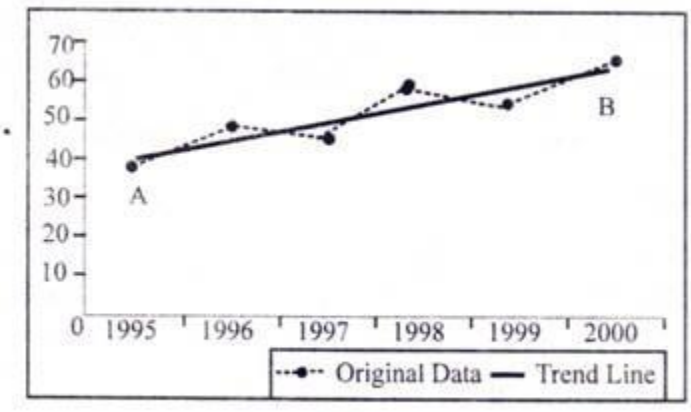


Fig. 1

(b) Least Square Method:

Under the least square method, a trend line can be fitted to the time series data with the help of statistical techniques such as least square regression. When the trend in sales over time is given by straight line, the equation of this line is of the form: y = a + bx. Where 'a' is the intercept and 'b' shows the impact of the independent variable. We have two variables—the independent variable x and the dependent variable y. The line of best fit establishes a kind of mathematical relationship between the two variables .v and y. This is expressed by the regression y on x.

In order to solve the equation v = a + bx, we have to make use of the following normal equations:

$\Sigma y = na + b \Sigma X$

$\sum xy = a \sum x + b \sum x2$

(ii) Barometric Technique:

A barometer is an instrument of measuring change. This method is based on the notion that "the future can be predicted from certain happenings in the present." In other words, barometric techniques are based on the idea that certain events of the present can be used to predict the directions of change in the future. This is accomplished by the use of economic and statistical indicators which serve as barometers of economic change.

Generally forecasters correlate a firm's sales with three series: Leading Series, Coincident or Concurrent Series and Lagging Series:

(a) The Leading Series:

The leading series comprise those factors which move up or down before the recession or recovery starts. They tend to reflect future market changes. For example, baby powder sales can be forecasted by examining the birth rate pattern five years earlier, because there is a correlation between the baby powder sales and children of five years of age and since baby powder sales today are correlated with birth rate five years earlier, it is called lagged correlation. Thus we can say that births lead to baby soaps sales.

(b) Coincident or Concurrent Series:

The coincident or concurrent series are those which move up or down simultaneously with the level of the economy. They are used in confirming or refuting the validity of the leadingindicator used a few months afterwards. Common examples of coinciding indicators are G.N.P itself, industrial production, trading and the retail sector.

(c) The Lagging Series:

The lagging series are those which take place after some time lag with respect to the business cycle. Examples of lagging series are, labour cost per unit of the manufacturing output, loans outstanding, leading rate of short term loans, etc.

(iii) Regression Analysis:

It attempts to assess the relationship between at least two variables (one or more independent andone dependent), the purpose being to predict the value of the dependent variable from thespecific value of the independent variable. The basis of this prediction generally is historicaldata. This method starts from the assumption that a basic relationship exists between twovariables. An interactive statistical analysis computer package is used to formulate the mathematical relationship which exists.

For example, one may build up the sales model as:

Quantum of Sales = a. price + b. advertising + c. price of the rival products + d. personal disposable income +u

Where a, b, c, d are the constants which show the effect of corresponding variables as sales. The constant u represents the effect of all the variables which have been left out in the equation but having effect on sales. In the above equation, quantum of sales is the dependent variable and the variables on the right hand side of the equation are independent variables. If the expected values of the independent variables are substituted in the equation, the quantum of sales will then be forecasted.

The regression equation can also be written in a multiplicative form as given below:

Quantum of Sales = $(\text{Price})^a$ + $(\text{Advertising})^b$+ $(\text{Price of the rival products})^c$ + (Personal disposable income Y + u

In the above case, the exponent of each variable indicates the elasticities of the corresponding variable. Stating the independent variables in terms of notation, the equation form is $QS = P^{\circ 8}. A^{o42} . R^{\circ .83}. Y_2^{\circ .68}. 40$

Then we can say that 1 per cent increase in price leads to 0.8 per cent change in quantum of sales and so on.

If we take logarithmic form of the multiple equation, we can write the equation in an additive form as follows:

$\log QS = a \log P + b \log A + c \log R + d \log Y_d + \log u$

In the above equation, the coefficients a, b, c, and d represent the elasticities of variables P, A, Rand Y_d respectively.

The co-efficient in the logarithmic regression equation are very useful in policy decision makingby the management.

(iv) Econometric Models:

Econometric models are an extension of the regression technique whereby a system of independ-ent regression equation is solved. The requirement for satisfactory use of the econometric model in forecasting is under three heads: variables, equations and data.

The appropriate procedure in forecasting by econometric methods is model building.Econometrics attempts to express economic theories in mathematical terms in such a way that they can be verified by statistical methods and to measure the impact of one economic variable upon another so as to be able to predict future events.

Utility of Forecasting:

Forecasting reduces the risk associated with business fluctuations which generally produce harm-ful effects in business, create unemployment, induce speculation, discourage capital formation and reduce the profit margin. Forecasting is indispensable and it plays a very important part inthe determination of various policies. In modem times forecasting has been put on scientific footing so that the risks associated with it have been considerably minimised and the chances of precision increased.

Forecasts in India:

In most of the advanced countries there are specialised agencies. In India businessmen are not at all interested in making scientific forecasts. They depend more on chance, luck and astrology. They are highly superstitious and hence their forecasts are not correct. Sufficient data are not available to make reliable forecasts. However, statistics alone do not forecast future conditions. Judgment, experience and knowledge of the particular trade are also necessary to make proper analysis and interpretation and to arrive at sound conclusions.

Conclusion:

Decision support systems consist of three elements: decision, prediction and control. It is, of course, with prediction that marketing forecasting is concerned. The forecasting of sales can be regarded as a system, having inputs apprises and an output.

This simplistic view serves as a useful measure for the analysis of the true worth of sales forecasting as an aid to management. In spite of all these no one can predict future economic activity with certainty. Forecasts are estimates about which no one can be sure.

CRITERIA OF A GOOD FORECASTING METHOD:

There are thus, a good many ways to make a guess about future sales. They show contrast incost, flexibility and the adequate skills and sophistication. Therefore, there is a problem of choosing the best method for a particular demand situation.

There are certain economic criteria of broader applicability. They are:

(i) Accuracy, (ii) Plausibility, (iii) Durability, (iv) Flexibility, (v) Availability, (vi) Economy, (vii) Simplicity and (viii) Consistency.

(i) Accuracy:

The forecast obtained must be accurate. How is an accurate forecast possible? To obtain an accurate forecast, it is essential to check the accuracy of past forecasts against present performance and of present forecasts against future performance. Accuracy cannot be tested by precise measurement but buy judgment.

(ii) Plausibility:

The executive should have good understanding of the technique chosen and they should have confidence in the techniques used. Understanding is also needed for a proper interpretation of results. Plausibility requirements can often improve the accuracy of results.

(iii) Durability:

Unfortunately, a demand function fitted to past experience may back cost very greatly and still fall apart in a short time as a forecaster. The durability of the forecasting power of a demand function depends partly on the reasonableness and simplicity of functions fitted, but primarily onthe stability of the understanding relationships measured in the past. Of course, the importance ofdurability determines the allowable cost of the forecast.

(iv) Flexibility:

Flexibility can be viewed as an alternative to generality. A long lasting function could be set upin terms of basic natural forces and human motives. Even though fundamental, it would nevertheless be hard to measure and thus not very useful. A set of variables whose co-efficient

could be adjusted from time to time to meet changing conditions in more practical way to maintain intact the routine procedure of forecasting.

(v) Availability:

Immediate availability of data is a vital requirement and the search for reasonable approximations to relevance in late data is a constant strain on the forecasters patience. The techniques employed should be able to produce meaningful results quickly. Delay in result will adversely affect the managerial decisions.

(vi) Economy:

Cost is a primary consideration which should be weighed against the importance of the forecasts to the business operations. A question may arise: How much money and managerial effort shouldbe allocated to obtain a high level of forecasting accuracy? The criterion here is the economic consideration.

(vii) Simplicity:

Statistical and econometric models are certainly useful but they are intolerably complex. Tothose executives who have a fear of mathematics, these methods would appear to be Latin or Greek. The procedure should, therefore, be simple and easy so that the management mayappreciate and understand why it has been adopted by the forecaster.

(viii) Consistency:

The forecaster has to deal with various components which are independent. If he does not make an adjustment in one component to bring it in line with a forecast of another, he would achieve a whole which would appear consistent.

Conclusion:

In fine, the ideal forecasting method is one that yields returns over cost with accuracy, seems reasonable, can be formalized for reasonably long periods, can meet new circumstances adeptly and can give up-to-date results. The method of forecasting is not the same for all products.

There is no unique method for forecasting the sale of any commodity. The forecaster may try oneor the other method depending upon his objective, data availability, the urgency with which forecasts are needed, resources he intends to devote to this work and type of commodity whose demand he wants to forecast.

Questions:

1. Explain the different types of production with its merits and demerits.
2. Explain the different types of strategies used.
3. Write short notes on World Class Manufacturing.
4. Enumerate the different methods of demand forecasting.

UNIT II

NEW PRODUCT DEVELOPMENT

2.1 INTRODUCTION

Product development is the process of identifying, designing, building, and marketing a product or service for consumers. For product developers to be effective, they must understand their customers' needs and wants, the competitive landscape, and have the ability to optimize cost,time to market, and quality of the product. A good idea does not ensure the success of the idea asa viable product.

New product development is a task taken by the company to introduce newer products in the market. Regularly there will arise a need in the business for new product development. Your existing products may be technologically outdated, you have different segments to target or you want to cannibalize an existing product. In such cases, New product development is the answer for the company.

STAGES OF NEW PRODUCT DEVELOPMENT.

1. Idea generation – in this you are basically involved in the systematic search for new product Ideas. A company has to generate many ideas in order to find one that is worth pursuing. The Major sources of new product ideas include internal sources, customers, competitors, distributors and suppliers. Almost 55% of all new product ideas come from internal sources according to one study. Companies like 3M and Toyota have put in special incentive programs or their employees to come up with workable ideas.

Almost 28% of new product ideas come from watching and listening to customers. Customers: even create new products on their own, and companies can benefit by finding these products and putting them on the market like Pillsbury gets promising new products from its annual Bake-off. One of Pillsbury's four cake mix lines and several variations of another came directly from Bake-Off winners' recipes.

2. Idea Screening: -The second step in New product development is Idea screening. Thepurpose of idea generation is to create a large pool of ideas. The purpose of this stage is to pare these down to those that are genuinely worth pursuing. Companies have different methods for doing this from product review committees to formal market research. It, is helpful at this stageto have a checklist that can be used to rate each idea based on the factors required for successfully launching the product in the marketplace and their relative importance. Against these, management can assess how well the idea fits with the company's marketing skills and experience and other capabilities. Finally, the management can obtain an overall rating of the company's ability to launch the product successfully.

3. Concept Development and Testing – The third step in New product development is Concept Development and Testing. An attractive idea has to be developed into a Product concept. As opposed to a product idea that is an idea for a product that the company can see itself marketing to customers, a product concept is a detailed version of the idea stated in meaningful consumer terms. This is different again from a product image, which is the consumers' perception of an actual or potential product. Once the concepts are developed, these need to be tested with consumers either symbolically or physically. For some concept tests, a word or a picture may be sufficient, however, a physical presentation will increase the reliability of the concept test. After being exposed to the concept, consumers are asked to respond to it by answering a set of questions designed to help the company decide which concept has the strongest appeal. The company can then project these findings to the full market to estimate sales volume.

PROCESS OF NEW PRODUCT DEVELOPMENT

4. Marketing Strategy Development – This is the next step in new product development. The strategy statement consists of three parts: the first part describes the target market, the planned product positioning and the sales, market share and profit goals for the first few years. The second part outlines the product's planned price, distribution, and marketing budget for the first year. The third part of the marketing strategy statement describes the planned long-run sales, profit goals, and the marketing mix strategy.

5. Business Analysis – Once the management has decided on the marketing strategy, it can evaluate the attractiveness of the business proposal. Business analysis involves the review of projected sales, costs and profits to find out whether they satisfy a company's objectives. If they do, the product can move to the product development stage.

6. Product Development – Here, R&D or engineering develops the product concept into a physical product. This step calls for a large investment. It will show whether the product idea can be developed into a full- fledged workable product. First, R&D will develop prototypes that will satisfy and excite customers and that can be produced quickly and at budgeted costs. When the prototypes are ready, they must be tested. Functional tests are then conducted under laboratory and field conditions to ascertain whether the product performs safely and effectively.

7.Test Marketing – If the product passes the functional tests, the next step is test marketing: the stage at which the product and the marketing program are introduced to a more realistic market settings. Test marketing gives the marketer an opportunity to tweak the marketing mix before the going into the expense of a product launch. The amount of test marketing varies with the type of product. Costs of test marketing can be enormous and it can also allow competitors to launch a "me-too" product or even sabotage the testing so that the marketer gets skewed results. Hence, at times, management may decide to do away with this stage and proceed straight to the next one:

8.Commercialization – The final step in new product development is Commercialization. Introducing the product to the market-it will face high costs for manufacturing and advertising and promotion. The company will have to decide on the timing of the launch (seasonality) andthe location (whether regional, national or international). This depends a lot on the ability of the company to bear risk and the reach of its distribution network.

Today, in order to increase speed to market, many companies are dropping this sequential approach to development and are adopting the faster, more flexible, simultaneous development approach. Under this approach, many company departments work closely together, overlapping the steps in the product development process to save time and increase effectiveness.

1.2 VALUE ANALYSIS

Value Analysis is one of the major techniques of cost reduction and control. It is a disciplined approach which ensures the necessary functions for the minimum cost without diminishing quality, reliability, performance and appearance.

It is a creative approach to eliminate the unnecessary costs which add neither to quality nor to theappearance of the product. It is a systematic application of techniques to identify the functions of a product or a component and to provide the desired function at the lowest total cost.
These are the days of providing the customer with really best quality products at least cost whichis possible through value analysis which proves wrong rightly "Best and Cheap" or "Best isnever cheap" or "Cheap is Costly".
The concept of value analysis was developed during World War II by Lawrence D. Miles of General Electric Company

What is Value Analysis?

Before understanding the meaning of phrase "value analysis" or "value engineering", let us knowabout value. 'Value' is one of those terms having good many connotations and even contradictory definitions.
'Value' is a word that is very often used by individuals without being clearly understood. Forget about common people. Even different departments of the same organisation have differentopinions of the 'value' of the product that the company manufactures.

The designer equates value with reliability; purchase people with price paid for them; productionpersonnel with that of cost from the angle of manufacture; sales people with what customer is willing to pay.

In the field of value investigation, value refers to economic value, which itself can be sub- divided into four types as cost value, exchange value, use value and esteem value.

"Cost Value" is the measure of sum of all costs incurred in producing the product. The 'cost value', therefore is the sum of raw-material cost, labour cost, tool cost and overheads expendedto produce the product.

"Exchange Value" is the measure of all the properties, qualities and features of the productwhich make the product possible of being traded for another product or for money. In a conventional sense, 'exchange value' refers to the price that a purchaser will offer for the product, the price being dependent upon the satisfaction value which derives from the product.
Value derived from the product consists of two components namely (a) value due to reliability ofperformance of the product and the value which the possession bestows upon the buyer. These are often referred to as "value in value" and "esteem in value".

"Use Value" is the measure of properties, qualities and features which make the product accomplish a use, work or service. Use value, therefore, is the price paid by the buyer or the cost incurred by the manufacturer in order to ensure that the product performs its intended function efficiently.

Use value in the fundamental form of economic value. An item without use value can have neither exchange value nor esteem value. “Esteem Value” is the measure of properties, features, attractiveness graphic packaging and the like which increases sales appeal or which attracts customers and create in them a strong desire to own the product.

Value analysis is a systematic application of established techniques to identify the functions of a product or component and to provide the desired functions at the lowest total cost. It is a creative approach to eliminate unnecessary costs which add neither to quality no to the appearance of the product.

Value Analysis can be defined as, A process of systematic review that is applied to existing product designs in order to compare the function of the product required by a customer to meet their requirements at the lowest cost consistent with the specified performance and reliability needed.

It is a rational and structured process consisting of:

(a) Functional analysis to define the reason for the existence of a product or its components,

(b) Creatively analysis for generating new and better alternatives and

(c) Measurement for evaluating the value of present and future concepts.

The phrase value analysis can be defined as a technique which examines the facts of a function and cost of a product in order to determine whether the cost can be reduced or altogether eliminated, while retaining all the features of performance and quality of a product or both.

Therefore, logically, VA is an organised approach of exposing and eliminating unnecessarycosts. The method has logical foundation in its fundamental approach to cost reduction and profitimprovement and in this objective approach, the VA techniques has to analyse the functionalcost of an item and recommend a change.

Put alternatively, VA is a team approach to think functionally about a component as to “what it does” rather than “what it is”. This approach is the real test of understanding problems under study.

Value Analysis and Value Engineering:

'VA' and 'VE' are closely related terms so much so that many people use them interchangeably. Though the philosophy understanding the two is the same the identification of unnecessary costs yet they are different. The difference lies in the time and stage at which the technique is applied.

"Value Analysis" is the application of a set of techniques to an existing product with a view to improve its value. Thus, it is remedial process. "Value Engineering" is the application of exactly the same set of techniques to a new product at the design stage project concept or preliminary design when no hardware exists to ensure that bad features not added. Thus, it is a 'preventive' measure. In that sense, 'VE' is fundamental and VA is collateral because 'prevention is better than cure."

OBJECTIVES OF VALUE ANALYSIS

1) To provide better value to a product/service.
2) To improve the company's competitive position.
3) To ensure that every element of Cost (Labour Materials Suppliers and service) contribute equally to the Function of theproduct.
4) To Eliminate unnecessary Cost.

PHASES OF VALUE ANALYSIS:

1. Phase of Origination:

In the first phase, a value analysis study team is constituted. The project is selected and clearly defined. The team examines in detail the product and its components to understand thoroughly their nature.

2. Phase of Information:

After familiarisation, a functional analysis is carried out to determine the functions and uses of the product and its components. The cost and importance of each function are identified. A valueindex is calculated on the basis of cost benefit ratio for each function. A list is being prepared in which the items of functions are arranged in decreasing order of value.

3. Phase of Innovation:

This is the creative phase concerned with the generation of new alternatives to replace orremoving the existing ones.

4. Phase of Evaluation:

Each and every alternative is analysed and the most promising alternatives are selected. These alternatives are further examined for economic and technical feasibility.

The alternatives finally selected must be capable of performances the desired functions satisfactorily. These must meet the standards of accuracy, reliability, safety, maintenance and repairs, environmental effects and so on.

5. Phase of Choice:

In this phase, report is prepared. This report contains a summary of the study, conclusions and specific proposals. The decision makers choose the alternative. The programs and action places are then developed to implement the chosen alternative.

6. Phase of Implementation:

The chosen alternative is put to the actual use with the help of the programs and action plans so developed in advance.

7. Phase of Review:

The progress of analysis changes in continuously monitored and followed up in order to provide assistance, to clarify any misconceptions and to ensure that the desired results are achieved.

MERITS OF VALUE ANALYSIS:

Value analysis is really a very valuable technique of cost reduction and quality improvement.The specific merits of its are:

1. Improvement in Product Design:

It leads to improvements in the product design so that more useful products are given shape.Now in case of ball points, we do not have clogging, there is easy and even flow of ink and rubber pad is surrounding that reduces figures fatigue.

2. High Quality is maintained:

High quality implies higher value. Thus, dry cells were leaking; now they are leak proof; they arepen size with same power. Latest is that they are rechargeable.

3. Elimination of Wastage:

Value analysis improves the overall efficiency by eliminating the wastages of various types. It was a problem to correct the mistakes. It was done by pasting a paper. Now, pens are there and liquid paper is developed which dries fast and can write back.

4. Savings in Costs:

The main aim of value analysis is to cut the unwanted costs by retaining all the features of performance or even bettering the performance. Good deal of research and development hastaken place. Now milk, oils, purees pulp can be packed in tetra packing presuming the qualities and the tetra pack is degradable unlike plastic packs.

5. Generation of New Ideas and Products:

In case of took brushes, those in 1930's were flat and hard, over 60 to 70 years brushes have come making brushing teeth easy, cosy and dosy as it glides and massages gums.

6. Encourages Team-Spirit and Morale:

Value analysis is a tool which is not handled by one, but groups or teams and an organisation itself is a team of personnel having specification. A product is the product of all team efforts. Therefore, it fosters team spirit and manures employee morale as they are pulling together for greater success.

7. Neglected Areas are brought under Focus:

The organisational areas which need attention and improvement are brought under the spot-light and even the weakest gets a chance of getting stronger and more useful finally join's the main strain.

8. Qualification of Intangibles:

The whole process of value analysis is an exercise of converting the intangibles to tangible for decision making purpose. It is really difficult to make decisions on the issues where the thingsare (variables) not quantifiable.

However, value analysis does it. The decision makers are provided with qualified data and on thebasis of decisions are made. Such decisions are bound to be sound.

9. Wide Spectrum of Application:

The principles and techniques of value analysis can be applied to all areas-man be purchasing, hardware, products, systems, procedures and so on.

10. Building and Improving Company Image:

The company's status or image or personality is built up or improved to a great extent. Improvement in quality and reduction in cost means competitive product and good name in product market; it is a good pay master as sales and profits higher and labour market it enjoys reputation; it capital market, nobody hesitates to invest as it is a quality company.

Limitations:

Like any other cost reduction technique, value analysis has its own limitations. The most common limitations are that the man made excuses are the blocks in implementing these plans ofvalue analysis.

The most common excuses given are:

(a) Lack of motivation

(b) Resistive to change

(c) Inertia

(d) Lack of knowledge and patience

(e) Attitude of 'It will not work in India

(f) We are very small or very big

(g) This has been tried earlier and failed

(h) The change is too big

(i) 'Let competitors try before we try'

(j) Difficulty of teams meeting or team meeting for getting consensus.

These limitations are man-made and can be over-come one the company divides to implement. However, they should be educated of the plus and minus points and the main beneficiaries are those that are to be told and they are to be taken into confidence.

CONCLUSION

Value analysis is a technique with immense possibilities, and systematically employed, it can achieve great economies and increased efficiency. Although good results have been obtained in several individual cases in some industries, only a large scale and systematic application of this technique in all industries, and in defense production, can result in substantial economies on a national scale. To conclude, we can say that benefits of value analysis include, Reduced production cost, Materials and distribution cost, Improved profit margin, Increased customer satisfaction.

1.3 CAPACITY PLANNING

Capacity planning is the process of determining the production capacity needed by an organization to meet changing demands for its products. In the context of capacity planning, design capacity is the maximum amount of work that an organization is capable of completing ina given period. Effective capacity is the maximum amount of work that an organization iscapable of completing in a given period due to constraints such as quality problems, delays, material handling, etc.

A discrepancy between the capacity of an organization and the demands of its customers results in inefficiency, either in under-utilized resources or unfulfilled customers. The goal of capacity planning is to minimize this discrepancy. Demand for an organization's capacity varies based on changes in production output, such as increasing or decreasing the production quantity of an existing product, or producing new products. Better utilization of existing capacity can beaccomplished through improvements in overall equipment effectiveness (OEE). Capacity can be increased through introducing new techniques, equipment and materials, increasing the numberof workers or machines, increasing the number of shifts, or acquiring additional production facilities.

Capacity is calculated as (number of machines or workers) × (number of shifts) × (utilization) × (efficiency).

Capacity Planning Classification

Capacity planning based on the timeline is classified into three main categories long range, medium range and short range.

Long Term Capacity: Long range capacity of an organization is dependent on various other capacities like design capacity, production capacity, sustainable capacity and effective capacity. Design capacity is the maximum output possible as indicated by equipment manufacturer under ideal working condition.

Production capacity is the maximum output possible from equipment under normal working condition or day.

Sustainable capacity is the maximum production level achievable in realistic work condition and considering normal machine breakdown, maintenance, etc.

Effective capacity is the optimum production level under pre-defined job and work-schedules, normal machine breakdown, maintenance, etc.

Medium Term Capacity: The strategic capacity planning undertaken by organization for 2 to 3 years of a time frame is referred to as medium term capacity planning.

Short Term Capacity: The strategic planning undertaken by organization for a daily weekly or quarterly time frame is referred to as short term capacity planning.

Goal of Capacity Planning

The ultimate goal of capacity planning is to meet the current and future level of the requirement at a minimal wastage. The three types of capacity planning based on goal are lead capacity planning, lag strategy planning and match strategy planning.

Factors Affecting Capacity Planning

Effective capacity planning is dependent upon factors like production facility (layout, design,and location), product line or matrix, production technology, human capital (job design, compensation), operational structure (scheduling, quality assurance) and external structure (policy, safety regulations)

Determinants of Effective Capacity

- **Facilities:** The size and provision for expansion are key in the design of facilities. Other facility factors include locational factors (transportation costs, distance to market, labor supply, energy sources). The layout of the work area can determine how smoothly work can be performed.
- **Product and Service Factors:** The more uniform the output, the more opportunities there are for standardization of methods and materials. This leads to greater capacity.
- **Process Factors:** Quantity capability is an important determinant of capacity, but so is output quality. If the quality does not meet standards, then output rate decreases because

of need of inspection and rework activities. Process improvements that increase quality and productivity can result in increased capacity. Another process factor to consider is thetime it takes to change over equipment settings for different products or services.

- **Human Factors:** the tasks that are needed in certain jobs, the array of activities involved and the training, skill, and experience required to perform a job all affect the potential and actual output. Employee motivation, absenteeism, and labor turnover all affect the output rate as well.
- **Policy Factors:** Management policy can affect capacity by allowing or not allowing capacity options such as overtime or second or third shifts
- **Operational Factors:** Scheduling problems may occur when an organization has differences in equipment capabilities among different pieces of equipment or differences in job requirements. Other areas of impact on effective capacity include inventory stocking decisions, late deliveries, purchasing requirements, acceptability of purchased materials and parts, and quality inspection and control procedures.
- **Supply Chain Factors:** Questions include: What impact will the changes have on suppliers, warehousing, transportation, and distributors? If capacity will be increased, will these elements of the supply chain be able to handle the increase? If capacity is to be decreased, what impact will the loss of business have on these elements of the supply chain?
- **External Factors:** Minimum quality and performance standards can restrict management's options for increasing and using capacity.
- Inadequate planning can be a major limiting determining of effective capacity.

Forecasting v/s Capacity Planning

There would be a scenario where capacity planning done on a basis of forecasting may not exactly match. For example, there could be a scenario where demand is more than production capacity; in this situation, a company needs to fulfill its requirement by buying from outside. If demand is equal to production capacity; company is in a position to use its production capacity tothe fullest. If the demand is less than the production capacity, company can choose to reduce the production or share it output with other manufacturers.

The broad classes of capacity planning are lead strategy, lag strategy, match strategy, andadjustment strategy.

- **Lead strategy** is adding capacity in anticipation of an increase in demand. Lead strategy is an aggressive strategy with the goal of luring customers away from the company's competitors by improving the service level and reducing lead time. It is also a strategy aimed at reducing stock out costs. A large capacity does not necessarily imply high inventory levels, but it can imply higher cycle stock costs. Excess capacity can also be rented to other companies.

Advantage of lead strategy: First, it ensures that the organization has adequate capacity to meet all demand, even during periods of high growth. This is especially important when the

availability of a product or service is crucial, as in the case of emergency care or hot newproduct. For many new products, being late to market can mean the difference between success and failure. Another advantage of a lead capacity strategy is that it can be used to preempt competitors who might be planning to expand their own capacity. Being the first in an area to open a large grocery or home improvement store gives a retailer a define edge. Finally many businesses find that overbuilding in anticipation of increased usage is cheaper and less disruptivethan constantly making small increases in capacity. Of course, a lead capacity strategy can be very risky, particularly if demand is unpredictable or technology is evolving rapidly.

- **Lag strategy** refers to adding capacity only after the organization is running at full capacity or beyond due to increase in demand (North Carolina State University, 2006). This is a more conservative strategy and opposite of a lead capacity strategy. It decreases the risk of waste, but it may result in the loss of possible customers either by stockout or low service levels. Three clear advantages of this strategy are a reduced risk of overbuilding, greater productivity due to higher utilization levels, and the ability to putoff large investments as long as possible. Organization that follow this strategy often provide mature, cost-sensitive products or services.
- **Match strategy** is adding capacity in small amounts in response to changing demand in the market. This is a more moderate strategy.
- **Adjustment strategy** is adding or reducing capacity in small or large amounts due to consumer's demand, or, due to major changes to product or system architecture.

The Advantages of Capacity Planning

Capacity planning is the process of projecting future capacity needs based on current company use and industry trends. For example, the gradual increase of a production workforce in response to an increase in product demand is capacity planning. A company invests significant resources into capacity planning, including the purchase of new equipment and the leasing of new facilities. Understanding the advantages of capacity planning can help justify the costs.

Monitor Costs. Capacity planning takes into account personnel, facilities, production schedules and supplies. When the capacity level is carefully planned, the company can monitor costsduring periods of growth and recession. Being able to see projected capacity needs allows the company to budget for upcoming changes, and apply financial resources where needed. Capacityplanning is also used to help develop delivery schedules for supplies and shipping schedules for completed products.

Production Cycles

Your company can use capacity planning to maintain proper production levels during expected business cycles. For example, if your company traditionally sees an increase in orders during the summer in anticipation of the Christmas season, then you can use historical data to plan production capacity and have ample staff on hand to handle the rise in demand. Your capacity

planning also identifies when the cycle starts to head downwards so that you can lay off seasonalworkers and avoid the added personnel expense.

New Locations

As your company grows, you may find the need to open new production facilities. Using your capacity planning information from your existing locations, you can develop a more accurate projection of needs for facilities and personnel levels, and of the kind of production that can be expected from the new location. This is a valuable tool when putting together the business plan and budgets for your company's growth.

Information

Personnel and production are not the only areas where capacity planning can be useful. Your company accumulates digital information on a daily basis. That information is critical in being able to run your business and maintain profitability. A capacity plan that stays ahead of digital information storage demands and also allows for the permanent archiving of vital information is essential in the efficient growth of your organization.

STEPS IN THE CAPACITY PLANNING PROCESS:

1. Estimate future capacity requirements
2. Evaluate existing capacity and facilities and identify gaps
3. Identify alternatives for meeting requirements
4. Conduct financial analyses of each alternative
5. Assess key qualitative issues for each alternative
6. Select the alternative to pursue that will be best in the long-term
7. Implement the selected alternative Monitor results

2.11 PROCESS PLANNING

In companies, planning processes can result in increased output, higher precision, and faster turnaround for vital business tasks. A process is described as a set of steps that result in a specificoutcome. It converts input into output. Process planning is also called manufacturing planning, material processing, process engineering, and machine routing. It is the act of preparing detailed work instructions to produce a part. It is a complete description of specific stages in the production process. Process planning determines how the product will be produced or servicewill be provided. Process planning converts design information into the process steps andinstructions to powerfully and effectively manufacture products. As the design process is supported by many computer-aided tools, computer-aided process planning (CAPP) has evolved to make simpler and improve process planning and realize more effectual use of manufacturing resources.

Process Planning

It has been documented that process planning is required for new product and services. It is the base for designing factory buildings, facility layout and selecting production equipment. It also affects the job design and quality control.

Objective of Process Planning:

The chief of process planning is to augment and modernize the business methods of a company. Process planning is planned to renovate design specification into manufacturing instructions and to make products within the function and quality specification at the least possible costs. Thiswill result in reduced costs, due to fewer staff required to complete the same process, higher competence, by eradicating process steps such as loops and bottlenecks, greater precision, by including checkpoints and success measures to make sure process steps are completed precisely, better understanding by all employees to fulfill their department objectives.

Process planning deals with the selection of the processes and the determination of conditions of the processes. The particular operations and conditions have to be realised in order to change rawmaterial into a specified shape. All the specifications and conditions of operations are included inthe process plan. The process plan is a certificate such as engineering drawing. Both the engineering drawing and the process plan present the fundamental document for themanufacturing of products. Process planning influences time to market and productions cost. Consequently the planning activities have immense importance for competitive advantage.

Effect of process planning on competitive advantage: Process Planning

Principles of Process Planning

General principles for evaluating or enhancing processes are as follows:

First define the outputs, and then look toward the inputs needed to achieve those outputs. Describe the goals of the process, and assess them frequently to make sure they are stillappropriate. This would include specific measures like quality scores and turnaround times.

When mapped, the process should appear as a logical flow, without loops back to earlier steps ordepartments.

Any step executed needs to be included in the documentation. If not, it should be eliminated ordocumented, depending on whether or not it's necessary to the process.

People involved in the process should be consulted, as they often have the most currentinformation.

Process planning includes the activities and functions to develop a comprehensive plans and instructions to produce a part. The planning starts with engineering drawings, specifications,parts or material lists and a forecast of demand. The results of the planning are routings which specify operations, operation sequences, work centres, standards, tooling and fixtures. This

routing becomes a major input to the manufacturing resource planning system to define operations for production activity control purposes and define required resources for capacity requirements planning purposes.

Process plans which characteristically offer more detailed, step-by-step work instructions including dimensions linked to individual operations, machining parameters, set-up instructions, and quality assurance checkpoints. Process plans results in fabrication and assembly drawings to support manufacture and annual process planning is based on a manufacturing engineer's experience and knowledge of production facilities, equipment, their capabilities, processes, and tooling. But process planning is very lengthy and the results differ based on the person doing the planning.

Major steps in process planning:

Process planning has numerous steps to complete the project that include the definition, documentation, review and improvement of steps in business processes used in a company.

Definition: The first step is to describe what the process should accomplish. It includes queries like, what is the output of this process? Who receives the output, and how do they define success?, What are the inputs for the process?, Are there defined success measures in place - such as turnaround time or quality scores? And Are there specific checkpoints in the process that need to be addressed?

Documentation: During the documentation stage, interviews are conducted with company personnel to determine the steps and actions they take as part of a specific business process. The results of these interviews is written down, generally in the form of a flow chart, with copies of any forms used or attached. These flow charts are given to the involved departments to review, tomake sure information has been correctly captured in the chart.

Review: Next, the flow charts are reviewed for potential problem areas.
Process planning is concerned with planning the conversion or transformation processes needed to convert the materials into finished products .A production process is a series of manufacturing operations performed at workstations to achieve the design specifications of the planned output
.A vast number of different operations and various kinds of equipments and machines may be required to produce a complex product (for e.g. an aircraft or a ship). Simpler parts may require fewer operations (for e.g. a bolt and a nut).

Process planning consists of two parts namely

1. Process design
2. Operations design

Both stages provide information on what is required to effectively utilize the existing equipment and machinery and to determine what new equipment and machinery would be required.

Process Design

Process design is concerned with the overall sequence of operations required to achieve the product specifications. It specifies the type of work stations that are to be used, the machines andequipment necessary and the quantities in which each are required.

The sequence of operations in the manufacturing process is determined by

1. The nature of the product
2. The materials used
3. The quantities being produced
4. The existing physical layout of the plant.

Operations Design

Operations design is concerned with the design of the individual manufacturing operations .It consists of examining the man-machine relationship in the manufacturing process for converting the raw materials into the finished or semi-finished product .Operations design must specify how much of man and machine time is required for each unit of production.

Frame Work for Process Design

The design of the transformation process requires answers to several questions given below:

1. What are the characteristics of the product or service being supplied or offered to the customer?

2. What is the expected volume of the output?

3. What kinds of equipment or machinery are available?

4. Should the equipment or machinery be custom built?

5. What is the cost of equipment and machinery needed?

6. What types of labor skills are available, in what quantities and at what wage rates?

7. How much money can be spent on the manufacturing process?

8. Should the process be capital intensive or labor intensive?

9. Should the components or parts be made or purchased ?(Make or buy decision)

10. Which would be the best way to handle the materials?

Process planning in manufacturing may include the following activities:

Selection of raw-stock, Determination of machining methods,Selection of machine tools,
Selection of cutting tools,
Selection or design of fixtures and jigs,
Determination of set-up,
Determination of machining sequences, Calculations or determination of cutting conditions,Calculation and planning of tool paths,
Processing the process plan

Computer Aided Process Planning

Manufacturers have been following an evolutionary step to improve and computerize processplanning in the following five stages:

Stage I - Manual classification; standardized process plansStage II -

Computer maintained process plans

Stage III - Variant CAPP Stage IV

- Generative CAPP

Stage V - Dynamic, generative CAPP

Earlier to CAPP, producers attempted to triumph over the issues of manual process planning by basic categorization of parts into families and developing standardized process plans for parts families that is called
Stage I. When a new part is initiated, the process plan for that family would be manually recovered, marked-up and retyped. While this improved output but it did not enhance the quality of the planning of processes.

Computer-aided process planning originally developed as a device to electronically store aprocess plan once it was shaped, recover it, amend it for a new part and print the plan. It is calledStage II. Other ability of this stage is table-driven cost and standard estimating systems.
Stage III: Computer-aided approach of variant CAPP is based on a Group Technology codingand classification approach to recognize huge number of part attributes or parameters. These attributes permit the system to choose a baseline process plan for the part family and achieve about ninety percent of the planning work. The schemer will add the remaining ten percent of theeffort modifying or fine-tuning the process plan. The baseline process plans stored in the computer are manually entered using a super planner concept that is, developing standardized plans based on the accumulated experience and knowledge of multiple planners andmanufacturing engineers.

Stage IV: It is generative CAPP. In this stage, process planning decision rules are developed into the system. These decision rules will work based on a part's group technology or featurestechnology coding to produce a process plan that will require minimal manual interaction and modification.

While CAPP systems move towards being generative, a pure generative system that can create a complete process plan from part classification and other design data is a goal of the future. Thesetypes of generative system will utilize artificial intelligence type capabilities to produce process plans as well as be fully integrated in a CIM environment. An additional step in this stage is dynamic, generative CAPP which would consider plant and machine capacities, tooling availability, work center and equipment loads, and equipment status in developing process plans.

The process plan developed with a CAPP system at Stage V would differ in due course depending on the resources and workload in the factory. Dynamic, generative CAPP also entails the need for online display of the process plan on a work order oriented basis to cover that the appropriate process plan was provided to the floor.

There are numerous advantages of this type of process planning. It can decrease the skill requiredof a planner. It can reduce the process planning time. It can reduce both process planning and manufacturing cost. It can create more consistent plans. It can produce more accurate plans. It

can increase productivity. Automated process planning is done for shortening the lead-time, manufacturability feedback, lowering the production cost and consistent process plans. Advantages of Computer-aided Process Planning include reduced demand on the skilled planner, reduced process planning time, reduced process planning and manufacturing cost, created more consistent plans, produced accurate plans, increased productivity, increased high flexibility,attained high efficiency, attained adequate high product quality and possibility of integrationwith the other automated functions and systems.

Manufacturing Process Planning delivers essential process planning potential for all manufacturing industries. Using Manufacturing Process Planning, process planners canpowerfully create and authenticate the original process plan using the product structure from product engineering, modify the plan to specific requirements, and link products and resources tothe steps of the plan.

To summarize, Process Planning is important action in a production enterprise that verifies which processes, materials, and instructions will be used to produce a product. Process planning describes a manufacturing facility, processes and parameters which are to be used to change materials from a primary form to a predetermined final stage.

Questions:

1. Explain the stages in New Product Development
2. Explain the merits and demerits of Value analysis
3. Explain the steps in capacity planning
4. Explain the various determinants of capacity planning.
5. Explain the merits of capacity planning.
6. Bring out the principles and the steps in Process planning.

UNIT III

PLANT LOCATION AND LAYOUT

3.1 INTRODUCTION

Location, localization and planned location of industries are often felt to be synonymous. But,the distinction among these three terms is of immense importance. Entrepreneurs locate their enterprises where the cost of production comes, the lowest at the time of establishing industries. This is known as 'location of industries'.

The concentration of a particular industry mainly in one area, as occurred with many industriesin India, for example, textile industry in Mumbai is known as 'localisation of industries'.'Planned location of industries' is a term whereby the location of industries is planned to give each industrial area a variety of industries so that large industries are dispersed and not localised.

It was Alfred Weber (1929) to whom the credit of enunciating the theory of industrial location went when his magnum opus "The Theory of the Location of Industry," was published inGerman in 1909 and English in 1929.

The early theories of industrial location carried out the analysis on a simple framework where thelocational and special diversification was simply determined by an adjustment between location and weight distance characteristics of inputs and outputs.

The reason is that the then industrial structure was heavily dominated by the natural resource- base and consumer-oriented industries. But, over the period the very consideration for locating industries in a particular region has undergone a considerable change so the early theories of industrial location have become improper to explain location. Consideration of natural resources in the choice of industrial location has declined and the industries are likely to be establishedeven in those areas with poor natural endowment.

This holds especially true in the case of industries which are not heavily biased in favour of raw material source for their location. It is seen that such industries are gaining increasingly greater importance in the industrial map of India during the recent decades. Concentration of IT industries in Bangalore and Hyderabad are such examples.

Plant location may be understood as the function of determining where the plant should be located for maximum operating economy and effectiveness. The selection of a place for locating a plant is one of the problems, perhaps it is one of the task for the entrepreneur while launching anew enterprise. Selection of a location is on pure economic considerations will ensure an easy

and regular supply of raw material, labour, efficient plant layout to reduce cost of production. Once a mistake is made in locating a plant, it becomes extremely difficult and costly to correct it.

Need for plant location :- When the business is newly started. The existing business hasoutgrown its original facilities and expansion not possible. The volume of the business or the extent market necessitates the establishment of branches. A lease expires and the landlord does not renew the lease. Social and economic reasons i.e., in-adequate labour supply and shifting of the market.

FACTORS THAT INFLUENCE THE SELECTION OF PLANT LOCATION

It is not always possible to explain industrial location independently with the help of any one factor. In fact, several factors/ considerations influence the entrepreneur's decision in selecting the location for industry. Selection of industrial location is a strategic decision. It is a onetime decision and not be retracted again and again without bearing heavy costs.

Nonetheless, regardless of the type of business/enterprise, there are host of factors but notconfined to the following only that influence the selection of the location of an enterprise:

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.

Let us discuss these in some details.

(i) Availability of Raw Materials:

One of the most important considerations involved in selection of industrial location has been theavailability of raw materials required. The biggest advantage of availability of raw material at thelocation 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 tolocate 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 hasno 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.

Similarly if the transportation costs add substantially to one's product costs, then also a location close to the market becomes all the more essential. If the market is widely scattered over a vast territory, then entrepreneur needs to find out a central location that provides the lowest distribution cost. In case of goods for export, availability of processing facilities gains importance in deciding the location of one's industry. Export Promotion Zones (EPZ) are such examples.

(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.

Similarly adequate water supply at low cost may become a dominant decisional factor in case of selection of industrial location for leather, chemical, rayon, food processing, chemical and alike. Just to give you an idea what gigantic proportions can water as a resource assumes. Note that a tone of synthetic rubber requires 60 thousand gallons, a tone of aluminum takes 3 lakhs gallons, and a tone of rayon consumes 2 lakh gallons of water.

Similarly, location of jute industry on river Hoogly presents an example where transportation media becomes a dominant decisional factor for plant location. Establishing sea food industry next to port of embarkation is yet another example where transportation becomes the deciding criteria for industrial location.

(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 thelocation 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 entrepreneurshould 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.

While one can get cheaper labour in industrially backward areas, higher cost of their training andfall in quality of production may not allow the entrepreneur to employ the cheap manpower and, thus, establish his/her enterprise in such areas.

(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 pollutionmay 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 areawill 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 thedegree of competition from other competitors' location nearby plays a crucial role in selectingthe 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 eitherno 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 canattract entrepreneurs to establish industries in backward areas provided other required facilitiesdo also exist there.

For example, incentives and concessions cannot duly compensate for lack of infrastructural facilities like communication and transportation facilities. This is precisely one of the major reasons why people in-spite of so many incentives and concessions on offer by the Government, are not coming forward to establish industries in some backward areas.

(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 andhence, 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 industrialactivity 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 amongthe 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 andmay not be viable in every case.
Besides, an entrepreneur will have also to look into the availability of community services such as housing, schools and colleges, recreational facilities and municipal services. Lack of these facilities makes people hesitant and disinterested to move to such locations for work.

Very closer to political conditions is law and order situation prevalent in an area also influences selection of industrial location. Hardly any entrepreneur will be interested to establish his / her industry in an area trouble-torn by nexalites and terrorists like Jharkhand, Nagaland and Jammu & Kashmir.

People will be interested to move to areas having no law and order problem to establish their industries like Maharashtra and Gujarat. It is due to this law and order problem the Nano car manufacturing unit shifted from Nandigram in West Bengal to Gujarat.

3.2 PLANT LAYOUT

A plant layout study is an engineering study used to analyze different physical configurations for a manufacturing plant. It is also known as Facilities Planning andLayout.

The ability to design and operate manufacturing facilities that can quickly and effectively adaptto changing technological and market requirements is becoming increasingly important to the success of any manufacturing organization. In the face of shorter product life cycles, higher product variety, increasingly unpredictable demand, and shorter delivery times, manufacturing facilities dedicated to a single product line cannot be cost effective any longer. Investment efficiency now requires that manufacturing facilities be able to shift quickly from one product line to another without major retooling, resource reconfiguration, or replacement of equipment.

Investment efficiency also requires that manufacturing facilities be able to simultaneously make several products so that smaller volume products can be combined in a single facility and that fluctuations in product mixes and volumes can be more easily accommodated. In short, manufacturing facilities must be able to exhibit high levels of flexibility and robustness despite significant changes in their operating requirements.

In industry sectors, it is important to manufacture the products which have good quality and meetcustomers’ demand. This action could be conducted under existing resources such as employees, machines and other facilities. However, plant layout improvement, could be one of the tools to

response to increasing industrial productivity. Plant layout design has become a fundamental basis of today's industrial plants which can influence parts of work efficiency. It is needed to appropriately plan and position employees, materials, machines, equipment, and othermanufacturing supports and facilities to create the most effective plant layout.

Definition Plant layout refers to the arrangement of physical facilities such as machines, equipment, tools, furniture etc. in such a manner so as to have quickest flow of material at the lowest cost and with the least amount of handling in processing the product from the receipt of raw material to the delivery of the final product.

Objectives of Plant Layout:

1. Reduce accidents
2. Provide for volume and product flexibility
3. Provide ease of supervision and control
4. Provide for employee safety and health
5. Allow ease of maintenance of machines and plant.
6. Allow high machine or equipment utilization
7. Improve productivity.
8. Proper and efficient utilization of available floor space.
9. Reduce material handling costs.

Classifications or Types of Layouts: Types of Layouts Product or line layout Process or functional layout Fixed position or location layout Combined or group layout

Some of the important types of plant layout are:

A. Product or line layout,
B. Process or functional layout,
C. Layout by stationary material or Fixed layout.

(A) PRODUCT OR LINE LAYOUT:

Product or Line Layout is the arrangement of machines in a line (not always straight) or a sequence in which they would be used in the process of manufacture of the product. This type of layout is most appropriate in case of continuous type of industries where raw materials is fed at one end and taken out as finished product at the other end. For each type of product a separate line of production will have to be maintained.

This type of layout is most suitable in case of metal extraction industry, chemical industry, soap manufacturing industry, sugar industry and electric industry. It should be noted that this methodis most suitable in case of mass production industries.
Two types of lines are used in product layouts: paced and un paced. Paced lines can use somesort of conveyor that moves output along at a continuous rate so that workers can perform operations on the product as it goes by. For longer operating times, the worker may have to walk alongside the work as it moves until he or she is finished and can walk back to the workstation tobegin working on another part (this essentially is how automobile manufacturing works).

On an un paced line, workers build up queues between workstations to allow a variable work pace. However, this type of line does not work well with large, bulky products because too muchstorage space may be required. Also, it is difficult to balance an extreme variety of output rates without significant idle time. A technique known as assembly-line balancing can be used togroup the individual tasks performed into workstations so that there will be a reasonable balance of work among the workstations.

Product layout is suitable where:
(i) large quantity of standardized products are produced;

(ii) the standardized products are to be processed repetitively or continuously on the given production facilities;

(iii) there must be sufficient volume of goods processed to keep the production line actively occupied,

(iv) there should be greater interchangeability of the parts; and (v) to maintain good equipment balance each work station must employ machines or equipment's of approximately equal capacities. Similarly to maintain good labour balance, each work station must require an equal amount of work to be performed.

ADVANTAGES OF PRODUCT LAYOUT:

(1) Removal of obstacles in production: Product layout ensures unrestricted and continuous production thereby minimizing bottlenecks in the process of production, this is because work stoppages are minimum under this method.

(2) Economies in material handling:

Under this method there are direct channels for the flow of materials requiring lesser time which considerably eliminate back-tracking of materials. On account of this, cost of material handlingis considerably reduced. This is greatly helpful in achieving desired quality of the end product.

(3) Lesser manufacturing time:

Under this method (as already pointed), backward and forward handling of materials is not involved, it leads to considerable saving in manufacturing time.

(4) Lesser work in progress:

On account of continuous uninterrupted mass production, there is lesser accumulation of work inprogress or semi-finished goods.

(5) Proper use of floor space:

This method facilitates proper and optimum use of available floor space. This is due to non- accumulation of work in progress and overstocking of raw materials.

(6) Economy in inspection:

Inspection can be easily and conveniently undertaken under this method and any defect in production operations can be easily located in production operations. The need for inspection under this method is much less and can be confined at some crucial points only.

(7) Lesser manufacturing cost:

On account of lesser material handling, inspection costs and fullest utilisation of available space, production costs are considerably reduced under this method.

(8) Lesser labour costs:

Due to specialisation and simplification of operations and use of automatic simple machines, employment of unskilled and semi-skilled workers can carry on the work. The workers are required to carry routine tasks under this method. This leads to lesser labour costs.

(9) Introduction of effective production control:

Effective production control on account of simple operation of this method can be employed successfully. Production control refers to the adoption of measures to achieve production planning.

DISADVANTAGES OF PRODUCT LAYOUT:

(1) Lesser flexibility:

As work is carried in sequence and process arranged in a line, it is very difficult to make adjustments in production of operations. Sometimes, certain changes under this method become very costly and impractical. On account of this drawback, this method is not suitable in the production of goods which are subject to quick style and design changes.

(2) Large investment:

Under this method, machines are not arranged in accordance with functions as such similar type of machines and equipment is fixed at various lines of production. This leads to unavoidable machinery duplication resulting in idle capacity and large capital investment on the part of the entrepreneur.

(3) Higher overhead charges:

Higher capital investment leads to higher overheads (fixed overheads) under this method. This leads to excessive financial burden.

(4) Interruption due to breakdown:

If one machine in the sequence stops on account of breakdown, other machines cannot operate and work will be stopped. The work stoppage may also take place on account of irregular supply of material, poor production scheduling and employee absenteeism etc.

(5) Difficulties in expanding production:

Production cannot be expanded beyond certain limits under this method.

(6) Lack of specialization in supervision:

Supervision of different production jobs becomes difficult under this method as there is absence of specialized supervision as the work is carried on in one line having different processes and noton the basis of different departments for different specialised jobs. Under this method a

supervisor is supposed to have detailed knowledge of all the machines and processes which leadsto absence of specialization in the process of supervision.

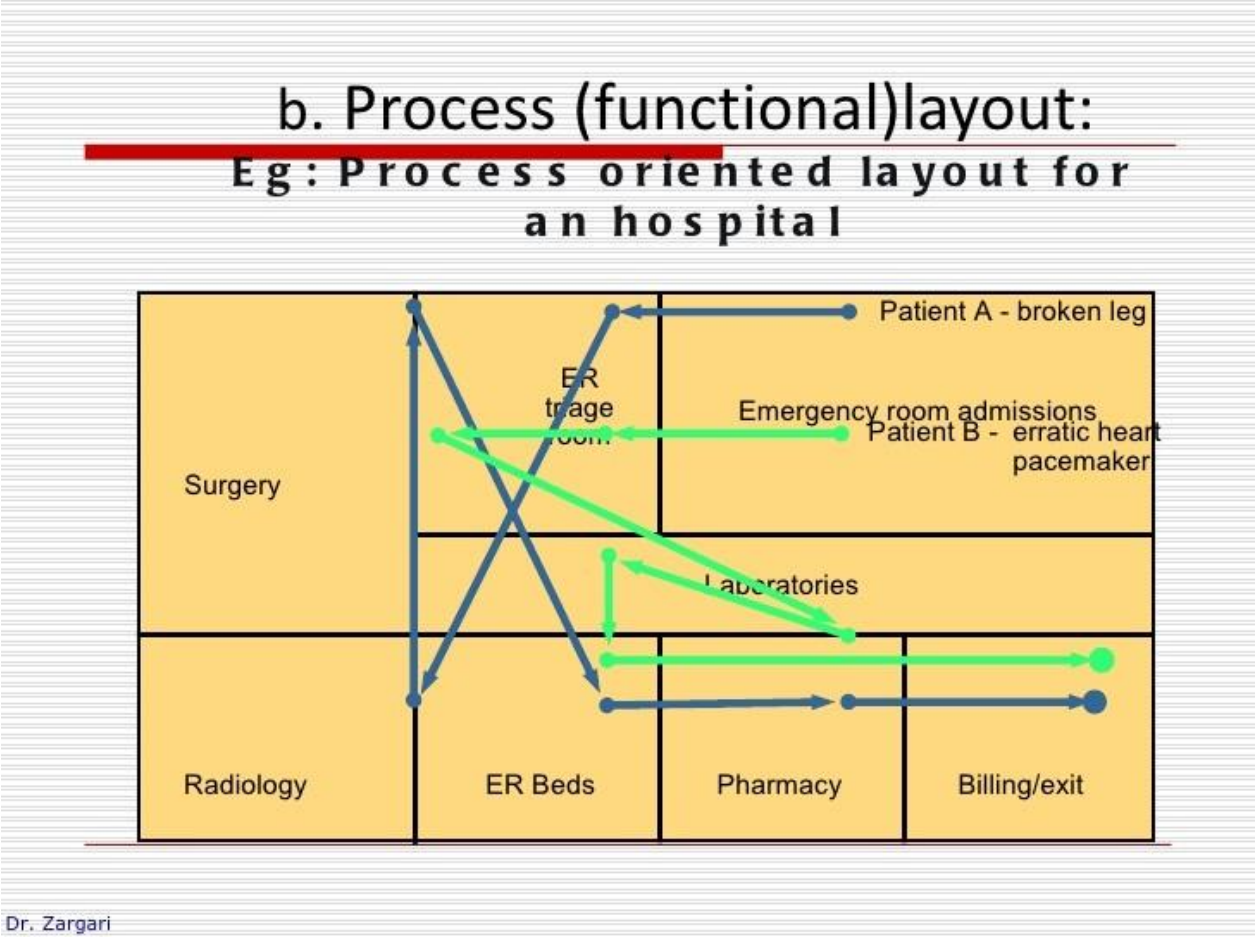
(7) Under-utilization of machines:

As has already been pointed out, separate set of one type of machines is fixed at different lines ofproduction. Usually, these machines are not properly and fully utilised and there remains idle capacity in the form of under utilised equipment.

(B) FUNCTIONAL OR PROCESS LAYOUT:

It is just the reverse of product layout. There is a functional division of work under this method. For example, lathes are fixed in one department and welding activities are carried in another department of the factory. The salient features of this type of layout are based on Frederick W. Taylor's concept of 'functional organization'.

This method is generally adopted for producing different varieties of unlike products. This is particularly adopted tor job order industries like engineering, ship building and printing etc. The following diagram shows that raw material travels through various process or departments from lathes passing through mills, grinders, drills, welding, inspection, finishing, and assembly and to finished product.



Advantages of Process Layout:

(1) Maximum utilisation of machines:

This method ensures fuller and effective utilisation of machines and consequently investment in equipment and machines becomes economical.

(2) Greater flexibility:

Changes in the sequence of machines and operations can be made without much difficulty. This is because the machines are arranged in different departments in accordance with the nature of functions performed by them.

(3) Scope for expansion:

Production can be increased by installing additional machines without much difficulty.

(4) Specialisation:

As has already been pointed out that under this method, specialised machines are used for performing different production operations. This leads to specialisation.

(5) Effective utilisation of workers:

Specialised workers are appointed to carry different type of work in different departments. This leads to effective and efficient use of their talent and capabilities.

(6) More effective supervision:

As the machines are arranged on the basis of functions, performed by them, the specialised and effective supervision is ensured by the specialised knowledge of supervisors. Each supervisorcan perform his task of supervision effectively as he has to supervise limited number machines operating in his department.

(7) Lesser work stoppages:

Unlike the product method, if a machine fails, it does not lead to complete work stoppage and production schedules are not seriously affected. Due to breakdown in one machine, the work can be easily transferred to the other machines.

Disadvantages of Process Layout:

(1) Coverage of more floor area:

Under this method, more floor space is needed for the same quantum of work as compared to product layout.

(2) Higher cost of material handling:

Material moves from one department to another under this method, leading to the higher cost of material handling. The mechanical devices of material handling cannot be conveniently employed under this method on account of functional division of work. Material has to be carriedby applying other methods from one department to another, resulting into higher cost of material handling.

(3) Higher labour costs:

As there is functional division of work, specialised workers are to be appointed in different departments for carrying specialised operations. The appointment of skilled worker leads to higher labour costs.

(4) Longer production time:

Production takes longer time for completion under this method and this leads to higher inventories of work-in-progress.

(5) Difficulties in production, planning and control:

Due to large variety of products and increased size of the plant, there are practical difficulties in bringing about proper coordination among various areas (departments) and processes of production. The process of production, planning and control becomes more complex and costly.

(6) Increased inspection costs:

Under this type of layout more supervisors are needed and work is to be checked after every operation which makes the process of supervision costlier.

(C) LAYOUT BY STATIONARY MATERIAL:

This type of layout is undertaken for the manufacture of large parts and assemblies. In this case, material remains fixed or stationary at one place, men and equipment are taken to the site of material. This is suitable in case of ship building, locomotives and heavy machinery industries etc.
A fixed-position layout is appropriate for a product that is too large or too heavy to move. For example, battleships are not produced on an assembly line. For services, other reasons may dictate the fixed position (e.g., a hospital operating room where doctors, nurses, and medical equipment are brought to the patient). Other fixed-position layout examples include construction (e.g., buildings, dams, and electric or nuclear power plants), shipbuilding, aircraft, aerospace, farming, drilling for oil, home repair, and automated car washes. In order to make this work, required resources must be portable so that they can be taken to the job for "on the spot" performance.

Advantages:

(a) Economies in transformation: As the work is carried at one place and material is not taken from one place to another, this leads to savings in transformation costs.

(b) Different jobs with same layout: Different projects can be undertaken with the help of same layout.

(c) Production in accordance with specifications: The jobs can be performed in accordance with the specifications given by the customers.

(d) Scope for flexibility: It provides maximum flexibility for various changes in production processes and designs of the products.

Disadvantages:

(a) Immobility of material: As material is fixed at one place, this leads to certain difficulties in arranging specialised workers, machines and equipment for the job.

(b) Large investment: This method is time consuming and costlier as compared to first two methods.

(c) Unsuitable for small products: This method is not suitable for producing and assembling small products in large quantities. In actual practice, it has been observed that a judicious combination of three types' viz., product, process and stationary material layout is undertaken by different organisations. This is done with the view to enjoy the advantages of all the methods.

Due to the nature of the product, the user has little choice in the use of a fixed-position layout.

Disadvantages include:

Space. For many fixed-position layouts, the work area may be crowded so that little storagespace is available. This also can cause material handling problems.

Administration. Oftentimes, the administrative burden is higher for fixed-position layouts. Thespan of control can be narrow, and coordination difficult.

COMBINATION LAYOUTS

Many situations call for a mixture of the three main layout types. These mixtures are commonly called combination or hybrid layouts. For example, one firm may utilize a process layout for the majority of its process along with an assembly in one area. Alternatively, a firm may utilize a fixed-position layout for the assembly of its final product, but use assembly lines to produce the components and subassemblies that make up the final product (e.g., aircraft).

CELLULAR LAYOUT

Cellular manufacturing is a type of layout where machines are grouped according to the process requirements for a set of similar items (part families) that require similar processing. These

groups are called cells. Therefore, a cellular layout is an equipment layout configured to support cellular manufacturing.

Processes are grouped into cells using a technique known as group technology (GT). Group technology involves identifying parts with similar design characteristics (size, shape, and function) and similar process characteristics (type of processing required, available machinery that performs this type of process, and processing sequence).

Workers in cellular layouts are cross-trained so that they can operate all the equipment within thecell and take responsibility for its output. Sometimes the cells feed into an assembly line that produces the final product. In some cases a cell is formed by dedicating certain equipment to the production of a family of parts without actually moving the equipment into a physical cell (these are called virtual or nominal cells). In this way, the firm avoids the burden of rearranging its current layout. However, physical cells are more common.

An automated version of cellular manufacturing is the flexible manufacturing system (FMS). With an FMS, a computer controls the transfer of parts to the various processes, enablingmanufacturers to achieve some of the benefits of product layouts while maintaining the flexibility of small batch production.

Some of the advantages of cellular manufacturing include:

Cost. Cellular manufacturing provides for faster processing time, less material handling, less work-in-process inventory, and reduced setup time, all of which reduce costs.
Flexibility. Cellular manufacturing allows for the production of small batches, which provides some degree of increased flexibility. This aspect is greatly enhanced with FMSs.
Motivation. Since workers are cross-trained to run every machine in the cell, boredom is less of afactor. Also, since workers are responsible for their cells' output, more autonomy and jobownership is present.

CELLULAR LAYOUT

ADVANTAGES

- reduced material handling and transit time
- reduced setup time
- reduced work-in-process inventory
- better use of human resources
- better scheduling, easier to control and automate
- less floor space required
- reduced direct labor

• heightened sense of employee participation
• increased use of equipment & machinery
• reduced investment on machinery & equipment

DISADVANTAGES

• sometimes cells may not be formed because of inadequate part families
• some cells may have a high volume of production and others very low. this results in poorly balanced cells
• when volume of production changes, number of workers are adjusted and workers are reassigned to various cells. to cope with this type of reassignments, workers must be multi- skilled and cross-trained
• sometimes, machines are duplicated in different cells. this increases capital investment

3.3 PRODUCTION PLANNING AND CONTROL

Introduction

What is Production Planning & Control (PPC)?

Production planning and control is a predetermined process which includes the use of human resource, raw materials, machines etc. PPC is the technique to plan each and every step in a long series of separate operation. It helps to take the right decision at the right time and at the right place to achieve maximum efficiency.

For efficient, effective and economical operation in a manufacturing unit of an organization, it is essential to integrate the production planning and control system. Production planning andsubsequent production control follow adaption of product design and finalization of a productionprocess.

Production planning and control address a fundamental problem of low productivity, inventory management and resource utilization.

Production planning is required for scheduling, dispatch, inspection, quality management, inventory management, supply management and equipment management. Production control ensures that production team can achieve required production target, optimum utilization of resources, quality management and cost savings.

Planning and control are an essential ingredient for success of an operation unit. The benefits of production planning and control are as follows:

- It ensures that optimum utilization of production capacity is achieved, by proper scheduling of the machine items which reduces the idle time as well as over use.
- It ensures that inventory level are maintained at optimum levels at all time, i.e. there is no over-stocking or under-stocking.
- It also ensures that production time is kept at optimum level and thereby increasing the turnover time.
- Since it overlooks all aspects of production, quality of final product is always maintained.

OBJECTIVE OF PPC

• To deliver goods in required quantities to customers in required delivery schedule.ion

• To ensure maximum utilization of all resources

• To ensure production quality products

• To minimize the product throughput time

• To maintain optimum level inventory

• To maintain flexibility in manufacturing operations

• Coordinate between labour and machines and various supporting departments

Production Planning

Production planning is one part of production planning and control dealing with basic conceptsof what to produce, when to produce, how much to produce, etc. It involves taking a long-term view at overall production planning. Therefore, objectives of production planning are as follows:

- To ensure right quantity and quality of raw material, equipment, etc. are available during times of production.
- To ensure capacity utilization is in tune with forecast demand at all the time.

A well thought production planning ensures that overall production process is streamlinedproviding following benefits:

- Organization can deliver a product in a timely and regular manner.
- Supplier are informed will in advance for the requirement of raw materials.
- It reduces investment in inventory.
- It reduces overall production cost by driving in efficiency.

Production planning takes care of two basic strategies' product planning and process planning. Production planning is done at three different time dependent levels i.e. long-range planning dealing with facility planning, capital investment, location planning, etc.; medium-range planning deals with demand forecast and capacity planning and lastly short term planningdealing with day to day operations.

Production Control

Production control looks to utilize different type of control techniques to achieve optimum performance out of the production system as to achieve overall production planning targets. Therefore, objectives of production control are as follows:

- Regulate inventory management
- Organize the production schedules
- Optimum utilization of resources and production process

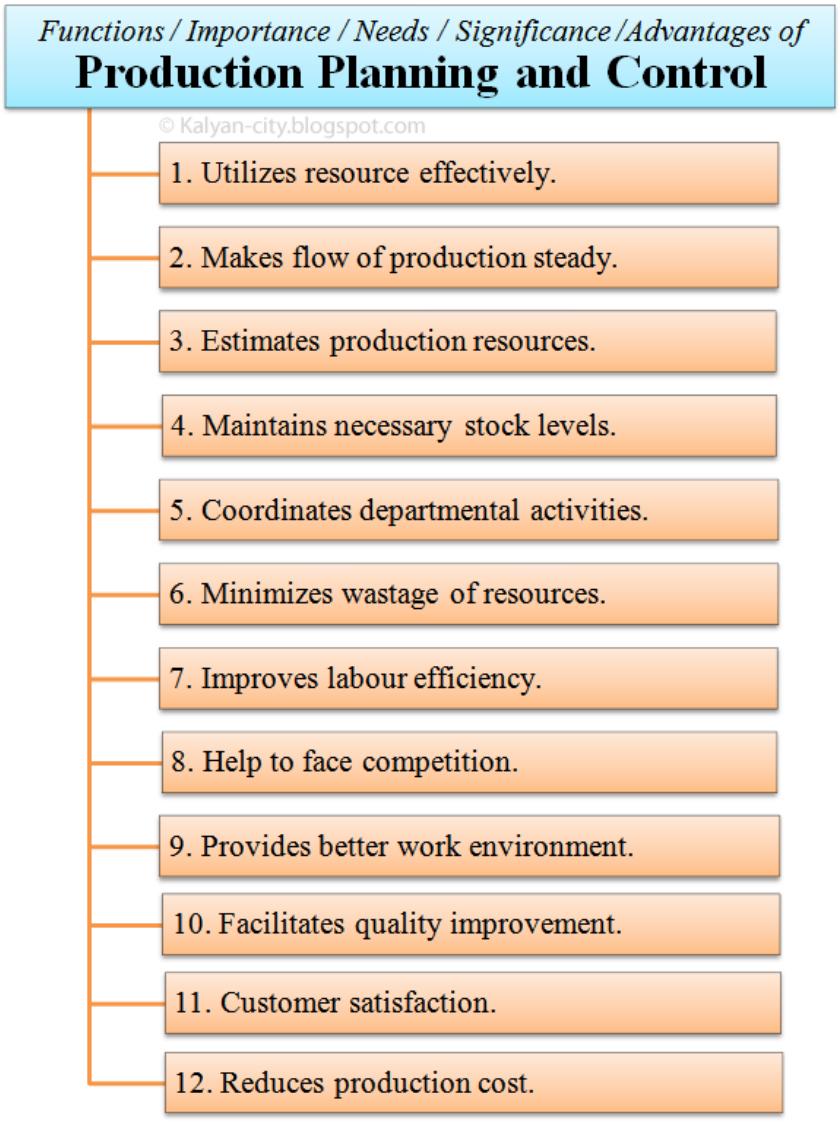
The advantages of robust production control are as follows:

- Ensure a smooth flow of all production processes
- Ensure production cost savings thereby improving the bottom line
- Control wastage of resources
- It maintains standard of quality through the production life cycle.

Production control cannot be same across all the organization. Production control is dependent upon the following factors:

- Nature of production(job oriented, service oriented, etc.)
- Nature of operation
- Size of operation

Production planning and control are essential for customer delight and overall success of an organization.



Now let's discuss above listed functions of production planning and control.

1. Utilizes resources effectively

Production planning and control result in effective utilization of plant capacity, equipment and resources. It results in low-cost and high-returns for the organization.

2. Makes flow of production steady

Production planning and control ensure a regular and steady flow of production. All machinesare put to their optimum use. This helps in achieving a continuous production of goods.This also helps to provide a regular supply of goods to consumers.

3. Estimates production resources

Production planning and control help to estimate the resources like men, materials, machines, etc. The estimate is made based on sales forecast.So, production is planned to meet salesrequirements.

4. Maintains necessary stock levels

Production planning and control prevent over-stocking and under-stocking of materials. Necessary stocks are maintained. Stock of raw-material is maintained at a proper level in order tomeet production demands. Stock of finished goods is also maintained to meet regular demands from customers.

5. Coordinates departmental activities

Production planning and control helps to co-ordinate the activities of different departments. Consider, for an example, the marketing department co-ordinates with production department to sell the goods. This results in profit to the organization.

6. Minimizes wastage of resources

Production planning and control ensure proper inventory of raw-materials and effective handling of materials. This helps to minimize the wastage of raw materials. It also ensures production of quality goods. This results in minimal rejects. So, it results in minimum wastage.

7. Improves labor efficiency

There is maximum utilization of manpower. Training is provided to the workers. The profits are shared with the workers in form of increased wages and other incentives. Workers are motivated to perform their best. This results in improved labor efficiency.

8. Helps to face competition

Production planning and control help to give delivery of goods to customers in time. This is because of regular flow of quality production. So, the company can face competition effectively, and it can capture the market.

9. Provides better work environment

Production planning and control provide a better work environment to workers. They get better work facilities, proper working hours, leave and holidays, increased wages and other incentives.

10. Facilitates quality improvement

Production planning and control facilitate quality improvement because the production is checked regularly.

Quality consciousness is developed among the employees through training, suggestion schemes, quality circles, etc.

11. Customer satisfaction

Production planning and control help to give a regular supply of goods and services to consumers at competitive market price. This results in customer satisfaction.

12. Reduces production costs

Production planning and control make optimum utilization of resources, and it minimizes wastage. It also maintains an optimal level of inventories. Overall, this reduces the production costs.

Main elements of Production Planning & Control

The following are main elements of Production Planning and 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 capacityof 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.
According to Kimball and Kimball, scheduling is defined as, the determination of the time that should be required to perform the entire series as routed, making allowance for all factors concerned.

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

Production Planning & Control is done in three stages namely,

Pre-planning

Planning

Control.

Stage 1: Pre-Planning

Under this phase of production planning, basic ground work on the product design, layout designand work flow are prepared. The operations relating to the availability scope and capacity ofmen, 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.

3.4 AGGREGATE PLANNING

Introduction

An organization can finalize its business plans on the recommendation of demand forecast. Oncebusiness plans are ready, an organization can do backward working from the final sales unit to raw materials required. Thus annual and quarterly plans are broken down into labor, raw material, working capital, etc. requirements over a medium-range period (6 months to 18 months). This process of working out production requirements for a medium range is called aggregate planning.

Factors Affecting Aggregate Planning

Aggregate planning is an operational activity critical to the organization as it looks to balance long-term strategic planning with short term production success. Following factors are critical before an aggregate planning process can actually start;

- A complete information is required about available production facility and raw materials.
- A solid demand forecast covering the medium-range period
- Financial planning surrounding the production cost which includes raw material, labor, inventory planning, etc.
- Organization policy around labor management, quality management, etc.

For aggregate planning to be a success, following inputs are required;

- An aggregate demand forecast for the relevant period
- Evaluation of all the available means to manage capacity planning like sub-contracting, outsourcing, etc.
- Existing operational status of workforce (number, skill set, etc.), inventory level and production efficiency

Aggregate planning will ensure that organization can plan for workforce level, inventory level and production rate in line with its strategic goal and objective.

Aggregate planning as an Operational Tool

Aggregate planning helps achieve balance between operation goal, financial goal and overall strategic objective of the organization. It serves as a platform to manage capacity and demand planning.

In a scenario where demand is not matching the capacity, an organization can try to balance both by pricing, promotion, order management and new demand creation.

In scenario where capacity is not matching demand, an organization can try to balance the both by various alternatives such as.

- Laying off/hiring excess/inadequate excess/ workforce until demand decrease/increase.
- Including overtime as part of scheduling there by creating additional capacity.
- Hiring a temporary workforce for a fix period or outsourcing activity to a sub-contractor.

Importance of Aggregate Planning

Aggregate planning plays an important part in achieving long-term objectives of the organization. Aggregate planning helps in:

- Achieving financial goals by reducing overall variable cost and improving the bottom line
- Maximum utilization of the available production facility
- Provide customer delight by matching demand and reducing wait time for customers
- Reduce investment in inventory stocking
- Able to meet scheduling goals there by creating a happy and satisfied work force

Aggregate Planning Strategies

There are three types of aggregate planning strategies available for organization to choose from.They are as follows.

Aggregate Planning Strategies

Active strategy:

Attempts to handle fluctuations in demand by focusing on demand managementUse pricing strategies and/or advertising and promotion
Develop counter-cyclical products
Request customers to backorder or advance-orderDo not meet demand

Passive strategy (reactive strategy):

Attempts to handle fluctuations in demand by focusing on supply and capacitymanagement
Vary size work force size by hiring or layoffs
Vary utilization of labour and equipment through overtime or idle timeBuild or draw from inventory
Subcontract production
Negotiate cooperative arrangements with other firmsAllow backlogs, back orders, and/or stockouts **Mixed strategy:**
Combines elements of both an active strategy and a passive (reactive) strategyFirms will usually use some combination of the two.

Passive (reactive) Strategies in Aggregate Planning: Basic Approaches

Chase approach

capacities (workforce levels, production schedules, output rates, etc.) are adjustedto match demand requirements over the planning horizon.

Advantages:

- anticipation inventory is not required, and investment in inventory is low
- labour utilization is kept high

Disadvantages:

- expense of adjusting output rates and/or workforce levels
- alienation of workforce

Level Approach

Capacities (workforce levels, production schedules, output rates, etc.) are keptconstant over the planning horizon.

Advantages:

- stable output rates and workforce levels

Disadvantages:

- greater inventory investment is required
- increased overtime and idle time
- resource utilizations vary over time

Aggregate Planning Methods: Intuitive Methods

Intuitive methods use management intuition, experience, and rules-of-thumb,frequently accompanied by graphical and/or spreadsheet analysis.

Advantage:

- easy to use and explain

Disadvantage:

- many solutions are possible, most of which are not optimal

Aggregate Planning Example:

Suppose you have the following forecasts for demand to meet:

Month	1	2	3	4	5	6
Demand	1000	1200	1500	1900	1800	1600

Relevant Costs:

Regular production cost	$35/unit
Lost sales	$100/unit
Inventory carrying costs	$10/unit/month

Subcontracting costs	$60/unit
Hiring costs	$1500/worker
Firing costs	$3000/worker
Beginning workforce level	20 workers
Capacity per worker	50 units/month
Initial inventory level	700 units
Closing inventory level	100 units

LEVEL PRODUCTION STRATEGY

Find the requirements for the period of the plan and produce the average amountneeded per month to meet the plan.

First determine the average requirements per month:

Avg. requirements = $\frac{\text{total requirements - opening inv. + closing inv.}}{\text{number of periods}}$

Avg. requirements = (9000 - 700 + 100)/6 = 1400 units/periodSteps:

1. Enter the production data
2. Determine hire/fire to get to production level desired
3. Update inventory levels
4. Does the inventory run out - If it does recalculate average production needed and go to step 1
5. Calculate totals for each category
6. Calculate costs

CHASE STRATEGY

- Produce exactly what is required every period.
- Hire and fire to adjust monthly production to monthly requirements.
- The first and last period production levels are adjusted to account for opening inventory and closing inventory requirements.

Intuitive (Mixed) Strategy

- Trial and Error to find a good solution

- Use Excel to model the problem and test the impact of different solutions

- Build the model using proper structure with key variables at the top and a summary of key results immediately below.

Finding Optimal Solutions Using Linear Programming

- Aggregate planning problems can be solved optimally using linear programming (LP).

- Given the constraints on requirements, production capabilities, allowed workforce changes, overtime and subcontracting limits plus all relevant costs LP will find an optimal solution to the problem which minimizes total costs.

Problems related to Aggregate Planning

Smoothing

- Smoothing refers to costs that result from changing production and workforce levels from one period to the next.

Bottleneck Problems

- It is the inability of the system to respond to sudden changes in demand as a result of capacity restrictions.

Planning Horizon

- The number of periods for which the demand is to be forecasted, and hence the number of periods for which workforce and inventory levels are to be determined, must be specified in advance.

Treatment of Demand Aggregate planning methodology requires the assumption that demand is known with certainty. This is simultaneously a weakness and a strength of the approach.

3.5 MASTER PRODCUTION PLAN/ SCHEDULE

Master production schedule (MPS) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded. This plan quantifies significant processes, parts, and other resources in order to optimize production, to identify bottlenecks, and to anticipate needs and completed goods. Since an MPS drives much factory activity, its accuracy and viability dramatically affect profitability. Typical MPSs are created by software with user tweaking.

Due to software limitations, but especially the intense work required by the "master production schedulers", schedules do not include every aspect of production, but only key elements thathave proven their control affectivity, such as forecast demand, production costs, inventory costs, lead time, working hours, capacity, inventory levels, available storage, and parts supply. The choice of what to model varies among companies and factories. The MPS is a statement of what the company expects to produce and purchase (i.e. quantity to be produced, staffing levels, dates,available to promise, projected balance).

The MPS translates the customer demand (sales orders, PIR's), into a build plan using planned orders in a true component scheduling environment. Using MPS helps avoid shortages, costly expediting, last minute scheduling, and inefficient allocation of resources. Working with MPS allows businesses to consolidate planned parts, produce master schedules and forecasts for any level of the Bill of Material (BOM) for any type of part.

How an MPS works?

By using many variables as inputs the MPS will generate a set of outputs used for decision making. Inputs may include forecast demand, production costs, inventory money, customer needs, inventory progress, supply, lot size, production lead time, and capacity. Inputs may be automatically generated by an ERP system that links a sales department with a production department. For instance, when the sales department records a sale, the forecast demand may beautomatically shifted to meet the new demand. Inputs may also be inputted manually from forecasts that have also been calculated manually. Outputs may include amounts to be produced,staffing levels, quantity available to promise, and projected available balance. Outputs may be used to create a Material Requirements Planning (MRP) schedule.

A master production schedule may be necessary for organizations to synchronize their operationsand become more efficient. An effective MPS ultimately will:

- Give production, planning, purchasing, and management the information to plan and control manufacturing
- Tie overall business planning and forecasting to detail operations
- Enable marketing to make legitimate delivery commitments to warehouses and customers
- Increase the efficiency and accuracy of a company's manufacturing

Benefits of Master Production Scheduling

1/ Can help to smooth the demand signal

Most customer demand signals will contain peaks and troughs of demand – this profile can resultin planning problems and inefficiency for manufacturers. A significant benefit of MPS is that since it decouples the customer demand from what is manufactured – batch sizes can be tuned to optimize the production process. Where demand is particularly spiky (ie. Peeks and troughs of demand) this can be of enormous assistance producing a steady drum beat of manufacture(taking advantage of batch sizes and minimal setup times) which can then ripple through the supply chain.

2/ Protects lead time and helps book future deliveries

A common complaint for many organizations is that demand is loaded within lead time – i.e. if a part takes 100 days to manufacture it's no good taking a customer demand for delivery in 50days where there is no stock – you are struggling before you've even started the manufacturing process. This can create panic amongst the staff – throwing existing priorities into disarray. Whilst there are a variety of methods that can be used to stop this – MPS can be a very effective method as it is the production schedule that drives the manufacturing not the customer demand. This enables the organization to protect its lead time but also assists planning in looking at when future customer requirement is best supported by manufacturing output.

3/ Acts as a single communication tool to the business

A major benefit to any organization that adopts MPS is that it acts as a single communicationtool for the business regarding its manufacturing plans. The MPS schedule is typically available via the MRP system however whatever the method it's imperative that its communicated in an easily understandable form that can be used throughout the organization.

4/ Helps the Supply chain prioritize requirement

Having a fixed schedule enables the supply chain team – in particular the procurement functionto communicate priorities and requirements effectively. One of the key problems many manufacturing organizations face where they are led by changing customer requirement is where the supply chain gets reprioritized depending on the "problem of the week". Its no surprise that suppliers work best to regular smoothed demand – where that demand in unstable it can often lead to missed deliveries (of what was planned) let alone the detrimental affect to relationships with suppliers that struggle to keep up with what's really required.

5/ Helps stabilize production

Master production schedules are best reviewed as part of a formal business process which includes the relevant stakeholders and often requires senior sign off before it is either loaded intothe MRP system or is passed to production for action. It's common the production schedule to beoutputted from a formal SIOP review.

Typically master production schedules do not allow "planning in arrears" so where failures have happened and product has not been manufactured as planned – these items are re-planned to a relevant point in the future.

Another common attribute of a master production schedule is that there is usually a fixedplanning window whereby plans do not get changed. For example the first 6 weeks of the plan maybe termed fixed. This enables production to concentrate on what's ahead of them without worrying about reprioritizations. Additions may be added to this fixed period but usually such amendments are tightly controlled.

Whilst, as with any business process, there are challenges associated with deploying a master production schedule there are some enormous and tangible benefits. Manufacturing plants canget themselves into chaos by not administering the manufacturing demand signal appropriately and this can have huge affects on the supply chain – driving reprioritizations, excess inventory and causing untold grief to the relationships to key suppliers. Used correctly MPS can right manyof these problems generating a stable and considered plan to drive the business.

Questions :

1. Enumerate the factors to be considered in selecting a plant location.
2. Explain the different types of layout with its merits and demerits.
3. Explain the stages in PPC.
4. Write short notes on Aggregate planning
5. State the benefits of Master Production plan.

UNIT IV

QUALITY CONTROL

4.1 Quality Control: Meaning, Importance, Definition and Objectives

What is 'Quality Control'?

Quality control is a process through which a business seeks to ensure that product quality is maintained or improved and manufacturing errors are reduced or eliminated. Quality control requires the business to create an environment in which both management and employees strive for perfection. This is done by training personnel, creating benchmarks for product quality, and testing products to check for statistically significant variations.

A major aspect of quality control is the establishment of well-defined controls. These controls help standardize both production and reactions to quality issues. Limiting room for error by specifying which production activities are to be completed by which personnel reduces the chance that employees will be involved in tasks for which they do not have adequate training.

Definition :An aspect of the quality assurance process that consists of activities employed in detection and measurement of the variability in the characteristics of output attributable to the production system, and includes corrective responses.

Meaning and Importance:

Present era is the 'Era of Quality'. In this age of cutthroat competition and large scale production, only that manufacturer can survive who supplies better quality goods and renders service to-the consumers. In fact quality control has become major consideration before establishing an industrial undertaking. Proper quality control ensures most effective utilisation ofavailable resources and reduction in cost of production.

The word quality control comprises of two words viz., quality and control. It would be appropriate to explain these two words separately to understand clearly the meaning of quality control.

According to Dr. W.K. Spriegel "The quality of a product may be defined as the sum of anumber 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".

It is clear from these definitions that quality refers to various characteristics of a product andtheir excellence. Quality is a relative term and is never absolute depending upon the use of the product and circumstances under which it is used.

To achieve and maintain a satisfactory level of quality of products is a very difficult task.

It involves many steps to be undertaken viz:

(a) Product must possess a minimum level of quality so that it could be easily sold in the market.

(b) In order to measure quality, accurate standard measurements must be established.

(c) Reasonable deviation from the pre-determined standards must be determined.

(d) Satisfactory level of quality must be achieved with a minimum cost.

Control refers to the use of all the ways and means whereby quality standards could be maintained. Control precisely aims at bringing the product up to predetermined standards by minimising deviations from established and present standards.

According to Henry Fayol, "Control consists in verifying whether everything occurs in conformity with the plan adopted, the instructions issued and principles established. It hasobjected to point out weaknesses and errors in order to rectify them and prevent recurrence. It operates on everything things, people, actions".

In the words of Theo Haimann, "control is the process of checking to determine whether or not, proper progress is being made towards the objectives and goals and acting if necessary to correct any deviation".

From the above mentioned definitions, it is clear that a good control system should be suchwhich suggests corrective remedies so that negative deviations may not re-occur in future. The scope of the term 'control' is wider, including not only product to be produced but also extending to workmen and their methods of operations.

In the absence of effective control over production operations, desired quality in products to be produced cannot be achieved. How it may be pointed out here that words quality and control cannot be studied separately in this context but as 'Quality Control'.

Quality control is concerned with the control of quality of the product during the process of production. It aims at achieving the predetermined level of quality in a product. In other words quality control is concerned with controlling those negative variances which ultimately affect theexcellence of a manufacturer in producing the products.

Definition:

Some of the important definitions of quality control are enumerated as under:

"Quality control may be defined as that industrial management technique or group of techniques by means of which products of uniform acceptable quality are manufactured. It is indeed the mechanism by which products are made to measure up to specifications determined from customer's demand and transformed into sales, engineering and manufacturing requirements. Itis concerned with making things right rather than the discovering and rejecting those made wrong". —Alford and Beatty

"Quality control means the recognition and removal of identifiable causes and defects, and variables from the set standards".—J.A. Shubin.

"Quality control is used to connote all those activities which are directed for defining, controllingand maintaining quality".—K.G. Lockyer.

"Quality control is systematic control by management of the variables in the manufacturing process that affect goodness of the end-product."—H.N. Broom.

"Quality control is systematic control of these variables in the manufacturing process which affect the excellence of the end product. These variables result from the application of materials, men, machines and manufacturing condition. The production system possesses those inputs to produce desirable outputs.

Only when these variables in the inputs are regulated to the extent that they do not deviate unnecessarily from the excellence of the manufacturing process as reflected in the quality of the finished product, can the control of quality be said to exist. "—Bethel, At water and Stackman

"Quality control includes techniques and systems for the achievement of the required quality in the articles produced and for the elimination of sub standard goods."—Tome, Simen and HcGill.

"Quality control is a system of inspection, analysis and action applied to a manufacturing processso that, by inspecting a small portion of the product currently produced, an analysis of its quality can be made to determine what action is required on the operation in order to achieve and maintain the desired level of quality."—Joseph Manueb.

"Quality control is a technique of scientific management which has the object of improving industrial efficiency by concentrating on better standards of quality and on controls to ensure thatthese standards are always maintained….It is not intended to show what is wrong with current technology, but rather to establish what can be achieved with existing methods when they are operated correctly. " —D.J. Desmond.

From the above mentioned definitions, it is clear that quality control is concerned with controlling the negative variables which affect the ultimate quality of a product and in a broader sense it is concerned with the performance of those activities leading to fulfillment the company's objectives.

OBJECTIVES OF QUALITY CONTROL:

Following are the important 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.

NEED OR IMPORTANCE OR BENEFITS OF QUALITY CONTROL

Some of the importance or benefits of quality control are: 1. Encourages quality consciousness 2.Satisfaction of consumers 3. Reduction in production cost 4. Most effective utilisation of resources.

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:

By 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 utilization 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.

12. Increased sales:

Quality control ensures production of quality products which is immensely helpful in attracting more customers for the product thereby increasing sales. It is greatly helpful in maintaining existing demand and creating new demand for the product. It has been rightly pointed out that quality control is a powerful instrument with the help of which markets both at home and abroad can be expanded.

QUALITY CONTROL TECHNIQUES

In manufacturing the quality control aspect of the business is there to ensure that the end product meets the requirements of the customer. If the product is not acceptable to the customer'sstandards, they will not purchase the product. This means the manufacturer not only received no compensation for the product, but that he must absorb the costs of the materials, labor and equipment use that it took to create that faulty or defective product. As with many steps and employee roles in manufacturing and business as a whole, quality assurance is a natural step that is needed to ensure that the product or service being produced will be accepted and paid for by the consumer. After all, if there is no pay there is no reason to produce in the first place.

Quality control techniques for manufacturing will vary from plant to plant as processes, equipment and human skill will vary from plant to plant. Small variations in quality control methods are in some cases a "secret weapon" used by manufacturers to give them an edge over the competition. In general however there are some basic quality control techniques that most other strategies stem from. Here are some brief descriptions of these quality control techniques:

- **A . Failure testing -** In a failure testing quality control technique, the end product is put through a series of tests to determine the circumstanced under which it will fail to perform its function. For example, increasing factors of material stress, vibration, temperature, and other forms of wear and tear will eventually reveal any weaknesses the product has. These weaknesses can then be researched and improvements can be found. In some cases this process of improvement can be simple with only small modifications a product can be made to perform much better. But in cases where improvements are needed extensively, the process can be very time consuming and financially straining.
- B. **Statistical control -** Statistical control is a quality control technique that uses mathematics to uncover the likelihood of product failure. If the probability of failure is extremely low, than the whole batch of products may be passed off as acceptable. If there is an indication that based in the sample product, that there may be a higher probability of failure, the product is re-evaluated and any errors are corrected. In ideal circumstances the probability of error or defect is found before the products are produced and the problems are corrected.
- C. **Company quality -** This quality control technique involves the entire company's participation when it comes to quality control. This technique is certainly not limited only to those in the field of manufacturing either. Principles of job management, adequate processes, performance and integrity criteria and identification of records as well as competence in areas such as knowledge, skills, experience, qualifications and elements, such as personnel integrity, confidence, organizational culture, motivation, team moral and quality relationships are all terms that are pertinent to the application of the company quality control technique.

- D.**Total quality control -** The total quality control technique is usually used in cases where other methods of quality control have still not corrected the quality concerns or there is still some sort of sales decrease. In cases like these the total quality control team would place more emphasis on giving the customer what they wanted and less emphasis on trying to perfect a product that even in its perfected state is not pleasing the customer. Customer specifications would be re-evaluated to see if there are any areas of importance that have been neglected or not addressed with as much emphasis as may be needed. Management teams would ensure that their employees are sufficiently qualified for the work that they are being asked to perform.

QUALITY CONTROL TECHNIQUES

Various techniques of quality control have been developed. More prominent of them are: Just-In-Time, quality at the source, quality circles, statistical quality control and total quality management. A brief explanation of each, is as follows.

4.2 CONTROL CHART

Control charts are a great tool to monitor your processes overtime. This way you can easily see variation. Control charts are a great tool that you can use to determine if your process isunder statistical control, the level of variation inherent in the process, and point you in the direction of the nature of the variation (common cause or special cause).

Generally a control part in a DMAIC project is used in the control phase to help lock in the gainsthat you made and automate an alarm system to let you know if the process is misbehaving. However, if a process has existing data, you could use the same tools and techniques to illustrate the level (or lack) of control in the current state system. And of course the findings from analysis on a control chart could be a launching point for improvement initiatives.

A control chart is an extension of a run chart. The control chart includes everything a run chart does but adds upper control limits and lower control limits at a distance of 3 Standard Deviationsaway from the process mean. This shows process capability and helps you monitor a process to see if it is within acceptable parameters or not.

There are multiple kinds of control charts. You need to choose the right one depending uponthe kinds of data sets you are mapping and other conditions. The kind of chart you use will affectthe calculations of control limits you place in the chart.

A colleague once labeled the Upper & Lower control limits for a process he was responsible for as the “Time to update the resume lines” because if the process got out of control, he might beout of a job!

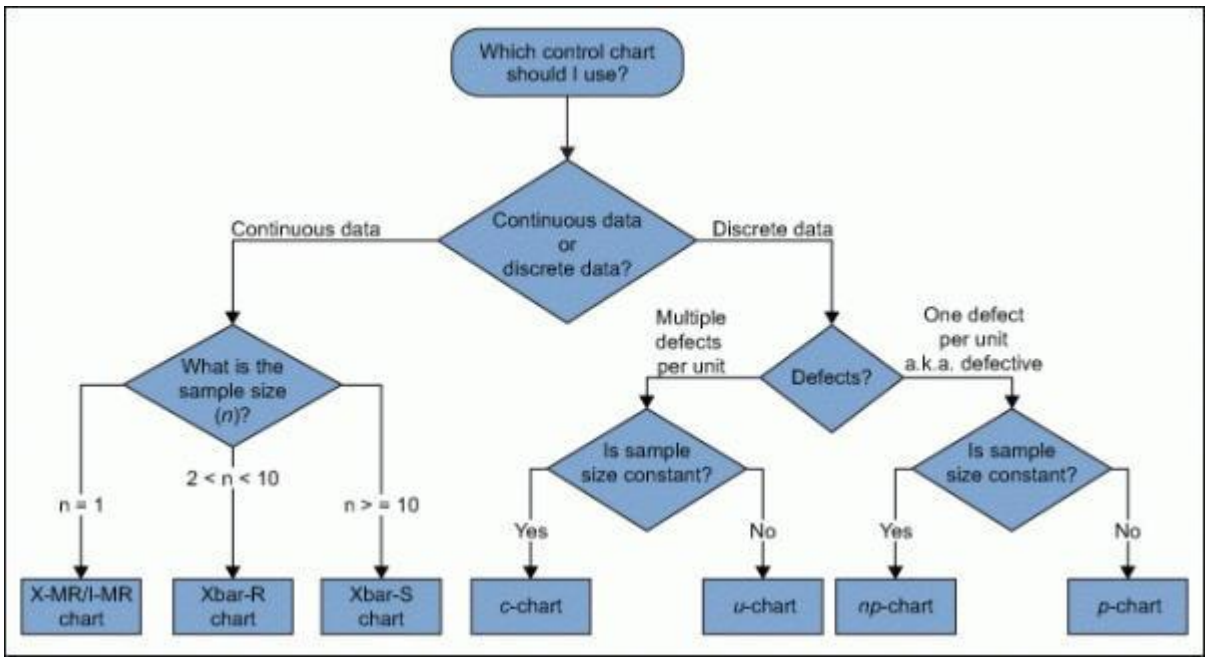
Use a control chart to distinguish between common cause and special cause variation in a new process. Or use it to determine how much common cause variation exists.

Control Chart Tips

- Specification lines should NEVER be included on a control chart
- You should gather data for a control chart in the order of production
- The ease of data collection is not a major consideration.
- It is more important to collect data that relates to a critical product or process parameter.
- Never gather data from inspection records, because it is too late — the cause for a point out of control, shift, or trend is lost because it happened hours earlier.
- Put at least 6 points in the range of a control chart to ensure adequate discrimination.
- A control chart can be used to identify the following assignable causes

    - Shifts
    - Trends
    - A point outside control limits
    - NOT anything to do with specification limits.

What Kind of a Control Chart to Use?



P & np charts

For discrete-attribute data, p-charts and np-charts are ideal. Attribute data is for measures that categorize or bucket items, so that a proportion of items in a certain category can be calculated. Thus a p-chart is used when a control chart of these proportions is desired.

An np-chart is appropriate when the number of items used to calculate each proportion is the same. For example, 100 reports may be reviewed each week and categorized as either accurate orinaccurate. The proportion of inaccurate reports could be plotted on a p-chart or the actual number of inaccurate reports could be plotted on an np-chart. If the number of reports reviewed each week varies, then a p-chart must be used.

C & u charts

Discrete-count data differs from attribute data in that the occurrence of a characteristic or eventcan be counted, but a non-occurrence cannot be counted. Thus the data plotted for a c-chart or u-chart is always the count of occurrences. The c-chart is used when the opportunity foroccurrences is equal for each data point and the u-chart is required when the opportunities differ. The u-chart looks different from the individuals chart in that the limits actually vary from pointto point, as seen here:

ADVANTAGES OF CONTROL CHARTS:

Various advantages of control charts for variables are as follows:

(1) Control charts warn in time, if required rectification is done, well in time the scrap and percentage rejection can be reduced.

(2) Thus ensures product quality level.

(3) A control chart indicates whether the process is in control or out of control thus information about the selection of process and tolerance limits are provided.

(4) The inspection work is reduced.

(5) The control charts separate out the chance and assignable causes of variations in the observation thus substantial quality improvement is possible.

(6) Determines process variability that and detects unusual variations taking place. So reputation of the concern/firm can be built by application of these charts.

OBJECTIVES OR PURPOSE OF CONTROL CHARTS FOR VARIABLES:

Various objectives of control charts for variables are as follows:

(1) To establish whether the process is in statistical control and in which case the variability is attributable to chance. The variability that is inherent in the process cannot be removed, unless there is a change in the basic conditions under which the production system/process is operating.

(2) It guides the production engineer in determining whether the process capability is compatible with the design specifications.

(3) To detect the trend of the observations for further planning, adjustment and resetting tools.

(4) To get prior information regarding the process, if that is likely to go out to control.

Control charts typically fall under three types. Below we take an in-depth look at each:

1. **X bar and Range Chart**: The most common type of chart for those operators searching for statistical process control, the “Xbar and Range Chart” is used to monitor a variable’s data when samples are collected at regular intervals. The chart is particularly advantageous when your sample size is relatively small and constant.
2. **Individual-X Moving Range Chart**: When it doesn’t make sense to take multiple readings, the “Individual-X Moving Range Chart” is the ideal option. This particular chart is used to monitor variables data when it is impractical to use rational subgroups. “When data is very expensive or there is a whole lot of time between samples, the concept of Xbar and Range makes no sense,” Wise explains. “It is better to go with Individual-X Moving Range.”
3. **X bar and Standard Deviation Chart**: This chart is primarily used to show how much variation or "dispersion" exists from the average or expected value. The Xbar and Standard Deviation Chart is touted for helping manufacturers, engineers and operators understand variation better.

Control Charts

The control chart is a graph which is used to study process changes over time. The data isplotted in a timely order. A control chart is bound to have a central line of average, an upper line of upper control limit and a lower line of lower control limit.

Control charts are the tools in control processes in statistics to determine whether a manufacturing process or a business process is in controlled statistical state.

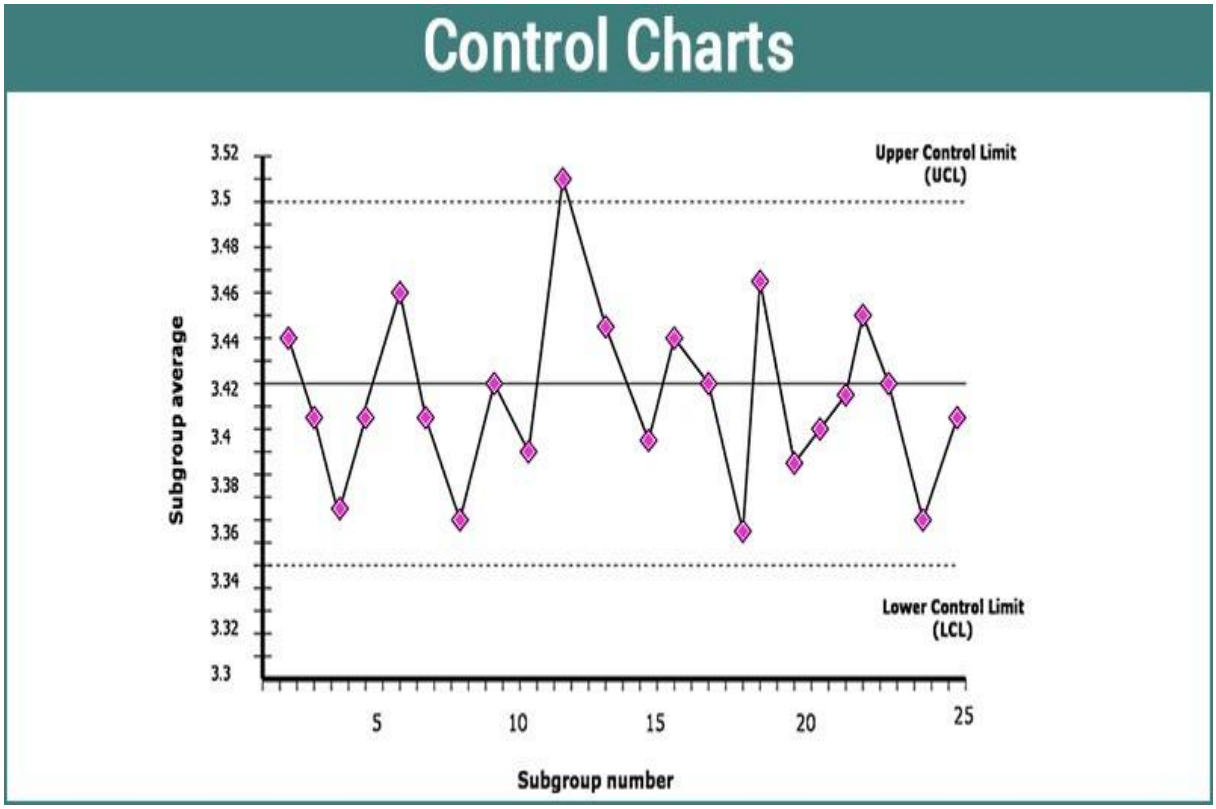
In addition, the data obtained from the process can also be applied in making the prediction of the future performances of the process.

When the analysis made by the control chart indicates that the process is currently under control, it reveals that the process is stable with the variations that come from sources familiar with the process. No changes or corrections are required to be made to the parameters of process control.

After the basic chart is created, one can use various menus and options to make required changes that may be in a format, type or statistics of the chart.

To create a chart it is not necessary to know the name or structure of any chart. You just need to select the columns or variables that are to be charted and drag them in respective zones. When the data column is dragged to the workplace, the user starts working on itto create an accurate chart that is based on the data type and given sample size.

Control charts, also known as Shewhart charts (after Walter A. Shewhart) or process-behavior charts, are a statistical process control tool used to determine if a manufacturing or business process is in a state of control.



Types of control charts

Control Charts for Variables:

The control charts of variables can be classified based on the statistics of subgroupsummary plotted on the chart.

$\bar{X}$ chartR

Chart S

Chart

$\bar{X}$ chart describes the subset of averages or means, R chart displays the subgroup ranges,and S chart shows the subgroup standard deviations. Regarding the quality that is to be measured on a continuous scale, a particular analysis makes both the process mean andits variability apparent along with a mean chart that is aligned over its corresponding S-or R- chart.

Levey – Jennings Charts:

This chart displays a mean process based on a long-term sigma with control limits. The control limits are placed such that the distance between them and the center line is ‘3s’. The standard deviation value ‘s’ for these charts is determined by the same method as the standard deviation for the distribution platform.

Control Charts for Attributes:

This type of data is usually continuous and based on the theoretical concept of continuousdata. Count data is a different kind of data available which is also known as level counts of character data. The interest variable is a unique count here for the number of blemishesor defects per subgroups. These attribute charts are appropriately applicable for such discrete count data.

Pre-summarize Charts:

The data can be combined into one measurement unit if the data you have contains repetitive measurements of the same unit process. But this is not recommended until the data contains repeating measurements of every measurement process.
Typically, pre-summarize summarizes the process columns into standard deviations or sample means based on the size of the sample.

4.3 ACCEPTANCE SAMPLING

Acceptance sampling uses statistical sampling to determine whether to accept or reject a production lot of material. It has been a common quality control technique used in industry. It is usually done as products leaves the factory, or in some cases even within the factory. Most often a producer supplies a consumer a number of items and a decision to accept or reject the items is made by determining the number of defective items in a sample from the lot. The lot is accepted if the number of defects falls below where the acceptance number or otherwise the lot is rejected.

- **Quality at the source**

- Where workers are made responsible to produce parts of perfect quality, before they are passed on to the next operation, the concept of quality at the source emerges. The worker is put in the drivers seat in controlling product quality. The principles underlying quality at the source are:

- 1. Every workers job becomes a quality control station. The worker is responsible for inspecting his own work, identifying any defects and reworking them into non-defectives, and correcting any cause of defect.

- 2. Statistical quality control techniques are used to monitor the quality of parts produced at each work station, and easy-to-understand charts and graphs are used to communicate progress to workers and managers.

3. Each worker is given the right to stop the production line to avoid producing defectiveparts.

- 4. Workers and managers are organized into quality circles â€“ groups of people who analyze quality problems, work to solve the problems and implement programs to improve product quality.

Acceptance Sampling: Meaning, Advantages and Limitations

Meaning of Acceptance Sampling or Sampling Inspection:

One method of controlling the quality of a product is 100% inspection which requires huge expenditure in terms of time, money and labour. Moreover due to boredom and fatigue involved in repetitive inspection process, there exists a possibility to overlook and some defective products may pass the inspection point.

Also when the quality of a product is tested by destructive testing (e.g., life of a candle or testing of electrical fuses) then 100% inspection shall destroy all the products.

The alternative is statistical sampling inspection methods. Here from the whole lot of products/items to be inspected, some items are selected for inspection.

If that sample of items conforms to be desired quality requirements then the whole lot isaccepted, if it does not, the whole lot is rejected. Thus the sample items are considered to be the representative of the whole lot. This method of acceptance or rejection of a sample is called Acceptance Sampling.

In general acceptance sampling method proves to be economical and is used under the assumption when the quality characteristics of the item are under control and relatively homogeneous.

CLASSIFICATION OF ACCEPTANCE SAMPLING:

Depending upon the type of inspection acceptance sampling may be classified in two ways:

(i) Acceptance sampling on the basis of attributes i.e. GO and NOT GO gauges, and

(ii) Acceptance sampling on the basis of variables.

In acceptance sampling by attributes, no actual measurement is done and the inspection is done by way of GO & NOT GO gauges. If the product conforms to the given specifications it is accepted, otherwise rejected. The magnitude of error is not important in this case.

For example if cracks is the criteria of inspection/the products with cracks will be rejected and without cracks accepted the shape and size of the cracks shall not be measured and considered.

In acceptance sampling by variables, the actual measurements of dimensions are taken or physical and chemical testing of the characteristics of sample of materials/products is done. If theresults are as per specifications the lot is accepted otherwise rejected.

Terms Used in Acceptance Sampling:

Following terms are generally used in acceptance sampling:

(i) Acceptable Quality Level (AQL):

It is the desired quality level at which probability of a acceptance is high. It represents maximum proportion of defectives which the consumer finds acceptable or it is the maximum percent defectives that for the purpose of sampling inspection can be considered satisfactory.

(ii) Lot Tolerance Percent Defective (LTPD) or Reject able Quality Level (RQL):

It is the quality level at which the probability of acceptance is low and below this level the lots are rejected. This prescribes the dividing line between good and bad lots. Lots at this qualitylevel are considered to be poor.

(iii) Average outgoing Quality (A.O.Q):

Acceptance sampling plans provides the assurance that the average quality level or percent defectives actually going to consumers will not exceed certain limit. Fig 9.2 demonstrates the concept of average outgoing quality related with actual percent defectives being produced.

The AOQ curve indicates that as the actual percent defectives in a production process increases, initially the effect is for the lots to be passed for acceptance even though the number ofdefectives has gone up and the percent defectives going to the consumer increases.

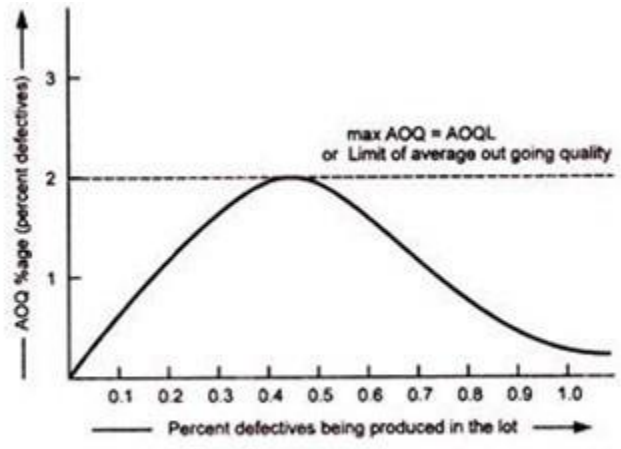


Fig. 9.3: An Average out going Quality (AOQ) Curve

If this upward trend continues, the acceptance plan beings to reject lots and when lots are rejected, 100% inspection is followed and defective units are replaced by good ones. The net effect is to improve the average quality of the outgoing products since the rejected lots which to are ultimately accepted contain all non-defective items (because of 100% inspection).

(iv) Operating Characteristic Curve or O.C. Curve:

Operating characteristic curve for a sampling plan is a graph between fraction defective in a lot and the probability of acceptance. In practice the performance of acceptance sampling fordistinguishing defectives and acceptable or good and bad lots mainly depends upon the sample size (n) and the number of defectives permissible in the sample.

The O.C. curve shown in Fig. 9.4 is the curve of a 100 percent inspection plan is said to be an ideal curve, because it is generated by and acceptance plan which creates no risk either for producer or the consumer. Fig. 9.3 shows the O.C. curve that passes through two stipulatedpoints i.e. two pre-agreed points AQL and LTPD by the producer and the consumer.

Usually the producer's and consumer's risks are agreed upon Fig. 9.4: and explicitly recorded in quantitative terms.

This leads to following two types of risks:

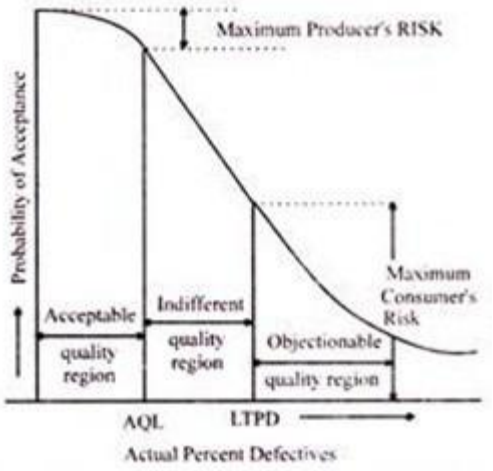


Fig. 9.4: The general form of an operating characteristic curve that pass through two stipulated points

The merit of any sampling plan depends on the relationship of sampling cost to risk. As the costof inspection go down the cost of accepting defectives increases.

Characteristics of O.C. Curve:

(i) The larger the sample size and acceptance number steeper will be the slope of O.C. curve.

(ii) The O.C. curve of the sampling plans with acceptance number greater than zero are superior to those with acceptance number as zero.

(iii) Fixed sample size tends towards constant quality production.

Advantages of Acceptance Sampling:

(i) The method is applicable in those industries where there is mass production and the industries follow a set production procedure.

(ii) The method is economical and easy to understand.

(iii) Causes less fatigue boredom.

(iv) Computation work involved is comparatively very small.

(v) The people involved in inspection can be easily imparted training.

(vi) Products of destructive nature during inspection can be easily inspected by sampling.

(vii) Due to quick inspection process, scheduling and delivery times are improved.

Limitations of Acceptance Sampling:

(i) It does not give 100% assurance for the confirmation of specifications so there is always some likelihood/risk of drawing wrong inference about the quality of the batch/lot.

(ii) Success of the system is dependent on, sampling randomness, quality characteristics to be tested, batch size and criteria of acceptance of lot.

Producer's and Consumer's Risk:

The acceptance or rejection of the whole batch of products in acceptance sampling depends uponthe results of the sample inspected. There is always a chance that a sample may not be true representative of the batches or lots from which it is drawn.

This leads to following two types of risks:

(i) Producer risk.

(ii) Consumer risk.

(i) Producer Risk (α):

It is the small probability of a lot/batch being good or even better acceptable quality level (AQL) but yielding a bad sample and thus getting rejected. So this probability of rejection of a good lot which otherwise would have been accepted is known as producer's risk (α).

(ii) Consumer Risk (β):

It is the probability of a batch/lot being bad or worse than the limiting quality (LQ) but yielding agood sample and getting accepted. So this probability of a defective lot being accepted which otherwise would have been rejected is known as consumer risk (β).

4.4 SIX SIGMA (6Σ)

SIX SIGMA is a set of techniques and tools for process improvement. It was introduced by engineers Bill Smith & Mikel J Harrywhile working at Motorola in 1986.[1][2] Jack Welch madeit central to his business strategy at General Electric in 1995.

It seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has specific value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits.

The term *Six Sigma* (capitalized because it was written that way when registered as a Motorola trademark on December 28, 1993) originated from terminology associated with statistical modeling of manufacturing processes. The maturity of a manufacturing process can be described by a *sigma* rating indicating its yield or the percentage of defect-free products it creates. A six sigma process is one in which 99.99966% of all opportunities to produce some feature of a part are statistically expected to be free of defects (3.4 defective features per million opportunities). Motorola set a goal of "six sigma" for all of its manufacturing operations, and this goal became a by-word for the management and engineering practices used to achieve it.

Six Sigma management approach follows DMAIC application process.

Define problem and why it needs to be solvedMeasure

process and gap in performance

Analyse process to find or identify root cause or causesImprove

process measure results and learn

Control process to highest performance or capability.What

return can you expect on your investment?

Companies organising all their resources reference to six sigma can expect to experience a 20%margin improvement, 15-20% increases in capacity, 15-40% capital reduction.

By focusing on business and manufacturing processes and the “sigma” capability, your companycan:

Reduce rework

Reduce high inventory levels Improve

delivery performance Reduce non-value

added activities

Produce more competitively priced productsGain

more satisfied customers

Win more business!

All this depends on right experienced and knowledgeable people you use in Laboratory andquality dependent to at least degree level i.e, B Eng., M Eng type of people.

Six sigma come in stages white, yellow, green, black, master black belt basis these people takeon projects and implement improvement tasks to achieve above mentioned results.

Advantages of Six sigma

- It is customer driven
- Defined as a limit of 3.4 defects per one million products or service processes, where anything not acceptable to the end customer is considered a defect.
- It addresses the entire process behind the production of an item or completion of a service, rather than just the final outcome.
- It is proactive rather than reactive, as it sets out to determine how improvements can be made even before defects or shortcomings are found.

Other benefits include:

- Emphasis on achieving attainable goals
- Implementing projects that will produce results
- Effective use of scientific techniques and precise tools
- Infuses upper management with passion and dedication
- Integrated concepts benefiting employees and customers
- Using information that has real world meaning

A small company that achieves the coveted Six Sigma quality certification will certainly stand out among its competitors. It is particularly valuable to a specialty manufacturing concern that produces precision goods, such as medical technology, where quality is the utmost customer priority and the customer expects to bear the cost of the Six Sigma process. Even businesses that are unable to implement Six Sigma due to cost or practicality may benefit from having a partner or employee learn and implement some of the basics of the system, especially the philosophy of proactivity and customer satisfaction that underlies Six Sigma.

Disadvantages of Six sigma

Because Six Sigma is applied to all aspects of the production and planning process, it may create rigidity and bureaucracy that can create delays and stifle creativity.

Customer focus may be taken to extremes, where internal quality-control measures that make sense for a company are not taken because of the overlying goal of achieving the Six Sigma- stipulated level of consumer satisfaction. For example, an inexpensive measure that carries a risk

of a slightly higher defect rate may be rejected in favor of a more expensive measure that helpsto achieve Six Sigma, but adversely affects profitability.

Small company six sigma is extremely costly for many small businesses to implement. Employees must obtain training from certified Six Sigma institutes in order for an enterprise to receive Six Sigma certification. Even if a firm wishes to implement Six Sigma without formal certification, much training is necessary in order to understand the system and how to apply it to particular business processes. Many small businesses cannot possibly afford such training, even for a single employee. In addition, small businesses that need to remain nimble and creativeoften find the Six Sigma system of process analysis stifling, bureaucratic and overly timeconsuming.

Industry standard six sigma method is fully loaded with statistics Sometimes too much

focus on the tool instead of finding the right solutionOthers may thing six sigma is only

for the higher educated ones

4.5 QUALITY CIRCLES

A quality circle is a volunteer group composed of workers , usually under the leadership of their supervisor , who are trained to identify, analyze and solve work-related problems and present their solutions to management in order to improve the performance of the organization, and motivate and enrich the work of employees. When matured, true quality circles become self- managing, having gained the confidence of management.

Quality circle

Participative management technique within the framework of a company wide quality system inwhich small teams of (usually 6 to 12) employees voluntarily form to define and solve a qualityor performance related problem. In Japan (where this practice originated) quality circles are anintegral part of enterprise management and are called quality control circles. www.businessdictionary.com

"**A Quality Circle** is volunteer group composed of members who meet to talk about workplace and service improvements and make presentations to their management with their ideas." (Prasad, L.M, 1998).

Quality circles enable the enrichment of the lives of the workers or students and creates harmonyand high performance. Typical topics are improving occupational safety and health, improving product design, and improvement in the workplace and manufacturing processes.

These are related especially to the quality of output or services in order to improve theperformance of the organization / department and motivate and enrich the work of employees.

This group carries on continuously as a part of organization-wide control activities, self and mutual developments and control and improvement within the workplace utilizing quality control techniques with all the members participating. Generally six to twelve volunteers fromthe same work area make up a circle. The members receive training in problem solving, statistical quality control and group processes. Quality Circle generally recommends solutionsfor quality and services which may be implemented by the management. Thus Quality Circle is not merely a suggestion system or a quality control group but extends beyond that because its activities are more comprehensive. Furthermore, it is not a taskforce because it can be made a permanent feature of the organization or a department.

Quality Circles (QC) or Quality Control Circles (QCC) : History

- Pioneered by Japanese.
- Japanese nomenclature: Quality Control Circles (QCC), generally now known as Quality Circles (QC) or some call it as Small Group Activity (SGA).
- 1962: First QC Circle was registered with QC Circle Head Quarters in Japan.
- 1974: Lockheed Company, USA started Quality Circle movement.
- 1977: International Association of Quality Circles (IACC) was formed in USA.
- 1980: BHEL, Hyderabad first in India to start Quality Circles.
- 1982: Quality Circle Forum of India (QCFI) was founded.

Facts

"Chorei" is a common morning meeting ritual in Japanese organizations. Each work day begins with a meeting where employees stand in a circle and share their day's work agenda or project status. Chorei is a cultural export in the expanding global economy. Practitioners of chorei believe this type of meeting technique can help improve communication resulting in better productivity.

There are various forms and styles of participative management. One of them which is widely applied and practised is ‘Quality circles’. The ‘quality circle’ concept first originated in USA which was very successfully applied in Japan afterwards. This technique boosted the Japanese firms to endeavour for high quality products at low costs.

Objectives of Quality Circle

The perception of Quality Circles today is 'Appropriateness for use1 and the tactic implemented is to avert imperfections in services rather than verification and elimination. Hence the attitudes of employees influence the quality. It encourages employee participation as well as promotes teamwork. Thus it motivates people to contribute towards organizational effectiveness through group processes. The following could be grouped as broad intentions of a Quality Circle:

To contribute towards the improvement and development of the organization or a department.

1. To overcome the barriers that may exist within the prevailing organizational structure so as to foster an open exchange of ideas.

2. To develop a positive attitude and feel a sense of involvement in the decision making processes of the services offered.
3. To respect humanity and to build a happy work place worthwhile to work.
4. To display human capabilities totally and in a long run to draw out the infinite possibilities.
5. To improve the quality of products and services.
6. To improve competence, which is one of the goals of all organizations.
7. To reduce cost and redundant efforts in the long run.
8. With improved efficiency, the lead time on convene of information and its subassemblies is reduced, resulting in an improvement in meeting customers due dates.
9. Customer satisfaction is the fundamental goal of any library. It will ultimately be achieved by Quality Circle and will also help to be competitive for a long time.

BENEFITS :

There are no monetary rewards in the QC's. However, there are many other gains, which largely benefit the individual and consecutively, benefit the business. These are: **Self-development:** QC's assist self-development of members by improving self-confidence,attitudinal change, and a sense of accomplishment.

- **Social development:** QC is a consultative and participative programme where every member cooperates with others. This interaction assists in developing harmony.

- **Opportunity to attain knowledge:**QC members have a chance for attaining new knowledge by sharing opinions, thoughts, and experience.

- **Potential Leader:** Every member gets a chance to build up his leadership potential, in view of the fact that any member can become a leader.

- **Enhanced communication skills:**The mutual problem solving and presentation before the management assists the members to develop their communication skills.

- **Job-satisfaction:** QC's promote creativity by tapping the undeveloped intellectual skills of the individual. Individuals in addition execute activities diverse from regular work, which enhances their self-confidence and gives them huge job satisfaction.

- **Healthy work environment:** QC's creates a tension-free atmosphere, which each individual likes, understands, and co-operates with others.

- **Organizational benefits:** The individual benefits create a synergistic effect, leading to cost effectiveness, reduction in waste, better quality, and higher productivity.

All these benefits are lasting in nature, which bring about progress over a period of time.

Pitfalls And Problems In Quality Circle

- Lack of faith in and support to Quality Circle activities among management personnel
- Lack of interest or incompetence of leaders/facilitator
- Apathy, fear and misunderstanding among middle level executives
- Delay or non-implementation of Circle recommendations
- Irregularity of Quality Circle activities
- Non-application of simple techniques for problem solving
- Lack of or non-participation by some members in the Circle activities
- Circles running out of problems
- Antagonism of non-members towards Quality Circle operations
- Inadequate visibility of management support
- Complexity of problems taken up
- Non-maintenance of Quality Circle records
- Too much facilitation or too little
- Language difficulty in communication
- Communication gap between Circles and departmental head
- Change of management
- Confusing Quality Circle for another technique
- Resistance from trade unions

4.6 TOTAL QUALITY MANAGEMENT

Total Quality Management is a management approach that originated in the 1950s and has steadily become more popular since the early 1980s. Total Quality is a description of the culture, attitude and organization of a company that strives to provide customers with products and services that satisfy their needs. The culture requires quality in all aspects of the company's operations, with processes being done right the first time and defects and waste eradicated from operations.

Total Quality Management, TQM, is a method by which management and employees canbecome involved in the continuous improvement of the production of goods and services. It is a combination of quality and management tools aimed at increasing business and reducing losses due to wasteful practices.

Some of the companies who have implemented TQM include Ford Motor Company, Phillips Semiconductor, SGL Carbon, Motorola and Toyota Motor Company.

TQM Defined

TQM is a management philosophy that seeks to integrate all organizational functions (marketing,finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives.

TQM views an organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers. The simple objective of TQM is "Do the right things, right the first time, everytime." TQM is infinitely variable and adaptable. Although originally applied to manufacturing operations, and for a number of years only used in that area, TQM is now becoming recognized as a generic management tool, just as applicable in service and public sector organizations. Thereare a number of evolutionary strands, with different sectors creating their own versions from the common ancestor. TQM is the foundation for activities, which include:

- Commitment by senior management and all employees
- Meeting customer requirements
- Reducing development cycle times
- Just in time/demand flow manufacturing
- Improvement teams
- Reducing product and service costs
- Systems to facilitate improvement
- Line management ownership
- Employee involvement and empowerment
- Recognition and celebration
- Challenging quantified goals and benchmarking
- Focus on processes / improvement plans
- Specific incorporation in strategic planning

This shows that TQM must be practiced in all activities, by all personnel, in manufacturing,marketing, engineering, R&D, sales, purchasing, HR, etc.

Principles of TQM

The key principles of TQM are as following:

Management Commitment

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

Employee Empowerment

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

Fact Based Decision Making

- SPC (statistical process control)
- DOE, FMEA
- The 7 statistical tools
- TOPS (Ford 8D – team-oriented problem solving)

Continuous Improvement

- Systematic measurement and focus on CONQ
- Excellence teams
- Cross-functional process management
- Attain, maintain, improve standards

Customer Focus

- Supplier partnership
- Service relationship with internal customers
- Never compromise quality
- Customer driven standards

The Concept of Continuous Improvement by TQM

TQM is mainly concerned with continuous improvement in all work, from high level strategic planning and decision-making, to detailed execution of work elements on the shop floor. It stemsfrom the belief that mistakes can be avoided and defects can be prevented. It leads to continuously improving results, in all aspects of work, as a result of continuously improving capabilities, people, processes, technology and machine capabilities.

Continuous improvement must deal not only with improving results, but more importantly with improving capabilities to produce better results in the future. The five major areas of focus for capability improvement are demand generation, supply generation, technology, operations and people capability.

A central principle of TQM is that mistakes may be made by people, but most of them arecaused, or at least permitted, by faulty systems and processes. This means that the root cause of such mistakes can be identified and eliminated, and repetition can be prevented by changing the process.[1]
There are three major mechanisms of prevention:

1. Preventing mistakes (defects) from occurring (mistake-proofing or poka-yoke).
2. Where mistakes can't be absolutely prevented, detecting them early to prevent them being passed down the value-added chain (inspection at source or by the next operation).
3. Where mistakes recur, stopping production until the process can be corrected, to prevent the production of more defects. (stop in time).

Advantages & Disadvantages of Total Quality Management

Some of the advantages of total quality management are: 1. Emphasizing the needs of the market
2. assures better quality performance in every sphere of activity 3. helps in checking non- productive activities and waste 4. helpful in meeting the competition 5. it helps in developing an adequate system of communication and 6. continuous review of progress.

1. Emphasizing the needs of the market:

TQM helps in highlighting the needs of the market. Its application is universal and helps the organisation 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 organization'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. It provides excellent opportunities for self development and increasing employee's interest in the job.

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

Every organisation 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 wasteand inefficiency of every king by introducing systematic approach. Such efforts are helpful in achieving cost-effectiveness and safety in the organisation.

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 organisations has become very vital issue. TQM helps in understanding the customers as well as the market. It provides an opportunity to the organisation to meet the competition by resorting to the techniques of TQM.

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 organisation. It results in misunderstanding, low- productivity, poor quality, duplication of efforts and low morale. TQM techniques bind together members of various related sections, departments and levels of management for effective communication andinteraction.

6. Continuous review of progress:

TQM helps to review the process needed to develop the strategy of never ending improvement. Quality improvement efforts have to be undertaken continuously to meet the dynamic challenges. From the above, it can be concluded that TQM results in both tangible and intangiblegains.

Tangible gains are in the form of better product quality, improvements in productivity, increased market share and profitability etc. Whereas intangible gains are, effective team work, enhancement of job interest, improvements in human relations, participative culture, customer satisfaction, improved communication and building better image of the company.

Total Quality Management is a system of continuous improvement that involves all workers in a business from upper management to production line workers. The focus of the improvement program is to improve customer service and reduce waste in the business. Quality improvement teams use problem-solving techniques and analysis to identify and eliminate weaknesses in the company.

Production Disruption

Implementing a Total Quality Management system in a company requires extensive training of employees. The employee training includes instruction in problem solving techniques and the tools to evaluate a process and identify weaknesses such as statistical process control, Pareto diagrams and brainstorming techniques. During the initial training period, productivity candecline. Meetings for quality improvement teams also take workers away from their duties,which also reduce productivity. While the improvements do reduce lead time, eliminate waste and improve productivity, the beginning stages of implementing Total Quality Management inan organization can reduce worker output.

Lowers Production Costs

A Total Quality Management program eliminates defects and waste, which reduces production costs in a business. As teams gather to identify and eliminate weaknesses in the business, the company continues to enjoy reduced costs and higher profit. Quality improvement teams can eliminate defects, reduce lead time and identify redundancies in the production process that can significantly add to the profit the company earns.

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. Total QualityManagement uses small incremental improvements to move the business forward. It can take years for a company to enjoy the benefits of the program.

Employee Participation

Once workers understand their participation and involvement in Total Quality Management is essential to its success, morale and productivity improve. Workers become empowered through participation on quality improvement teams. Businesses can improve morale further by recognizing improvement teams that make meaningful changes in the production process to reduce or eliminate waste.

DISADVANTAGES OF TQM

Some Total Quality Management detractors have noted that long-range plans advocated byTQM may limit an organization's flexibility and agility. TQM teaches that a long-term plan is required to achieve a complete quality transformation, but a long-term plan that has been

pursued for a long period may become an end unto itself. Completion of the plan becomes the ultimate goal.

Objectives the plan was designed to accomplish are forgotten; achieving the transformation becomes the most important objective. Instead of maintaining continuous change, the organization may reach a stable point and stagnate. To produce continuously high qualityservices, an organization must react quickly to changes in the community and not be restrictedby its management style.

TQM detractors also argue that although Total Quality Management calls for organizational change, it does not demand radical organizational reform. Real quality improvement requires radical structural change, such as flattening organizational structures. It requires liberation of employees from stifling control systems and the tyranny of functionalism, both of which stifle teamwork.
Total Quality Management calls for the elimination of the goals and objectives required by Management-by-Objectives. Critics of TQM claim that this may negatively affect motivation.

They claim that having established production goals gives employees increasingly higher goals to reach, which motivates them to find new ways to reach the goals. When there are noestablished production goals, some employees will only produce the minimum required to keep their job.
Some maintain that Total Quality Management delegates the determination of quality to quality experts rather than to "real" people.

TQM claims that quality is a complicated entity that is beyond the average employee to comprehend without specialized training in statistical techniques. It takes what is common senseto the ordinary worker and makes it sound complicated by changing the name and dressing it up with technical language.

Total Quality Management calls for the elimination of performance assessments that rate employees in relation to each other. Critics fear that without performance assessment managers would have too much power over employees and may be use it capriciously. Many managersfeel performance assessments let them document employee performance for possible reward,but some employees fear the assessments might be used against them in some disciplinary actions.

Performance assessments may give employees with grievances the documentation they need to prove managers are treating them unfairly. Without them, managers could make unfair accusations about an employee's performance and the employee would not have the documentation to counter the claims.

Conclusion

TQM encourages participation amongst shop floor workers and managers. There is no single theoretical formalization of total quality, but Deming, Juran and Ishikawa provide the core assumptions, as a "…discipline and philosophy of management which institutionalizes planned

and continuous… improvement … and assumes that quality is the outcome of all activities that take place within an organization; that all functions and all employees have to participate in the improvement process; that organizations need both quality systems and a quality culture."

4.7 JUST-IN-TIME (JIT)

JIT has different interpretations. For some, it is buying material on time, for some others, it means planning and controlling production on the shop floor, and for others it is a philosophy of production that permeates every facet of organizations. For our purpose, JIT is viewed as a technique of quality control. Just as JIT has different interpretations, it has varied names too. For some companies, IBM for examples, continuous flow manufacture; for some others, Hewlett Packard, for example, it is called stockless production and repetitive manufacturing system; GE calls it management by sight; and many Japanese firms use the term Toyota system instead of JIT.

- JIT helps achieve quality, because it is a philosophy that seeks to constantly improve production processes and methods. Specifically, JIT contributes to high product quality in the following ways:

- 1. Production is highly standardized. Workers perform standard tasks everyday. They are familiar with their tasks. Familiarity ensures high quality.

- 2. In-process inventories are drastically reduced by cutting lot-sizes. Any interruption, therefore, causes production to stop until the problem has been solved. In this way, JIT has been called a system of enforced problem solving. Now, this stoppage in production forces everybody to solve the quality problem, so that the defect will not repeat. Hence, high product quality is ensured.

- 3. Suppliers of materials, under the JIT system supply materials of perfect quality. Many companies do not even inspect suppliers deliveries of materials; rather, the emphasis is on working with suppliers to produce perfect parts and materials.

- 4. JIT system envisages the use of automated equipment and robots in production processes. Use of such sophisticated machines will ensure high product quality.

- 5. JIT system also envisages the use of intensive preventive maintenance programs in order to prevent any machine breakdown. This results in machines producing parts of perfect quality.

- 6. Workers are responsible for producing parts of perfect quality or with zero defects, before they are passed on to the next production operation.

Just-In-Time (JIT) Manufacturing is a philosophy rather than a technique. By eliminating all waste and seeking continuous improvement, it aims at creating manufacturing system that is response to the market needs. Just-in-time manufacturing was a concept introduced to the United States by the Ford motor company. It works on a demand-pull basis, contrary to hitherto used techniques, which worked on a production-push basis. To elaborate further, under just-in-time manufacturing (colloquially referred to as JIT production systems), actual orders dictate what should be manufactured, so that the exact quantity is produced at the exact time that is required. Just in Time (JIT) production is a manufacturing philosophy which eliminates waste associated with time, labour, and storage space. Basics of the concept are that the company produces only what is needed, when it is needed and in the quantity that is needed. The company produces only what the customer requests, to actual orders, not to forecast. JIT can also be defined as producing the necessary units, with the required quality, in the necessary quantities, at the last safe moment. It means that company can manage with their own resources and allocate them very easily.

HISTORY : Problems before JIT system were that companies cannot properly calculate their material flows. Also, there were problems with warehouses because there were situations that in one moment warehouses are full with stocks, and in other they are almost empty. Because of these problems it was really difficult for engineers and managers to deal with logistics. JIT, however, is not new. The technique was first used by the Ford Motor Company during 1920s, but the technique was subsequently adopted and publicized by Toyota Motor Corporation of Japan as part of its Toyota production System(TPS). In 1954 Japanese giant Toyota implemented this concept in order to reduce wasteful overstocking in car production.

Shiego Shingo, a Japanese JIT authority and engineer at the Toyota Motor Company identifies seven wastes as being the targets of continuous improvement in production process. By attending to these wastes, the improvement is achieved. Waste of over production eliminate by reducing set-up times, synchronizing quantities and timing between processes, layout problems. Make only what is needed now. Waste of waiting eliminate bottlenecks and balance uneven loads by flexible work force and equipment. Wastes of transportation establish layouts and locations to make handling and transport unnecessary if possible. Minimize transportation and handling if not possible to eliminate. Waste of processing itself question regarding the reasons for existence of the product and then why each process is necessary. Waste of stocks reducing all other wastes reduces stocks. Waste of motion study for economy and consistency. Economy

improves productivity and consistency improves quality. First improve the motions, then mechanize or automate otherwise. There is danger of automating the waste. Waste of making defective products develop the production process to prevent defects from being produced, so as to eliminate inspection. At each process, do not accept defects and makesno defects. Make the process fail-safe. A quantify process always yield quality product.

Wastes in Operation Just-in-time

(JIT) inventory systems are not just a simple method that a company has to buy in to; it has a whole philosophy that the company must follow. The ideas in this philosophy comefrom many different disciplines including; statistics, industrial engineering, production management and behavioural science. In the JIT inventory philosophy there are views with respect to how inventory is looked upon, what it says about the management within the company, and the main principle behind JIT. Firstly, inventory is seen as incurring costs instead of adding value, contrary to traditional thinking. Under the philosophy, businesses are encouraged to eliminate inventory that doesn't add value to the product. Secondly, it sees inventory as a sign of poor management as it is simply there to hide problems within the production system. These problems include backlogs at work centers, lack of flexibility for employees and equipment, and inadequate capacity among other things. In short, the just-in-time inventory system is all about having "the right material, at the right time, at the right place, and in the exact amount." Just-in-time manufacturing goes hand in hand with concepts such as Kanban, continuous improvement and total quality management (TQM). Just-in-time production requiresintricate planning in terms of procurement policies and the manufacturing process if its implementation.

ADVANTAGES JUST-IN-TIME SYSTEMS

Following are the advantages of Adopting Just-In-Time Manufacturing Systems

□ Just-in-time manufacturing keeps stock holding costs to a bare minimum. The release of storage space results in better utilization of space and thereby bears a favorable impact on the rent paid and on any insurance premiums that would otherwise need to be made.

□ Just-in-time manufacturing eliminates waste, as out-of-date or expired products; do not enter into this equation at all.

□ As under this technique, only essential stocks are obtained, less working capital is required to finance procurement. Here, a minimum re-order level is set, and only once that mark is reached, fresh stocks are ordered making this a boon to inventory management too.

□ Due to the aforementioned low level of stocks held, the organizations return on investment (referred to as ROI, in management parlance) would generally be high.

□ As just-in-time production works on a demand-pull basis, all goods made would be sold, and thus it incorporates changes in demand with surprising ease. This makes it especially appealing today, where the market demand is volatile and somewhat unpredictable.

□ Just-in-time manufacturing encourages the 'right first time' concept, so that inspection costs and cost of rework is minimized.

□ High quality products and greater efficiency can be derived from following a just-in-time production system.

□ Close relationships are fostered along the production chain under a just-in-time manufacturing system.

□ Constant communication with the customer results in high customer satisfaction.

Overproduction is eliminated when just-in-time manufacturing is adopted.

DISADVANTAGES

Following are the disadvantages of Adopting Just-In-Time Manufacturing Systems

□ Just-in-time manufacturing provides zero tolerance for mistakes, as it makes re-working very difficult in practice, as inventory is kept to a bare minimum.

□ There is a high reliance on suppliers, whose performance is generally outside the purview of the manufacturer.

□ Due to there being no buffers for delays, production downtime and line idling can occur which would bear a detrimental effect on finances and on the equilibrium of the production process.

□ The organization would not be able to meet an unexpected increase in orders due to the fact that there are no excess finish goods.

□ Transaction costs would be relatively high as frequent transactions would be made.

□ Just-in-time manufacturing may have certain detrimental effects on the environment due to the frequent deliveries that would result in increased use of transportation, whichin turn would consume more fossil fuels.

PRECAUTIONS

Following are the things to remember When Implementing a Just-In-Time Manufacturing System

□ Management buy-in and support at all levels of the organization are required; if a just-in-time manufacturing system is to be successfully adopted.

□ Adequate resources should be allocated, so as to obtain technologically advanced software that is generally required if a just-in-time system is to be a success.

□ Building a close, trusting relationship with reputed and time-tested suppliers will minimize unexpected delays in the receipt of inventory.

Questions

1. Explain the quality control techniques
2. Explain the different types of control charts
3. Explain acceptance sampling with its merits and demerits
4. Explain the concept of six sigma with its advantages and disadvantages.
5. What are quality circles? What are its advantages?
6. Explain TQM with its advantages and disadvantages.
7. Write short notes on JIT.

UNIT 5

5.1 Flexible manufacturing system

A flexible manufacturing system (FMS) is a manufacturing system in which there is some amount of flexibility that allows the system to react in case of changes, whether predicted or unpredicted. This flexibility is generally considered to fall into two categories, which bothcontain numerous subcategories.

The first category, machine flexibility, covers the system's ability to be changed to produce new product types, and ability to change the order of operations executed on a part. The second category is called routing flexibility, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability.

Most FMS consist of three main systems. The work machines which are often automated CNC machines are connected by a material handling system to optimize parts flow and the central control computer which controls material movements and machine flow.

The main advantages of an FMS is its high flexibility in managing manufacturing resources like time and effort in order to manufacture a new product. The best application of an FMS is foundin the production of small sets of products like those from a mass production.

A flexible manufacturing system is designed to react and adapt to changes within the production process, including any unexpected issues or problems. Since the 1970s, flexible manufacturing systems have helped companies to create products quickly and more efficiently.

Flexible manufacturing systems today still work to improve the production process and offer twotypes of flexibility. Machine flexibility refers to how much a system can change in order tocreate new product types. It also describes how a system can change the order of operations on a specific part.

The second category is routing flexibility. This is the ability of a system to use many machines toperform the same operations on one part. It also refers to how much a system can adapt changes in volume, capacity, or capability.

INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEM

“Manufacturing Industries are facing vigorous threats by inflation in market needs, corporate lifestyle and globalization. Hence, in current situation, Industries which are responding rapidly tomarket fluctuations with more competitiveness will have great capabilities in producing productswith high quality and low cost. In the view of manufacturers, production cost is not at all a significant factor which affects them. But, some of the factors which are important to themanufacturer are flexibility, quality, efficient delivery and customer satisfaction.” “Hence, with

the help of automation, robotics and other innovative concepts such as just-in-time (JIT), Production planning and control (PPC), enterprise resource planning (ERP) etc., manufacturers are very keen to attain these factors."

"Flexible manufacturing is a theory which permits production systems to perform under high modified production needs. The problems such as minimum inventories and market-response time to bump into customer needs, response to adjust as per the deviations in the market. In orderto sweep market by reducing the cost of products and services will be mandatory to various companies to shift over to flexible manufacturing systems. FMSs as a possible way to overcome the said issues while making reliable and good quality and cost effective yields. Flexible manufacturing system has advanced as a tool to bridge the gap between high mechanized line and CNC Machines with efficient mid volume production of a various part mix with low setup time, low workin-process, low inventory, short manufacturing lead time, high machine utilization and high quality .

FMS is especially attractive for medium and low-capacity industries such as automotive, aeronautical, steel and electronics." ""Flexible manufacturing system incorporates the following concepts and skills in an automated production system

1. Flexible automation 2. Group technology 3. Computer numerical control machine tools 4. Automated material handling between machines"

FMS Flexibility:

The three capabilities that a manufacturing system must process in order to the flexible

1. The ability to identify and distinguish among the different incoming part or product styles processed by the system.

2. Quick changeover of operating instructions.

3. Quick changeover of physical setup. Flexibility is an attribute that applies to both manual and automated systems. In manual systems the human workers are often the enables of the systems flexibility.

Types of flexibility;

The flexibility allows a mixed model manufacturing system to cope with level of variation in part or product style without interruptions in production for changeover between models. It is generally a desirable feature of a manufacturing system.

The feature of flexibility is broadly classified in to following ways

1. Machine flexibility

2. Part flexibility
3. Route flexibility
4. Volume flexibility
5. Man flexibility.

FMS technology is approaches to simultaneously manufacture different parts in theshortest time possible, with the highest quality and at the lowest costs possible. To do this a maximum of management of management information must be available for the FMS host to work with. When this is achieved there are several types of flexibility available; to an FMS user.

1. FMS user flexibility
2. FMS supplier flexibility.

1. FMS user flexibility

The first area is that in which the FMS user is interested. This most important area.
The available flexibilities are provided for the FMS user to be able to satisfy the demands oftheir customers.

2. FMS supplier flexibility.

The second type of flexibility concerns the method of applying FMSs.this is of extremeinterest to the FMS host supplier. Every FMS application's different, and no. of
FMS supplier can start from scratch to supply a FMS host solution every time for each new
FMS user. A supplier's solution need to be flexible enough to integrate the differentmachine types in to different FMS configurations and layouts for different product mixes.

Components of FMS systems;

- Workstations
- Material handling and storage
- Computer control system
- Human resources

1. Workstations

The first element in the FMS is work stations; it may,

- Load/unload stations
- Machining stations

- Other processing stations
- Assembly

2. Material handling and storage systems

For the below mentioned functions are the material handling device

- Random, independent movement of workparts between stations.
- Handle a variety of workpart configurations.
- Temporary storage.
- Convenient access for loading and unloading workpartcontrol.s.
- Compatible with computer

The material handling is classified in ot two types they are,

- Primary material handling
- Secondary material handling

The material handling function in a FMS is often shared between two systems:

1. **Primary handling system** - establishes the basic layout of the FMS and is responsible for moving work parts between stations in the system.

2. **Secondary handling system** - consists of transfer devices, automatic pallet changers, and similar mechanisms located at the workstations in the FMS.

3. Computer control system

- Workstation control
- Distribution of control instructions to workstations
- Production control
- Traffic control
- Shuttle control
- Work piece monitoring
- Tool control
- Performance monitoring and reporting
- Diagnostics

4. Human resources

For loading and unloading the materials in the machines and for the maintenanceworks the human resource are required in the flexible manufacturing system.

TYPES OF FMS

"Flexible manufacturing systems can be separated into various types subject to their natures:"

1. DEPENDING UPON KINDS OF OPERATION "Flexible manufacturing system can be illustrious subject to the kinds of operation performed:"

a. "Processing operation. It performs some activities on a given job. Such activities convert the job from one shape to another continuous up to the final product. It enhances significance by 43 altering the geometry, features or appearance of the initial materials."

b. "Assembly operation. It comprises an assembly of two or more parts to make a newcomponent which is called an assembly/subassembly. The subassemblies which are joined permanently use processes like welding, brazing, soldering , adhesive bonding, rivets, press fitting.

2. BASED ON NUMBER OF MACHINES "There are typical varieties of FMS based on the number of machines in the system:"

a. "Single machine cell (SMC). It consists of completely automated machines which arecapable of performing unattended operations within a time period lengthier than one complete machine cycle. It is skilful of dispensing various part mix, reacting to fluctuations in manufactureplan, and inviting introduction of a part as a new entry. It is a sequence dependent production system."

b. "Flexible manufacturing cell (FMC). It entails two or three dispensing workstations and a material handling system. The material handling system is linked to a load/unload station. It is a simultaneous production system."

c. An Flexible Manufacturing System (FMS). "It has four or more processing work stations (typically CNC machining centers or turning centers) connected mechanically by a common part handling system and automatically by a distributed computer system. It also includes non-processing work stations that support production but do not directly participate in it e.g., part / pallet washing stations, co-ordinate measuring machines.

These features significantly differentiate it from Flexible manufacturing cell (FMC)." Number ofmachines(M) Annual Production(Z), Flexibility (F), cost incurred(C) Flexible manufacturing System
Flexible manufacturing cell Single machine cell Fig. 3.1:Comparison

for three categories of FMS

In this research, authors focused on Flexible manufacturing system

3. BASED ON LEVEL OF FLEXIBILITY "FMS is further classified based on the level of flexibility related to the manufacturing system. Two categories are depicted here:"

a. Dedicated FMS. "It is made to produce a certain variety of part styles. The product design is considered fixed. So, the system can be designed with a certain amount of process specialization to make the operation more efficient."

b. Random order FMS. "It is able to handle the substantial variations in part configurations. To accommodate these variations, a random order FMS must be more flexible than the dedicated FMS. A random order FMS is capable of processing parts that have a higher degree of complexity. Thus, to deal with these kinds of complexity, sophisticated computer control system is used for this FMS type."

ELEMENTS OF FLEXIBLE MANUFACTURING SYSTEM

"A flexible manufacturing system consists of two subsystems:"

 Physical subsystem Control subsystem

Physical subsystem includes the following elements:

1. Workstations. "It consists of NC machines, machine-tools, inspection equipments, loading and unloading operation, and machining area. More recent Flexible manufacturing system,however, include other types of processing equipment also."

2. Storage-retrieval systems. "It acts as a buffer during WIP (workin-processes) and holdsdevices such as carousels used to store parts temporarily between work stations or operations."

3. Material handling systems. It consists of power vehicles, various types of automated material handling equipment such as conveyors , automated guided vehicles, in floor carts and robots are used to transport the work parts and sub-assemblies to the processing or workstation.

HARDWARE COMPONENTS OF FLEXIBLE MANUFACTURING SYSTEM

1. Pallets and fixtures 2. Machining centers 3. Robots 4. Inspection equipment 5. Chip removal system 6. In process storage facility 7. Material handling systems

LAYOUT CONFIGURATIONS OF FLEXIBLE MANUFACTURING SYSTEM

"Flexible manufacturing system brings rewards in actual manufacture of products as the processis designed for several products to be run on different machines within a manufacturing facility

which allows for greater growth and stability with more diversity in the output. A Flexible manufacturing system is designed to provide an effective operation sequence to fulfill theproduction requirements and reasonably allocate the resources

The objectives of the system are to shorten the throughput time and reduce the resource requirements which include avoiding deadlock in material flow, decreasing in process inventory ,balancing the workload of all machines and make good use of the bottleneck devices "

1 Line layout - "An Automated guided vehicle is most efficient when the movement is in straight-lines along the AGV path in a single-row machine layout. Machines are arranged onlyon one side of AGV path , and in double row machine layout, machines are arranged on both sides.

2 Loop layout -"The loop layout uses conveyor systems that allow unidirectional flow of parts around the loop. A secondary material handling system is provided at a workstation which permits the flow of parts without any obstruction.

3 Ladder type layout- "Ladder type layout consists of rungs on which workstations are located. This reduces the average travel distance thereby reducing the transfer time between workstations.

4 Carousel layout -"In the Carousel layout configuration, parts flow in one direction around the loop. The load, unload stations are placed at one end of loop,

5 Robot centered cell- "If a handling robot is used in a Flexible manufacturing system cell , the machines are laid out in a circle, such a layout is called circular layout.

6 The open field layout - "The open field layout is also an adoption of the loop configuration. The open field layout consists of loops and ladders organized to achieve the desired processing requirements. This is used for the processing of a large family of parts. The number of different machines may be limited, and the parts are routed to different workstations depending on availability of machines.

Benefits of FMS

Flexible manufacturing system benefits are listed as follows:

□ Reduction of inventories throughout the complete chain of manufacturing including work-in-progress
□ Reduction of lead time by 40%
□ Improved machine utilization by 30%
□ Reduction of labour times by 30%
□ Reduction of direct and indirect labour costs
□ Increased management control over the entire manufacturing process
□ Substantially reduced scrap levels.
□ The ability to adapt quickly to new work pieces

5.2 POKA YOKE

Poka Yoke or Mistake Proofing

Poka-yoke (poh-kah yoh-keh) was coined in Japan during the 1960s by Shigeo Shingo who was one of the industrial engineers at Toyota. Shigeo Shingo is also credited with creating and formalizing Zero Quality Control (poka-yoke techniques to correct possible defects + source inspection to prevent defects equals zero quality control).
The initial term was baka-yoke, which means 'fool-proofing'. In 1963, a worker at Arakawa Body Company refused to use baka-yoke mechanisms in her work area, because of the term's dishonorable and offensive connotation. Hence, the term was changed to poka-yoke, which means 'mistake-proofing' or more literally avoiding (yokeru) inadvertent errors (poka). Ideally, poka-yokes ensure that proper conditions exist before actually executing a process step, preventing defects from occurring in the first place. Where this is not possible, poka-yokes perform a detective function, eliminating defects in the process as early as possible.

Characteristics of PokaYoke devices

□ 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 A detection device cannot provide a complete error proof solution Necessary and not a sufficient solution

Why is it important?

Poka-yoke helps people and processes work right the first time. Poka-yoke refers to techniques that make it impossible to make mistakes. These techniques can drive defects out of products andprocesses and substantially improve quality and reliability. It can be thought of as an extensionof FMEA. It can also be used to fine tune improvements and process designs from six-sigma Define - Measure - Analyze - Improve - Control (DMAIC) projects. The use of simple poka- yoke ideas and methods in product and process design can eliminate both human and mechanicalerrors. Poka-yoke does not need to be costly. For instance, Toyota has an average of 12 mistake- proofing devices at each workstation and a goal of implementing each mistake-proofing device for under $150.

When to use it?

Poka-yoke can be used wherever something can go wrong or an error can be made. It is a technique, a tool that can be applied to any type of process be it in manufacturing or the service industry. Errors are many types -

1 Processing error-Process operation missed or not performed per the standard operating procedure.
2 Setup error -Using the wrong tooling or setting machine adjustments incorrectly.
3 Missing part -Not all parts included in the assembly, welding, or other processes.
4 Improper part/item Wrong part used in the process.

5 Operations error -Carrying out an operation incorrectly; having the incorrect version of the specification.
6 Measurement error-Errors in machine adjustment, test measurement or dimensions of a part coming in from a supplier.

How to use it?

Step by step process in applying poka-yoke:

1 Identify the operation or process - based on a pareto.
2 Analyze the 5-whys and understand the ways a process can fail.
3 Decide the right poka-yoke approach, such as using a shut out type (preventing an error being made), or an attention type (highlighting that an error has been made) poka-yoke take a more comprehensive approach instead of merely thinking of poka-yokes as limit switches, or automatic shutoffs a poka-yoke can be electrical, mechanical, procedural, visual, human or any other form that prevents incorrect execution of a process step .
4 Determine whether a contact - use of shape, size or other physical attributes for detection, constant number - error triggered if a certain number of actions are not made sequence method – use of a checklist to ensure completing all process steps is appropriate
5 Trial the method and see if it works
6 Train the operator, review performance and measure success.

Benefits of Poka Yoke implementation

A typical feature of Poka Yoke solutions is that they don't let an error in a process happen. But that is just one of their advantages. Others include:

- Less time spent on training workers;
- Elimination of many operations related to quality control;
- Unburdening of operators from repetitive operations;
- Promotion of the work improvement-oriented approach and actions;
- A reduced number of rejects;
- Immediate action when a problem occurs;
- 100% built-in quality control.

Poka yoke, or mistake proofing, describes any behavior changing constraint that is built into a process to prevent an incorrect operation or act occurring. The three aims of mistake proofing are:
To reduce the risk of mistakes or errors arising.
To minimize the effort required to perform activities.
To detect errors prior to them impacting on people, materials, or equipment.
Ideally, poka-yoke ensures that proper conditions exist before actually executing a process step, preventing defects from occurring in the first place. Where this is not possible, poka-yokeperforms a detective function, eliminating defects in the process as early as possible.

PRINCIPLES OF POKA YOKE

This can be achieved by following the 6 principles or methods of mistake proofing. These are listed in order of priority in fundamentally addressing mistakes:

1. Elimination seeks to eliminate an error-prone process step by redesigning the product or process so that the task or part is no longer necessary. This may require redesigning a new process or product simplification or part consolidation that avoids a part defect or assembly error in the first place.

Example: An example of elimination is the use of ambient-light sensors to turn outside lighting on and off.

2. Prevention modifies the product or process so that it is impossible to make a mistake or that a mistake becomes a defect. This includes Limit switches to assure that a part is correctly placed or fixtured before process is performed; part features that only allow assembly the correct way, unique connectors to avoid misconnecting wire harnesses or cables, part symmetry that avoids incorrect insertion.

Example: An example would be a camera that will not function when there is not enough light totake a picture. Also some clothes dryers shut down when they detect an overheating situation.

3. Replacement substitutes a more reliable process to improve repeatability. This includes use of robotics or automation that prevents a manual assembly error.

Example: An example would be the implementation of an automatic dispenser to insure the correct amount of adhesive is applied during an assembly process or the coin dispenser in food stores preventing that customers are getting short changed.

4. Facilitation is the most used principle and employs techniques and combining steps to make a process step easier to perform or less error-prone. This includes visual controls including color coding, marking or labeling parts to facilitate correct assembly; checklists that list all tasks that need to be performed; exaggerated asymmetry to facilitate correct orientation of parts.

Example: An example would be to color code parts that are similar in shape. This would make it easier to identify the correct part for assembly. Another example would be the use of a slipping- type torque wrench to prevent over tightening. When gas stations introduced unleaded gasoline, the nozzle on the leaded pump was designed to be too big to fit into an unleaded tank, thereby preventing mistakes. Electrical outlets have been mistake proofed to assure proper polarity. It is impossible to put a plug in an outlet incorrectly.

5. Detection involves identifying a mistake before further processing occurs so that the operator can quickly correct the defect. This includes sensors in the production process to identify when parts are incorrectly assembled; scales to measure and control the weight of a package; built-in self-test capabilities in products.

Example: Examples would include a weld counter to ensure the correct number of welds or a software modification that will not allow incorrect entries. Also warning device, using sound andlight, like the seat belt buzzers, can be used to predict when something is about to go wrong.

6. Mitigation seeks to minimize the effects or the mistake. This includes mechanisms that reduce the impact of a error and defect; products designed with low-cost, simple rework procedures when an error is discovered; extra design margin or redundancy in products to compensate forthe effects of errors.

Example: An example would be a smoke or heat detector detecting a hazardous situation. Also fuses to prevent overloading circuits resulting from shorts are mitigation techniques.

Ideally, mistake-proofing should be considered during the development of a new product to maximize opportunities to mistake-proof through design of the product and the process (elimination, replacement, prevention and facilitation). Once the product is designed and the process is selected, mistake proofing opportunities are more limited (prevention, facilitation, detection and mitigation).

Eradicating human errors is crucial to any business. Errors cost money and impact customer satisfaction. By introducing simple measures to trap and stop errors organizations can not only save costs but also become more efficient.

5.3 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 CEOto field staff) to ensure improvement of all processes and systems of a particular organization**. Work for a Japanese company and you would soon realize how much importance they give to the process of Kaizen. The process of Kaizen helps Japanese companies to outshine all other competitors by adhering to certain set policies and rules to eliminate defects and ensure long term superior quality and eventually customer satisfaction.

Kaizen works on the following basic principle.

"*Change is for good*".

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.

Kaizen process aims at continuous improvement of processes not only in manufacturing sector but all other departments as well. Implementing Kaizen tools is not the responsibility of a single individual but involves every member who is directly associated with the organization. Every individual, irrespective of his/her designation or level in the hierarchy needs to contribute by incorporating small improvements and changes in the system.

Elements of Kaizen

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

- For any **Kaizen system** to be successful, whether for business or personal purposes, there are five elements that must be considered.

  The first element is teamwork. In the corporate or business set up, there is a need for all employees to work as a team towards the common goal of achieving the desired improvement on production. All participants must work their best for the good of their colleagues and the company. Teamwork involves sharing chores, training, timely delivery among many others.

- The second element that significantly contributes to the success of the Kaizen system is personal disciple. Discipline is paramount to all types of success. The employee should have self-discipline in time management, quality assurance, material management, finances and loyalty to the company and its public. Any back fall in personal discipline will definitely affect the productivity of the employee, not to mention the negative impact it has on the other employees' efforts.

- No matter how hard the situation might be during a specific time, the employer and employees must strive to keep morale up. The employer, or the senior management, should put in place motivational strategies in their **Kaizen concept** such as good working conditions, merit promotions, better remuneration, and worker benefits such as paid leaves, allowances, medical care, bonuses, and loans among many others. All these give employees the security of employment as well as a sense of belonging.

- Giving employees the opportunity to interact with other quality circles is very vital to the success of the Kaizen system. Employees will have opportunities to share ideas, skills, technology and other relevant resources. The exchange encourages them to gauge their performance based on other companies Kaizen programs and thus try to improve.

- The last element of the Kaizen system is the provision for the opportunity to air suggestions freely no matter the worker's rank. No matter how absurd the suggestions may be, they should be welcomed, appreciated and considered at all times.

Five S of Kaizen

"Five S" of Kaizen is a systematic approach which leads to foolproof systems, standard policies, rules and regulations to give rise to a healthy work culture at the organization. You would hardly find an individual representing a Japanese company unhappy or dissatisfied. Japanese employeesnever speak ill about their organization. Yes, the process of Kaizen plays an important role in employee satisfaction and customer satisfaction through small continuous changes and eliminating defects. Kaizen tools give rise to a well organized workplace which results in better productivity and yield better results. It also leads to employees who strongly feel attachedtowards the organization.

Let us understand the five S in Detail:

1. **SEIRI -** SEIRI stands for Sort Out. According to Seiri, employees should sort out and organize things well. Label the items as "Necessary", "Critical", "Most Important", "Not needed now", "Useless and so on. Throw what all is useless. Keep aside what all is not needed at the moment. Items which are critical and most important should be kept at a safe place.
2. **SEITION -** Seition means to Organize. Research says that employees waste half of their precious time searching for items and important documents. Every item should have its own space and must be kept at its place only.
3. **SEISO -** The word "SEISO" means shine the workplace. The workplace ought to be kept clean. De-clutter your workstation. Necessary documents should be kept in proper folders and files. Use cabinets and drawers to store your items.
4. **SEIKETSU-SEIKETSU** refers to Standardization. Every organization needs to have certain standard rules and set policies to ensure superior quality.
5. **SHITSUKE or Self Discipline -** Employees need to respect organization's policies and adhere to rules and regulations. Self discipline is essential. Do not attend office incasuals. Follow work procedures and do not forget to carry your identity cards to work. Itgives you a sense of pride and respect for the organization.

Kaizen focuses on continuous small improvements and thus gives immediate results.

In his book "Out of the Crisis," Dr. Deming shared his philosophy of continuous improvement:

1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business and to provide jobs.
2. Adopt the new philosophy.
3. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.

4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost.
5. Improve constantly and forever the system of production and service to improve quality and productivity and thus constantly decrease costs.
6. Institute training on the job.
7. Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job.
8. Drive out fear so that everyone may work effectively for the company.
9. Break down barriers between departments. People in research, design, sales and production must work as a team to foresee problems of production and use of the productor service.
10. Eliminate asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.
11. Remove barriers that rob the hourly worker of his right to pride of workmanship.
12. Remove barriers that rob people in management and in engineering of their right to pride of workmanship.
13. Institute a vigorous program of education and self-improvement.
14. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

Kaizen Process Steps

In order to properly implement Kaizen principals for process improvement, there are ten stepstowards reaching successful implementation of Kaizen:

1. **Get rid of any fixed ideas you may have based upon conventions**. Just because you've always done something a particular way, doesn't mean that it's the best way to complete that task. Instead, allow yourself to scrap conventions in exchange for potentials for growth.
2. **Think about the "hows," not the "whys."** Let me explain this. Perhaps you're looking for a way to cut costs on materials while engaging in the green movement. Many people would point out "why" this is not possible. If, instead of looking at why something cannot be done, you look at how it can be done, you focus upon action. Focus upon solutions to problems, not on the problems themselves.
3. **No excuses are allowed.** It is so easy to get to the point where you've found a place where improvement can occur, and you've even determined how to enforce the improvement and just stop. Why do companies stop at this point? They begin focusing on the negative, pessimistic view again - they make excuses. "I can't do x, because x is too hard." Scrap this line of thinking and take action!

4. **Perfection seeking does not lead to progress.** Just the word "perfect" can stop most people in their tracks. Do not wait until you have determined the "perfect" course of action. Scientists don't wait until they've created the "perfect" experiment (and those who do don't find employment for too long). Determine a course of action and follow it until you need to adjust it.
5. **When mistakes occur, don't wait to correct them!** If a tailor waited until the whole dress was complete before ripping out an uneven seam, he would create more work for himself. Correct mistakes as they occur. Make continuous adjustments throughout the process of implementing improvements.
6. **Practice the art of continuous monitoring and review.** Don't wind up in Argentina when you're trying to get to Vancouver. Make sure that you monitor the progress of the improvements being implemented and review whether the implementations are truly improvements.
7. **Practice the five why approach to determining root causes.** When faced with a problem or a mistake, ask the question, "Why" to go deeper into the problem.
8. **Implement the 3G approach for decision making.** The 3G approach involves *Gemba* (place or location), *Genbutsu* (the product), and *Genjitsu* (the problem being specifically looked at). By viewing the problem, in a given space, related to the product, it helps you to bespecific about the changes you wish to implement.

9. **Improvements need to occur on a daily basis.** Every day, in a Kaizen workplace, a new improvement should be put forth.
10. **Look to the group rather than the individual.** While an individual may be extremely gifted at what she does, groups tend to put forth synergy - the conglomeration of new ideas and new thinking. By focusing upon collaboration, new ideas can spring forth.

THE KAIZEN IMPLEMENTATION PHASES

From planning phase to follow-up: all the implementation phases of Kaizen methodology

Phase 1: Planning and Preparation

The first challenge is to identify an appropriate target area for a rapid improvement event.
Such areas might include: areas with substantial work-in-progress; an administrative process or production area where significant bottlenecks or delays occur; areas where everything is a"mess" and/or quality or performance does not meet customer expectations; and/or areas that have significant market or financial impact (i.e., the most "value added" activities).
Once a suitable production process, administrative process, or area in a factory is selected, a more specific "waste elimination" problem within that area is chosen for the focus of the kaizen event (i.e., the specific problem that needs improvement, such as lead time reduction, quality improvement, or production yield improvement). Once the problem area is chosen, managers typically assemble a cross-functional team of employees

Phase 2: Implementation

The team first works to develop a clear understanding of the "current state" of the targeted process so that all team members have a similar understanding of the problem they are workingto solve.

During the kaizen event, it is typically necessary to collect information on the targeted process, such as measurements of overall product quality; scrap rate and source of scrap; a routing of products; total product distance traveled; total square feet occupied by necessary equipment; number and frequency of changeovers; source of bottlenecks; amount of work-in-progress; and amount of staffing for specific tasks. Team members are assigned specific roles for research and analysis. As more information is gathered, team members add detail to value stream maps of the process and conduct time studies of relevant operations (e.g., takt time, lead-time).

Once data is gathered, it is analyzed and assessed to find areas for improvement. Team members identify and record all observed waste, by asking what the goal of the process is and whethereach step or element adds value towards meeting this goal. Once waste, or non-value added activity, is identified and measured, team members then brainstorm improvement options. Ideas are often tested on the shopfloor or in process "mock-ups". Ideas deemed most promising are selected and implemented. To fully realize the benefits of the kaizen event, team membersshould observe and record new cycle times, and calculate overall savings from eliminated waste, operator motion, part conveyance, square footage utilized, and throughput time

Phase 3: Follow-up

The success of the Kaizen depends on timely completion of the Improvement process andeffective change management. A key part of a kaizen event is the follow-up activity that aims to ensure that improvements are sustained, and not just temporary.

Following the kaizen event, team members routinely track key performance measures (i.e., metrics) to document the improvement gains. Metrics often include lead and cycle times, processdefect rates, movement required, square footage utilized, although the metrics vary when the targeted process is an administrative process. Follow-up events are sometimes scheduled at 30 and 90-days following the initial kaizen event to assess performance and identify follow-up modifications that may be necessary to sustain the improvements.

Questions:

1. Explain the different types of flexibility.
2. Explain the Components of FMS systems
3. Explain the different types of FMS.
4. Explain the Benefits of FMS.
5. Bring out the benefits and process in applying poka-yoke.
6. Explain the principles of poka yoke..
7. Define Kaizen and state the elements of Kaizen
8. Explain the five S of Kaizen
9. Explain the steps in Kaizen Process.
10. Explain the phases of kaizen implementati