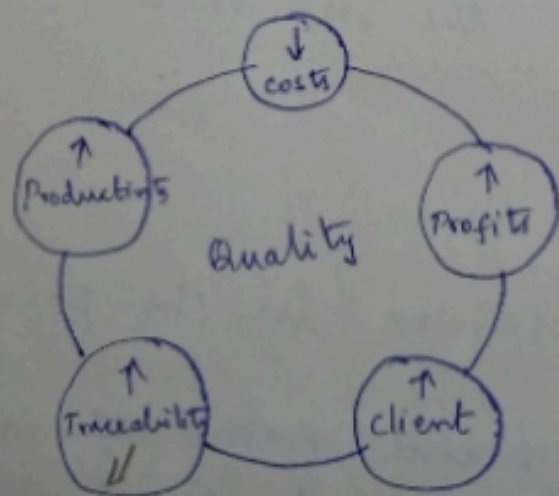


Basic Concepts of QualityIntroduction

- * Quality is one of the most important in all sectors and plays an important role in business
- * To achieve or survive in the world the quality of a product or process are to be improved continuously depending upon the market.
- * Quality is an important requirement since the customer expects long life, good performance, low cost and good services of the product
- * As markets have become much more competitive the quality has become a key ingredient for success in today's life.
- * Management looks to achieve customer satisfaction by running the business at desired economy.
- * These can be obtained by proper quality development, maintenance and improvement of product.



Meaning of Quality

- * Quality is a relative term, generally used with reference to end use of the product.
- * Quality means productivity, competitive cost, timely delivery and total consumer satisfaction.
- * Quality depends on perception of person in a given situation.
 - Right time
 - Right cost
 - Right place
 - Right thing

Quality product must meet the following requirements

- * Quality raw materials should be used
- * Quality parts should be used
- * process assembly should be good.
- * should have high reliability
- * should conform the standards
- * Quality services.

Need for Quality

- * To achieve and survive in the present competitive world
- * To increase the brand name of industry to get new orders from customer

- * To achieve customer satisfaction
- * To increase productivity and no. of customers
- * To improve profit turn overs
- * To increase the performance of the product, reliability durability etc.
- * To retain the customers
- * To increase the recognition
- * To earn profit.

Evolution of Quality

Historical Review of Quality Management

- 1990s - The scientific approach to management resulting in rationalisation of work & its breakdown leads to greater need for standardisation, inspection and supervision
- 1930s - Statistical beginnings and study of quality control, studies of R.A Fisher on experimental design & beginning of control charts at western electric in U.S.A.
- ^① Concept of specialisation of labor was introduced during Industrial revolution
- As most products manufactured during early periods were not complicated, quality was not greatly affected.

- As products became more complicated & jobs more specialized, it is necessary to inspect products after manufacture
- In 1924 W.A Shewart of Bell Telephone Laboratories developed a statistical chart for control of product variables. It is the beginning of statistical quality control.
- In 1946, American Society for Quality Control was formed. This organisation, through publication conferences, & training sessions promoted the use of quality for all types of production & service.
- In 1950, W. Edward Deming gave lectures to Japanese on statistical methods and quality responsibility to CEO of largest organisation of Japan. The Japanese set the quality standards for rest of the world to follow.
- In 1960, the first quality control circles were formed for purpose of quality improvement.
- By middle of 1980 the concept of TQM was publicized

- In late 1980 automotive industry began to emphasize statistical process control (SPC)
- Department of Defense also implemented SPC.
- The Malcolm Baldrige National Quality Award was established & became means to measure TQM
- Genichi Taguchi introduced design of experiment (DOE) as valuable quality improvement tool.
- In 1996 ISO 9000 became worldwide model for quality management system
- ISO 14000 was approved as world wide model for environmental management system.

Definition of Quality

Quality is the ability of a part/component to perform satisfactorily as intended by end user. Satisfaction represents some specification or requirements

Dimension of Quality

Quality has nine different dimension

Performance

Primary operating characteristic of a product, such as signal coverage, audio quality, display

quality

Features:

Secondary characteristics, added features, calculators, and alarm clock features

Conformance

Meeting specification or the degree to which a product's design or operating characteristics match pre established standards

Reliability

The probability of product falls within a specified period of time

Durability

It is a measure of product's life having both economic and technical dimensions

Service

Resolution of problem and complaints, ease of repair

Response

Human to human interface

Reputation

Past performance and other intangibles, such as being ranked first

Basic concepts of TQM ⁽⁴⁾

1. Top management commitment

- Top management should participate & involve in total quality programme.
- They should ensure their complete commitment through management meetings, company magazines or newsletters
- Everyone in the organization from top to bottom should be communicated about TQM programme.

2. Focus on Customer

- Customer satisfaction is the heart of TQM
- It is the key for any TQM programme

3. Effective involvement and utilization of entire workforce

- TQM is a team work
- It is also referred as 'principle of employees involvement' or 'respect for people'.
- It recognises that each person is responsible for quality of his work & group
- All persons must be trained in TQM, statistical process control (SPC) and quality improvement skills.

4. Continuous improvement

- TQM is based on quest for progress and improvement
- TQM is a better way of doing things and use the resources to be more productive

5. Treating suppliers as partners

6. Establishing performance measures for the processes

→ Quantitative data are necessary for continuous quality improvement

→ Performance measures such as productivity, sales turnover, customer satisfaction are determined for each functional area

→ These results are used for further improvement

TQM Framework

The important elements of TQM

1. The philosophical element

→ customer driven quality

→ Leadership

→ Continuous improvement

→ Employee participation and development

→ Quick response

→ Design quality and prevention

→ Management by fact

→ partnership development

→ Quality management system

→ Environmental management system

2. The generic tools

→ SPC tools

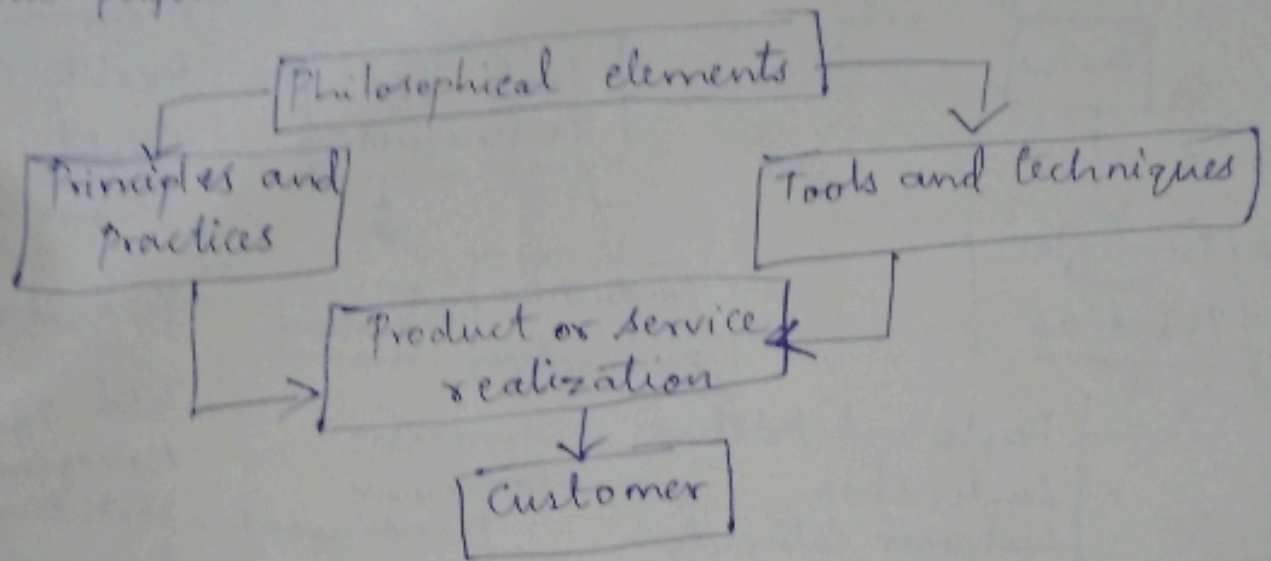
→ Quality function

→ New seven management tools

→ Failure mode and effect analysis

Tools of QC department

- SQC methods
- Bench marking
- Total performance maintenance



Contribution of Deming

- Dr. W. Edward Deming is the founder of worldwide quality management system
- According to Deming quality means "continuous improvement in never ending cycle of events"

Deming's Philosophy was summarised by

- when people and organisation focus primarily on quality

$$\text{Quality} = \frac{\text{Work effort Result}}{\text{Total cost}}$$

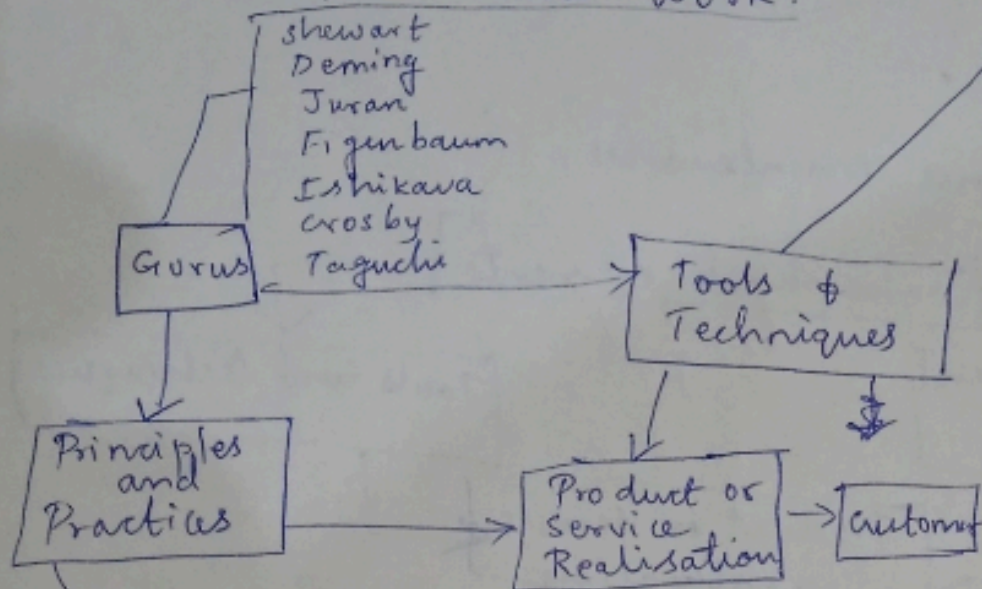
Quality tends to increase and cost fall over time

- when people and organisation focus primarily on cost, cost tend to rise and quality declines

Deming's 14 Principles are

1. Establish and publish the objectives and purpose

TQM Framework



People and Relation
 Leadership
 Customer Satisfaction
 Employee involvement
 Supplier partnership. Performance measures

Approach:
 Continuous Process improvement

- Benchmarking
- Information Technology
- Quality Management Systems
- Environmental management
- Quality Function Deployment
- Quality By Design
- Failure mode & Effect Analysis
- Product & Service Liability
- Total Product Maintenance
- Management Tools
- Statistical Process Control
- Experimental Design
- Taguchi's Quality Engineering

1) The Philosophical elements

- customer driven quality
- Leadership
- continuous improvement

Quality Improvement Guidelines

Inspection

- 1) Technology adoption
- 2) Data organisation
- 3) user needs
- 4) service & products

Quality Control

- Strategic plans
- organisation mandates
- land dispute
- land Admin
- workflow for LA
- HR development

Quality assurance

- Tenure security
- land policy
- legal framework
- finance & data cost

2) Learn and adopt new philosophy⁽⁶⁾
Management and employees learn new technologies for the success of management taking customer satisfaction & adopt new philosophy

3) Understand the purpose of inspection
To improve process and reduce the failure cost, management must understand the inspection

4) End the practice of awarding business on price alone

Management must stop awarding the business on the basis of price tag and their goal is to achieve quality

5) Improve constantly and forever the system
Find and correct problems to improve quality

6) Institute training

Train the employees to operate, to learn the system to handle the internal, external customers

7) Institute leadership

Teach and give training to supervisors to improve quality. Proper communication must be there between management & operators

8) Drive out fear

Management treats the employee dignity. employee drives out fear to communicate & insists right point

9) Eliminate exhortation for workforce

Urging the workers under pressure don't produce healthy product or service

10) Optimize the efforts of teams, groups

The people in all departments work as a team with single motive to achieve goal

11) Eliminate numerical quotas and management by objectives

Quotas replaced with statistical method of process. Management learn the process

12) Remove barriers to pride of workmanship

Management gives empowerment to the workers, so as the workers are proud of their work

13) Institute education

Management induces vigorous programme of education and self improvement of workers

14) Take action to accomplish the transformation

Management commit, convey & convince the goal of organisation

Contribution of Juran

- Juran wrote about cost of poor quality
- Juran trilogy, approach to cross functional management

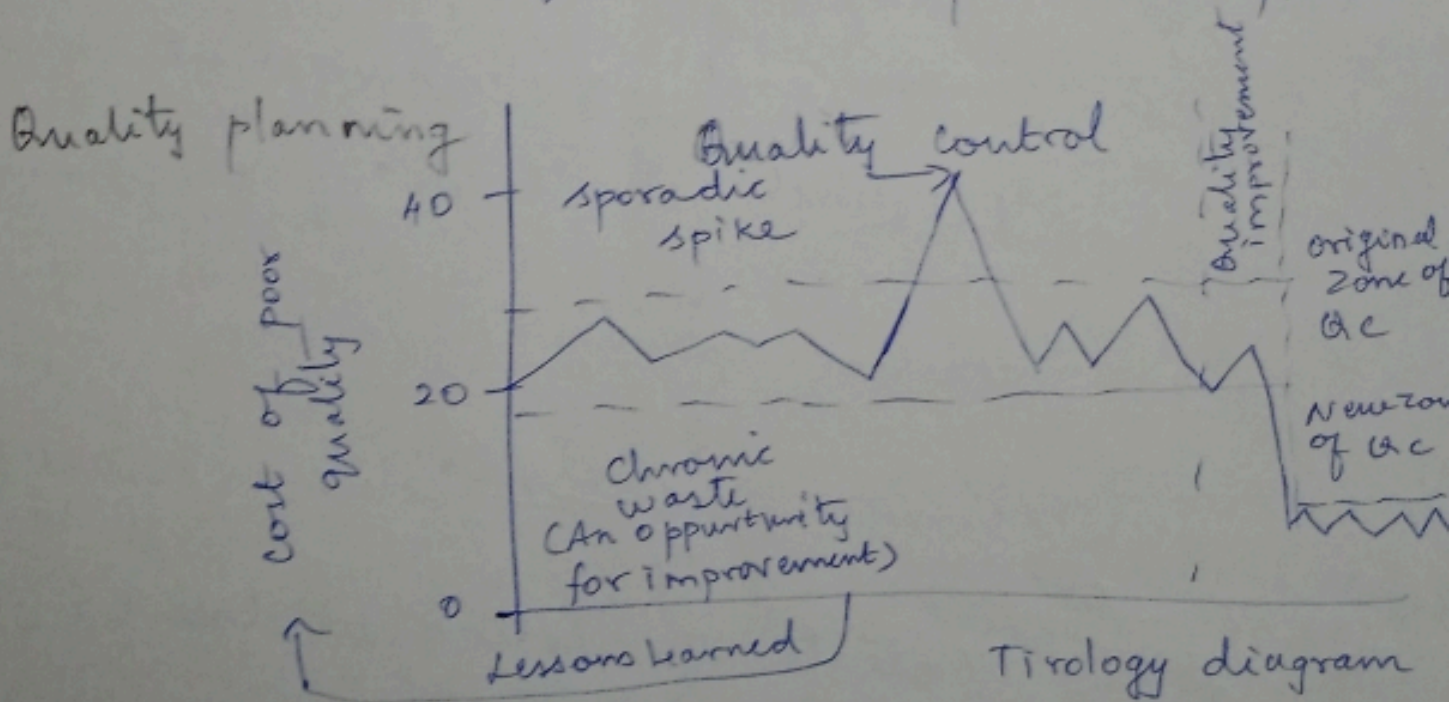
Three phases of Trilogy are

- Quality planning (QP)
- Quality control (QC)
- Quality improvement (QI)

In Juran trilogy diagram, he made distinction between sporadic waste and chronic waste

Sporadic waste can be defined and corrected through control.

Chronic waste requires an improvement process

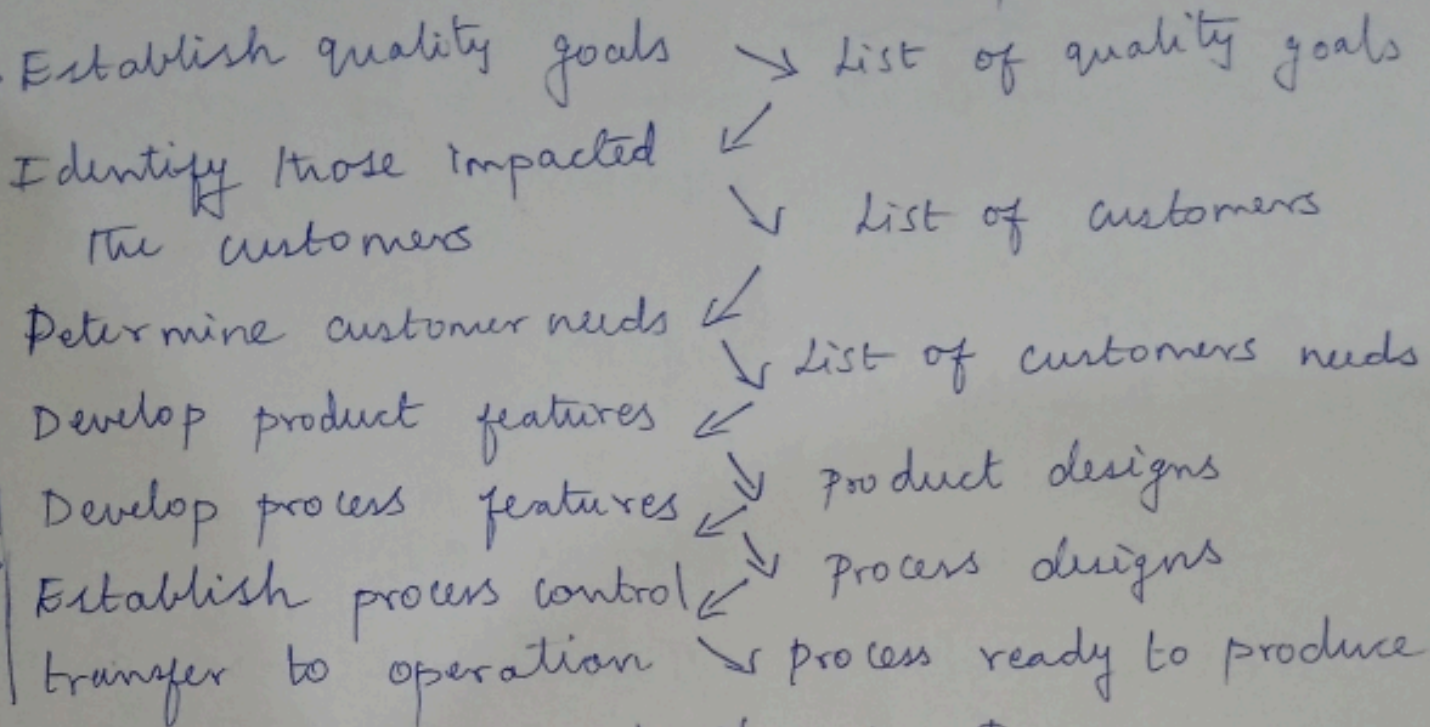


Quality Planning:

Juran proposed a self-explanatory road maps. During this planning stage, an organisation prepares to meet established quality goals

Activities

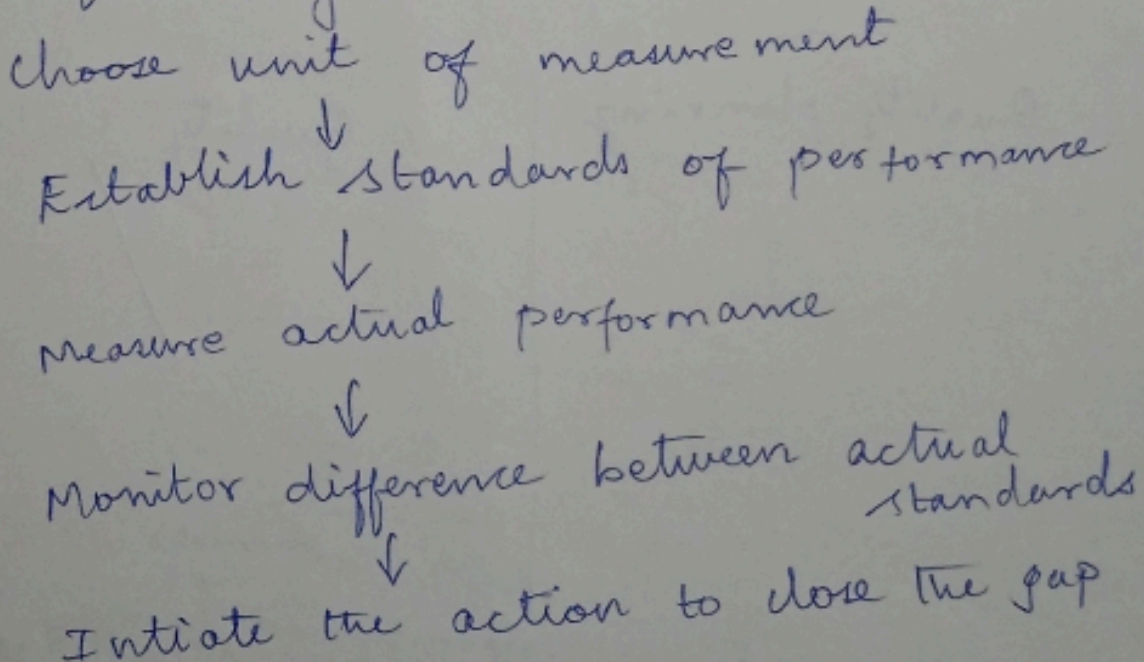
outputs



Quality Planning Process

Quality control:

Control proccers are designed to meet & ensure the quality goals set in the planning stage



Quality Improvement

→ To find the remedy for basic causes of poor quality, steps are given below

1. Build awareness of need
2. Sell goods for improvement
3. Organize to reach goals
4. Provide training
5. Carryout project to solve problem
6. Report progress, give recognition
7. communication, keep source
8. maintain momentum

Contribution by Crosby (8)

1. Management commitment: For quality improvement commitment must start at top. Individual performance requirements needed to match customer requirements
2. Quality improvement team: Representatives in each team form team. They are responsible for ensuring that suggested operations are brought into action
3. Quality measurement: To determine the status of quality of each activity. It identifies the areas where corrective actions is needed and where quality improvement efforts should be directed
4. Cost of quality evaluation: Indicates where to corrective action and quality improvement will result in savings for the company
5. Quality awareness: Getting everybody involved with quality facilities the quality attitude
6. Corrective action: Open communication and active discussion of problems create feasible solutions
7. Adhoc committee for Zero effects Programme
Everyone must understand achievement of goal
8. Supervisor training - All levels must be trained to explain programme to the employees
9. zero defect day - Ensures the uniform understanding of the concept for everyone

10. Goal setting - Employees with their supervisors should set the specific memorable goals
11. Error cause removal - Employees are asked to identify the reason that prevent from meeting the zero defects goal
12. Recognition - Award Programme should be based on recognition, so such programme encourages participation of everyone in quality programme
13. Quality councils - chairperson, leaders, professionals meet on regular basis to create new ideas
14. Do it over again - The whole process of quality improvement is continuous. It repeats again as the quality philosophy becomes ingrained

Barriers to TQM

- * Lack of management commitment
- * Lack of employees commitment
- * Lack of faith & support to TQM
- * Improper planning
- * Lack of effective communication
- * Non applicable of proper tools & techniques
- * Inadequate use of empowerment & teamwork
- * Lack of interest
- * Lack of continuous training & education
- * In effective measurement techniques
- * Inadequate attention to customers

Quality statements (9)

1) Vision Statement - It is a short declaration of what an organisation aspires to be tomorrow

It includes

- The organisation mission
- Basic strategies and performance
- Decision + ethical standards expected of all employees

eg: To enrich knowledge base of practitioners in mobility industry & institution in service of humanity

2) Mission statement - describes function of organisation. It provides the statement of purpose for employee, customers, suppliers. It refers to what an organisation wishes to do and become within and beyond its mandate

eg: concern for employees - sources of valued asset

concern for competitors - wish them well as healthy competition benefits the customers

3) Quality Policy - Guide for everyone in the organisation as to how they provide products and services to the customer. It should be written by CEO with feedback from the workspace and should be approved by quality council.

Customer Focus

→ Quality depends on customer satisfaction. To achieve quality, focus on customer plays major role

→ Customer focus is a strong contributor to the overall success of a business. It includes maintaining an effective customer relations and service programme

→ Customer service is a series of activities designed to deliver customer satisfaction

Steps to develop customer focus

1. Evaluate what goods or services you provide to a customer base
2. Use customer feedback tools to get information about your customer
3. Train your employees to offer customer focus. This includes elements of customer service, customer focus is about keeping attention on the customer, anticipating their needs & valuing their input
4. Consider providing customer incentives. Incentives in the form of sale offers, rebates, or targeted give away programmes are major part of customer focus
5. Work your business copy. Make all the business communication and business copy adopt a customer focus tone and outlook. For most business, customer are readers

Customer Orientation

(10)

customer - any person inside or outside the organisation with whom there is a service relationship

- It includes supervisor & employees

Customer Oriented skills

* Seeks to understand customers

Actively seeks information to understand customer circumstances, problems, expectations & needs.

* Educates customers

Shares information with customers to build their understanding of issues and capabilities

* Builds collaborative relationship

Builds rapport & cooperative relationship with customers

* ~~Types~~ Types of customers:
Customers:

a) Internal customers:

customers inside the company. Each department is considered as customer by previous department and as a supplier

b) External customers:

→ who uses the final product

→ who purchases final product

→ who influences the sale of product

Customer Satisfaction

Main goal of TQM is customer satisfaction

It is achieved by

- The manner in which people work together
- The manner in which work is done
- The environment in which work is done
- organization operations
- organization employees
- customer expectations

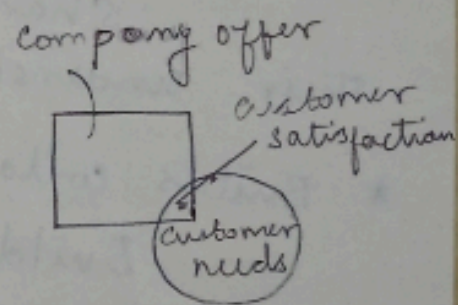
Quality is a measure of customer satisfaction

Teboul's model

Circle → customer needs

Square → service offered by company

Interaction portion → customer satisfaction



Benefits:

- i) Customers are retained by organisation by long period
- ii) Customers deepen their relation with organisation
- iii) Customer become less sensitive to changes in price of products offered by organisation
- iv) Customers recommend the product of organisation to other

Customer Orientation

→ making customers and their needs a primary focus of developing and sustaining customer relations

Customer oriented Skills

Seeks to understand customers

* actively seeks information to understand customer's circumstances, problems, expectations & needs

Educates customers

* shares information with customers to build their understanding of issues and capabilities

Builds collaborative Relationship

* Builds rapport and cooperative relationship with customers

Takes action to meet customer Needs & concern

* considers how actions or plans will affect customer

* Responds quickly to meet customer needs and resolve problems

* Avoid over commitments

* Is proactive whenever possible

sets up customer feedback system

- * Implements effective ways to monitor and evaluate customer concerns, issues satisfaction and to anticipate customer needs

For customer Oriented skills Every employee must have

- * patience
- * Attentiveness
- * clear communication skills
- * Knowledge of the product
- * Acting skills
- * Time management skills
- * Ability to 'Read' customers
- * Goal oriented focus
- * Ability to handle Surprise

Customer complaints

Complaints are information gathering tool. If customer is not satisfied with product usually turns out to be lost customer.

Only around 20% customers complain to front line personnel. But, 1.5% only complain directly to management. Complaints are to be dealt by front line engineer. These people should be dealt by front line engineer. They are

- Trained in problem solving techniques
 - Give responsibility and authority to provide service to customer quickly & effectively
 - Trained in communication and human relation to deal properly with customers
 - Organisation should focus on the complaints of internal & external customers & keep them satisfied.
- The corrective action should be taken immediately for the complaints.

For better satisfaction, the following have been suggested to handle complaints

- Regular feedback from customers to be obtained
- Analyse each complaint carefully
- Take necessary corrective action, to eliminate the root cause
- Bring into effect customer satisfaction measures and have a proper follow up.

Tools used for collecting complaints

Comment card - It is attached to warranty card issued with product.

Customer Questionnaire - It includes surveys through mail, e-mail or telephone.

Focus groups - It includes customer meetings, word association, discussion etc.

The Internet and computer - It includes newsgroup, electronic bulletin boards, mailing list etc.

How to avoid External Customer complaints

1. List out issues/problems in the organisation
2. Prioritize the issues based on risk at customer
3. Form a team and make a leader with good knowledge
4. Continuous monitoring system
5. Conform the method, material etc.
6. Poké yoke or defect free system
7. Trained operators follow the system of quality

Customer Retention

- Focus of retaining the existing customer
- more powerful & effective than customer satisfaction
- Activities that produce the necessary customer satisfaction that creates loyalty

- Improved by obtaining customer feedback

Customer feedback is obtained from customer satisfaction surveys, focus groups, interviews & observations. Customer satisfaction is measured

- Generating new customer costs 5 times more than satisfying and retaining the present customers
- A 2% increase in customer retention has same effect on profits as cutting cost by 10%
- On an average, company loses 10% of its customers every year
- A 5% reduction in customer defection rate can lead to an increase in profit by 25-1125% that depends on industry

Costs of Quality

- costs associated with the non-achievement of product or service quality as defined by the requirement established by the organization and its contracts with customer and society

Quality cost

Costs of control, prevention cost
Appraisal cost, cost of failure, Internal failure
External failure etc.

Types:

- 1) Failure cost: Direct and indirect costs incurred on those products or services which fail to comply with their prescribed specification
- 2) Appraisal cost: cost involved in actual checking of quality viz. the cost of carrying out actual inspection
- 3) Prevention cost - cost involved in ensuring that faulty or defective work or rejection are not produced in very first instance

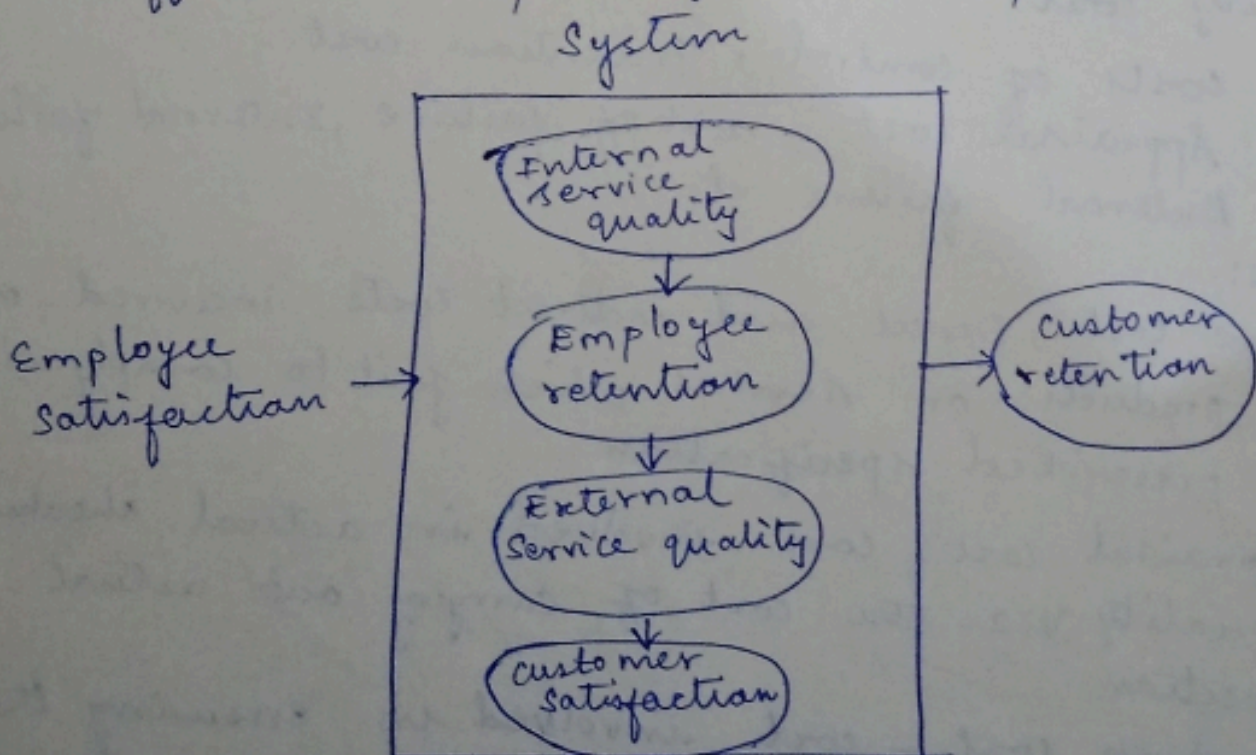
by using market share, ⁽¹³⁾ cash receipts etc.

customer care - every activity which occurs within an organisation that ensures that a customer is not only satisfied but also retained

customer delight - customer retention really moves the customer satisfaction to the next level

Organisation lose customer because of the following reasons

- customer dies $\approx 1\%$.
- customer moves away $\approx 3\%$.
- customer influenced by friends $\approx 5\%$.
- customer lured away by competition $\approx 10\%$.
- customer dissatisfied with product $\approx 15\%$.
- customer turned away by an attitude of indifference on part of service provider $\approx 66\%$.



System to improve customer retention

Basic Quality Improvement tools are

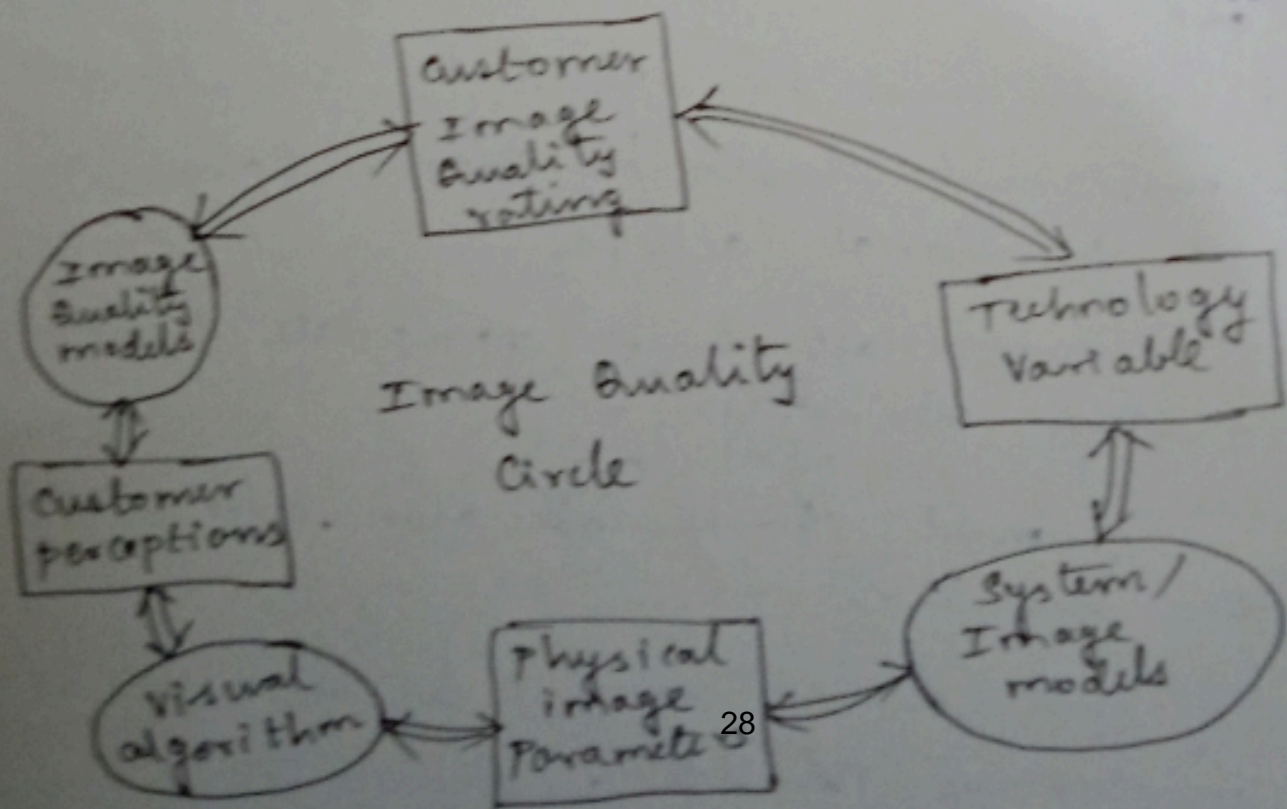
- * Fishbone diagram - shows hierarchy of causes contributing to a problem
- * Pareto chart analyses different causes by frequency to illustrate the vital cause
- * Process mapping data gathering tools, such as check sheet, graphical tools
- * Graphical tools, histogram, frequency diagram, spot charts and pie charts
- * Run charts and control charts
- * Scatter plots and correlation analysis
- * flow charts

Conditions for successful implementation of Quality Circles are

- * Quality circles must be staffed by volunteers
- * Each participant should be representative of different functional activity
- * Circle members must receive appropriate training in problem solving
- * The circle must choose its own leader within its own members
- * Management should appoint a manager as the mentor of the team.

Quality Circle

- Participatory management technique that enlists the help of employee in showing problem related to their own jobs
- Volunteer group composed of workers in the organisation who do the same work
 - lead by supervisor or senior workers
 - Established by Kaoru Ishikawa in Japan in 1962
- An alternative to the rigid concept of division of labour, where workers operate in a narrow scope & compartmentalized function
 - First company in Japan introduces this was Nippon wireless and Telegraph Company in 1962



by vendor, inspection, procedure adopted and acceptance of lost supplied - late delivery also cause stop in production; Large inventories may have to be carried in stock. Both the situations are not desirable and hence vendors are also reviewed for continuance as suppliers

Supplier Rating

Need for supplier rating

- Rate the supplier whether capable to supply good quality product
- Required quantity
- Perfect delivery time immediate response
- To rate they should be understand the criticality of parts.

Relationship development → maintain & improve the growth of customer-supplier relationship. It is improved through

Inspection :-

- Phases :-
- i) 100% inspection - all the items supplied by the suppliers are inspected
 - ii) If customer gains in the sampling inspection customer get chance to audit the suppliers performance
 - iii) At inspection audit, customer has complete confidence on the supplier and initiates identity checks
 - iv) Identity check occurs when both the customer and supplier perform only identity checks

Training - All are trained in quality, team work & other aspects

Team approach - customer-supplier teams establish in all functional areas. Team meetings help to understand each other process

Recognition - customer recognize suppliers by awarding them rewards

Leadership

Definition and concept

→ leadership is the process by which a person influences others to accomplish an objective and directs the organisation in a way that makes it more cohesive and coherent

→ It is defined as process whereby an individual influences a group of individual to achieve a common goal.

Types of Leadership

1. Authoritarian
2. Democratic
3. Laissez-faire

Authoritarian Leadership

→ the leader makes all decision and demands obedience from the people he supervises

→ All policies are determined by the leader without consulting the subordinates

→ The leader decides particular work task for a person

Authoritarian leadership succeeds where

1) Subordinates avoid work but want security

2) Subordinates do not want to take initiative

The advantages of authoritarian leadership is that

i) Decision can be taken quickly

ii) People who simply work for fear of punishment remain disciplined and devoted towards the tasks given to them

Democratic Leadership

→ Democratic leadership is most popular.

→ The leader discusses and consults his subordinates

→ A democratic leader promotes participation of subordinates and develops strong teamwork

→ All policies comes out of group discussion, the subordinates being constantly encouraged and assisted by the leader

→ The subordinates know the long term plans on which they are supposed to work

Democratic leadership

i) motivates subordinates to work, and improves their attitude towards work

ii) Promotes healthier relations between worker and management

iii) minimizes employee-grievances

iv) Raises the employee morale

Free Rein or Laissez-Faire leadership

- The leader acts as an information centre and exercises minimum of control
- The leader depends upon subordinate sense of responsibility and good judgement to get work done
- There is a complete freedom for group or individual decision with a minimum of leader participation
- The leader makes no attempt to appraise or regulate the course of events
- The subordinate group establishes its own goal and solves its own problems
- Free Rein leader can work if the subordinates are highly educated, brilliant and they possess good sense of responsibility

Principles of Leadership

1. Know yourself and seek self improvement:
This is accomplished through self study, formal classes, reflection and interacting with others.
2. Be technically proficient:
A leader should know his job and have solid familiarity with your employees task.
3. Seek responsibility and take responsibility for your actions:
Search for ways to grow organisation

4. Make sound and timely decision:
Use good problem solving decision making, and planning tools
5. Set the example:
Be a good model for your employees
6. Know your people and look out for their well being
7. Keep your workers informed:
Know how to communicate with seniors and other people
8. Develop a sense of responsibility in your worker
9. Ensure that tasks are understood, supervised and accomplished
10. Train as a team: Train the group of peoples doing their job
11. Use full capability of your organisation:
By developing a team spirit, The full capability can be utilized.

Leadership concepts

- Leadership means to create an order that is consistent, controllable and predictable.
- Leadership is helping people to do a better job.
- Leaders must have creativity, risk takers and have problem solving capability

③

To be an effective leader needs to know the following

1. People, paradoxically, need security and independence at the same time
2. People are sensitive to external rewards and punishments
3. People like to hear a kind word of praise
4. People can process only few facts at a time
5. People trust their gut reaction more than statistical data
6. People distrust a leader's rhetoric if the words are inconsistent.

Habits of Quality Leaders

Being Proactive

This is to take responsibility of oneself.

Proactive people think carefully and respond

Beginning with the End in mind

Begin with appropriate plan to produce necessary end result

Customer first

→ Leaders should listen to customers

→ Seek their opinion on value of products

Empower people

Train and coach people rather than supervising them

Strive for Excellence

Quality leaders emphasize continuous improvement rather than maintenance

Thinking win-win

→ approach anything with positive attitude

Gathering People Together for framework

→ To understand the use of teamwork

Build Supplier Partnership

→ clarify quality to suppliers, audit their capabilities
give feedback and discuss improvements

Value People

→ take care of development of people's skill and development.

Renewing

→ fine tune oneself for achieving their performance

This is done by four dimension

1. Physical dimension
2. Spiritual dimension
3. mental dimension

Establish System

Establish organisational system to support quality effort

(6)

Roles of the leader

Eight leadership roles

- producer role
- Director role
- Coordinator role
- checker role
- Stimulator role
- mentor role
- Innovator role
- Navigator role

Producer → promotes productive working environment

Director → Develop policy and rules

Coordinator → organizes and coordinates efforts of personal

Checker → watches and guides achievements

Stimulator → realises team work

Mentor → develop skills of people

Innovator → makes continuous improvement possible

Negotiator → Uses power and influences people

Roles of Senior Management

→ Senior management should ensure proper leadership to achieve end result

Senior management involve in two primary activities

- TQM implementation process
- Establishing quality council

TQM implementation process:

→ when TQM is implemented its success lies on senior management

Steps followed to implement TQM

1. Senior management is to be trained in TQM concepts
2. They should attend seminars and workshops.
3. They need to study and investigate TQM concepts and issues
4. To become coaches and cheer leaders for encouraging and supporting managers
5. To teach employees to realize the company's interest and their interest are geared to one another
6. To attend TQM training programmes
7. To monitor whether quality improvement programmes are conducted as planned
8. To create coordination and harmony among and within departments
9. To create basic of trust and respect and open communication that ensures individual participation
10. To keep communicating the result of TQM after implementation to everyone in the organization

Quality council

Quality council is a team to provide overall direction for achieving Total quality culture (TQC)

- The quality council is composed of
- (i) The Chief Executive Officer (CEO)
 - (ii) The senior management of the organization
 - (iii) A committee or committee.

Objectives of Quality Council

1. To establish a vision and quality standard
2. Development of business strategy
 - identify long term
 - expand quality improvement programme

Quality Statements

Quality statements are a part of strategic planning process.

- Vision Statement
- Mission Statement
- Quality policy statement

Vision Statement

- It is short declaration of what an organization wishes to be tomorrow
- The vision statement should be such a way that the leaders and employees should work towards attainment of vision statement
- A vision statement is usually short
- A vision statement should include the following
 - the organization mission
 - basic strategies and performance criteria

→ Decision and ethical standards expected of all employees

Mission statement

→ It is usually one paragraph, describes the function of the organisation

→ It provides a clear statement of purpose for employees, customers and suppliers

→ It refers to what an organisation wishes to do and become within and beyond its mandate

A mission statement indicates four basic elements

- 1) purpose
- 2) stakeholders
- 3) Goals and
- 4) core values

Quality Policy

→ It is a guide for everyone in the organisation

→ It should be written by CEO with feedback from the workforce and approved by quality council

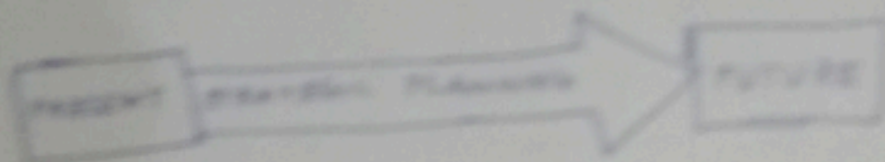
Strategic quality Planning

Strategic planning sets the long term direction of organisation in which it wants to proceed in future

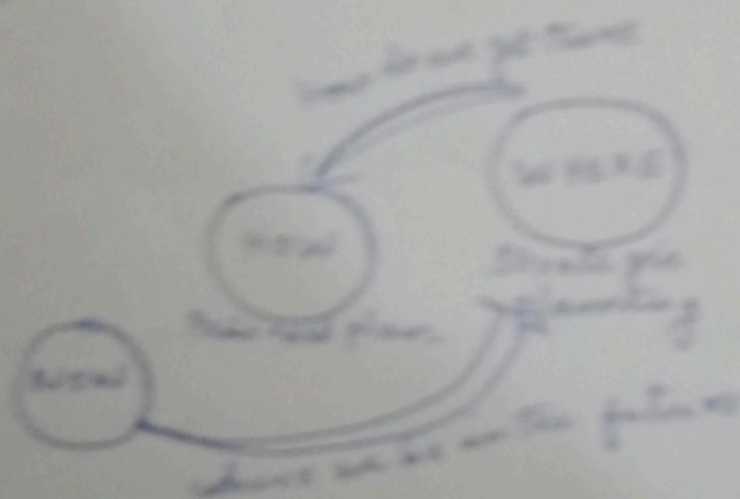
Definition:

Strategic planning is defined as the process of deciding on objectives of organization

eg: planned growth rate in sales, diversification of business into new lines



"Strategic planning is continuous, participatory and systematic process of defining an organization's direction"



7 steps of strategic planning are

- 1) customer needs
- 2) customer positioning
- 3) what the future
- 4) SWOT analysis
- 5) closing the gap
- 6) Alignment
- 7) Implementation

Customer needs:

It is step to determine the future needs of customer

Customer positioning

The step to determine where the organisation wants to be in relation to customers

Predict the future:

Predicting the future with help of economic forecast, technical assessment and so on.

Gap analysis:

It involves identifying the gaps between the current state and future state

Closing the gap:

It involves developing a plan to close the gap

Alignment:

It involves aligning the plan being developed with mission, vision and core values of organisation

Implementation:

It involves allocating resources to collect data designing changes and overcoming resistance to change

Quality Council

→ A quality council is a team to provide overall direction for achieving the total quality culture

It is composed of

→ The chief Executive officer CEO

→ Senior managers of functional areas

(1)

→ A quality council coordinator

Objectives of Quality council

- To raise the quality throu seminars, study tours and other promotion
- To ensure effective functioning of organisation on quality statement and plan
- To encourage basic & R&D in the field of quality
- To raise the level of training of each personnels

Objectives of Quality council

- To facilitate upgradation of testing and calibration facilities and laboratories and encourage overall quality of organisation

Duties of quality council

- To monitor the performance of each functional areas
- To determine continually those project and improve the process
- To determine multi-functional project
- To establish/revise the recognition and reward system periodically

Employee Involvement

- It is the backbone of TQM movement
- effective TQM requires total involvement from every person at all levels in the organisation
- It involves to meet the organisation goals and objectives.
- Some of the important aspects of employee involvement are
 - 1) Employee motivation
 - 2) Employee empowerment
 - 3) Team and Team work
 - 4) Recognition and reward
 - 5) Performance appraisal

Motivation

- management is the art of work done by subordinate in order to attain common goals of organisation
- The management is the art of should inspire and motivate the people for accomplishment of organizational objectives

"Motivation is a general term applying to the entire class of drives, desires, needs, wishes and forces that induce an individual or a group of people work."

Types of motivation

Positive motivation:

It involves proper recognition of employees' efforts and appreciation of employees' contribution towards goal achievement.

Negative motivation

It is based on force, fear and threats.

Extrinsic motivation

It is induced by external factors.

Intrinsic motivation

It is available at the time of performance of work.

Employee Empowerment

→ It is defined as the responsibility and authority given to employees to make decisions about their work without supervisory approval.

Concept:

→ Empowerment is the opposite of helplessness or dependency.

→ An empowered person does not feel incapable of doing the thing that he considers important for the well-being of his organization.

Conditions to create the Empowered Environment

1. Everyone must understand the need
2. The system needs to be changed to new paradigm
3. The organisation must provide information, education and skill to its employee

General Principles for Empowering Employee

- Tell people what their responsibilities are
- Give them the authority equal to responsibility assigned to them
- Set standard of excellence
- Provide them with training that will enable them to maintain standards
- Give them knowledge and information
- Provide them with feedback and their performance
- Trust them and create trust worthiness in the organisation
- Treat them with dignity and respect

Advantages of employee empowerment

- Increases employee motivation
- Job satisfaction and loyalty to organisation
- Promotes good employee-customer relations
- Increases employee contribution and employee education and training
- Improves employee competence and work satisfaction
- Results in personal growth and confidence

Team and Team Work

- A team is defined as a group of people working together to achieve common objectives or goal
- Team work is coordinated actions of the team

TEAM means

- T → Together
- E → Each
- A → Achieves
- M → More
- S → Success

- Teams are small groups of employees with complementary skills who are committed to a common purpose

Way of Classifying Teams

Quality Improvement Teams (QIT's)

- These teams are temporary to solve one or more problems
- This is additional work for members of the team

Problem Solving Teams (PST's)

- These teams are temporary teams to solve important specific problems and to identify their root cause

Natural Work Team

- These are permanent teams with people who naturally work together
- The team consists of multi skilled employees who share skills

Characteristics of Successful Team

Spontaneous

In order to have spontaneous teams with quality output, there should be a positive

Team composition

The size of the team should not exceed ten members except in the case of natural work team or self directed team.

Training

The team members should be trained in problem solving techniques.

Ground Rules

The team have separate rules of operation and conduct.

Clear objective

The objectives of the team should be stated clearly.

Well defined Decision Procedures

The decision should be made clearly at right time by the team.

Resources

The adequate information should be given to the team whenever needed.

Effective Problem solving

Problem solving methods are used to make effective decision.

Open Communication

Open communication should be encouraged i.e. everyone should feel free to speak in the team whatever they think, without any interruption

Leadership

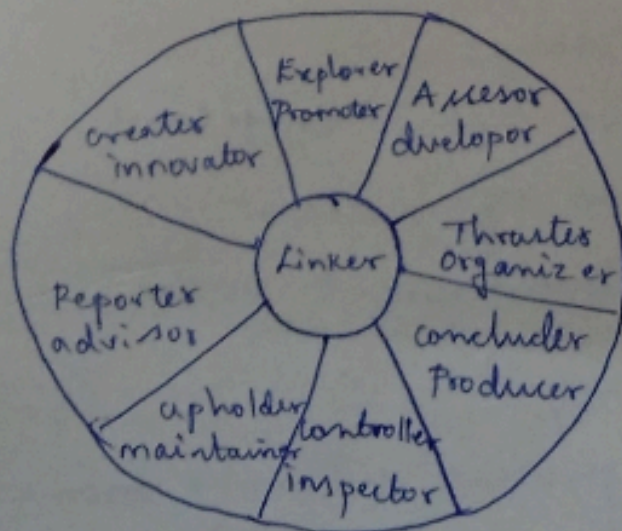
Leadership is important in all team. Leader is a person who leads the team

Elements of Effective Team Work

Seven elements

1. Purpose
2. Role and responsibilities
3. Activities
4. Effectiveness
5. Decisions
6. Results
7. Recognition

Team Management wheel



Activities of Team Management Which

it emphasizes the following activities

Advising
Innovating
Promoting
Developing
Organizing
Producing
Inspection
Maintaining
Linking

Barriers to Team Progress

1. Insufficient training
2. Incompatible rewards and compensation
3. First line superior resistance
4. Lack of planning
5. Lack of management support
6. Access to information systems
7. Lack of union support
8. Project scope too large
9. Project objectives are not significant
10. No clear measures of success
11. No time to do improvement work.

Recognition and Reward.

→ Recognition is a process whereby management shows acknowledgement or appreciation of an employee's outstanding performance

→ It is a form of employee's positive motivation

eg. of formal Recognition

→ presentation of accomplishment at management reviews

→ Awards certificates, letter of thanks.

→ publication of achievement in company media

Reward:

→ Reward is a tangible one, such as increased salaries, commissions, cash bonus

→ Reward is giving financial benefits linked to performance

eg. of Reward

→ Merit based increase in earnings

→ Promotion of an individual

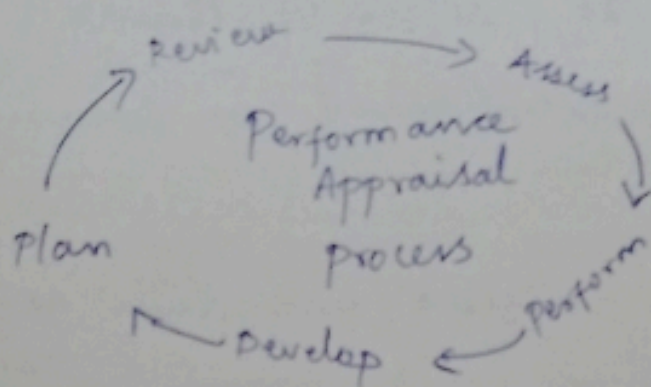
Types of Reward

Intrinsic : related to feelings of accomplishment or self work

Extrinsic : related to pay or compensation issues

Performance Appraisal

→ Performance appraisal is an important way to ensure that the organisation implements a comprehensive feedback.



→ Performance appraisal is a systematic and objective assessment or evaluation of performance.

Purpose of Performance Appraisal

- To let employee know how they are performing
- To take it as basis for salary increase promotion etc.
- To identify employees to be counselled for performance improvement
- To know personal strengths and weakness of different individual
- To establish basis for research and reference for personal decision in future
- To guide individual¹ to plan job

(12)

→ To validate selection procedures

Process of Performance appraisal

Establishing performance standards



Communicating standards and expectation



measuring the actual performance



Comparing with standards



Discussing results



Decision making - taking corrective actions

Benefits of performance appraisal

- provides useful feedback to the employee, supervisor
- It helps in determining pay adjustments, increment and bonus
- It provides basis for employee's promotion, transfer and demotion
- It helps in determining individuals training and development tools
- It helps employee to plan their career

Continuous Process Improvement

→ It is a systematic approach to plan, sequence and implement efforts using data

Meaning

Continuous → without a break

Process → Series of actions

Improvement → Betterment

The following points helps in continuous improvement

- All works are seen as process
- All works are made effective and adaptable
- Control in process performance by using appropriate techniques

Process

→ All works are to be seen as processes

eg: Business process - purchasing, marketing, accounting

→ All process have an input, in house process and o/p

→ Inputs are processed to get an o/p

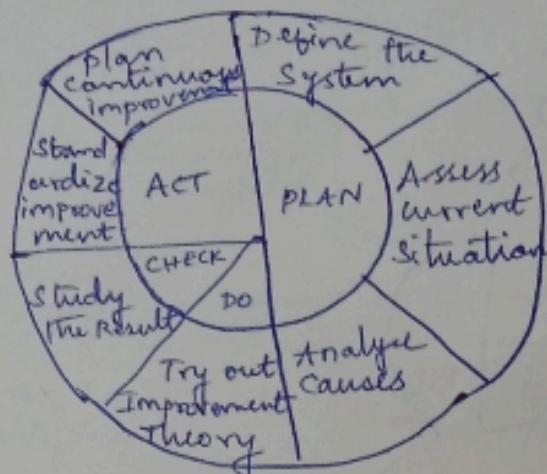
PDCA Plan Do Check Act

→ It is a model for testing ideas

→ It is used to test ideas for improvement quickly and easily based on existing ideas

→ It encourages starting with small changes, which can build into large improvements

Phases of PDCA cycle



Plan:

- Define the problem
- Analyse the causes and draft an action plan
- Determine the quality objectives and critical factors
- Define the performance indicators
- Generate possible solution

Do

- First, implement the plan on limited scale
- Train all involved employees in the use of quality improvement methods
- Describe the process which is considered for improvement

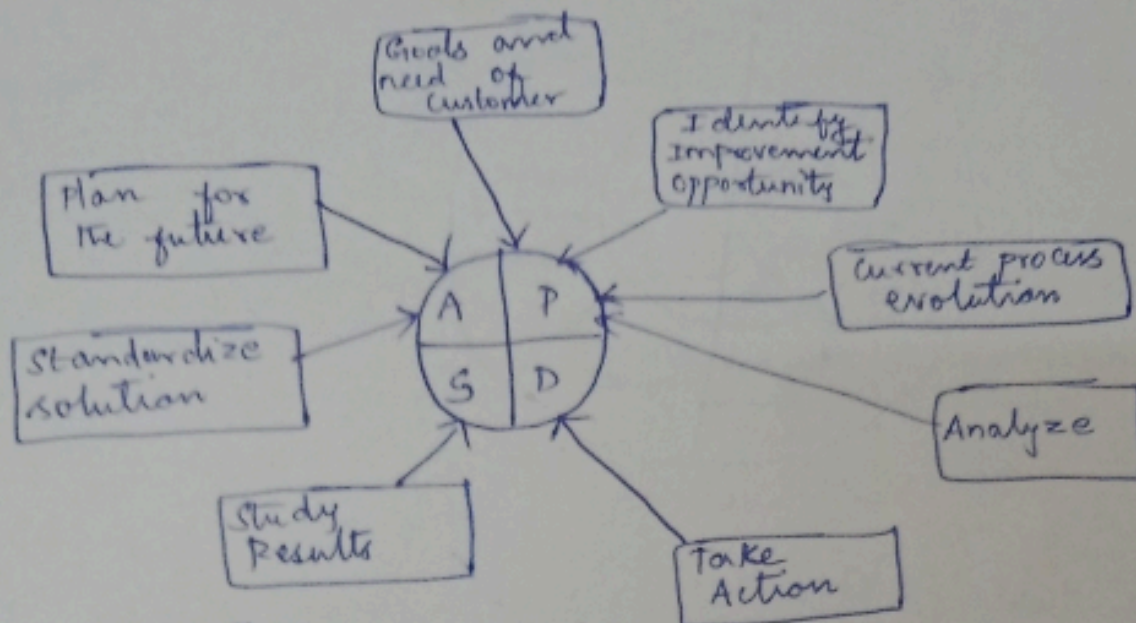
Study or check

- Evaluate the total project with performance indicators
- Verify whether improvement has successful or not

Act

- Act to implement proven improvements
- Document the improvement are in standard procedure and inform all employees.

Continuous Process Improvement cycle using PDCA



- Step 1: Identify improvement opportunity
- Step 2: Evaluate the current process
- Step 3: Analyze
- Step 4: Take action
- Step 5: Study Results
- Step 6: Standardize solution
- Step 7: plan for the future

Benefits of PDCA cycle

- Daily routine management → for individual or team
- Problem-solving process
- Project Management
- Continuous development
- Vendor development
- Human resources development
- New product development
- Process trials

5S: House Keeping

— used to establish & maintain productive quality improvement

meaning:	Japanese term	English term	Equivalent
	SEIRI	SORT	Tidiness
	SEITON	SET IN ORDER	orderliness
	SEISO	SHINE	cleanliness
	SEIKETSU	STANDARDIZE	Standardization
	SHITSUKE	SUSTAIN	Discipline

Objective of 5S

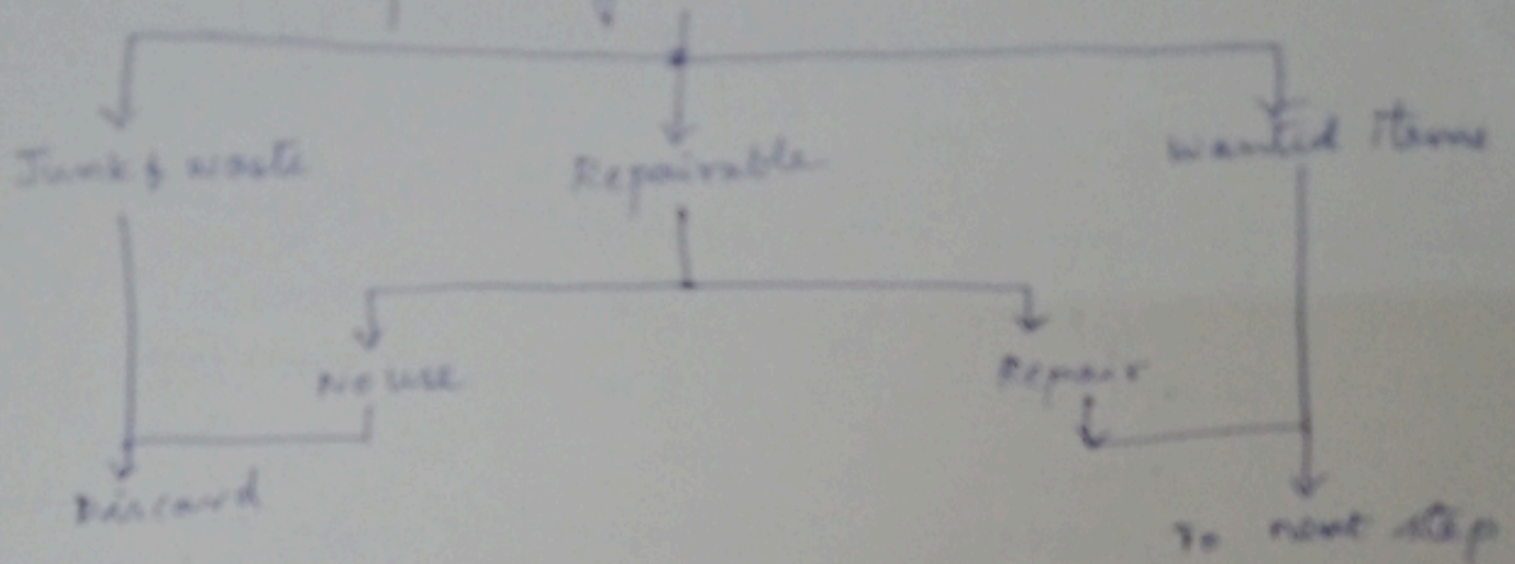
- To create a neat and clean work place
- To systemize day to day working
- To improve work efficiency
- To standardize work practices
- To improve work discipline

1S: SEIRI: CLEARING

— Take out unnecessary items and throw them away

Factory Floor	office	Home
machines to be scrapped	used/broken pens	Broken toys
Rejected material	useless paper	old clothes
expired goods	old diaries	Broken suit cases
Broken tools	Broken furniture	
pallets, bins, trolleys		

Separating wanted & unwanted



Consequences of not practising SEIRA

- The unwanted clutter up the place and wanted are hard to find
- Every place can only hold so much
- clutter sometimes causes misidentification

2.5 : SEITON : ARRANGING

- Arrange everything in proper order so that it can be easily picked up for use

Factory floor

unlabelled tool crib
cluttered shelves
lockers etc
stores - no clear location system
Things on floor

office

unlabelled file cabinet
cluttered drawer
shelves, tables
Record of documents
Not arranged well
File leafs & papers

Home

clutter
no orderly arrangement
the rooms

Consequences of not ⁽¹⁵⁾ practising SEITON

- Things are seldom available when needed
- Items are "lost" in stores
- Items - defectives - good get mixed up
- Accidents or near-accidents occur due to clutter
- Visual control of the shop floor is not possible
- Sometimes, product is lost because an item required is available, but can't be found
- In some offices, tax records may not be traceable. This leads finance loss, prosecution or embarrassment

3S : SEISO : Sweeping

- Sweep workplace thoroughly so that there is no dust anywhere

Factory Floor	office	Home
Dry machines	Dirty table & furniture	Dirty furniture, floor, windows
Dust on product	Dirty office equipments	book shelves
Dirty jigs fixtures		
Dirty walls, roofs	Dirty windows	

Consequences of not practicing Seiso!

- Most machines are affected by dirt & dust hence their performance go down
- Dust and dirt on products, materials, packing boxes etc. will affect either their performance quality

4S: SEIKETSU: CLEANLINESS

- washing with a strong overtone of keeping things disinfected as well as free of hazardous chemicals

Factory floor

office

Home

Handling hazardous chemicals

free of pests

Post control

Control of fumes
hazardous dust

personal hygiene

Personal hygiene

Disinfecting
personnel hygiene

Consequences of not practicing SEIKETSU:

- Good health and safety require the practice of ^{Seiketsu}
- Hazardous chemicals, dusty chemicals, fumes etc can make it a dangerous place to work in.
- Washing thoroughly and clearing a place makes the work place pleasure

5S: SHITSUKI: Discipline

- Discipline with regard to safety rules and punctuality

consequences of not practicing Shitsuki

- If discipline is not practiced, then first 4-S would back slide

- Lack of Shitsuki :- not following standards
All activities related to safety & quality will be affected

Implementing 5-S (16)

- 1) Top management resolve and training
- 2) Formation of top level team
- 3) Understanding current circumstances
- 4) Establishing priorities and targets
- 5) Forming sub teams and training
- 6) Major cleaning
- 7) Establishing improvement plans
- 8) Implementing the plans
- 9) Verifying results, standardizing
- 10) Establishing full control, Looking for further improvements

Kaizen

- Process of continuous improvements with small increments that make the process more efficient, effective, controllable & adequate

Kai - change, zen - better, kaizen - change for better

Features: Value-added & non value added work activities

→ Muda refers to 7 classes of wastes. wastes are over-production, delay, transportation, processing inventory, wasted motion & defective parts

→ Principles of motion study and use of cell technology principles of materials handling & use of one piece flow

- As for work place organisation
- Visual management by means of visual displays that everyone in the plant can use for better communication
- Just-in-time principle to produce only the units in the right quantities, at the right time and with right sources
- Poka Yoke to prevent/detect errors
- Team dynamic includes problem solving, communication skills & conflict reduction

Role of people implementing Kaizen

- Top management must be committed to introduce Kaizen as a company strategy
- Executive formulates & carryout Kaizen goals according to guidelines from top management
- Supervisors, workers involve in activities known as Kaizen

Supplier Partnership:

- Suppliers are partners in the organization without treating supplier as partners, quality improvement can't be translated into reality
- Supplier quality is a team who supports the supplier and feed the good product - organisation works with suppliers in a partnering atmosphere

Suppliers are selected based on their performance in terms of cost, quality and delivery reliability, supply criteria includes factors such as management compatibility, goal congruence and strategic direction of supplier firm.

Stages in Supplier Selection and evaluation

Survey Stage - based on information available through catalogues, advertisements, brochures etc a list is drawn up for further investigation

Enquiry Stage - Detailed analysis is made after obtaining required information. Standard enquiry forms are sent to the vendors, request them to furnish information. The vendors present customer may be enquired regarding his performance promptness in delivery etc

Negotiation and selection stage - During enquiry stage, many vendors are dropped from original list as unsatisfactory. The remaining vendor called for negotiations to discuss various terms and conditions like payment terms, discounts, supply procedures, quality control procedures, As a result of this final list of approved vendors is drawn up

Experience stage: Performance of supplier is evaluated on the basis of quality and promptness in delivery. A history card is maintained for each vendor. The card contains information like dates of supply of material.

The forces that have changed supplier relations are 'Deming Philosophy, Just in time (JIT) concept, Kaizen', ISO 9000 quality management system and supply chain management

Supplier Partnering.

→ continuing relationship between buying firm, supplying firm, involving commitment over an time period, exchange of information and acknowledgement of the risk and rewards of the relationship

→ Relation between customer and supplier based on trust, dedication to common goals/objectives and an understanding of each party's expectations and values

Partnering is defined as

- long term commitment between two or more organisations
- Achieve specific business goals/objectives
- achieved by using each partners resources

Benefits

- 1) Improved quality
- 2) Reduced cost
- 3) Increased productivity
- 4) Increased efficiency
- 5) Increased market share
- 6) Increased opportunity for innovation

Unit-III

TQM Tools and Techniques-I

Seven Traditional Tools of Quality

1. Check sheets
2. Histograms
3. Cause & effect diagrams
4. Pareto diagram
5. Stratification analysis
6. Scatter diagram
7. Control charts

Quality tools for problem solving

Sl.No.	QC Tool	Type	Purpose	Output
1.	Check sheet	Quantitative	To collect data quickly & efficiently in structural manner	Table
2.	Stratification analysis	Quantitative	To group the data according to various sources such as machine, source of material, shift, men & so on	Table
3.	Pareto Diagram	Quantitative	To prioritize the problem to be solved	Graph
4.	Cause & Effect Diagram	Brain storming	To enumerate the suspected causes related to a problem	Fish bone diagram
5.	Control charts	Quantitative	To monitor process continuously and to find out any special cause variation which influencing the process	Graph
6.	Scatter Diagram	Quantitative	To examine the existence of the relationship between two measured characteristics	Graph
7.	Histogram	Quantitative	To understand variation pattern in a process output in terms of location and spread where the process is measured	Graph

1. check sheet

- Tally sheet is a form for gathering the systematic data and registering to get clear view of the facts
- used to keep track of how often something occurs
- the form of check sheet is tailored for each situation
- check list is used to indicate the frequency of certain occurrence

- Steps:
- 1) Formulate the objective for collecting data
 - 2) Decide which data is necessary
 - 3) Determine who and how the data will be analysed
 - 4) Draw a format to record data problem-wise by putting tally lines
 - 5) Start counting by tallying list
 - 6) Total no. of facts are marked on the list.

Eg: A plain turning process is carried out on the machine number A in XYZ company. The final diameter of rod is $5.00 \pm 0.1 \text{ mm}$. Check 49 samples of the final product and makes a check sheet

Values in mm

4.98	5.00	5.04	5.06	5.02	5.00	5.06
5.02	5.00	5.02	5.00	5.02	5.00	5.02
4.96	4.96	4.94	5.02	5.00	4.96	5.00
5.00	5.06	4.96	5.02	5.04	5.02	4.96
5.00	5.00	5.04	5.00	5.04	5.02	4.96
4.98	5.98	5.02	5.02	5.08	5.00	5.04
5.00	5.00	4.98	4.98	4.98	5.04	4.98
				5.04	4.98	4.98

Measurement area: outer ¹⁵ diameter of rod
measuring equipment: micrometer

check sheet ⁽²⁾

measurement	number observed	frequency
4.94 - 4.959	I	1
4.96 - 4.976		5
4.98 - 4.999		9
5 - 5.019		14
5.02 - 5.039		10
5.04 - 5.059	I	6
5.06 - 5.079		3
5.08 - 5.099	I	1

Types of check sheets

- process distribution check sheet
- Defective item check sheet
- Defective location check sheet
- Defective factor check sheet

2) Histogram

- bar diagram shows the distribution of variable quantities
- graphical display of frequency distribution of numerical data
- shows where more frequently occurring values are located
- Tool for determining the max. process results

Steps:

- 1) After data collection, count no. of data values collected
- 2) Determine the range of data
- 3) Divide the data values in groups and count the no. of values in each class

4. Determine the width of the class

$$\text{Width of the class} = \frac{\text{Range}}{\text{No. of classes selected in the above table}}$$

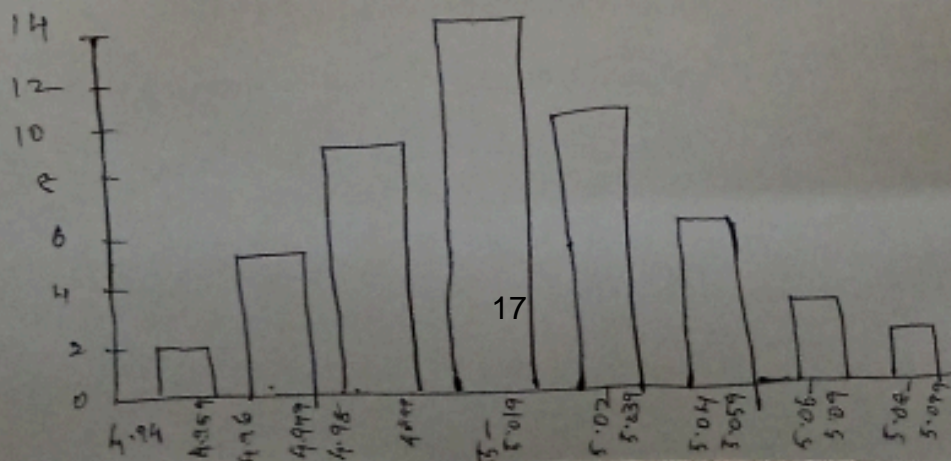
5. Draw a frequency table for all values

6. Construct a histogram based on frequency table

7. Write the number of values on the diagram.

Types of Histogram

1. Bell shaped - Symmetrical shape with a peak in middle representing a normal distribution
2. Double peaked - Two normal distribution with two peaks in middle indicates more than one description at work.
3. Plateau - Flat top, no distinct peak and tails indicating more than one distribution at work
4. Comb - Alternative peaks show possible errors in data collection & analysis
5. Skewed - Asymmetrical shape positively or negatively skewed
6. Truncated - Asymmetrical shape with a peak at the end
7. Isolated peak - Two normal distribution, peak at end indicates error in data recording
8. Edged peak - Normal distribution, peak at end indicates error in data recording



3) Cause and Effect Diagram

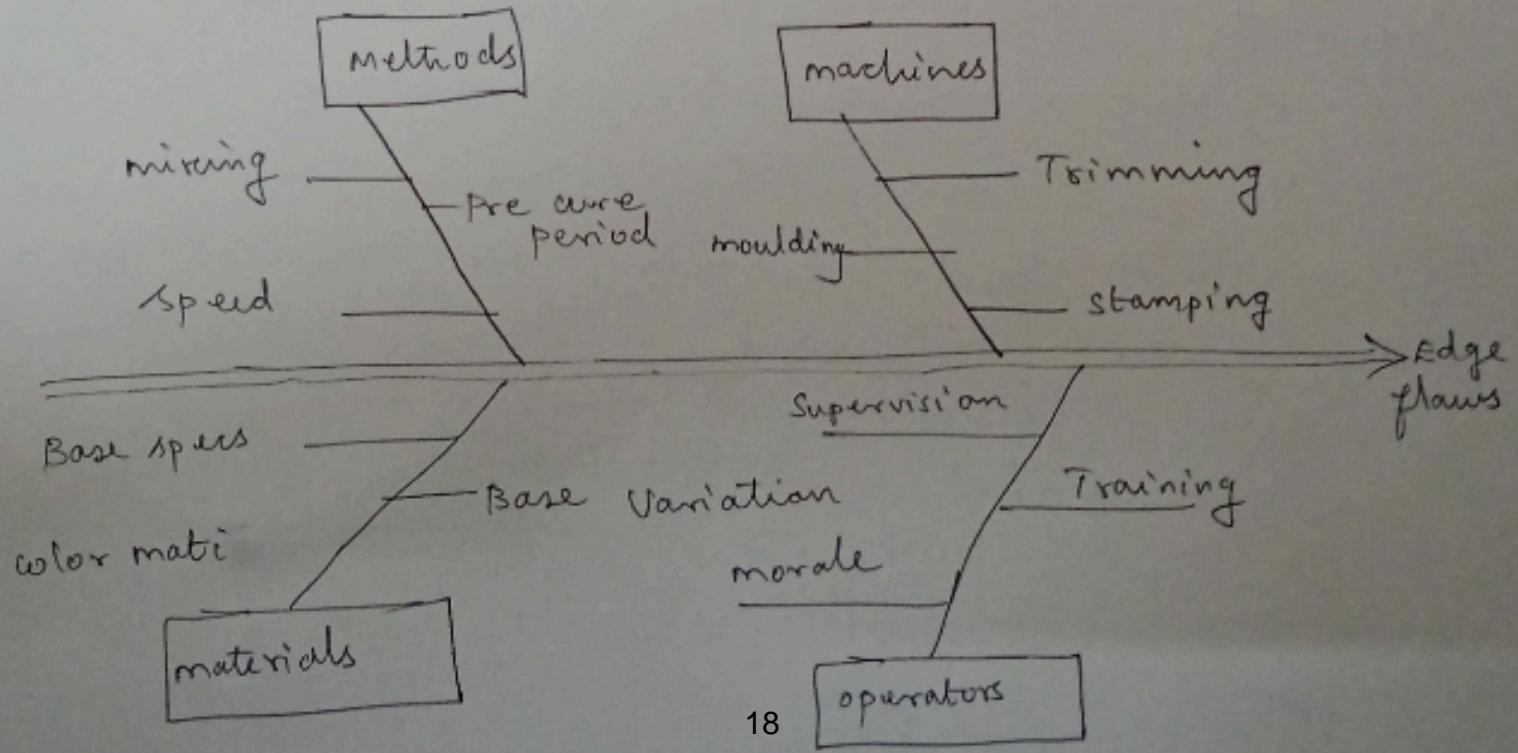
- Graphical tabular chart to list and analyses the potential causes of given problem

-> consists of central stem leading to the problem with multiple branches of stem listing various groups

- used to analyse cause & effect, standardise existing and proposed operations.

Steps:

- 1) Define the problem clearly in a box. Draw line from this box towards left
- 2) List down all possible major & minor causes throu' brain storming session
- 3) Mark major causes on branches & minor causes on sub-branches
- 4) look for possible solution
- 5) corrective action for the causes identified



Cause and Effect Diagram

4) Pareto Diagram

- diagnostic tool used for separating vital few causes that account for a dominant share of quality loss
- 80/20 rule. i.e. 20% of problems account for 80% of the effects
- used as risk assessment technique from activity level to system level

Steps:

- 1) obtain data using check sheet
- 2) Arrange data in descending order
- 3) calculate total and % of total for each
- 4) compute the cumulative percentages
- 5) Draw a bar chart with two vertical axes

Along the left vertical axis, mark the measured values for causes; right axis from zero to 100%.

Different kinds of causes along horizontal axis

6) plot a cumulative percentage line

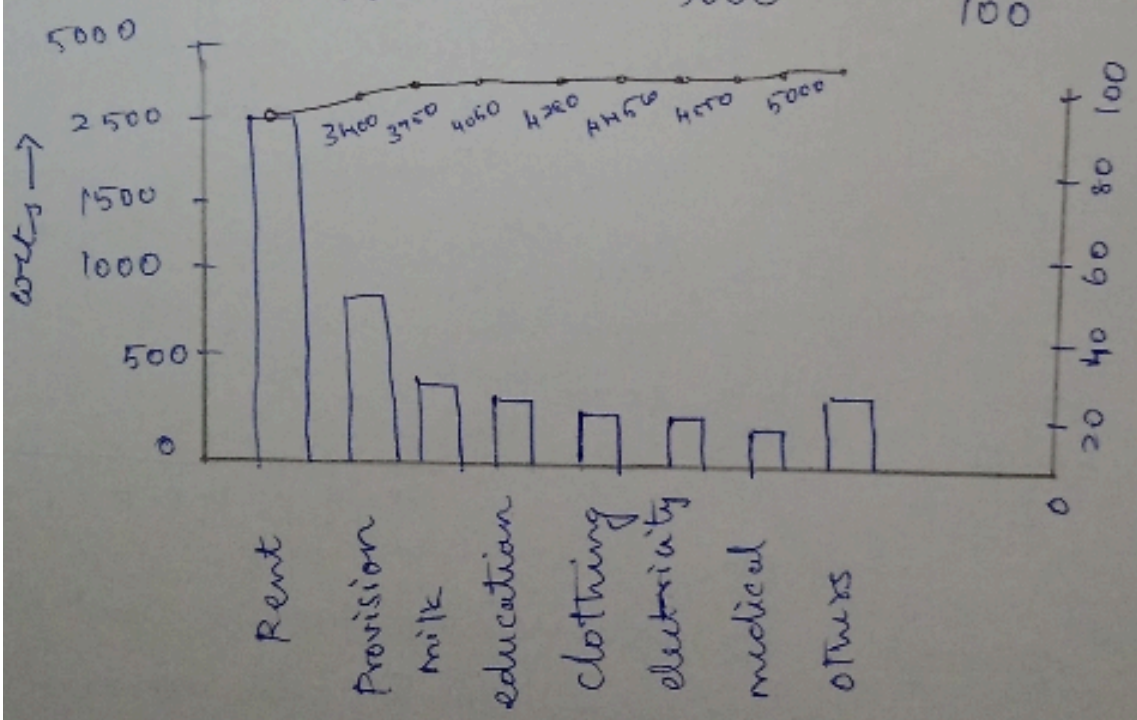
7) Draw horizontal line from 80%.

Eg. Construct Pareto diagram for expenses for a month and we want to cut down/reduce

Sl. No.	Particulars	Amount
1.	Rent	2500
2.	Provision	900
3.	education	300
4.	electricity	170
5.	milk	350
6.	medical	100
7.	clothing	230
8.	other	450
	Total	5000

(4)

S.No	particulars	Amount	%age	cumulative %age
1.	Rent	2500	50	50
2.	Provision	900	18	68
3.	Milk	350	7	75
4.	education	300	6	81
5.	clothing	230	4.6	85.6
6.	electricity	170	3.4	89
7.	medical	100	2	91
8.	others	450	9	100
Total		5000	100	



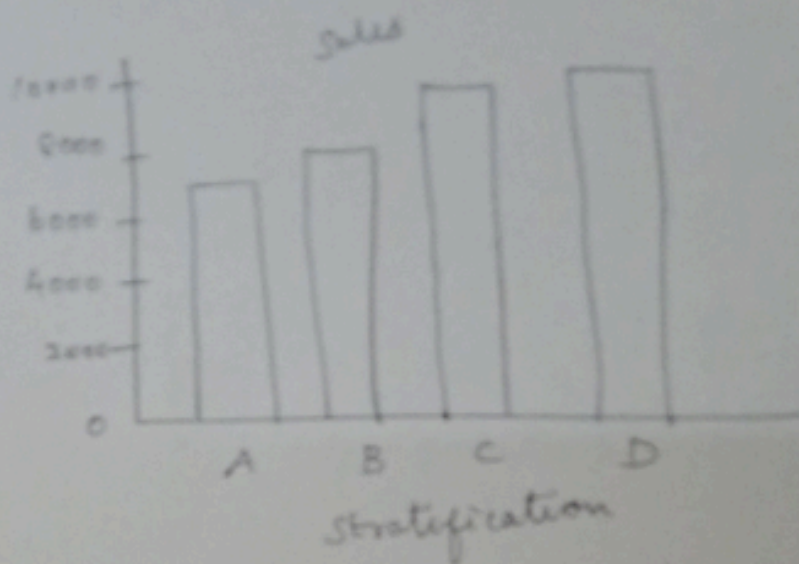
5) Stratification Analysis

- Method of analysis of data by group it in different ways
- machines, suppliers, operators, tools etc. are started with respect to which study of variations is conducted
- Effective QC tool for improving quality
- Grouping data is ²⁰ desired manner

Sales Summary

Product sales

Prod	A	7000
	B	8000
	C	9000
	D	10000



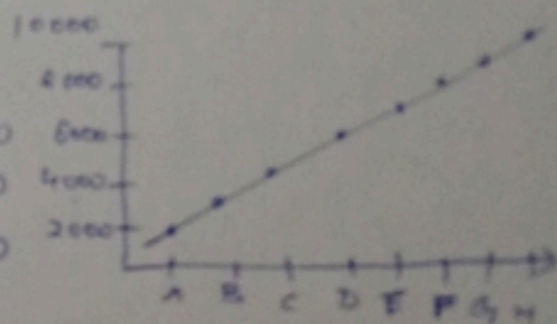
b) Scatter Diagram

- depicts relation between 2 variables
- horizontal axis has measured values of one variable & vertical axis represents measurements of variable

Category Values

A	→	2000
B	→	3000
C	→	4000
D	→	5000

E	→	6000
F	→	7000
G	→	8000
H	→	9000

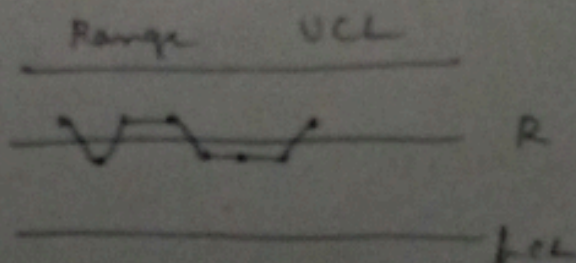
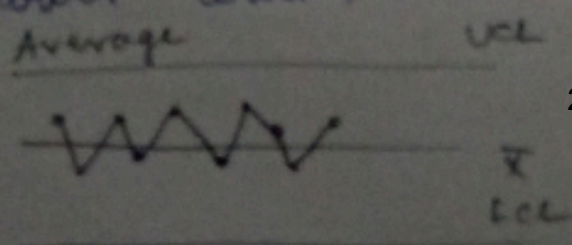


7) Control chart

- most widely used in statistical process control
- static picture of process variability - histogram
- dynamic performance of process - control chart

* central line (CL) & line on either side of central line are control limits (CL)

* The one above is upper control limit, below lower control limit



(5)

New Management Tools

1. Affinity diagram - for synthesizing, classifying, organizing industries ideas
2. Relationship diagram - for isolating cause & effect relationship
3. Tree diagram - For deploying general concepts into details
4. Matrix diagram - For correlating in logical form, in order to evaluate select & decide
5. Decision tree - for identifying alternatives
6. Arrow diagram - for planning
7. Matrix data analysis - for quantifying relationships

1) Affinity diagram: - Tool to collect large amount of verbal expressions and organize them in groups according to natural relationships between individual items

- special kind of brainstorm tool KJ diagram
- used to provide visual representation of large amount of ideas
- used to determine logical priorities
- used to extract large amount of useful information from unrelated ideas
- to create new concept

eg: A publication team wanted to reduce the typo-graphical errors in documentation so, they conducted a brainstorming session that produced the following list of factors that influenced errors

Computers
 Printers
 Lighting
 Comfort
 font
 Grammar
 draft copy
 Technical Jargon
 Computer skill

No feedback
 Typing Skill
 Typewriters
 Desk height
 Interruptions
 slang
 punctuation
 final copy
 unreasonable

Noise
 Proofreading Skill
 Chair height
 Time of day
 Handwriting
 Spelling
 Distribution
 Editing Skill
 no measurement

Typographical errors

Environment

Interruptions
 unreasonable
 deadlines
 Time of delay

Ergonomics
 Noise
 Lighting
 desk height
 chair height
 comfort

Equipment
Computers printers Typewriters
Training
Typing Skill Editing Skill Computer Skill Proofreading Skill

original document

Author Skill	Requirement
Handwriting Grammar punctuation Spelling	Draft copy Final copy Distribution Font
Technical Jargon	slang

2) Relationship diagram (6)

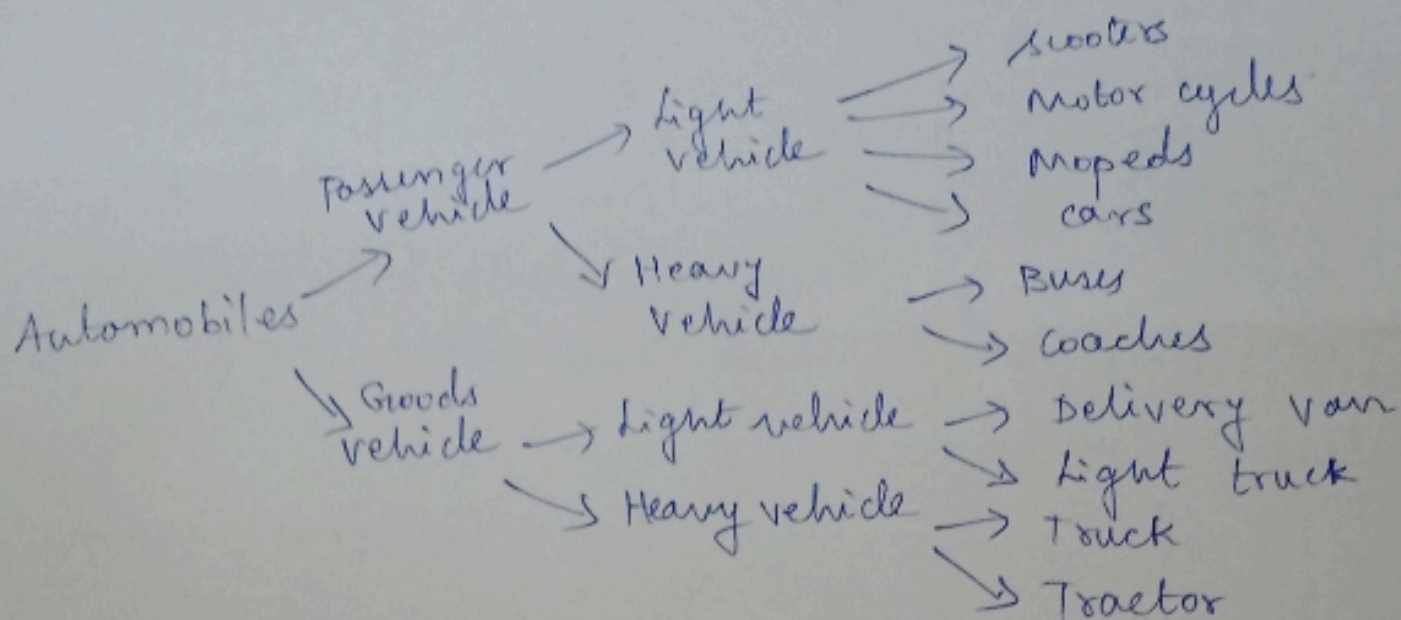
- Tool for finding causes to a problem
- Graphical representation of all factors in a complicated problem
- To generate a visual interpretation of relation between as effects & causes
 - used to identify key problems from existing
- root cause of existing problems, key factors needed to make decision

Steps:

- 1) Identify and decide the effect of problem
- 2) conduct brainstorm to identify the immediate cause of effect
- 3) connect those causes to effect
- 4) outgoing arrows - root causes
Incoming arrows - key outcomes

3) Tree Diagram

- It breaks down a topic with components and shows logical links between them
- It outlines the complete spectrum of paths that must be carried out to achieve a goal
- It is used to explore the ways to achieve objective
- It helps to develop a systematic, step by step strategy to achieve an objective
- eg: Tree diagram for automobiles classification



4) Matrix Diagram:

- Tool depicts the relations between two set of factors in the form of table or matrix
- used to show relations between individual items in two sets of factors

Steps: 1) Decide two sets of factors to be compared

2) place the main factors vertically on the left hand side of matrix and dependent factors horizontally on top of matrix

3) Place symbols at intersecting square boxes

4) Score relationship and select important relationship for analysis

5) Decision Tree: Planning tool to outline every conceivable and likely occurrence in any planning.

→ helps to anticipate undesirable occurrences and enables one to prepare with plans to neutralize their effect

→ used in decision making when the task is new complex and unique

- Steps:
- 1) Prepare normal flow chart of process with all expected events as steps in the chart
 - 2) Identify various possibilities of process not going as per the plan due to abnormal occurrences
 - 3) Write occurrences on the flow chart thro' effect due to abnormal occurrences
 - 4) Identify the ways and means to counter the effect due to abnormal occurrences
 - 5) Write counter measures in rectangular connecting the corresponding abnormal occurrence on one side & process objective on the other

6) Arrow Diagram:

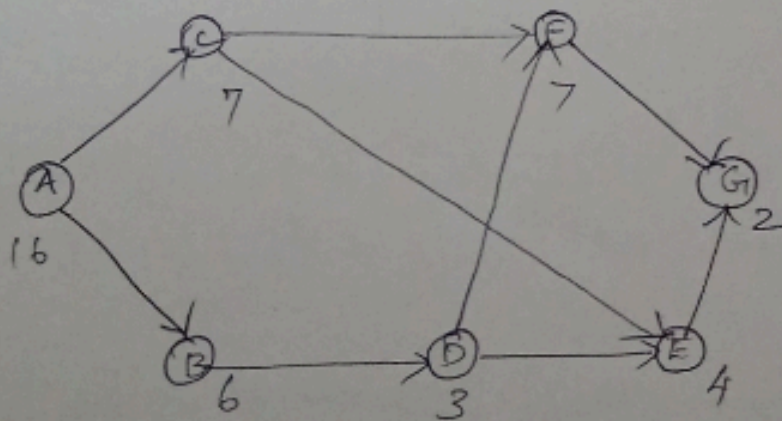
- Graphic representation of sequential steps that must be completed before a project can be completed
- PERT (Program evaluation & Review Technique) and CPM (critical path method) are best arrow diagram
- Planning tool that determines critical path of project
- used to show paths to complete the project
- To find shortest time possible for the project
- > To display graphically simultaneous activities

Process: Brain storm all of the tasks required to complete a given project, includes estimated time required for each task

- 2) sequence all the cards from start to finish removing duplication, adding new & additional task

3) Re evaluate the shortest, longest and average estimated time for each task and identify longest path
 eg: construct an arrow diagram (ie) CPM for following

<u>Activity</u>	<u>Designation</u>	<u>Immediate predecessor</u>	<u>Time in weeks</u>
Design	A	—	16
Build Prototype	B	A	6
Evaluate equipment	C	A	7
Test prototype	D	B	3
write equipment report	E	C, D	4
write methods report	F	C, D	7
Write final report	G	E, F	2



7) Matrix Data Analysis Diagram

— To present numerical data about two sets of factors in matrix form and analyze it to get numerical output

→ used in 'principal component analysis' where only two characteristics can be studied at a time

— study parameters of production process, analyze market information, find links between numerical & non numerical variables and so on.

Six Sigma

- Six standard deviation from mean
 - similar to zero defects, is a philosophical benchmark
 - provides techniques & tools to improve capability and reduce defects in any process
 - improves the process performance, decrease variation and maintains consistent quality of process output
- This leads to defect reduction and improvement in profits, product quality and customer satisfaction

Concepts of Six Sigma

Process capability ratio $C_p = \frac{\text{Design width}}{\text{Process width}} = \frac{USL - LSL}{UCL - LCL}$

USL → upper specification limit

LSL → lower specification limit

C_p measures how well the product requirements match with the process capabilities. Higher the value of C_p , better the match between product and process

Methodology

- 1) Identify the process you create or service you provide
- 2) Identify the customers for your product or device and determine what they consider important
- 3) Identify your needs to provide the product that satisfies the customer
- 4) The five phases approach [DMAIC] is used to achieve the six sigma state

If a sample drawn from the process lies inside UCL & LCL limits, it means the process is in control. If the sample lies outside these limits, then the process is said to be out of control. So, appropriate corrective action is necessary to eliminate the condition.

DMAIC principle

Determine benchmarks
Set base line
Determine customer requirements
Get customer commitment
Map process flow

DEFINE

Develop Defect measurement
Develop data collection process
Collect data
Create forms
Complete and display data

MEASURE

Verify data
Draw conclusion from data
Test conclusion

ANALYSE

Determine improvement opportunities
Determine root causes
Map causes to effects

IMPROVE

create improvement & models
Experiment & set goals
Create problem statement
Create solution statement
Implement improvement

CONTROL

Monitor improvement progress
measure improvement
Assess effectiveness
Make needed adjustments

Applications to manufacturing

An application of six sigma in manufacturing helps an organization reduce pollution, reduce the time cycle of one or more processes and reduce the cost of production for increasing profits and satisfaction level of its customers

Six Sigma implementation methodology in a manufacturing company encompasses the following steps

1. Concept Introduction seminar - for seniors & operational management
2. Formulation of six sigma deployment strategy with senior management
3. Selection of six sigma projects - in consultation with senior & operational management
4. Selection of suitable champions, black & green belt candidates
5. clearly define roles & responsibilities
6. Training for sigma awareness, also for champions
7. Consult & hand hold implementation of six sigma project
8. Assist champions in final project evaluation
9. participation in the monthly review by steering committee

Benefit of six sigma manufacturing

- > improve efficiency of production
- > Valued strategy for management
- > positive result in production of services/goods

ii) Service Sector including IT

Some challenges facing Six Sigma in the IT sector are lengthy projects, Data oriented tools, Lack of knowledge in knowledge based industry, failure to use DMAIC in a software development project & sigma as a project based approach

In IT, projects are too long to realize benefits. Six Sigma reduces duration & eliminate changes in the organisation

Six Sigma projects create strong processes that enhance learning and reduce cost

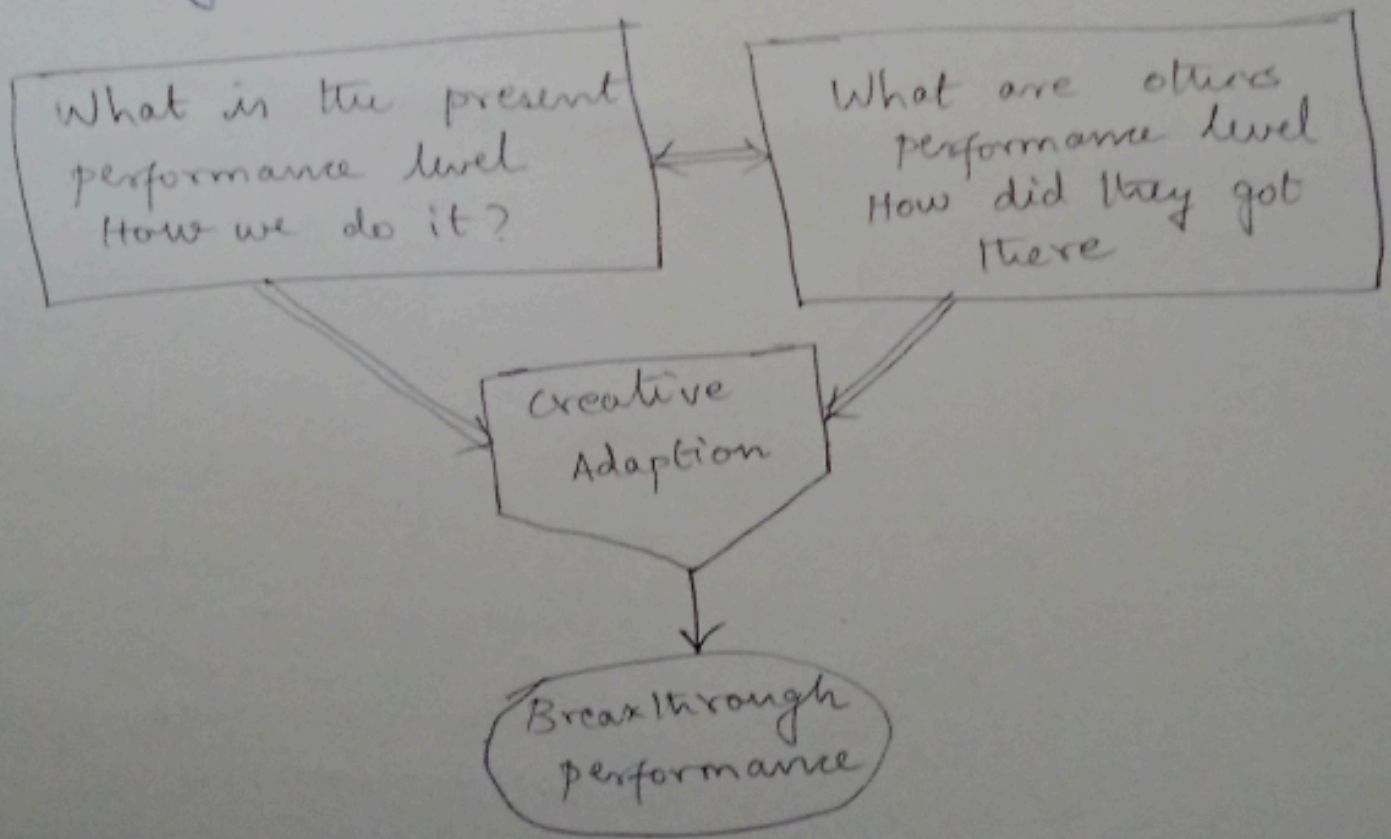
Service sectors transact at customer level. Every customer is different. Six Sigma might not apply to all service processes. with adjustments it can apply to most services

Benefits of Six Sigma to Service Sectors

- Increase profitability - reduce waste
- Improve customer focus
- Generate sustained improvement
- Set direction and goals

Benchmarking

- Art of finding legally how others are doing certain things better than our organisation in order to improve upon their techniques
- Process of identifying, understanding, and adapting outstanding practices and processes from organisations anywhere in the world to an organisation to improve its performance
- Continuous process of measuring products services and practices against the toughest competitors or those companies recognized as industry leaders



Benchmarking Concept

Reason to benchmark

- Benchmarking aims at a goal setting process to facilitate comparison with the best
- It aims at motivating and stimulating company employees towards the goal of continuous quality improvement
- It aims at external orientation of the company
- It aims at identify a technological breakthrough
- It aims at searching for industry best practices

Benchmarking Process

Phases	Step NO.	Steps
Selection of benchmark	1	Earmark what is to be benchmarked
	2	Identify the best competitor
Planning	3	Determine the data collection method & start collecting data
	4	Collect data & understand
Analysis	5	Determine current performance
	6	Project future performance level
Integration	7	Communicate benchmark finding & gain acceptance
	8	Establish functional goals
	9	1) Communicate data ii) Give acceptance
Action		Develop action plans
	10	Implement specific action
	11	Recalibrate benchmark monitor progress
Maturity	12	Attain leadership position
	13	Integrate practices into process

Phase I: Selection & Planning

Step 1: What can be benchmarked?

- Benchmarking is applied to any business
- Determine which functions, tasks within own organisation will be subjected to benchmarking
- Appoint benchmarking team that will pilot the activity within the organisation
- Formulate project goals, determine of data to be collected and prepare a tentative list of questions

Step 2: To whom or what shall we compare

- Identify the world-class companies that have similar production process
- Select the benchmark partners

Step 3: Determine data collection and collect data

- Gather both qualitative & quantitative data about process performance of partners, based on interviews
- Examine the process and underlying working methods of partners

Phase II: Analysis

Step 4: understanding the data

- After collection of data needs to be understood to progress the project

Step 5: Determine the current performance gap

- Determine the gap between performance level of organisation and its benchmark partner

→ Documents the differences in underlying working methods and causes of the differences in performance

Step 6: Project future performance levels

→ Gap is a projection of performance.

Performance will change as industry practices change

Phase III: Integration

— Process of using benchmark findings to get operational targets for change

Step 7: Communicate benchmark findings and gain acceptance

→ Demonstrate the benchmark finding to the management for their acceptance

→ Communicate the benchmark findings to all organisation to obtain support & ownership

Step 8: Establish functional goals

→ Establish goals and achieve them through benchmarking process

Phase IV: Action

Step 9: Develop action plans

* Transform goals into action plans

Step 10: Implement specific action & monitor the process

→ Execute improvement actions

→ Monitor implementation of action

Step 11: Recalibrate benchmarks

Benchmarking is a continuous quality improvement tool, to recalibrate benchmark

Phase V: Maturity

Step 12: Attain leadership position

Step 13: Integrate practices into process

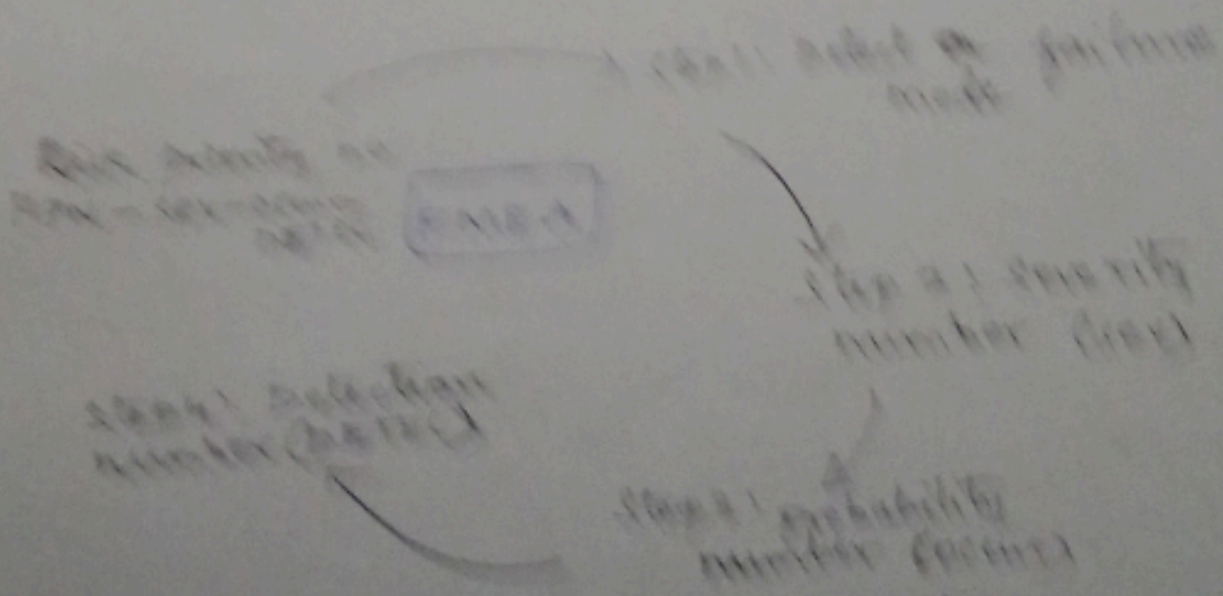
Benefits of benchmarking

- create a culture that values continuous improvement to achieve excellence
- share the best practices between benchmarking partners
- Prioritize the area that needs improvement
- Enhance creativity by devaluing the not-invented here syndrome
- Increase sensitivity to changes in the external environment
- Focus resources thruon' performance target set with employee unit

Failure Mode and Effect Analysis (FMEA)

- Procedure in product development and operations management for analysis of potential failure modes within a system for classification by the severity and probability of failures
- used in manufacturing industries in various phases of product life cycle and used in service industry

The first step in the design of a system is to define the requirements. This involves identifying the user needs and the constraints of the system. The next step is to develop a functional decomposition of the system, which is a hierarchical breakdown of the system into its constituent parts. This is followed by the development of a detailed design, which includes the selection of components and the specification of their interconnections. The final step is the implementation and testing of the system.



Failure: The loss of an intended function of a device under stated conditions

(13)

Failure Mode - The manner by which a failure is observed and it describes the failure occurs

Failure effect - Immediate consequences of failure on operation, function or status of item

Indenture levels - An identifier for item complexity

Local effect - Failure effect as it applies to the item under analysis

End effect - The failure effect at the total system

Failure cause - Defects in design which leads to failure

Severity - consequences of failure mode

Types of FMEA

System FMEA → Analyse component, subsystem & main system in early design

Design FMEA → Analyse product before they are released to manufacturing

Process FMEA → Focus on manufacturing and assembly process

Service FMEA → Analyse service industry process before they are released to impact customer

Equipment FMEA
Maintenance FMEA
Concept FMEA
Environmental FMEA

Stages of FMEA

1. Specifying Possibilities
 - i) functions
 - ii) possible failure modes
 - iii) Root Causes
 - iv) Effects
 - v) Detection/prevention
2. Quantifying Risk
 - i) Possibility of cause
 - ii) Severity of effect
 - iii) Effectiveness of control to prevent cause
 - iv) Risk priority Number (RPN)
3. Correcting high risk causes
 - i) prioritizing work
 - ii) Detailing action
 - iii) Assigning action responsibility
 - iv) check points on completion
4. Re-evaluation of risk
 - i) Re calculation of risk number

FMEA procedure

- Describe product and its function
- create a block diagram of product
- complete the header of FMEA form worksheet
- List product/process function
- Identify failure modes
- Describe potential failure effect
- Establish a numerical ranking for severity of effect
- Identify potential causes of failure

Benefits of FMEA

- Improve product reliability
- Increase customer satisfaction
- Early identification of failure
- Prioritize process deficiency
- Capture engineering knowledge
- Document & track actions to reduce risk
- Provide focus for improved testing
- Act as catalyst for team work

Control charts

- Graph displays data taken over time and the variation of this data.
- It distinguishes between chance and assignable causes of variation in a process.
- It is used to check whether the process is controlled statistically or not.
- It is used to find the natural capability of a production process.
- It is used to evaluate process stability and to decide when to adjust the process.

Types

- * control chart for variables
- * control chart for attributes

control charts for variables

→ Quality characteristics is measured and expressed in specific units of measurements called variables

Types

1) \bar{x} or average chart → used to monitor the centering of process to control its accuracy

2) R or range chart \rightarrow monitors dispersion or precision of the process

3) σ or standard deviation chart \rightarrow shows the variation of process

2) Control charts for attributes

Attributes are quality characteristics that conform to specification.

Types of attributes are

i) attributes whose measurement are not possible
eg: Visually inspected item such as colour scratches etc

ii) attributes whose measurements can be made but are not made because of economy of time, cost

Control charts for attributes \rightarrow monitor the no. of defects or fraction defect rate present in the sample

Types: 1) P-chart - fraction rejected as non-conforming to specification

2) np-chart - for no. of non-conforming items

3) c-chart - for no. of non-conformities

4) u-chart - for no. of non-conformities per unit

P-chart: Quality characteristics of interest is proportion to non-conforming units.

(2)

* Average fraction defective \bar{p} → ratio of no. of defective articles found in any inspection to total no. of articles actually inspected

Average fraction defective $\bar{p} = \frac{\sum np}{\sum n}$; $\sum np$ → Total no. of defectives
 n → no. of items inspected in sub group.

Control line or central line = \bar{p}

Upper control limit $UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

Lower control limit $LCL_p = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

Purpose of P-chart

- To discover, identify and correct bad quality
- To discover, identify and correct the erratic causes of quality improvement
- To discover the average proportion of defectives over a period of time
- To determine average quality level

np chart

→ when subgroup size is variable, P-chart is used

If subgroup size is constant, np-chart is used
np-chart saves one calculation for each sub-group
the division of no. of rejects by subgroup size to get P.

control limit or central line $C_{np} = n\bar{p}$

upper control limit $UCL_{np} = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$

Lower control limit $LCL_{np} = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$

where \bar{p} - average defective fraction = $\frac{\sum np}{\sum n}$

n - no. of items inspected in sub group

Ex. 1. Ten samples of equal size are taken to prepare a p-chart. The total no. of parts in those 10 samples was 1200 and total no. of defects counted was 155. Find centre, UCL & LCL of p-chart.

Sol: Total no. of parts sampled $\sum n = 1200$

Total no. of defects $\sum np = 155$

\therefore Average fraction defective $\bar{p} = \frac{\sum np}{\sum n} = 0.129$

Average sample size $n = \frac{1200}{10} = 120$

centre line $C_{cp} = \bar{p} = 0.129$

upper control limit $UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} = 0.221$

Lower control limit $LCL_p = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} = 0.037$

Ex: 2. The yield of good chips during a certain step in Si processing of ICs averages 91%. The no. of chips per wafer is 200. Determine centre, UCL, LCL for p-chart

(3)

Sol: Percentage defective = $100 - 91 = 9\%$.

$$\bar{P} = 9\% = 0.09$$

Sample size $n = 200$

\therefore centre line $CC_p = \bar{P} = 0.09$

$$\text{Upper control limit } UCL_p = \bar{P} + 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}} = 0.151$$

$$\text{Lower control limit } LCL_p = \bar{P} - 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}} = 0.029$$

Process Capability

\rightarrow It is the minimum spread of specific measurement variation which will include 99.7% of the measurement from the given process.

\rightarrow Process capability = 6σ (natural tolerance)

Purpose: 1) To find whether process is capable of meeting specified tolerance limits

2) To identify why a process 'capable' is failing to meet specifications

Control limit Vs Specification limits

\rightarrow control limits are averages

\rightarrow specifications are permissible variation in the size of part

Procedure

1) calculate the average \bar{x} and range R of each sample.

2) calculate grand average $\bar{\bar{x}}$. This measures centering of the process

- 3) calculate the control limits and plots \bar{x} & R charts
 4) calculate process capability = 6σ

where $\sigma = \frac{\bar{R}}{d_2}$; $\bar{R} \rightarrow$ averages of range
 $d_2 \rightarrow$ statistical factor

This process capability measures the piece to piece variability of the process

Measure of process variability:

- i) Process capability C_p - index compares Variation within the process to specification limit

the higher the number, less variation in the process

* To find C_p ; let USL - upper specification limit
 LSL - lower specification limit

Tolerance = $USL - LSL$; σ - population std. deviation

$$\text{Process capability index } C_p = \frac{\text{Tolerance}}{\text{process capability}} = \frac{USL - LSL}{6\sigma}$$

- i) If $C_p > 1$, Process variation is less than specified
 ii) If $C_p < 1$, Process is not capable of meeting specification
 iii) If $C_p = 1$, Process is just meeting specifications

ii) Process Capability Index C_{pk} :

It measures how close a process is running to its specification limits, relative to target of process

$$C_{pk} = \frac{C_{pk} \min \{ USL - \bar{x} \} \text{ or } (\bar{x} - LSL)}{3\sigma}$$

- a) C_{pk} is always equal to less than C_p value
- b) If $C_{pk} > 1$, process conforms the specification
- c) If $C_{pk} < 1$, process doesn't conform to specification
- d) If $C_{pk} = 1$, process is just meeting specification or critical.

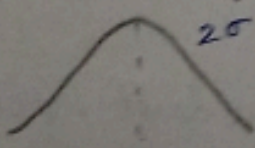
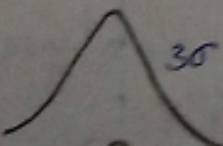
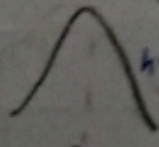
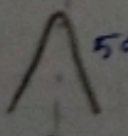
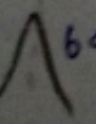
Concepts of Six Sigma:

Process capability ratio $C_p = \frac{\text{Design width}}{\text{Process width}}$

$C_p = \frac{USL - LSL}{UCL - LCL}$; USL - upper specification limit
 LSL - lower specification limit

C_p measures how well the product requirements match with the process capabilities. The higher the value of C_p , better the match between product and process

Process Variability curves

Process Variability	C_p	Total amount outside limits	Typical action to be taken
 2σ	0.67	4.56% (45500 ppm)	Heavy process control, sorting network etc
 3σ	1.0	2700 ppm	Heavy process control inspection
 4σ	1.33	64 ppm	Reduced inspection, selected use of control charts
 5σ	1.67	1 ppm	spot checking, selected use of control charts
 6σ	2	0.001 ppm	Reduced need for control uniformity in process input

Positive Shift - The process level shifts to the positive side, there will be no change in spread, but there will be increase in defects on positive side.

Negative Shift - Process level shifts to the negative side without any change in spread, but increase in defects on negative side

Quality Function Development (QFD)

* planning tool to ensure that the voice of the customers is deployed throughout product planning and design stages

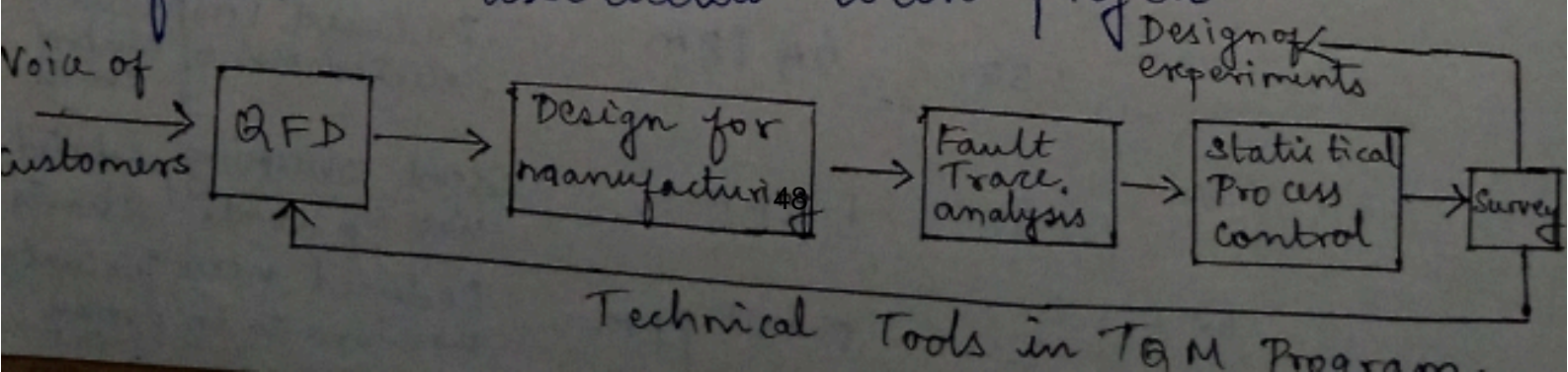
* It is a technique used to document the overall design logic.

* It is a systematic and organized approach of taking customer needs and demands into consideration while designing new products

Objectives:

* To translate customers voice into product specification

* To help in organisation and to analyse all information associated with project.



APD Process

Phase 1: Product Planning

- centered on house of quality
- Define customer wants in relation to product

Phase 2: Parts deployment

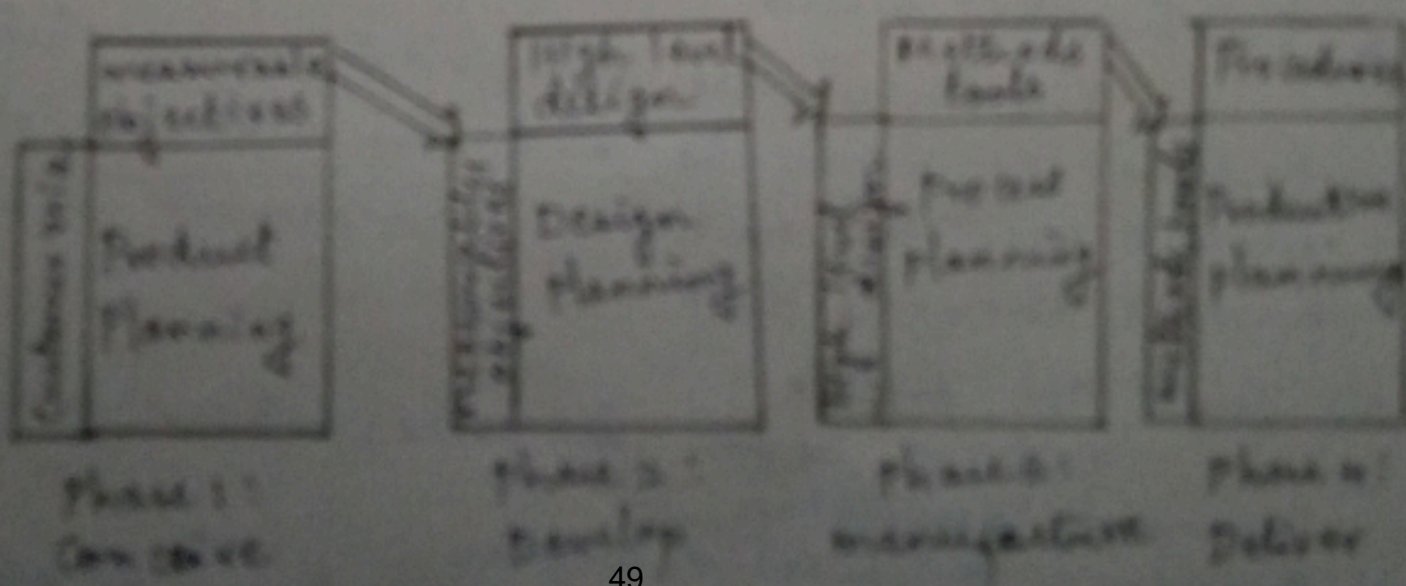
- Product engineering functions
- Design characteristics are transferred to part characteristics

Phase 3: Process Planning

- move from design to manufacturing operations
- Process for improvement is developed
- Involve floor level personnel

Phase 4: Production planning

- Employees on the floor contribute knowledge
- Employees activities interact to achieve customer expectations



House of Quality

- * It is planning tool used in QFD
- * It converts the voice of customer into product design characteristics
- * Uses series of matrix diagrams (quality tables)

Structure of House of Quality

It has 6 sections. They are,

1. Customer requirements

The exterior walls of house are customer requirements. It is a system for translating customer requirement to company requirement

2. Prioritized customer requirements.

It includes customer benchmarking, target value scale up factor etc. and listed on right side.

3. Technical Descriptors

Second floor contains technical descriptors product design characteristics located in this ceiling

4. Relationship matrix

Interior walls are relationship between customer requirements and technical descriptors matrix correlates customer requirements with product characteristics

5. Trade off matrix

Roof of house is interrelationship between technical descriptors

6. Prioritized technical descriptors

Foundation is prioritized technical descriptors Some items are benchmark, target value etc.

Benefits of QFD:

- Promotes team work
- Improves customer satisfaction
- Facilitates better understanding of design intentions,
- Involves manufacturing in the design process
- Concentrates on design effort
- minimizes the no. of engineering changes
- QFD helps in improving productivity & quality.

Taguchi Quality loss function

Taguchi Methods

- developed statistical methods to improve the quality of manufactured goods

Taguchi principle contributions are

- Taguchi's loss function
- Philosophy of offline quality control
- Innovations in design of experiments

Taguchi's loss function

Taguchi defines quality as the "loss imparted by the product to society from the time the product is shipped".

- This loss includes costs to operate, failure to function, maintenance and repair costs, customer dissatisfaction, injuries caused by poor design
- Defective products that are detected, repaired, removed

scrapped before shipment are not considered as part of this loss

→ Suppose specifications for a widget 20 ± 3 mm under traditional manufacturing perspective, if the widget produced is ≤ 17 mm or ≥ 23 mm, then it is discarded

→ Traditional perspective in box shape. Variation gives quality loss cost.

→ The area of customer dissatisfaction is given by 'U' shape curve.

Quadratic Quality loss function

* Quality loss occurs when a product's specifications deviate from target

* If deviation grows, then loss increases

$$L(x) = K(x-N)^2$$

$L(x)$ → loss function

K → constant of proportionality

x → Quality characteristic of selected product

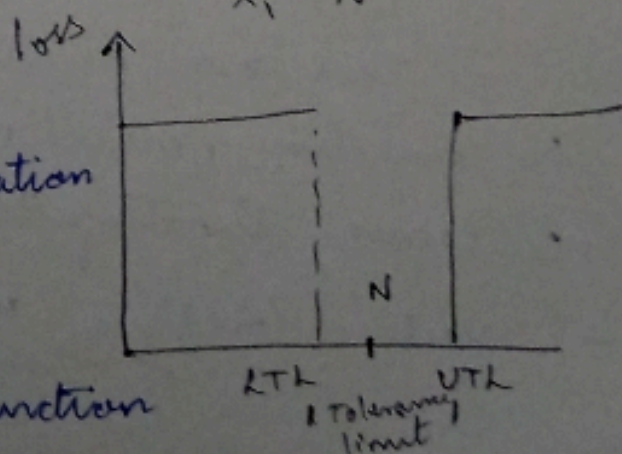
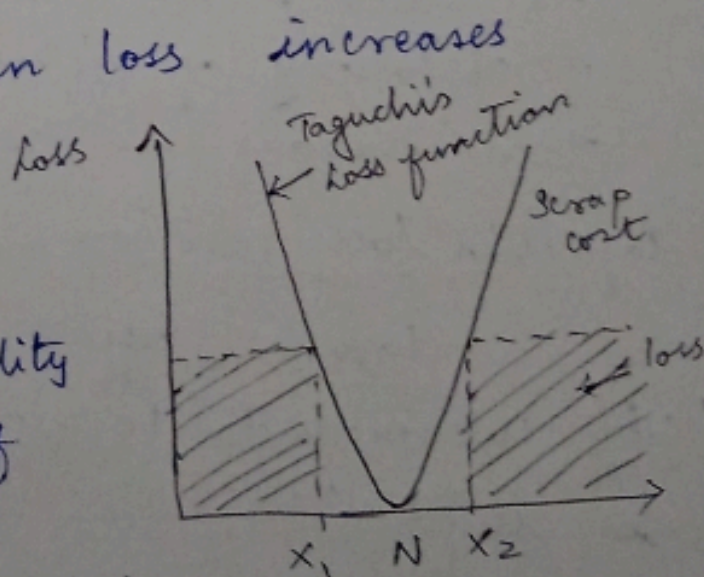
$x-N$ → Tolerance

$$K = \frac{c}{d^2}$$

c → loss associated with specification limit

d → deviation of specification from target value

K → determines slope of quality function



(6)

TPM (Total Productive Maintenance)

- Equipment and process improvement strategy that brings together the various elements of good maintenance programme in order to achieve a higher level of equipment effectiveness.

T (Total) - Everyone from maintenance and production areas working together

P (Productive) - Production of products and services that meet the expectations of customer

M (Maintenance) - Ensure that the plant and equipment are kept in a condition that matches with its original condition

Maintenance - definition:

→ management, control, execution and quality assurance of activities which ensure the achievement of optimum availability and performance of a plant in order to meet business objectives

Types of maintenance

i) Corrective or breakdown maintenance

→ It implies that repairs are made after the failure of machine

→ It says that until a failure occurs and recovers the situation as quickly as possible.

ii) Scheduled or routine³ maintenance

→ strict in time procedure aimed at avoiding breakdown

→ It includes all work undertaken to keep the production equipment in efficient condition

→ Types: i) running maintenance ii) shut down maintenance

iii) Preventive maintenance

→ It is carried out before failure occurs

→ It is safety measure designed to minimize breakdown

iv) Predictive maintenance

→ Equipment condition is measured periodically

→ Extends the service life of equipment without any fear of failure

TPM is systematic execution of maintenance by all employees through small activities

→ the dual goal of TPM - zero breakdown
zero defects

Objectives of TPM:

* To improve equipment effectiveness

* To achieve autonomous maintenance

* To plan maintenance

* To train all staff in relevant maintenance skills

* To achieve early equipped management

* To move towards zero maintenance thru' maintenance prevention camp

Concept and Improvement needs

→ Proper maintenance of all producing facilities is a must for ensuring a productive manufacturing system.

It aims to keep the existing plant and equipment at its maximum productive level with the help of cooperation of all areas in the organisation.

The philosophy of TPM resembles that of TQM in many aspects, such as

- Full commitment to the programme by the top management is necessary
- Employees are to be empowered to initiate corrective action
- TPM is an ongoing process and it will take time to fully implement as concrete results will become a reality only when employee mindset towards their job responsibility is changed.

Steps for TPM development

1. Preparation stage

1. Announce top management about the decision to introduce TPM.

eg: Use statement at TPM lecture in company articles and newspapers.

2. Launch education and campaign to introduce TPM.

eg: Use seminars, slide presentation etc.

3. Create organisation to promote teams
eg: create special committee at top, medium
low levels and assign staff.

4. Establish basic TPM policies and goals
eg: Analyse existing conditions, set goals and
predict results

5. Formulate basic TPM policies and goals.
eg. Prepare detailed implementation plans

2. Preliminary Implementation Stage:

1. Hold TPM Kick off

eg. Invite clients, affiliated and subcontracting
companies

3. TPM Implementation Stage:

1. Improve effectiveness of each piece of equipment
eg: Select model equipment and form project teams

2. Develop an autonomous maintenance programme
eg: Build diagnosis skills and establish worker
certification procedure.

3. Develop a scheduled maintenance programme
for the maintenance department
eg: Include periodic and preventive maintenance
and management of spare parts, tools, blue
prints etc.

4. Conduct training to improve operation
and maintenance skills.

ex: Train leaders together. leaders share information with group members

5. Develop early equipment management programme
eg: Design, commission and control the maintenance prevention programme

4. Stabilization Stage

1. Perfect TPM implementation and raise TPM levels

eg: Evaluate TPM and set higher goals

Improvement Needs:

Let the operators and maintenance technician tell management which machines and systems need the most attention

The following measurements were developed by Japanese and accepted by practitioners: six major loss areas need to be measured and tracked.

Downtime losses

1. Planned

a) Start-Ups

b) Shift changes

c) coffee & lunch breaks

d) Planned maintenance shut downs

2. Unplanned Downtime

- a) Equipment breakdown
- b) change over
- c) Lack of material

Reduced Speed Losses

3. Idling and minor stoppages
4. Slow downs

Poor Quality Losses

5. process nonconformities
6. scrap

These losses are quantified into 3 metrics and can be summarized into one equipment effectiveness metric.

Downtime losses are measured by equipment availability using the equation

$$A = \left(\frac{T}{P} \right) \times 100$$

where A = availability

T = Operating time (P-D)

P = Planned operating Time

D = Downtime

Reduced speed losses are measured by tracking performance efficiency using the equation

$$E = \left(\frac{C \times N}{T} \right) \times 100$$

9

where F - performance efficiency

c - theoretical cycle time

N - processed amount (quantity)

Poor quality losses are measured by tracking the rate of quality products produced using the equation

$$R = \left(\frac{N - Q}{N} \right) \times 100$$

where R - rate of quality products

N - Processed amount (quantity)

Q - non-conformities

Equipment effectiveness is measured as the product of decimal equivalent of the three previous metrics using equation

$$\text{Equipment Effectiveness } EE = A \times E \times R$$

Target for improvement is 85% EE

Problem: Last week's production numbers on machining center J258 were as follows

Scheduled operation = 10 hrs/day ; 5 days/week

Manufacturing downtime due to meetings, material outages, training, breaks and so forth = 410 min/week

Maintenance downtime scheduled and equipment breakdown } = 227 min/week

Theoretical (std) cycle time = 0.5 min/unit

Production for the week = 4450 units

Defective parts made = 15 units

$$P = 10 \text{ hours/day} \times 5 \text{ days/week} \times 60 \text{ min/hr} = 3000 \text{ min/week}$$

$$D = 410 \text{ min/week} + 227 \text{ min/week} = 637 \text{ min/week}$$

$$T = (P - D) = 3000 - 637 = 2363 \text{ min}$$

$$A = \left(\frac{T}{P} \right) \times 100 = \left(\frac{2363}{3000} \right) \times 100 = 78.8 \%$$

$$E = \left(\frac{C \times N}{T} \right) \times 100 = \frac{0.5 \times 4450}{2363} \times 100 = 94.2 \%$$

$$R = \left(\frac{N - B}{N} \right) \times 100 = \left(\frac{4450 - 15}{4450} \right) \times 100 = 99.7 \%$$

$$EE = A \times E \times R = 0.788 \times 0.942 \times 0.997 \\ = 0.74 \text{ or } 74 \%$$

The equipment availability should be improved to reach the goal of 85% equipment effectiveness

Performance measures

The TPM efforts are measured by the factor called overall Equipment Effectiveness (OEE)

Six Big losses

- 1. Breakdowns
- 2. Setup and change over
- 3. Idling and minor stoppages
- 4. Reduced Speed
- 5. Defects and reworks
- 6. Start up losses

Calculation of OEE

$$\text{Availability} = \frac{\text{loading time} - \text{down time}}{\text{loading time}} \times 100$$

eg. Availability = $\frac{460 - 60}{460} \times 100 = 87\%$

$$\text{Performance efficiency} = \frac{\text{Theoretical cycle time} \times \text{no. of units}}{\text{unit}} \times 100$$

ex: per. eff = $\frac{0.5 \times 400}{400} \times 100 = 50\%$

$$\text{Rate of Quality Product} = \frac{\text{Produced quantity} - \text{Defect quantity}}{\text{Produced quantity}} \times 100$$

= $\frac{400 - 5}{400} \times 100 = 98\%$

$$\text{OEE} = \text{Availability} \times \text{Performance efficiency} \times \text{Rate of Quality Product}$$

OEE = $0.87 \times 0.5 \times 0.98 \times 100 = 42.5\%$

Performance measures are required for the manager for managing an organization properly

Performance measures are used to achieve the following objectives

- To establish performance measures framework
- To identify the processes to be improved
- To determine the process gains and losses
- To compare actual performance with standard performance
- > To provide information for individual and team evaluation
- > To determine overall performance of organization
- > To provide information for making superior decisions

What should be measured

Human Resources

1. Lost time due to accidents, absenteeism
2. Employee turn over
3. Employee satisfaction index
4. Training cost per employee
5. No. of grievances

Customers

1. No. of complaints from customers

Performance measures are required for the managers for managing an organization perfectly

Performance measures are used to achieve the following objectives

- To establish performance measures & reveal trend
- To identify the processes to be improved
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What should be measured

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Customers

1. NO. of complaints from customers

Administration

- 1. Revenue per employee
- 2. Purchase order error
- 3. Billing accuracy
- 4. Cost of poor quality

Strategy:

The quality council has the overall responsibility for the performance measures. It ensures that all the measures are integrated into a total system of measures

A typical system contains the following functions
Quality, cost, flexibility, reliability, Innovation

There are six basic techniques for presenting performance measures. They are

- 1. Time Series graph
- 2. Control charts
- 3. Capability Index
- 4. Taguchi's loss function
- 5. Cost of poor quality
- 6. Malcolm Baldrige National Quality Award.

2. NO. of on time deliveries
3. Warranty data
4. Dealer satisfaction

Production

1. Inventory
2. Amount of scrap/rework
3. machine down time

Research and Development

1. New product time to market
2. Design change orders
3. cost estimating errors

Suppliers:

1. On time delivery
2. Service rating
3. Quality performance
4. Average leadtime

Marketing / sales

1. sales expense to revenue
2. New product sales to total sales
3. New customers

⑫
The following five categories are analysed. They are

- a) Manufacturing
- b) Service
- c) Small business
- d) Health care
- e) Education

Unit - V Quality Systems

Introduction:

International Organisation for Standardization (ISO) was founded in 1946, Geneva, Switzerland

- It promotes the development of international standards to facilitate exchange of goods and services
- It is composed of more than 90 member countries
- ISO Technical Committee (TC) 176 developed a series of international standards for quality systems
- The standards (ISO 9000, 9001 & 9004) have universally accepted
- In the United States, standards are published by ANSI / American Society for Quality (ASQ)
- ② 9000 series

Need for ISO 9000

- The American reason for implementing quality system is that customers are suggesting compliance to a quality system
- There are needed improvements in process and a desire for global deployment of products and services

Iso 9000 and other quality systems are needed to achieve improvements and benefits in the following areas:

- To improve internal quality which is measured by percent of scrap, rework and non conformities at final inspection
- To increase production reliability, that is measured by no. of breakdowns per month, percent of time dedicated to emergencies and percent of downtime per shift
- To improve external quality that is measured by product accepted by customers without inspection claims of non conforming product and returned product
- To improve time performance that is measured by time to market, on time delivery and throughput time
- To reduce cost of poor quality that is measured by external non conformities, scrap and rework
- While practicing quality systems, prevention and appraisal cost are increased.

ISO 9001-2008 Quality Systems ⁽²⁾

- The ISO 9000 series of standards is generic in scope
- The series can be tailored to fit any organization needs
- It can be applied to construction, engineering, health care, legal and other professional services as well as manufacturing products
- Its purpose is to unify quality terms and definitions used by industrialized nations

ISO 9001:2000

Requirements in the standard used for registration by demonstrating conformity of the QMS to customers, regulatory and organisation own requirements

ISO 9004:2000

QMS - Guidelines for performance improvement
Provides guidelines that an organization can use to establish a QMS focused on improving performance

ISO 9001 -

Model for quality in design development, production, installation and servicing

↳ specify quality system requirements for use when a contract between two parties requires demonstration suppliers capacity to design a product

ISO 9002

→ Model for quality assurance in production and installation

→ Applicable in situations where the specified requirements of products are stated in terms of established design or specification

ISO 9003 - Model for quality assurance in final inspection and testing

- used for external quality assurance purposes suited for two parties contractual purposes confirmation to specified requirements, is to be assured by suppliers at final inspection and testing.

ISO 9004 - provides guidance on the technical administrative and human factors affecting the quality of products and services at all stages of quality loop from detection of need to the customer satisfaction

ISO 9000 system is used by any industry other system for industries such as automotive or aerospace

As 9100¹: Aerospace industry quality system was released by the Society of Automotive Engineers in May 1997.

- Its development and release represents the first attempt to unify the requirements of NASA while satisfying the aerospace industry's business needs

ISO 9001:2000

- The additions are accepted aerospace approaches to quality practices and general requirements. Aerospace organization in Europe Japan and U.S will registrars and auditors

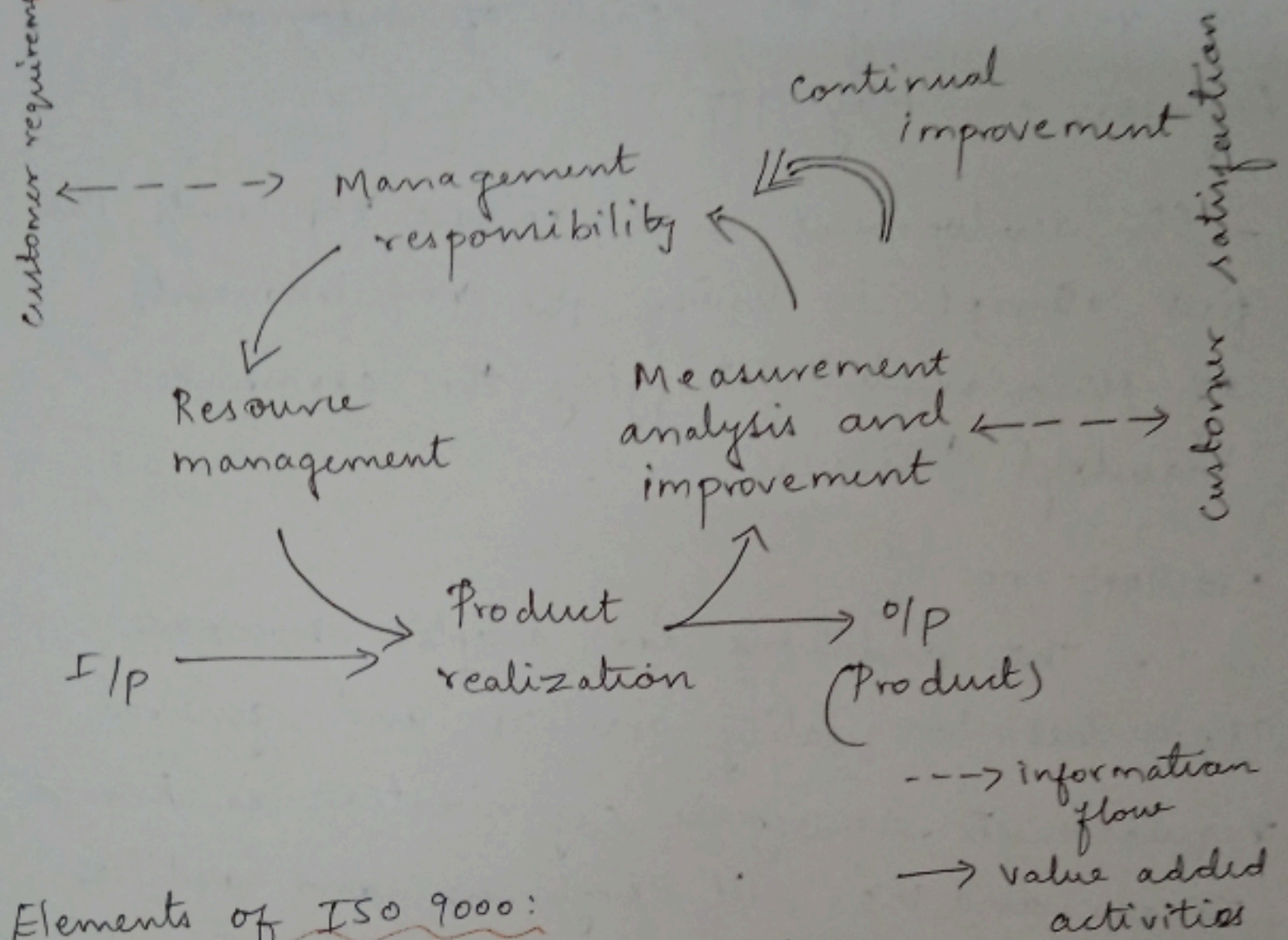
ISO / ITS 16949

It is entitled Quality systems automotive suppliers - Particular requirement for application of ISO 9001

- There are 3 basic needs) ISO 9001
2) sector specific 3) company specific requirements

→ Registrar will need to be certified to the standard and their number will be limited

ISO 9001: 2000 model



Elements of ISO 9000:

(Quality System requirements)

1) Management Responsibility

- Document its quality policy & objectives
- Define responsibility, authority & interrelation of employees
- Provide resources for internal verification activities

2) Quality System

- organization establish and maintain a quality system
- Documentation includes preparation of quality manual, procedure, process work instruction etc.

3) Control review

→ customer requirement should be reviewed to ensure that the supplier is capable in terms of both technical and organizational requirements

4) Design control

→ Design process to be documented and planned correctly

→ Both design inputs and output to be documented

→ Review the design that o/p meets the input requirement

5) Document control

→ Document include quality manual, procedures, instruction etc.

6) Product identification and traceability

→ This lays down the requirement for product to be correctly identified throughout production process

7) Inspection and Testing

Maintain the records of all inspection and tests

1) Receiving inspection and testing

3) In process inspection and testing

4) Final inspection and testing

5) Inspection, Measuring and Test Equipment

- > Identify the measurements to be made
- > select appropriate devices and calibrate it
- > Maintain calibration records

6) Operative and Preventive Action

- > It explains the system for recognizing actual and potential non conformities
- > corrective action includes effective handling of customer complaints

7) Internal Quality audit

- > Describes self evaluation mechanism
- > Verify the effectiveness of quality system
- > Document the audit results and report to managers

8) Training

- > Determine how training needs of personnel are identified

9) Sourcing

- > plan the sourcing
- > maintain the records

ii) In process inspection and testing

iii) Final inspection and testing

8) Inspection, Measuring and Test Equipment

- Identify the measurements to be made
- select appropriate devices and calibrate it
- Maintain calibration records

9) Corrective and Preventive Action

- It explains the system for removing actual and potential non conformities
- corrective action includes effective handling of customer complaints

10) Internal Quality audit

- Describes self evaluation mechanism
- Verify the effectiveness of quality system
- Document the audit results and report to managers

11) Training

- Describe how training needs of personal are identified

12) Servicing

- Plan the servicing
- Maintain the records

Implementation of Quality System

1. Top management commitment

Top management must be willing to commit the resources necessary to achieve certification

2. Appoint the management representative

Representative can be a member of top management group. He is responsible for coordinating the implementation and maintenance of the quality system

3. Awareness

Members should understand the process and implications of ISO programme

4. Appoint an implementation team

→ This team should be drawn from all levels and areas of organisation

5. Training

The implementation team, supervisors and internal audit team should be trained

6. Time schedule:

This develops a time schedule for the implementation and registration of the system

7. select Element owners ^(b)

→ The implementation team selects owners for each system element

8. Review the Present System

→ Copies of all quality manuals, procedures instructions presently in use are obtained.

9. Write the documents

→ Written quality and procedure manuals should be prepared

10. Install the new system

New system is installed

11. Internal audit

It ensures that system is working effectively and to provide management with information

12. Management Review

→ To determine the effectiveness of system to achieve quality goal

13. Pre assessment

→ If good job is done previously no need for pre assessment

14. Registration

→ leading register, relevant application and various units

→ Time depends on size, complexity and no. of units

15. Award of ISO 9000 certificate

→ After accepting application, register will review the quality system

→ Based on satisfactory report of assessment team, ISO certificate will be granted

→ certificate awarded is valid for 3 years

Documentation

Need for documentation

→ It serves as a reference for management staff and other agencies where involvement essential for implementation of quality system

Advantages

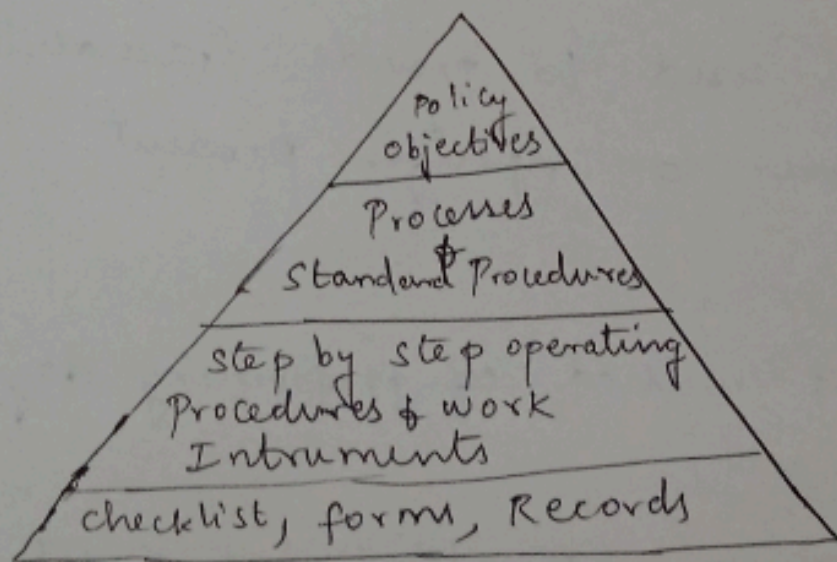
- Documents serve as a reference
- bring about clarity of objective and targets
- provide a common ²⁸distinction
- build confidence among employees

→ generate customers confidence

Documents are

- 1) Quality policy manual
- 2) Quality System Procedures
- 3) Work instructions
- 4) Records/formats/forms

1) Quality Policy manual



- communicates the quality policy and objectives of organisation
- first level of documentation
- this document defines 'what will be done and 'why'

2) Quality System Procedure

- these define who should perform specific tasks, when the task should be done and where documentation will be made.

3) Work Instruction

It gives details of how individual work processes are carried out within a company

4) Records / Formats / Forms

- This provides evidence of activity having been performed in compliance with quality system procedure

- Records are used to provide traceability of actions taken on specific product

Benefits:

- regularize the method of performing day to day activities
- provide formats for standardizing practices
- provide references for assessing degree of enforcement in practice
- Facilitate trouble shooting for tracking back on the processes
- Demonstrate the ISO quality system certification

Quality Auditing

(2)

It is systematic, independent examination and evaluation to determine whether quality activities and results comply with planned arrangements and achieving objectives

Objectives

- To assure the products are fit for use
- To assure the standards & regulations are followed
- To assure that data and records provide accurate information on quality
- To assure that deficiencies are identified and corrective actions are taken
- To follow up the compliance items of audits conducted previously
- Provide opportunity for improvement by giving feedback to the management

Auditor:

- Person who conducts audit.
- must be qualified by the way of training to ensure that they are well versed with auditing principles

Auditing Techniques

1) Examination of documents

→ Auditor examines various documents to check whether the procedure & work instructions are checked and recorded properly.

2) Observation of activities

Auditor sees directly what procedure is being followed when activity is ongoing.

3) Interviews

It requires excellent human relation skills of auditor to collect information from auditees.

Auditing Procedure

Before Auditing activities

a) Audit plan

- The department activities to be audited
- List of records and procedures involved
- Name of audit team
- Person to be informed about audit
- Person to whom audit report be given

b) Check list

prepared to help auditor have control over audit process

It includes

- questions to be asked with sequence
- necessary space to note answers and signs

3) Actual Auditing Activities

a) pre-audit meeting

- previous audit process follows up are reviewed
- minutes of meetings contains members who attend the meeting, details discussed in meeting

b) conducting the audit

- Examination of documents and records
- observation of activities
- Interviewing people and verifying records

c) closing meeting

- Decision is taken regarding time when report is issued
- minutes of meeting is prepared

QS 9000

- It is extension of ISO 9000 system
- QS 9000 used for automotive industry
- It is quality assurance programme for suppliers
- It helps product or service distribution

Steps involved to register QS 9000

1. Define, document, implement and maintain a quality management system
- 2) Manual, procedures, instructions and associated documents are reviewed
- 3) If the document is in order, on site audit is conducted to make sure that people are adopting it

ISO/ITS 16949

- It is an option for automotive supply chain to satisfy customer requirement that may require registration to multiple standard

→ ISO/ITS 16949 certification is recognized globally

→ It encourages use of process approach due to which both product & process quality improve

criteria to get ISO/TS16949 registration

- 1) organisation supplies ISO/TS 16949 subscribing customer
- 2) organisation is anyone tier of automotive supply chain
- 3) organisation perform value added manufacturing process
- 4) organisation is potential supplier to customer

ISO 14000 standards

→ These standards are set of norms for Environment management system either at organisation and process level

The standard are designed to cover

→ Environmental management system

→ Environmental auditing

→ Environmental performance evaluation

→ life cycle assessment

Need for ISO 14000 standards

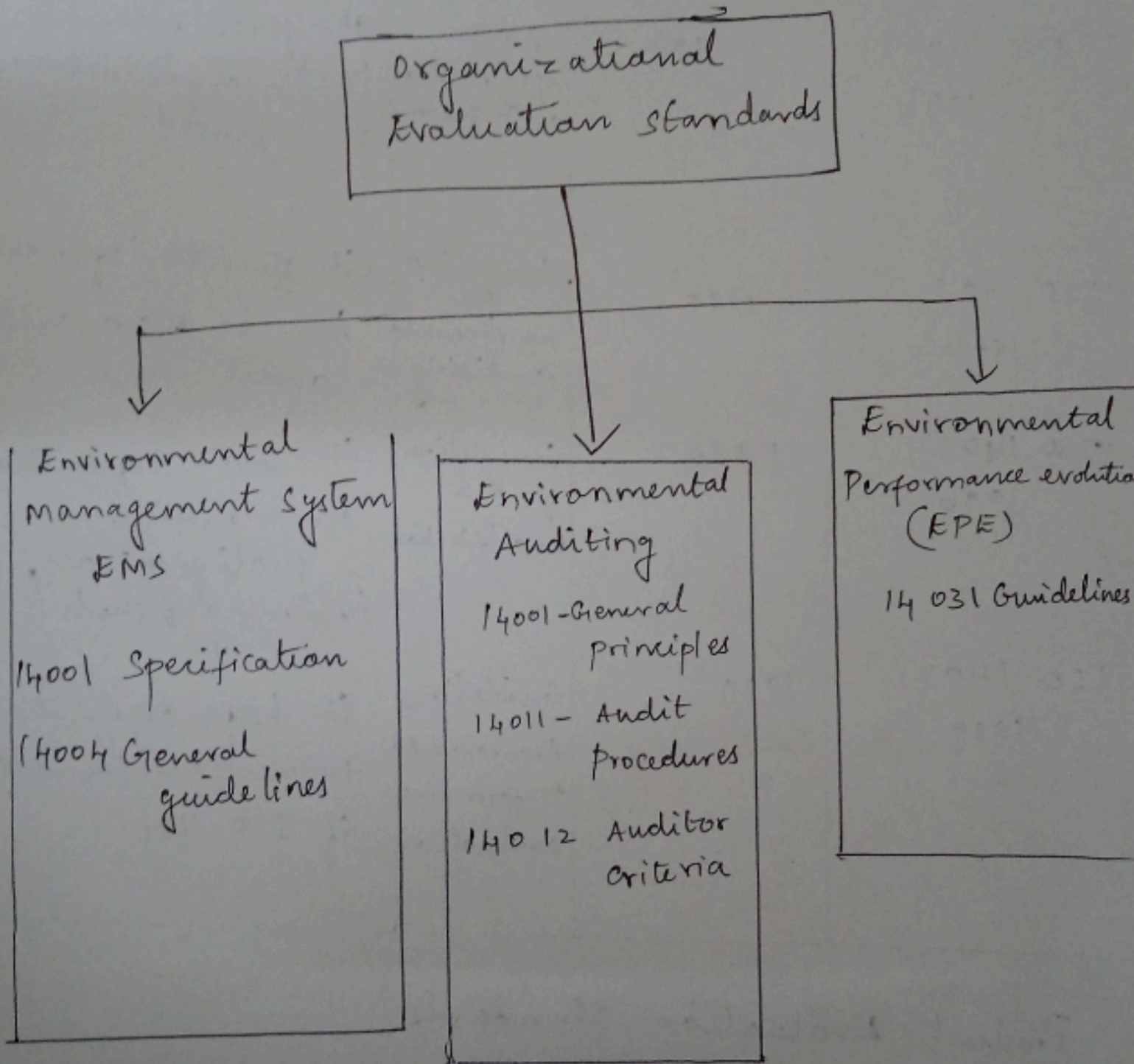
→ It brings focus to environment encouraging a cleaner, safer, healthier world for all

→ company requires environmental management certification to compete in market place

ISO 14000 series

- 1) organisation evaluation standard
- 2) Product evaluation standard

1) Organization evaluation standards



Designation	Publication	Title	Description
ISO 14001 1996	1996	EMS specification with guidance	It gives elements that organisation is required
ISO 14011 1996	1996	Guidelines for environmental auditing	It provides information how to plan and audit
ISO 14012 1996	1996	Guidelines for EA Qualification	It covers information on auditor qualification, training & skills
ISO 14031 1999	1999	Guidelines Environmental performance evaluation	It helps organisation to meet requirements of ISO 14001

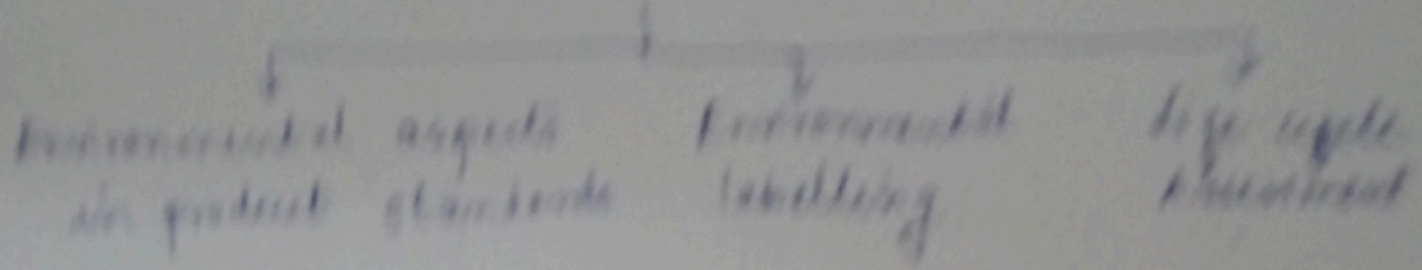
Product Evaluation Standards

Environmental Aspects in product standards
(EAPS)

Environmental Labels and Declaration (ECLD)

Life cycle Assessment (LCA)

(8)
Product
Evaluation
Standards



Guide by EPA
Guide

- 14000 Basic principle
- 14001 Policy objectives
- 14002 Symbols
- 14003 Testing & Verification
- 14004 Third party

- 14000 principle & framework
- 14001 Goals & Definition
- 14002 Impact assessment
- 14003 Environmental assessment

Terminologies used in ISO 14000 Standard

Environment:

Global surroundings includes air, water, land, natural resources, human and interaction

Environment impact:

Any change results from an organization activities products or services

Environmental aspect :

Element of organisation activities, products or services that interact with environment

Environmental objective

An overall environmental goal, arising from policy, statement that an organisation sets for itself

Environment target :

Detailed performance requirement and should be quantified in practical

Requirements of ISO 4000

General requirements

- It establishes and maintains an environmental Management system
- It includes policy, planning, implementation, operation, checking and corrective action and review

Environmental Policy:

- Management commitment to continual improvement

→ prevention of pollution

→ creating framework for setting objectives

Environment Aspects

It explains about environmental aspects and its relationship with environment aspects

Legal Aspects:

It explains the organisation to have a procedure to identify and have access to all legal requirements

Objective and targets

It describes the organisation to establish and maintain objective

Environmental Management Programme

It establish and maintain a program to achieve objective and target

Structure and responsibility

It addresses the roles, responsibility and authority of all personnel affecting EMS

Training Awareness and Competency

It details the training needs to be evaluated to ensure system effectiveness.

Communication

It describes procedure to establish communication with stake holders.

Documentation:

It requires information to maintain core elements.

Operation Control:

It aligns operation with identified environmental aspects.

Emergency preparedness and Response

It describes procedure to identify & respond to potential accidents.

Monitoring & Measuring:

It monitor and measure the key characteristics of objectives and activities.

Records:

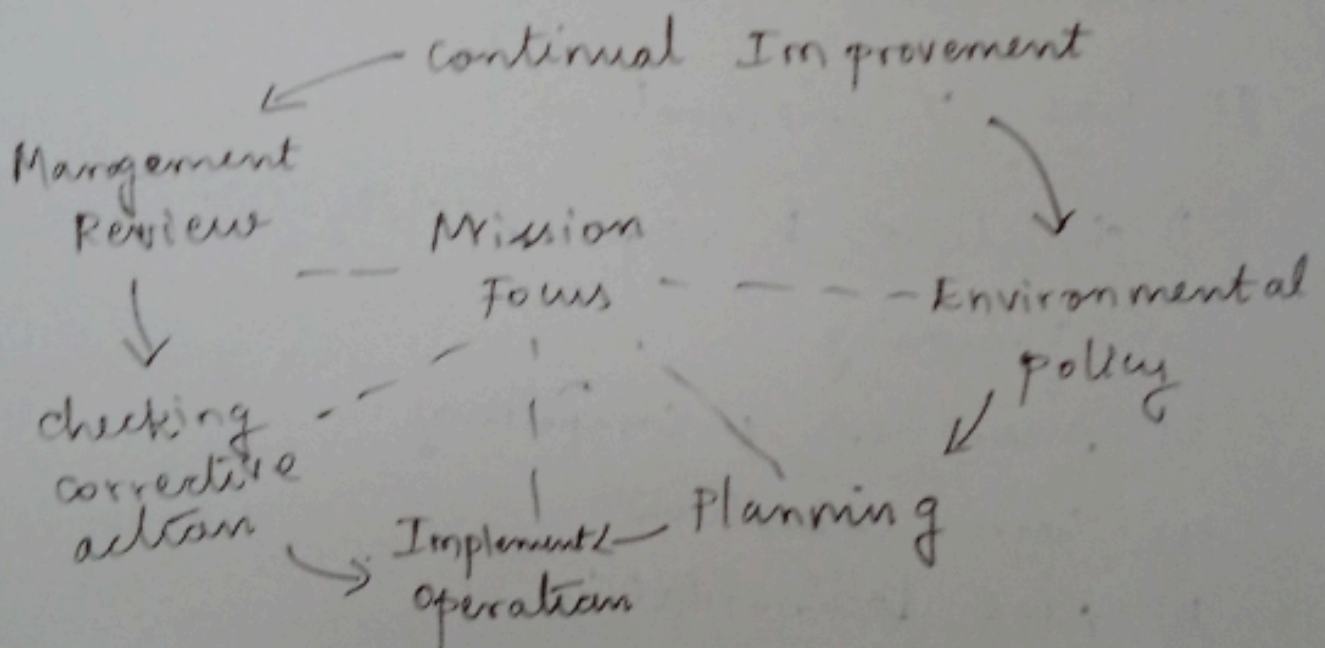
It requires procedure for maintenance and disposition of records.

(14)

Concept of ISO 14000

It consists of 5 stages

- 1) Environmental policy
- 2) Planning
- 3) Implementation & operation
- 4) Checking & corrective action
- 5) Management Review



1) Environmental Policy (EP)

- management commitment to continual improvement
- Prevention of pollution
- create framework for setting objective

2) Planning

It contains 4 elements

- 1) Environmental aspects
- 2) Legal requirement
- 3) Target & objectives
- 4) Environmental management Programmes

3) Implementation and operation

It has 7 elements

- 1) Structure & responsibility
- 2) Training
- 3) Awareness & competency
- 4) Communication
- 5) EMS documentation
- 6) Document control
- 7) operation control

4) checking and corrective action

It contains 4 elements

- 1) Monitoring & measuring
- 2) Non conformance

- 3) corrective & preventive action
- 4) final audit

5) Management Review

- evaluate feedback data and make improvement to the system

Benefits of ISO 14001

* Global benefits

- to facilitate trade and reduce trade barriers
- improve environmental performance
- build consequences for environmental management

Organisation benefits

- satisfying customer requirements
- maintain good relationship with society
- Increase Market
- Reducing incidents result in stability
- conserving input resources
- Improving turnover
- satisfying insurance conditions

TQM implementation in manufacturing & service sectors

- TQM is important in all sectors through business to achieve goal in sectors
- If quality is good it attracts customers
- The productivity depends on quality of product
- The profits depends on productivity
- TQM is implemented in all sectors (i) from security office to all departments
- Service is one part of TQM, since customer satisfaction depends on service parts

TQM is implemented in following area

1. Top Management commitment:
 - most important step to implement quality system is ISO certification
2. Awareness and training:
 - Team and supervisors are trained for job

Documentation :

Implement work instruction for each machine and in a service centre

Continuous improvement:

They have concept of kaizen, 5S and they apply on workspot

Quality Product:

They maintain and service vehicle will all safety aspect