CERTIFICATE

This is to certify that this course material for the subject **Total Quality Management** covers the entire syllabus prescribed by Anna University, Trichy.

Head of the Department

HEAD OF THE DEPARTMENT
DEPARTMENT OF CSE
A.V.C. COLLEGE OF ENGINEERING
MANNAMPANDAL -- 609 305
MAYILADUTHURAI.

Faculty-in-charge

Principal

TOTAL QUALITY MANAGEMENT

UNIT-I INTRODUCTION

TQM is an enhancement to the traditional way of doing business. It is the art of managing the whole to achieve excellence. It is defined both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. It is the application of quantitative methods and human resources to improve all the processes within an organization and exceed customer needs now and in the future. It integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach.

Explanation:

TQM requires that the company maintain the quality standard in all aspects of its business. This requires ensuring that things are done right the first time and that defects and waste are eliminated from operations**.**

Definition of Quality:

The dictionary has many definitions of "quality". A short definition that has achieved acceptance is Quality is Customer Satisfaction. Fitness for use is an alternative short definition. Here, customer means anyone who is impacted by the product or process.

Quality is a predictable degree of uniformity and dependability, at low cost and suited to the market. Quality is a relative term, generally used with reference to the end-use of a product. Quality should be aimed at the needs of the consumer, present and future.

The formula for Quality is

Quality = Performance x Expectations

Quality Costs are defined as those costs associated with the non achievement of product or service quality as defined by the requirements established by the organization and its contracts with customers and society. There are two analysis techniques for Quality Costs;

i. Trend Analysis

ii. Pareto Analysis and the primary categories of Quality cost are. Preventive cost category and Appraisal cost category. And the typical cost bases are. Labor,Production,Unit &Sales.

We determine the optimum cost by

- . Make comparison with other organizations
- . Optimize the individual categories
- . Analyze the relationships among the cost categories

New and Old Cultures:

	Quality Element	TQM
Definition	Product	Customer
Priorities	Service &Cost	Quality
Decisions-	Short	Long
Emphasis-	Detection	Prevention
Errors-	Operations	System
Responsibility	QC	Every Body
Problem	Managers	Teams
Procurement-	Price partners	JIT
Manager's Role	Plan	Delegate
	Assign Enforce	Coach Mentor

Dimensions of Quality

- . Features
- . Conformance
- . Reliability
- . Durability
- . Service
- . Response
- . Aesthetics
- Reputation

❖ Durability- Useful life, include repair.

❖ Service-Resolution of problems, ease of repair.

❖ Response- Human relations with Customers.

❖ Aesthetics-Sensory Features.

❖ Reputation- Past performance, Company Image.

Quality Planning:

The Definition for Quality Planning is

A quality plan sets out the desired product qualities and how these are assessed and define the most significant quality attributes. It should define the quality assessment process. It should set

Out which organizational standards should be applied and, if necessary, define new standards.

The Various quality statements are

- Vision Statement
- Mission Statement
- Quality Policy Statement

Quality policy:

The Quality Policy is a guide for everyone in the organization as to how they should provide products and service to the customers.

The common characteristics are

- Quality is first among equals.
- Meet the needs of the internal and external customers.
- Equal or exceed the competition.
- Continually improve the quality.
- Include business and production practices.
- Utilize the entire work force.
- **Customer-craft quality paradigm**:
  - – design and build each product for a particular customer.
  - – producer knows the customer directly.
- **Mass production and inspection quality paradigm**:
  - focus on designing and building products for mass consumption.
  - larger volumes will reduce costs and increases profits.
  - push products on the customer (limit choices).
  - quality is maintained by inspecting and detecting bad products.
- **TQM or "Customer Driven Quality" paradigm**:
  - potential customers determine what to design and build.
  - higher quality will be obtained by preventing problems

Why Quality Improvement?

- It pays
- Less rework, fewer mistakes, fewer delays, and better use of time and materials
- In United States today, 15 to 20% of the production costs are incurred in finding and correcting mistakes.

Quality Improvement Strategies are:

- . Reduce failure costs by problem solving
- . Invest in the "right" prevention activities
- . Reduce appraisal costs where appropriate and in a statistically sound manner
- . Continuously evaluate and redirect the prevention effort to gain further quality Improvement.

Basic Concepts of TQM:

- A committed and involved management to provide long-term top-to-bottom organizational support.
- An unwavering focuses on the customer, both internally and externally.
- . Effective involvement and utilization of the entire work force.
- . Continuous improvement of the business and production process.
- Treating suppliers as partners.
- . Establish performance measures for the processes.

Historical review:

Guru's of TQM:

- Walter.A.Shewhart -TQC &PDSA
- W.Edwards Deming- 14 Points & PDCA
- Joseph.M.Juran-Juran's Trilogy
- A.Feiganbaum-Customer requirement,CWQC,Employee Involvement, TQC.
- Kaoru Ishikawa-Disciple of Juran & Feigenbaum. TQC in Japan, SPC, Cause &Effect Diagram,QC.
- Philips.B.Crosby. Four Absolutes-Quality-Req, Prevention of NC,Zero Defects & Measure of NC.
- Taguchi.G-Loss Function.
- Philips B Crosby

  Quality is Conformance to requirements
- W.Edwards Deming

  A predictable degree of uniformity and dependability

- Bill Conway
  - Development, manufacture,administration and distribution of consistently low cost and products and services that customers need and want.
  - at low cost and suited to market

Benefits

Improved Quality

Employee Participation

Team Work

Internal & External Customer Satisfaction

Productivity ,Communication

Profitability & Market Share

Principles of TQM:

- ❖ Constancy of purpose: short range and long range objectives aligned Identify the customer(s); Customer orientation
- ❖ Identification of internal and external customers
- ❖ Continuous improvement
- ❖ Workflow as customer transactions
- ❖ Empower front-line worker as leader
- ❖ Quality is everybody's business
- ❖ For a service industry, some elements of quality are:
  - Empathy
  - Trust; i.e. expertise, integrity, courtesy
  - Responsiveness
  - Tangible product attractiveness (curb appeal)
  - Reliability, on time, no interruptions
- ❖ . Customer orientation to customer care services, a marketing perspective
- ❖ . Barriers that exist to a customer orientation

Deming Philosophy:

- ❖ . Create and publish the aim and purpose of the organization
- ❖ . Learn the new philosophy
- ❖ . Understand the purpose of inspection
- ❖ . Stop awarding business based on price alone.
- ❖ . Improve constantly and forever the system.
- ❖ . Institute training.
- ❖ . Teach an institute leadership.
- ❖ . Dry out fear, create trust and create climate for innovation.
- ❖ Optimize the efforts of teams, groups on staff.
- ❖ Eliminate exhortations for the work force.
- ❖ Eliminate management by objective (MOB).
- ❖ Remove barriers that rob people of workmanship.
- ❖ . Encourage education and self improvement for everyone.
- ❖ Take action to accomplish transformation.

Categories of Quality Cost:

Many companies summarize quality costs into four broad categories. They are

a) Internal failure costs - The cost associated with defects that are found prior to transfer of the product to the customer.

b) External failure costs - The cost associated with defects that are found after product is shipped to the customer.

c) Appraisal costs - The cost incurred in determining the degree of conformance to quality requirement.

d) Prevention costs - The cost incurred in keeping failure and appraisal costs to a minimum.

Some times we can also include the hidden costs i.e., implicit costs.

Traditional Quality cost model:

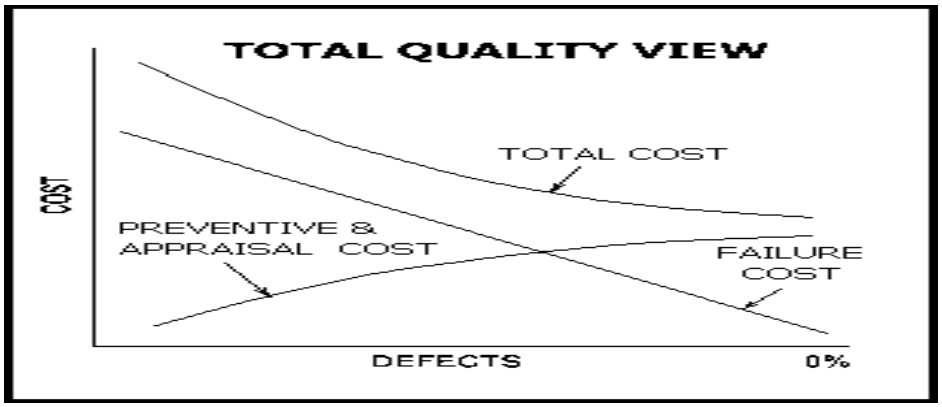


fig.1: **Traditional Quality cost model**

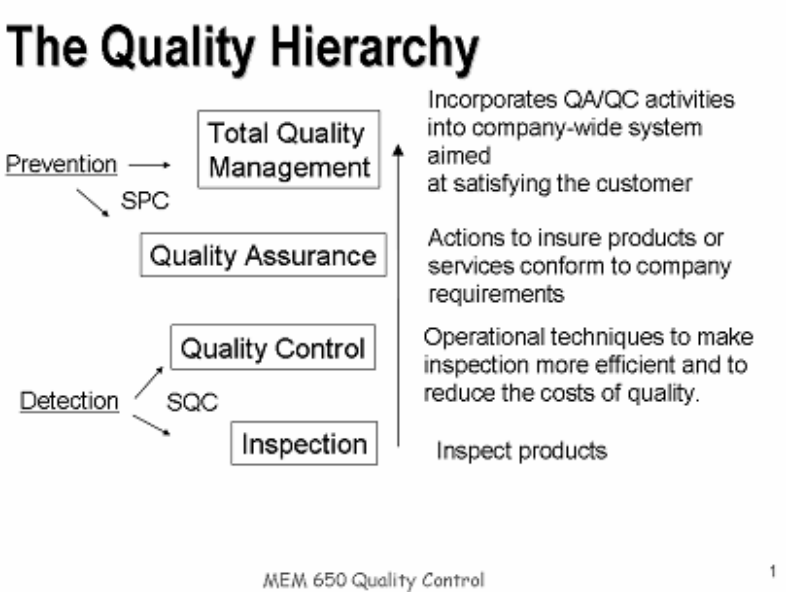
The companies estimate quality costs for the following reasons:

a) To quantifying the size of the quality problem in the language of money improves communication between middle managers and upper managers.

b) To identify major opportunities for cost reduction.

c) To identify the opportunities for reducing customer dissatisfaction and associated

threats to product



salability.

Objectives of TQM:

- To develop a conceptual understanding of the basic principles and methods associated with TQM;
- To develop an understanding of how these principles and methods have been put into effect in a variety of organizations;
- To develop an understanding of the relationship between TQM principles and the theories and models studied in traditional management;
- To do the right things, **right** the first time, every time.

Obstacles associated with TQM Implementation:

- . Lack of management commitment
- . Inability to change organizational culture
- . Improper planning

- Lack of continuous training and education
- Incompatible organizational structure and isolated individuals and departments
- Ineffective measurement techniques and lack of access to data and results.
- Paying inadequate attention to internal and external customers.
- Inadequate use of empowerment and teamwork.

LEADERSHIP

Principles for Effective Leadership:

To be effective, a leader needs to know and understand the following:

- People, paradoxically, need security and independence at the same time.
- People are sensitive to external rewards and punishments and yet are also strongly self motivated.
- People like to hear a kind word of praise.
- People can process only a few facts at a time; thus, a leader needs to keep things simple.
- People trust their gut reaction more than statistical data.
- People distrust a leader's rhetoric if the words are inconsistent with the leader's actions.

Characteristics of Quality Leaders

•Priority Attention to External & Internal Customers

•Empower Subordinates

•Improvement Than maintenance

•Prevention than Cure

•Coordination than Competition among Depts.

•Training & Guide Than Directing& Controlling

Characteristics of Quality Leaders

•Learn from problems

•Communication –Top to lower Mgt- vice versa

•Commitment to Quality

•Suppliers Based Quality not Price

•Organization Structure –Quality

•Encourage Team Work

Leadership Concepts

- **To become successful ,leader requires to understand human Natures, Basic needs, wants and abilities of people**
- **Gives Security & independence, rewards & punishments, word of Habit 1:-Be Proactive ("You are the Creator & In charge).praise, Trust& distrust**

Habit-2 Begin with the end in mind

- **Based on Personal philosophy**
  - **Honesty**
  - **Positive Attitude**
  - **Remember the people**
  - **Sense of humor**
  - **Do not fear mistakes**
  - **Encourage Subordinates**
  - **Read Books for leadership Developments**

The following table shows the habit 1 Be Proactive

Reactive	Proactive
There is nothing I can do	Let's Look at our alternatives
She makes me so mad	I control my feelings
I have to do that.	I will choose proper response
I can't	I choose
I must	I prefer
Things are getting worse	What initiative can we use ?

Table 1: Be Proactive

Habits-3Put first Things First (Self Management

Habit-4 Think Win Win

(Benefit all Human Interactions)

Four step process

- **See the Problem From Others View.**
- **Identify Key Issues.**
- **Determine & Analyze Results.**
- **Seek New Options To Achieve Results.**

<u>Habit-5 Seek First to understand, then to be Understood</u>

- **Empathic Listening to what others SAY**
- **Understand Person's Emotions & Intellectual ,Credit or Character.**

Habit-6 Synergy (Whole >Parts)

- **Team Achieves More Than Individual Efforts**

- **Habits 5 Integrates towards Habits 6**

- **Coordination & Understanding Reaches Better Solutions.**

Habit-7 Sharpen the Saw (Renewal)

Four Dimensions personal Nature

- **Physical –Good nutrition, Rest &Relaxation**
- **Spiritual- Prayer, Meditation &Spiritual Reading**
- **Mental – Reading, seminars, & Writings**
- **Social/Emotional –Our Relationship with others.**

Ethics

•Ethics is body of principles of human conduct that govern the behavior of individuals & organizations.

•Ethics Means something different to Different People, especially International Workforce & Vary Culture.

Ethics Management Program

- **Three Steps in EMP**

- **Appraisal** -The analysis of the costs associated with unethical behaviour.

- **Prevention** - The development of a system that will minimize costs.

- **Promotion** - The continuous advertising of ethical behaviour in order to develop an Organizational Culture.

Role of senior management:

- Listening to internal and external customers and suppliers through visits, focus
  - Groups and surveys.
- Communication.
- To drive fear out of the organization, break down barriers, remove system
  - roadblocks, anticipate and minimize resistance to change and in general,
  - Change the culture.

Quality Council:

In order to build quality in the culture, a quality council is established to provide overall direction. It is the driver for the TQM engine. In a typical organization the quality council is composed of the chief executive officer (CEO); the senior managers of the functional areas, such as design, marketing, finance, production, and quality; and a Coordinator or consultant.

General duties of a quality council:

(i) Develop, with input from all personnel, the core values, vision statement, Mission statement and quality policy statement.

(ii) Develop the strategic long-term plan with goals and the annual quality improvement program with objectives.

(iii) Create the total education and training plan.

(iv) Determine and continually monitor the cost of poor quality.

(v) Determine the performance measures for the organization, approve those for the functional areas, and monitor them.

(vi) Continually, determine those projects that improve the processes, particularly those that affect external and internal customer satisfaction.

(vii) Establish multifunctional project and departmental or work group teams and monitor their progress.

(viii)Establish or revise the recognition and reward system to account for the new way of doing business.

Agenda Preparation:

Contents of an Agenda:

- Progress report on teams
- . Customer satisfaction report
- . Progress on meeting goals
- . New project teams
- . Recognition dinner
- . Benchmarking report

Basic steps to strategic quality planning:

- Customer needs
- Customer positioning
- Predict the future
- Gap analysis
- Closing the gap
- Alignment
- Implementation

QUALITY STATEMENTS:

- **Mission statement**

The mission statement answers the following questions: who we are, who are the customers, what we do, and how we do it.

- **Vision statement**

The vision statement is a declaration of what an organization should look like five to ten years in a future.

Barriers to TQM Implementation:

Various obstacles associated with the Implementation are

- Inadequate organization structure
- Inefficient training
- Inadequate organization culture
- Inefficient communication
- No union among the team members
- No continuous improvement
- Inefficient leader

UNIT –II TQM PRINCIPLES

Customer Satisfaction:

Customers are important asset to the organization, satisfied customers will buy more, and buy more frequently, and pay their bill promptly. In a manufacturing and service organization, customer satisfaction is considered as a measure of quality. TQM implies an organizational drive with meeting or exceeding customer needs. Understanding the customer's needs and expectations is essential to winning new business. To attain this level, the organization should examine their quality system to respond to their ever changing customer's needs.

A simple definition of customer satisfaction is illustrated below defines the Teboul Model;

Teboul Model:

A simple definition of customer satisfaction is illustrated below defines the Teboul Model

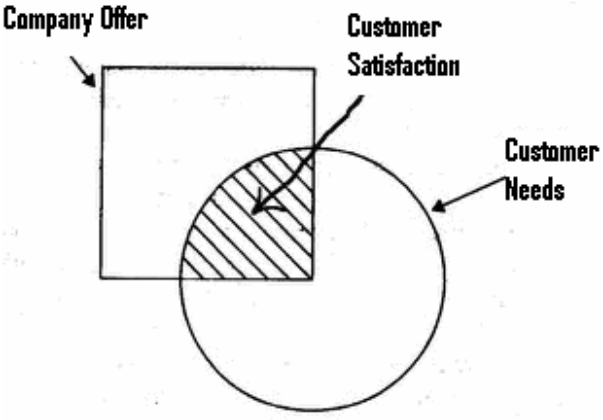


Fig .2 - Teboul Model

In this above figure Square depicts the company offer and the circle represents the Customer Needs. Total satisfaction is achieved when the offer matches the need or the circle is super imposed on the Square.

Characteristics of Customer Satisfaction:

1 .It is far from simple.
2 . It is not an objective statistic, but more of feeling and attitude.
3. It is subjective by nature.
4. It is difficult to measure.
5. The measurement of customer satisfaction is not precise.
6. The customer satisfaction should not be viewed in vacuum, i.e., it should be compared with the level of satisfaction they have with competitor's product are service

Types of customers:

1. Internal customers - each of them receives a product or service and in exchange, providers a Product or service.

2. External customers - one who uses the product or service, the one who purchase the product, or the who influences the sale of the product.

One basic concept of TQM is focus on customers, both internal and external.

Customer perception of quality:

In an organization there is no acceptable quality level because the customer's needs, values and expectations are constantly changing and becoming more demanding. An American Society for Quality (ASQ) survey reveals the following end-user perception of quality is

1.Performance
2.Features
3.Service
4.Warranty
5.Price
6.Reputation

Today customers are ready to pay a higher price to obtain value. Therefore it becomes increasingly important for an organization to identify, verify, and update each customer's perception of value against those of its competitors.

CUSTOMER COMPLAINTS:

Unlike the customer's feedback the customer complaints are reactive, and they are important in gaining data on customer perceptions. An unsatisfied customer can easily become a lost customer because of their frustrations. This customer unsatisfaction becomes a measure for an organizational process improvement measures.

Every single complaint should be accepted, analyzed, and acted upon to again win over customer's confidence. Since more than 50% of the unsatisfied customers will buy again if they are complaint has been heard and resolved. By adopting a positive approach the complaints can be seen as an opportunity to obtain information and provide a positive service to the customer.

HANDLING THE CUSTOMER COMPLAINTS:

1. Investigate customer's experiences by actively receiving the customer feedback and then acting promptly.
2. Develop procedures for complaint resolution that include empowering front-line employee.
3. Analyze complaints; try to put them in a category for speedy response.
4. Work to identify process and material variations and then eliminate the root cause, inspection is not a corrective action.
5. After receiving the response, a senior manager should contact the customer and strive top Resolve the concern
6. Establish customer satisfaction measures and constantly monitor them.
7. Communicate complaint information, as well as the results of all inquiries and solutions, to all people in the organization.
8. Provide a monthly complaint report to the quality council for their evolution and if needed, the assignment of process improvement teams.
9. Identify customer's expectations in advance rather than afterward through complaint

SERVICE QUALITY:

Customer service is the set of activities of an organization uses to win and retain customers' satisfaction. It can be provided before, during and after the sale of the product.

Elements of customer service are:

Organization

1. Identify each market segment;
2. Write down the requirements;
3. Communicate the requirements;
4. Organize processes;
5. Organize the physical spaces;

Customer care

6. Meet the customer's expectations;
7. Get the customer point of view;
8. Deliver what is promised;
9. Make the customer feel valued;
10. Respond to all complaints;
11. over respond to the customer;
12. Provide a clean and comfortable customer reception environment;

Communication

13. Optimize the trade for between time and personal attention;
14. Minimize the number of contact points;

15 provide pleasant, knowledgeable, and enthusiastic employees;

16. Write documents in customer friendly language;

Front-line people

17. Hire people who like people
18. Challenge them to develop better methods.
19. Give them a authority to solve problems
20. Serve them as internal customers
21. be sure they are adequately trained.
22. Recognize and reward performance.

Leadership

23. Lead by example
24. Listen to the front line employee
25. Strive for continuous process improvement.

Activities to be done using customer complaints:

- Investigate customer's experience both positive and negative, and then acting on it promptly.
- Develop procedures for complaint resolution.
- Analyze complaints.
- Work to identify process and material variations and then eliminate the root cause.
- When a survey response is received, a senior manager should contact the customer and strive to resolve the concern.
- Establish customer satisfaction measures and constantly monitor them.
- Communicate complaint information, as well as the results of all investigations and solutions, to all people in the organization.
- Provide a monthly complain report to the quality council.
- Identify customer's expectations beforehand rather than afterward through complaint analysis.

Elements of customer service:

- Organization
- Customer care
- Communication
- Front-line people
- Leadership

CUSTOMER RETENTION:

Customer retention represents the activities that produce the necessary customer satisfaction that creates customer loyalty, which actually improves the bottom line. It is the nexus between the customer satisfaction and the bottom line.

Customer retention moves customer satisfaction to the next level by determining what is truly important to the customers and making sure that the customer satisfaction system focuses valuable resources on things that are important to the customer. Customer retention is the connection between customer satisfaction and the bottom line. World-class companies know that continuous improvement and customer satisfaction should go hand-in-hand. Improved service to the customer is a costlier affair, so an organization must determine its return on the service investment. For this the important service elements that significantly improve revenues and market share should be determined.

One survey indicates, it requires five times of effort to win a new customer than retaining a present customer. In this context customer retention is important for organizational success.

EMPLOYEE INVOLVEMENT:

Employee involvement is a means to better meet the organization's goals for quality and productivity at all levels of an organization.

Employee involvement is one approach to improve quality and productivity. It is not a replacement for management nor is it the final word in quality improvement; it aims at better meeting of organizational goals at all levels.

Japanese management emphasizes the need to consider employee as a valuable resources rather than treating them as a mere tools for production. Motivation Knowledge for motivation helps us to understand the utilization of employee involvement to achieve process improvement.

THEORIES OF MOTIVATION:

Theory of motivation has five levels. These are survival, security, social, esteem, and self-actualization. The following figure illustrates the Maslow's Hierarchy of Needs. It is important to note that as employees move up the hierarchy, they will immediately revert back to the previous level if they feel threatened.

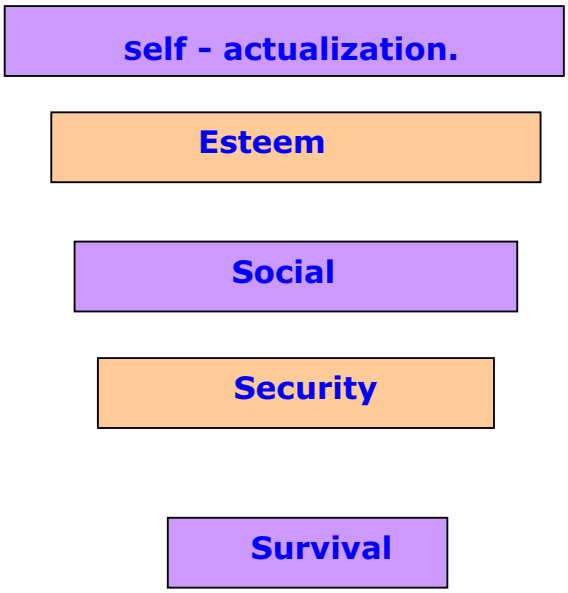
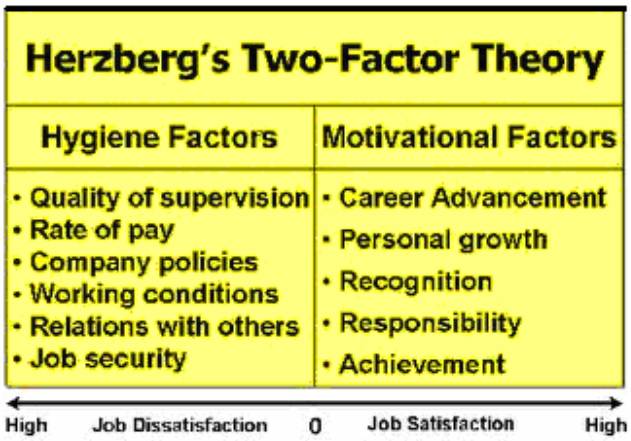


Fig .3 illustrates the Maslow's Hierarchy of Needs

HERZBERG'S TWO FACTOR THEORY:

Herzberg extends the Maslow's theory by using empirical research on employee motivation.



Hertzberg found that people were motivated by the motivators (intrinsic factors) like recognition, responsibility, achievement, advancement and the work itself. In addition he found that bad feelings were associated with preventable un satisfiers or hygiene factors (extrinsic factors) like low salary, minimal fringe benefits, poor working conditions, ill-defined organizational policies and mediocre (ordinary) supervision.

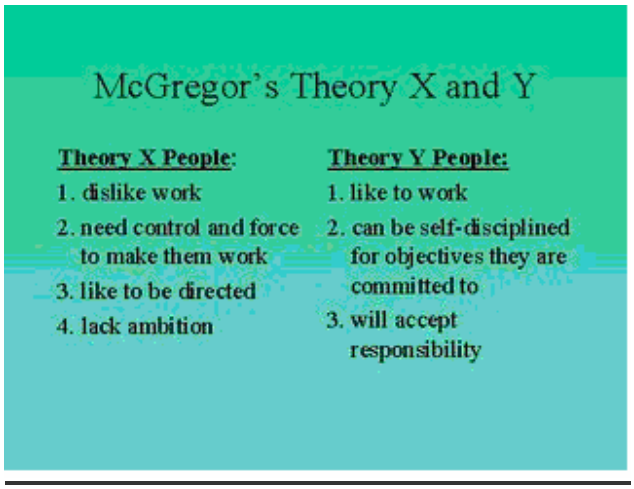
He also explained that the presence of extrinsic factors(for example good working condition) does not produce any motivation but their absence will create un satisfaction among employees. In a same manner the absence of intrinsic factors (for example advancement) does not produce any un satisfaction but their presence will provide strong level of motivation.

Needs of an employee:

- Interesting work
- Appreciation
- Involvement
- Job security
- Good pay
- Promotion/growth
- Good working conditions

- Loyalty to employees
- Help with personal problems
- Tactful discipline

McGregor's Theory X and Theory Y:



How to motivate work force:

1. **Know thyself**
2. **Know your employees**
3. **Establish a positive attitude**
4. **Share the goals**
5. **Monitor progress**
6. **Develop interesting work**
7. **Communicate**
8. **Celebrate success**

EMPOWERMENT:

The dictionary meaning of the term empowerment is to invest people with authority. Its purpose is to tap the enormous potential that lies within every worker. An operational definition is as follows:

Empowerment is an environment in which people have the ability, the confidence, and the commitment to take the responsibility and ownership to improve the process and initiate the necessary steps to satisfy customer requirements within well defined boundaries in order to achieve organizational values and goals.

Empowerment is nothing unusual; people generally want to be more in charge of their own jobs and carriers. After all, they do that successfully in their personal lives every day. Most people appreciate and value the trust and responsibility. This empowerment helps greatly in eliminating resistance to changes.

Empowerment is different from delegation or job enrichment, which means distributing or entrusting work to others. In empowerment employee is held responsible for accomplishing a whole task. i.e., employee becomes process owner, thus not only responsible but also accountable.

Three conditions are necessary for empowering employees:

1. Everyone must understand the need for change
2. The system needs to change to the new paradigm(model/standard)
3. The organization must enable its employees.

TEAMS:

Teams are very effective in solving all quality and productivity problems. Team is defined as a group of people working together to achieve common objectives or goals.

Teamwork is the cumulative actions of the team during which each member of the team subordinates his interests and opinions to fulfill the objectives or goals of the group. Many heads are better than one, especially in meeting ever-changing customer needs.

Each member of the team have special ability that can be used for the problem. Many

processes are so complex that one person cannot able solve completely. Based on the synergic effect, whole is greater than sum of its parts. Team work is better than sum of its member contribution.

Team builds a rapport with each other that allows everyone to do a better job. Teams provide the vehicle for improved communication.

Types of teams:

- Process improvement teams
- cross-functional teams
- natural work teams
- self-directed/ self managed teams

Characteristics of successful teams :

- Sponsor
- Team charter
- Team competition
- Training
- ground rules
- clear objectives
- accountability
- well-defined decision procedures
- resources
- trust
- effective problem solving
- open communication
- appropriate leadership
- balanced participation
- Cohesiveness.

Various decision-making methods in a Team:

- Non decision
- Unilateral decision
- Handclasp decision

- Minority-rule decision
- Majority-rule decision
- Consensus

Various Stages of team development:

- Forming
- Storming
- Norming
- Performing
- Adjourning
-

Various Common team problems:

- Floundering
- Overbearing participants
- Dominating participants
- Reluctant participants
- Unquestioned acceptance of opinions as facts
- Rush to accomplish
- Attribution
- Discounts and “plops”
- Wanderlust : digression and tangents
- Feuding team members

Various Common barriers to team progress:

- Insufficient training
- Incompatible rewards and compensation
- First-line supervisor resistance
- Lack of planning
- Lack of management support
- Access to information systems
- Lack of union support

Various Common steps involved in training process:

1st. Make everyone aware of what the training is all about.

2nd. Get acceptance.

3rd. Adapt the program.

4th. Adapt to what has been agreed upon.

Recognition and Reward:

Recognition is a form of employee motivation in which the organization Publicly acknowledges the positive contributions an individual or team has made to the success of the organization.

Reward is something tangible to promote desirable behavior. Recognition and reward go together to form a system for letting people know they are valuable members of the organization.

FEEDBACK:

Important factors that influenced purchases:

- Performance
- Features
- Service
- Warranty
- Price
- Reputation

Need for a feedback in an organization:

- Discover customer unsatisfaction.
- Discover relative priorities of quality.
- Compare performance with the competition.
- Identify customer's needs.
- Determine opportunities for improvement.

Tools used for feedback:

- Comment cards
- Surveys
- Focus groups
- Toll-free telephone lines
- Customer visits
- Report cards
- The internet
- Employee feedback
- American Customer Satisfaction Index

Various Types of appraisal formats:

- Ranking
- Narrative
- Graphic
- Forced choice

EMPLOYEE INVOLVEMENT:

Employee Involvement improves quality and increases productivity because employees make better decisions, employees are more likely to implement and support decisions they had a part in making. Employees are better able to spot and pinpoint areas for improvement.

Employees are better able to take immediate corrective action. Employee involvement reduces labor/management hassle by more effective communications and cooperation. Employee involvement increases morale by creating a feeling of belonging to the organization.

Employees are better able to accept change because they control the work environment. Employees have an increased commitment to unit goals because they are involved.

CONTINUOUS PROCESS IMPROVEMENT

Various basic ways for a continuous process improvement:

- Reduce resources
- Reduce errors
- Meet or exceed expectations of downstream customers
- Make the process safer
- Make the process more satisfying to the person doing it.

Various phases of a Continuous Process Improvement Cycle:

a) Identify the opportunity

b) Analyze the process

c) Develop the optimal solutions

d) Implement

e) Study the results

f) Standardize the solution

g) Plan for the future

Various components of the Juran Trilogy:

- Planning
- Control
- Improvement

Various steps in the PDSA cycle:

The basic Plan-Do-Study-Act is an effective improvement technique.

- Plan carefully what is to be done
- Carry out the plan
- Study the results
- Act on the results by identifying what worked as planned and what didn't.

Important steps for employee involvement in doing a process:

- Employee empowerment
- Customer retention
- Recognition and reward
- . Performance appraisal
- Motivation

Kaizen &5S:

Kaizen is a Japanese word for the philosophy that defines management's role in Continuously encouraging and implementing small improvements involving everyone. It is the Process of continuous improvement in small increments that make the process more efficient, Effective, under control and adaptable

5S Philosophy focuses on effective work place organization and standardized work procedures. **5S** simplifies your work environment, reduces waste and non-value activity while improving quality efficiency and safety.

Sort – (Seiri) the first S focuses on eliminating unnecessary items from the workplace.

Set In Order (Seiton) is the second of the 5Ss and focuses on efficient and Effective storage methods.

Shine: (Seiso) Once you have eliminated the clutter and junk that has been Clogging your work areas and identified and located the necessary items,the next step is to thoroughly clean the work area.

Standardize: (Seiketsu) Once the first three 5S's have been implemented, you should concentrate on standardizing best practice in your work area.

Sustain: (Shitsuke) This is by far the most difficult S to implement and achieve. Once fully implemented, the 5S process can increase morale, create Positive impressions on customers, and increase efficiency

PARTNERING RELATIONSHIP:

Various conditions for the selection and evaluation of suppliers:

I. The supplier understands and appreciates the management philosophy of the Organization.

II. The supplier has a stable management system.

III. The supplier maintains high technical standards and has the capability of dealing with future technological innovations.

IV. The supplier can supply precisely those raw materials and parts required by the Purchaser, and those supplied meet the quality specifications.

V. The supplier has the capability to produce the amount of production needed or can attain that capability.

VI. There is no danger of the supplier breaching corporate secrets.

VII. The price is right and the delivery dates can be met. In addition, the supplier is easily accessible in terms of transportation and communication.

VIII. The supplier is sincere in implementing the contract provisions.

IX. The supplier has an effective quality system and improvement program such as ISO/QS 9000.

X. The supplier has a track record of customer satisfaction and organization credibility.

Important three key elements to a partnering relationship:

- ❖ Long-term commitment
- ❖ Trust
- ❖ Shared vision

Important three types of sourcing:

- ❖ Sole sourcing
- ❖ Multiple sourcing
- ❖ Single sourcing

Important four phases of inspection

- ❖ 100% inspection
- ❖ Sampling
- ❖ Audit
- ❖ Identity check

Important objectives of Performance measures:

i. Establish baseline measures and reveal trends.
ii. Determine which processes need to be improved.
iii. Indicate process gains and losses.
iv. Compare goals with actual performance.
v. Provide information for individual and team evaluation.
vi. Provide information to make informed decisions.
vii. Determine the overall performance of the organization.

Important characteristics used to measure the performance of a particular process:

i. Quantity
ii. Cost
iii. Time
iv. Accuracy
v. Function
vi. Service
vii. Aesthetics

Important Six basic techniques for presenting performance measures:

a) Time series graph
b) Control chart
c) Capability index
d) Taguchi's Loss Function
e) Cost of poor quality
f) Malcolm Baldrige National Quality Award

Important Usage of an effective recognition and reward system:

- Serves as a continual reminder that the organization regards quality and productivity as important.
- Offers the organization a visible technique to thank high achievers for outstanding performance.
- Provides employees a specific goal to work toward. It motivates them to improve the process.
- Boosts morale in the work environment by creating a healthy sense of competition among individuals and teams seeking recognition.

Various typical measurements frequently asked by managers and teams:

- Human Resource
- Customers
- Production
- Research & Development
- Suppliers
- Marketing/Sales Administration

Important factors to improve the performance appraisal system:

- Use rating scales that have few rating categories.
- Require work team or group evaluations that are at least equal in emphasis to individual-focused evaluations.
- Require more frequent performance reviews where such reviews will have a dominant emphasis on future planning.
- Promotion decisions should be made by an independent administrative process that draws on current-job information and potential for the new job.
- Include indexes of external customer satisfaction in the appraisal process.
- Use peer and subordinate feedback as an index of internal customer satisfaction.
- Include evaluation for process improvement in addition to results.

UNIT-III - STATISTICS PROCESS CONTROL

Statistics is defined as the science that deals with the collection, tabulation, analysis, interpretation, and presentation of quantitative data. A measure of central tendency of a distribution is a numerical value that describes the central position of the data or how the data tend to build up in the center. There are three measures in common in use in quality via the average, the median and the mode.

Measures of dispersion:

Measures of dispersion describe how the data are spread out or scattered on each side of the central value. The measures of dispersion used are range and standard deviation.

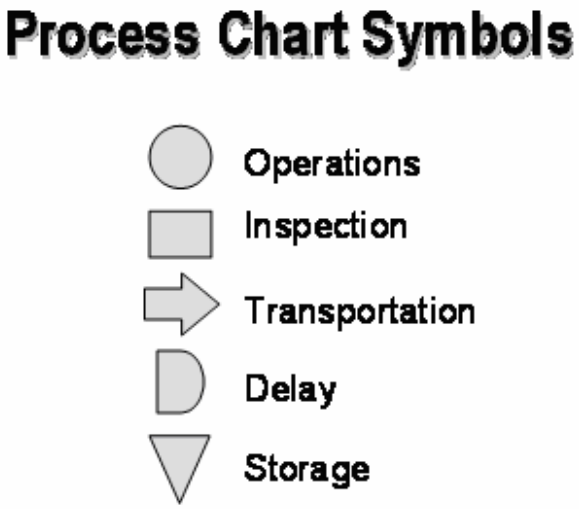
Normal curve:

The normal seven tools of quality curve is a symmetrical, unimodal, bell-shaped distribution with the mean, median and mode having the same value.

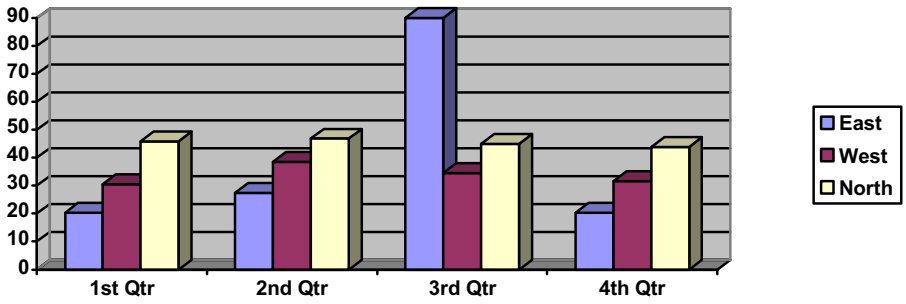
SEVEN TOOLS OF QUALITY:

- Pareto Diagram
- Process Flow Diagram
- Cause-and-Effect Diagram
- Check Sheets
- Histogram
- Control Charts
- Scatter Diagrams

Seven tools of quality:

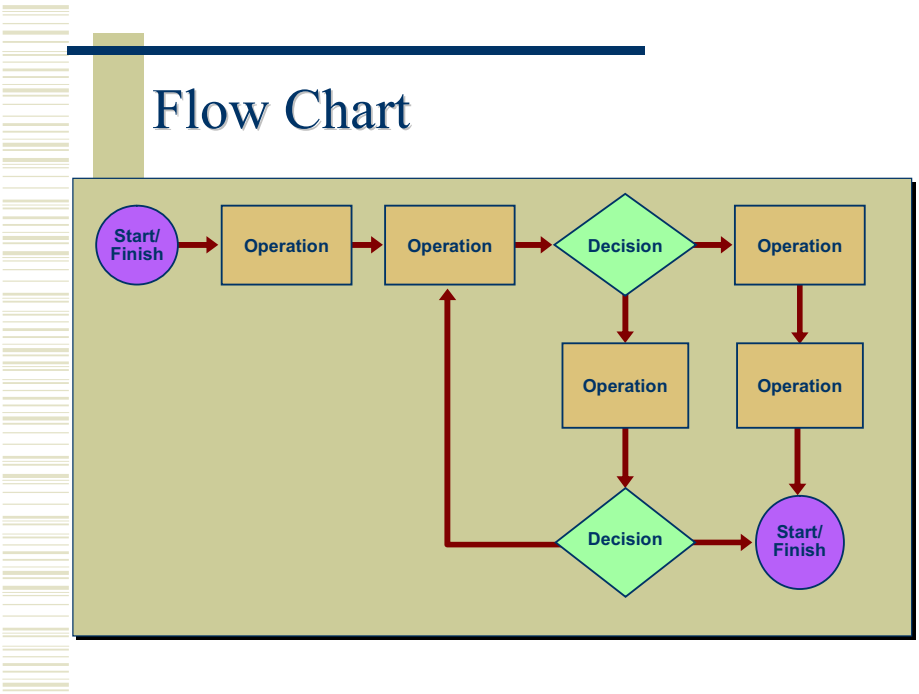


- Pareto Diagram:

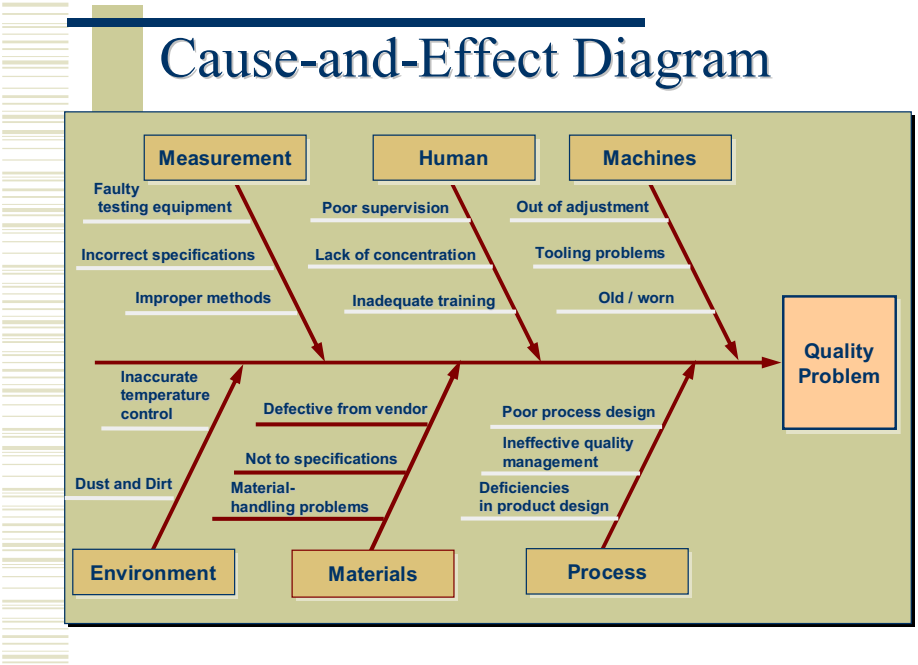


- Vilfredo Pareto (1848-1923) Italian economist
  - 20% of the population has 80% of the wealth
- Juran used the term "vital few, trivial many". He noted that 20% of the quality problems caused 80% of the dollar loss

◆ **Process Flow Diagram:**



◆ **Cause-and-Effect Diagram**:



Cause and effect diagrams

- Show the relationships between a problem and its possible causes.
- Developed by Kaoru Ishikawa (1953)
- Also known as …
  - Fishbone diagrams
  - Ishikawa diagrams

Advantages:

•making the diagram is educational in itself

•diagram demonstrates knowledge of problem solving team

•diagram results in active searches for causes

•diagram is a guide for data collection

To construct the skeleton, remember:

◆For manufacturing - the 4 M's

man, method, machine, material

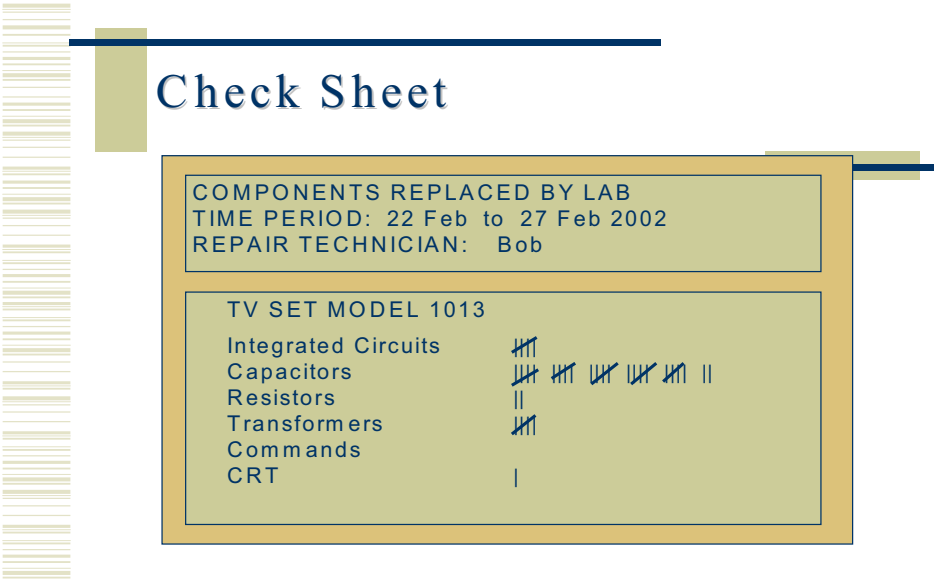
◆For service applications

equipment, policies, procedures, people

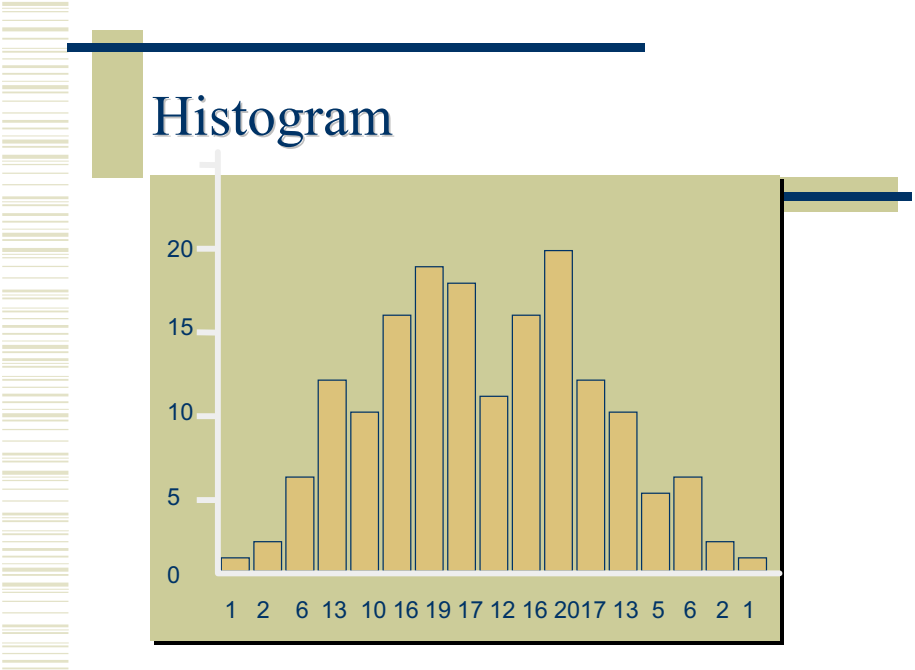
Usage of C&E diagrams:

- Analyze actual conditions for the purpose of product or service quality improvement,
- more efficient use of resources, and reduced costs.
- Eliminate conditions causing nonconformities and customer complaints.
- Standardize existing and proposed operations.
- Educate and train personnel in decision-making and corrective-action activities.

◆ **Check Sheets:**



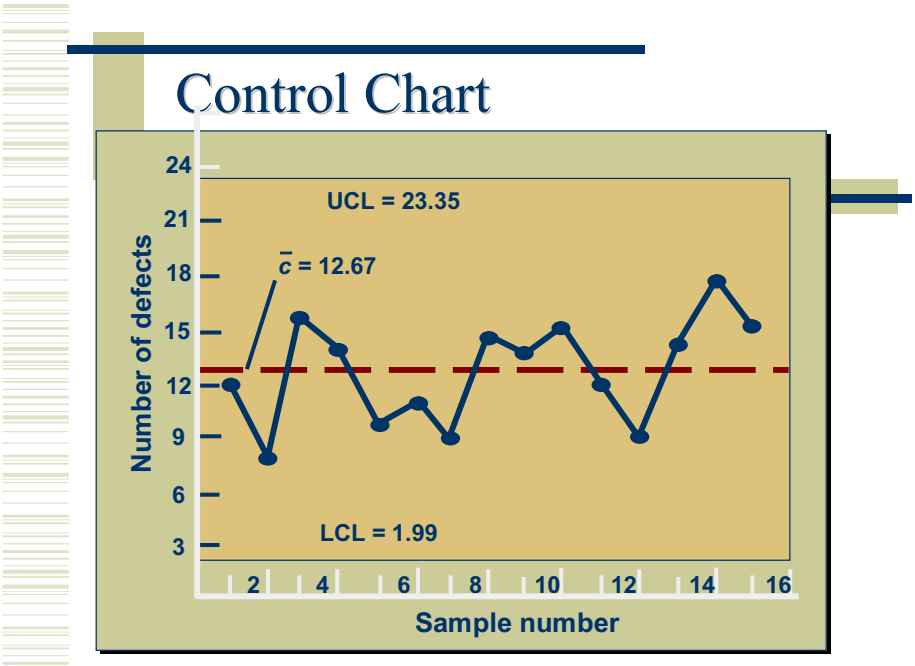
◆ **Histogram:**



various histogram shapes

- Symmetrical
- Skewed right
- Skewed left
- Peaked
- Flat
- Bimodal
- Plateau distribution
- Comb distribution
- Double peaked distribution

◆ **Control Charts:**

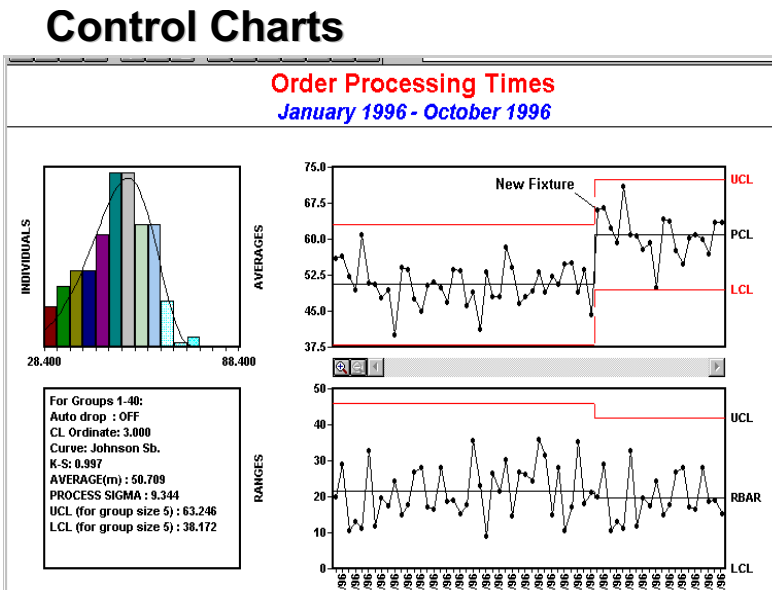


Control chart Definition:

Control chart is a means of visualizing the variations that occur in the central tendency and the dispersion of a set of observations. It is a graphical record of the quality of a particular characteristic.

Important use of the control chart:

The control chart is used to keep a continuing record of a particular quality characteristic. It is a picture of process.



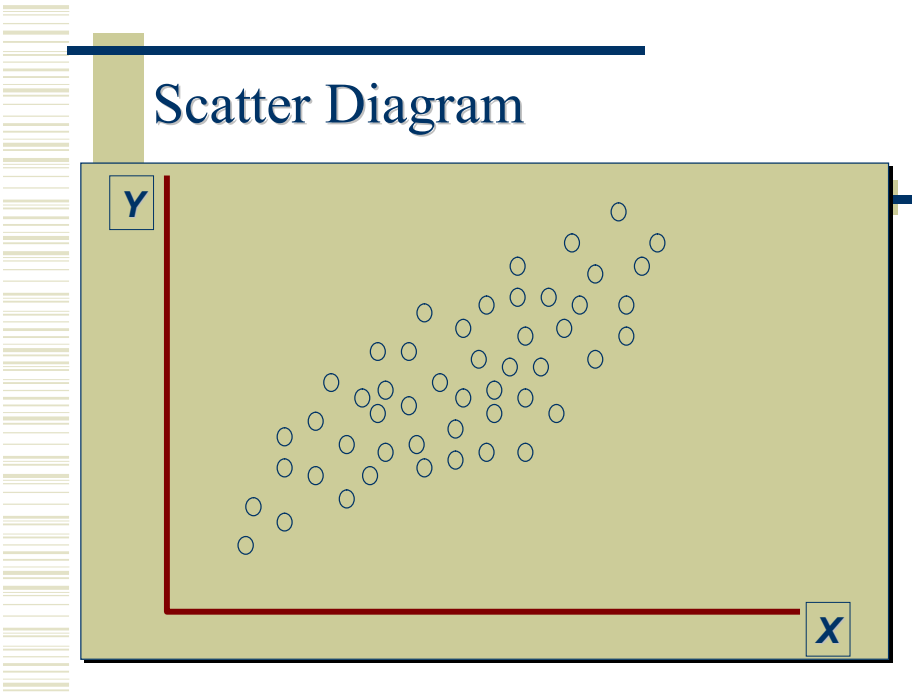
Objectives of the attribute charts:

- Determine the average quality level.
- Bring to the attention of management any changes in the average.
- Improve the product quality.
- Evaluate the quality performance of operating and management personnel.
- Determine acceptance criteria of a product before shipment to the customer.

Run chart:

A run chart is a very simple technique for analyzing the process in the development stage or, for that matter, when other charting techniques are not applicable.

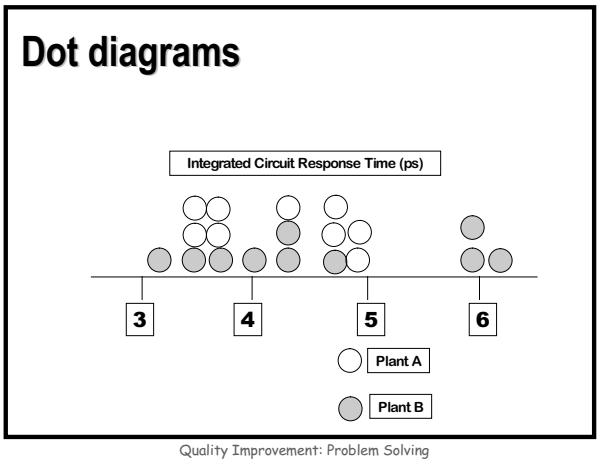
◆ **Scatter Diagrams:**



various patterns of scatter diagrams:

- Positive correlation
- Negative correlation
- No correlation
- Negative correlation may exist
- Correlation by stratification
- Curvilinear relationship

Other related Diagram:



Population & Sample:

Population represents the mathematical world and Sample represents the real world. A population frequency distribution is represented by a smooth curve whereas a sample frequency distribution is represented by a histogram.

Sources of variation:

- Equipment
- Material
- Environment
- Operator

Procedure for constructing the tree diagram:

- Choose an action –oriented objective statement from the interrelationship diagram,
- Affinity diagram, brainstorming, team mission statement, and so forth.
- Using brainstorming, choose the major headings.
- Generate the next level by analyzing the major headings.

Standard formats of matrix diagram:

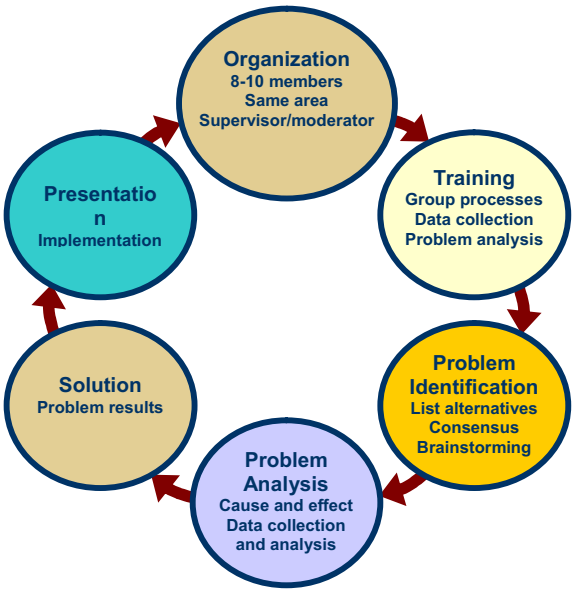
- L-shaped
- T-shaped
- Y-shaped
- C-shaped
- X-shaped

Benefits of an activity network diagram:

- A realistic timetable determined by the users.
- Team members understand the role in the overall plan.
- Bottlenecks can be discovered and corrective action taken.

- Members focus on the critical tasks.

QUALITY CIRCLE:



SIX SIGMA:

Six-Sigma is a business process that allows organizations to drastically improve their bottom line by designing and monitoring every day business activities in ways that minimize waste and resources while increasing customer satisfaction. It is achieved through continuous process measurement, analysis & improvement.

- A process for developing and delivering near perfect products and services
- Measure of how much a process deviates from perfection

Six Sigma Problem Solving Method:

Define - Improvement opportunity with an emphasis on increasing customer

Satisfaction.

Measure - Determines process capability (Cp/ Cpk) & dpmo (defects per Million opportunities).

Analyze - Identify the vital few process input variables that affect key Product output variables ("Finding the knobs").

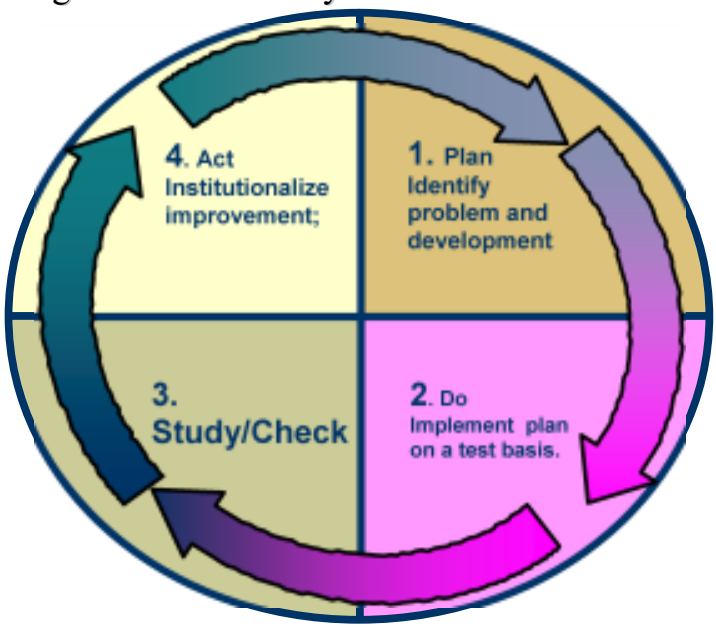
Improve - Make changes to process settings, redesign processes, etc. to reduce the number of defects of key output variables.

Control - Implement process control plans, install real-time process monitoring tools, standardize processes to maintain levels.

Continuous Improvement versus Traditional Approach:

S.no	Traditional Approach	Continuous Improvement
1.	Market-share focus	◆ Customer focus
2.	Focus on 'who" and "why"	◆ Focus on "what" and "how"
3.	Short-term focus	◆ Long-term focus
4.	Status quo focus	◆ Continuous improvement
5.	Product focus	◆ Process improvement focus
6.	Innovation	◆ Incremental improvements
7.	Fire fighting	◆ Problem solving

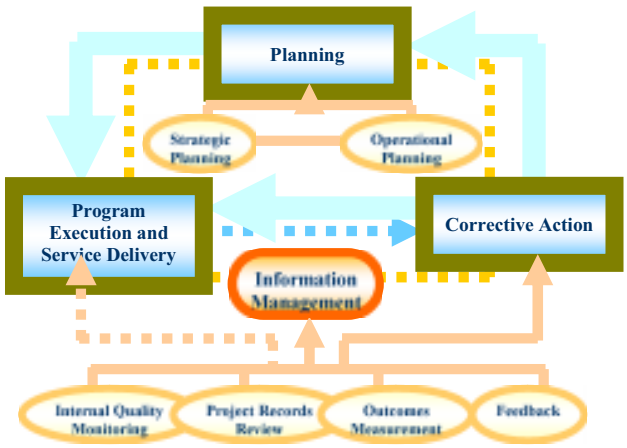
Deming Wheel: PDCA Cycle



The Continuous Quality Improvement Cycle

- **PLAN**
  - Plan for CQI and build team to do the following.
  - Set standards
  - Monitor current quality level and identify problem/s
  - Analyze root causes of problem/s
  - Generate solution/s
- **DO**
  - Implement chosen solution/s
- **CHECK**
  - Monitor success of solution
- **ACT**
  - Adjust solution/s to ensure success
  - Standardize effective solution/s

CQI Framework:



Seven phases:

- Identify the opportunity
- Analyze the process
- Develop the optimal solution
- Implement
- Study the Results
- Standardize the solution
- Plan for the future

Control chart :

- Control charts are decision-making tools - they provide an economic basis for deciding whether to alter a process or leave it alone
- Control charts are problem-solving tools - they provide a basis on which to formulate improvement actions
- Separate common and special causes of variation.
- Determine whether a process is in a state of statistical control or out-of-control

- Estimate the process parameters (mean, variation) and assess the performance of a process or its capability.
- To monitor output, we use a control chart.
    - we check things like the mean, range, standard deviation
- To monitor a process, we typically use two control charts.
    - mean (or some other central tendency measure)
    - variation (typically using range or standard deviation)

Control chart components:

- Centerline
    - shows where the process average is centered or the central tendency of the data

- Upper control limit (UCL) and Lower control limit (LCL)
    - describes the process spread
    - The centerline should be the population mean, μ
    - Since it is unknown, we use X double bar, or the grand average of the subgroup averages.
    - The centerline should be the population mean, μ
    - Since it is unknown, we use X double bar, or the grand average of the subgroup averages.

$$\overline{\overline{X}} = \frac{\sum_{i=1}^{m} \overline{X}_i}{m}$$

Determining an alternative value for the standard deviation :

$$\overline{R} = \frac{\sum_{i=1}^{m} R_i}{m}$$

$$UCL = \overline{\overline{X}} + A_2 \overline{R}$$

$$LCL = \overline{\overline{X}} - A_2 \overline{R}$$

Given data:

1.83,1.91,1.78,1.80,1.85,1.87,1.92

Average:

Formula: $\bar{x} = \sum x/n$

Where,

$\bar{X}$ =Average
N=number of data
X=given data value

ANS1: $\bar{x}$ **=1.85**

MEDIAN: **Md = n+1/2 =1.85**

MODE : **1.85**

RANGE:

Range =0.14

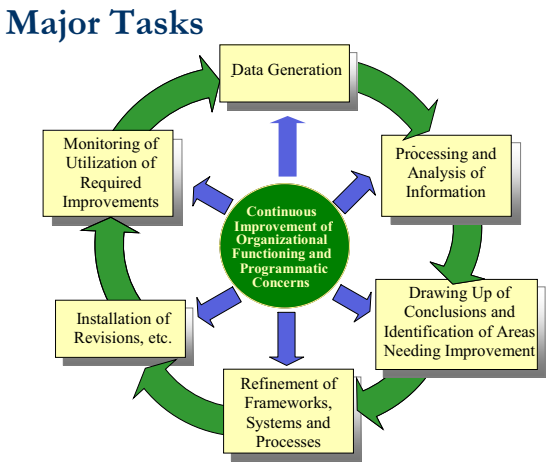
STD. DEVIATION: **0.05**

The formula for LCL and UCL Calculation:

$$UCL = \bar{\bar{X}} + 3\sigma$$

$$LCL = \bar{\bar{X}} - 3\sigma$$

σ = standard deviation



Need for New Tools

In 1976, the Union of Japanese Scientists and Engineers (JUSE) saw the need for tools to promote innovation, communicate information and successfully plan major projects

Affinity diagram (or) Affinity Chart (or) K-J method

- It was created in the 1960s by Japanese anthropologist Jiro Kawakita.
- organizes a large number of ideas in
  to their natural relationships
- This method taps a team's creativity and intuition.

When to Use

- When you are confronted with many facts or ideas in apparent chaos
- When issues seem too large and complex to grasp
- When group consensus is necessary

Typical situations Used

- After a brainstorming exercise
- When analyzing verbal data, such as survey results

Brainstorming for affinity diagram example

Possible Performance Measures	
Maintenance costs	Customer complaints
# of emergency jobs	Overtime/total hours worked
lbs. produced	$/lb. produced
Environmental accidents	Raw material utilization
Material costs	Yield
Overtime costs	Utility cost
# of pump seal failures	ppm water
Viscosity	Color
Cp_k values	Service factor
Safety	Time between turnarounds
Days since last lost-time	Hours worked/employee
% rework or reject	lbs. waste
Hours downtime	Housekeeping score
% uptime	% capacity filled

Relations Diagram (or) Interrelationship Diagram(or)Digraph(or) Network Diagram

- The relations diagram shows cause-and-effect relationships.
- The process of creating a relations diagram helps a group analyze the natural links between different aspects of a complex situation

When to use

- When trying to understand links between ideas or cause-and-effect relationships, such as when trying to identify an area of greatest impact for improvement.
- When a complex issue and Solution is being analyzed & Implemented for causes.
- After generating an affinity diagram, cause-and-effect diagram or tree diagram, to more completely explore the relations of ideas

Tree Diagram (or) Systematic diagram (or) Tree analysis (or) Analytical tree (or) Hierarchy diagram

Description

- The tree diagram starts with one item that branches into two or more, each of which branch into two or more, and so on.
- It looks like a tree, with trunk and multiple branches.
- When an issue is known or being addressed in broad generalities.
- When developing actions to carry out a solution or other plan.
- When analyzing processes in detail.
- When probing for the root cause of a problem.
- After an affinity diagram or relations diagram has uncovered key issues.
- As a communication tool, to explain details to others

Matrix Diagram (or) Matrix chart

Description

- The matrix diagram shows the relationship between two, three or four groups of information. It also can give information about the relationship, such as its strength, the roles played by various individuals or measurements

When to Use each Shape

- An L-shaped matrix relates two groups of items to each other (or one group to itself).

- A T-shaped matrix relates three groups of items: groups B and C are each related to A. Groups B and C are not related to each other.

- A Y-shaped matrix relates three groups of items. Each group is related to the other two in a circular fashion

When to Use each Shape

- A C-shaped matrix relates three groups of items all together simultaneously, in 3-D.

- An X-shaped matrix relates four groups of items. Each group is related to two others in a circular fashion.

- A roof-shaped matrix relates one group of items to itself. It is usually used along with an L- or T-shaped matrix. (Used in QFD)

Arrow Diagram (or) Activity Network Diagram (or) Network Diagram, Activity Chart (or) Node Diagram (or) CPM (critical path method) Chart

Description :

- The arrow diagram shows the required order of tasks in a project or process, the best schedule for the entire project, and potential scheduling and resource problems and their solutions.

When to Use each Shape

- When scheduling and monitoring tasks within a complex project or process with interrelated tasks and resources.
- When you know the steps of the project or process, their sequence and how long each task.
- When project schedule is critical, with serious consequences for completing the project late or significant advantage to completing the project early

Process Decision Program Chart
(or) PDPC

- The process decision program chart systematically identifies what might go wrong in a plan under development.
- Countermeasures are developed to prevent or offset those problems.

- Using PDPC, you can either revise the plan to avoid the problems or be ready with the best response when a problem occurs**.**

When to Use each Shape

- Before implementing a plan, especially when the plan is large and complex.
- When the plan must be completed on schedule.
- When the price of failure is high.

UNIT-IV TQM TOOLS

Benchmarking:

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage. It is a tool for continuous improvement.

Bench Mark is the systematic search for best practice, innovative ideas and highly effective operating procedure

W. Edward Deming says Bench Mark is Hazard to copy .It is necessary to understand the theory of what one wishes to do.

Definition By ROBERT CAMP

■**"**It is the search for the industry best practices that lead to superior performance**.**

BENCHMARKING CONCEPT

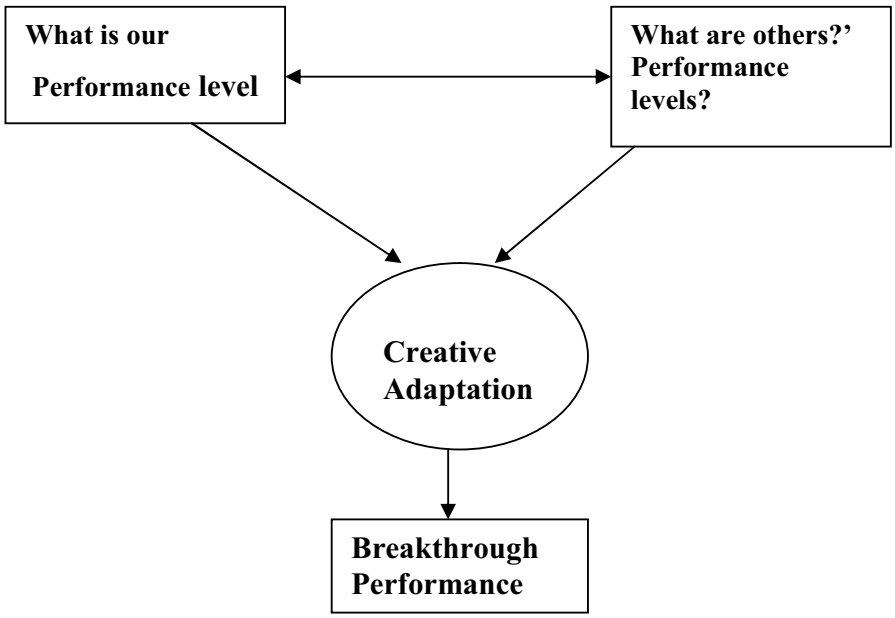


Fig 6: benchmarking concept

Reasons for Bench Marking:

- ■To achieve Business & Competitive Objectives.
- ■Goals & Objectives Based on External Environment.
- ■Cost Efficient.
- ■Continuous Improvement & New Development**.**

Bench Marking Process:

Phases	**S.no**	**Steps**
Planning	**1**	**Earmark what is to be Bench Marked?**
	2	**Identify the best competitor**
	3	**Determine the data collection method and start collecting data**
Analysis	**4**	**Determine the current performance GAP**
	5	**Project future performance levels**
	6	**Communicate bench mark findings and gain acceptance**
	7	**Establish Functional Goals**
	8	**Develop Action Plans**
	9	**Implement specific actions and monitor Progress**

Table 3: Bench Marking Process

Important steps to benchmark:

a) Decide what to benchmark

b) Understand current performance

c) Plan

d) Study others

e) Learn from the data

f) Use the findings

Types of benchmarking:

i. Internal

ii. Competitive

iii. Process

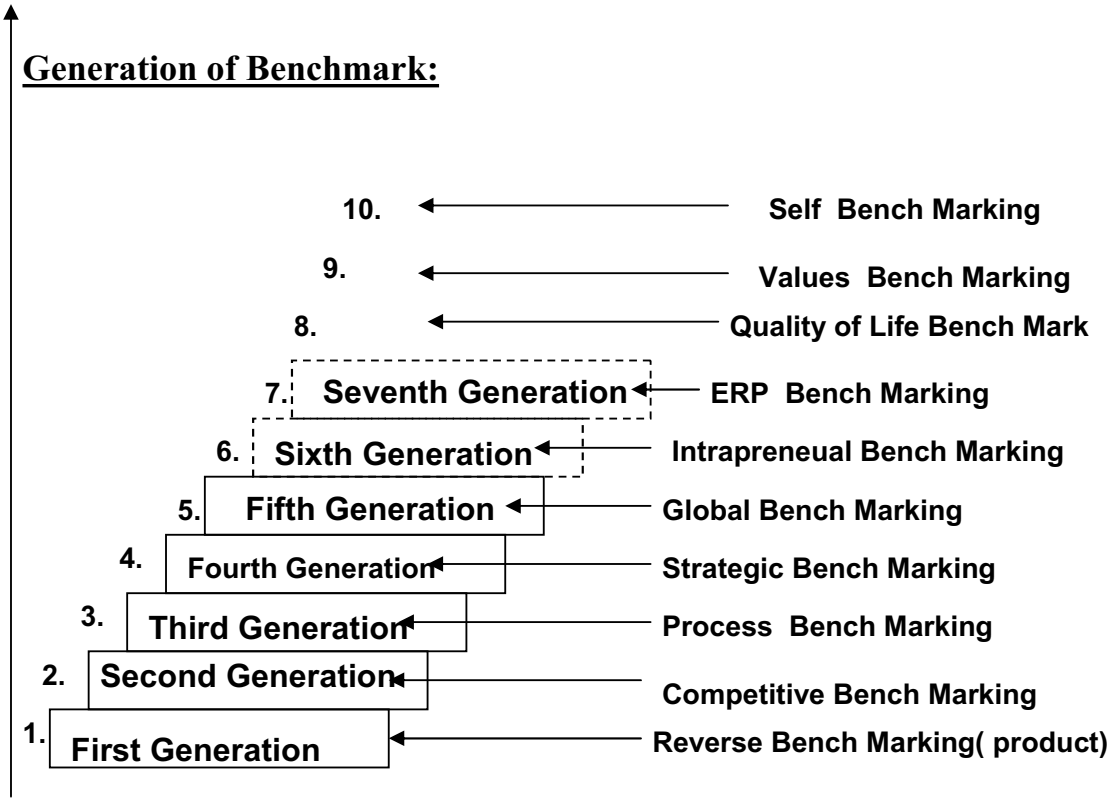


Fig 7 :Generation of Benchmark

Process of Gap Closing:

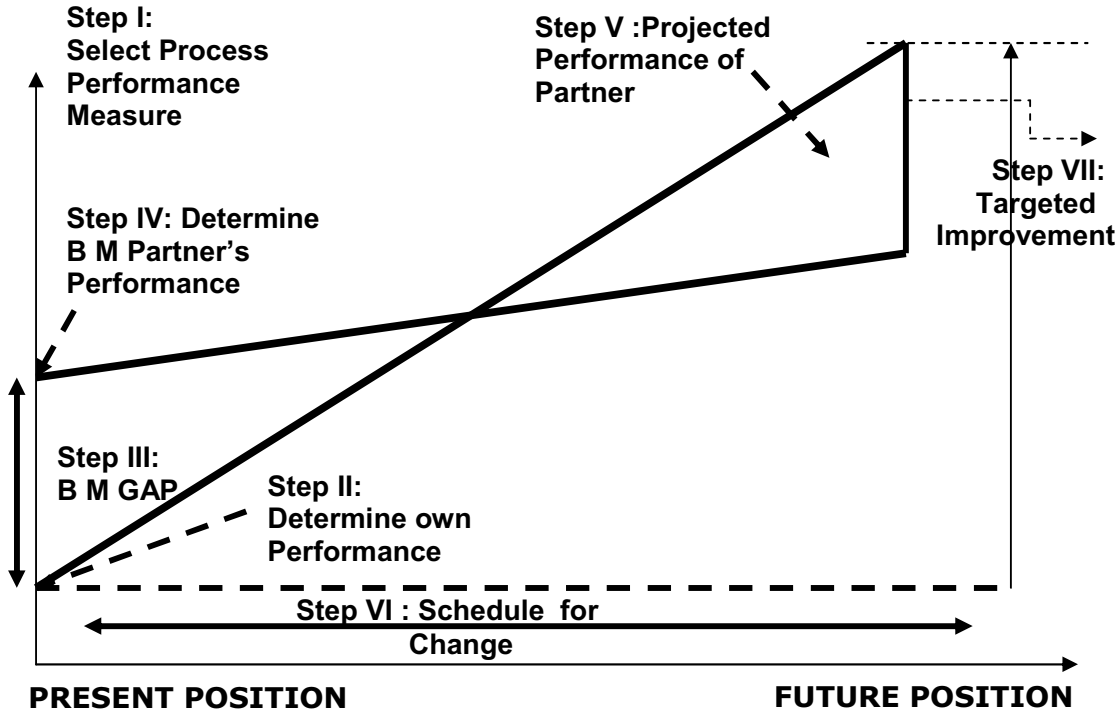


Fig 8: Process of Gap Closing :

Quality Function Deployment:

Quality Function Deployment is a planning tool used to fulfill customer expectations. It is a disciplined approach to product design, engineering, and production and provides in-depth evaluation of a product.

Important benefits of QFD:

i. Customer driven

ii. Reduces implementation time

iii. Promotes teamwork

iv. Provides documentation

- QFD was developed in Japan in the late 1960s by Professors Shigeru Mizuno and Yoji Akao.
- At the time, statistical quality control, which was introduced after World War II, had taken roots in the Japanese manufacturing industry.

Steps required to construct an affinity diagram:

i. Phrase the objective

ii. Record all responses

iii. Group the responses

iv. Organize groups in an affinity diagram

Why use QFD?

Once a team has identified the customers' wants, QFD is used for two fundamental reasons:

- To improve the communication of customer wants throughout the organization.

- To improve the completeness of specifications and to make them traceable directly to customer wants and needs.
- QFD links the needs of the customer (end user) with design, development, engineering, manufacturing, and service functions.

- QFD empowers organizations to exceed normal expectations and provide a level of unanticipated excitement that generates value

What is QFD?

- Quality Function Deployment (QFD) is a systematic process for motivating a business to focus on its customers.

- It is used by cross-functional teams to identify and resolve issues involve in providing products, processes, services and strategies which will more than satisfy their customers

Also used for

- Understanding Customer Requirements
- Quality Systems Thinking + Psychology + Knowledge
- Maximizing Positive Quality That Adds Value
- Comprehensive Quality System for Customer Satisfaction
- Strategy to Stay Ahead of The Game

- QFD links the needs of the customer (end user) with design, development, engineering, manufacturing, and service functions.

- QFD empowers organizations to exceed normal expectations and provide a level of unanticipated excitement that generates value

A team identified the following customer groups:

- Users who are mainly concerned with functionality.
- Management who is mainly concerned with financial and strategic issues.
- Distribution and Purchasing Agents who are concerned with purchase transaction and availability issues.
- Internal workers who are concerned with how the product will affect the quality of their work life.

How do we capture our Customers' Requirements?

- One on one customer interviews
- Focus groups
- In-context customer visits

VOICE OF CUSTOMER

Prioritizing Requirements :

What should we use to prioritize Requirements?

- Importance to the Customer
- Our Current Product
- Competitor One
- Competitor Two
- Our Future Product
- Improvement Factor
- Overall Importance
- Percent Importance

How does QFD differ from other quality initiatives?

QFD is quite different in that it seeks out both "spoken" and "unspoken" customer requirements and maximizes "positive" quality (such as ease of use, fun, luxury) that creates value;

What are the characteristics of QFD as a quality system?

- QFD is a quality system that implements elements of Systems Thinking and Psychology of customer needs, what, and how end users become interested.

- QFD is a quality method of good Knowledge.

- QFD is a quality system for strategic competitiveness.

- Quality Function Deployment (QFD) is the only comprehensive quality system that satisfy the customer throughout the development and business process -- end to end.

What are the tools of QFD?

7 Management and Planning Tools :

Which industry and business are using QFD?

- QFD has been applied in virtually every industry and business, from aerospace, manufacturing, software, communication, IT, chemical and pharmaceutical, transportation, defense, government, R&D, food to service industry**.**

Why is a conventional design process not sufficient?

- Conventional design processes focus more on engineering capabilities and less on customer needs

What are "expected quality" and "exciting quality?"

- Expected" quality or requirements are essentially basic functions or features that customers normally expect of a product or service.
- "Exciting" quality or requirements are sort of "out of ordinary" functions or features of a product or service that cause "wow" reactions in customers.

What is the House of Quality? Why it isn't a QFD

- The House of Quality is an assembly of several deployment hierarchies and tables, including the Demanded Quality Hierarchy, Quality Characteristics Hierarchy, the relationships matrix, the Quality Planning Table, and Design Planning Table. It is a table that connects dots between the Voice of the Customer and the Voice of the Engine

BENEFITS OF QFD:

- Improves Customer Satisfaction
- Reduces Development Time
- Improves Team Work
- Reduces Cost
- Quick New Product Release

- Documentation
- Critical Quality Features
- Right Technology

Phases of QFD process:

i. Product planning

ii. Part development

iii. Process planning

iv. Production planning

HOUSE OF QUALITY:

Parts of house of quality:

i. Customer requirements

ii. Prioritized customer requirements

iii. Technical descriptors

iv. Prioritized technical descriptors

v. Relationship between requirements and descriptors

vi. Interrelationship between technical descriptors

Factors to build a house of quality:

a) List customer requirements

b) List technical descriptors

c) Develop a relationship matrix between WHATs and HOWs

d) Develop an interrelationship matrix between HOWs

e) Competitive assessments

f) Develop prioritized customer requirements

g) Develop prioritized technical descriptors

Definition of FMEA:

Failure Mode Effect Analysis is an analytical technique that combines the technology and experience of people in identifying foreseeable failure modes of a product or process and planning for its elimination.

FMEA is a group of activities to understand and evaluate potential failure of product or process and its effects, and identify actions that eliminate or reduce the potential failures**.**

Types of FMEA

Major Classification

- Design FMEA
- Process FMEA

Sub Classification

- Equipment FMEA
- Maintenance FMEA
- Service FMEA
- System FMEA

DESIGN FMEA

Design FMEA use in the design process by identifying known and foreseeable failures modes and ranking failures according to their impact on the product**.**

PROCESS FMEA

It is used to identify potential process failure modes by ranking failures and establishing priorities, and its impact on the Internal or external customers.

RELIABILITY

●Reliability is defined as the probability that the product will perform as per the expectation for a certain period of time, under the given operating conditions, and the given set of product performance characteristics**.**

●The part, assembly, or process under consideration, the reliability of each sub system and factors that contribute to failure to be found**.**

FAILURE RATE

●Products follow a pattern of failure.

●There is no information about the reliability (i.e. Failure) of the product.

●Failure Rate is a constant is known period of failure can be found out using Exponential Distribution

$Rt = e - \lambda t$ Rt = Reliability of survival

$Rt = e - t / \theta$ t = Time for operation without failure

λ = Failure rate θ = Mean time to Failure

PROBLEM

●Failure Rate λ = .0002 per hour

●What is the probability that it will survive or reliable during the first 200 hours of operations?

Solution

$$Rt = e - \lambda t$$
$$= e - (200)(0.0002)$$
$$= 96.08\ \%$$

Stages of FMEA:

1. Specifying possibilities
    a. Functions
    b. Possible failure modes
    c. Root causes
    d. Effects
    e. Detection/Prevention
2. Quantifying risk
    a. Probability of cause

b. Severity of effect

c. Effectiveness of control to prevent cause

d. Risk priority number

3. Correcting high risk causes

a. Prioritizing work

b. Detailed action

c. Assigning action responsibility

d. Check points on completion

4. Revaluation of risk

a. Recalculation of risk priority number

TOTAL PRODUCTIVE MAINTENANCE:

Define TPM:

T : Total = All encompassing by maintenance and production individuals working together.

P : Productive = Production of goods and services that meet or exceed customer's expectations.

M : Maintenance = Keeping equipment and plant in as good as or better than te Original condition at all times.

Goals of TPM:

The overall goals of Total Productive Maintenance, which is an extension of TQM are

i. Maintaining and improving equipment capacity

ii. Maintaining equipment for life

iii. Using support from all areas of the operation

iv. Encouraging input from all employees

v. Using teams for continuous improvement

Seven basic steps to get an organization started towards TPM:

a) Management learns the new philosophy
b) Management promotes the new philosophy
c) Training is funded and developed for everyone in the Organization
d) Areas of needed improvement are identified
e) Performance goals are formulated
f) An implementation plan is developed
g) Autonomous work groups are established

Major loss areas in TPM:

i. Planned downtime
ii. Unplanned downtime
iii. Idling and minor stoppages
iv. Slow-downs
v. Process nonconformities
vi. Scrap

Several types of FMEA:

- Design FMEA
- Process FMEA
- Equipment FMEA
- Maintenance FMEA
- Concept FMEA
- Service FMEA
- System FMEA
- Environment FMEA etc.

Define TPM:

T : Total = All encompassing by maintenance and production individuals working together.

P : Productive = Production of goods and services that meet or exceed customer's expectations.

M : Maintenance = Keeping equipment and plant in as good as or better than te original

Taguchi's Loss Function

Definition:

Taguchi loss function is a way to show how each non-perfect part produced, results in a loss for the company. Deming states that it shows

"a minimal loss at the nominal value, and an ever-increasing loss with departure either way from the nominal value."

A technical definition is

*A parabolic representation that estimates the quality loss, expressed monetarily, that results when quality characteristics deviate from the target values. The cost of this deviation increases quadratic ally as the characteristic moves farther from the target value*t

Calculations

Formulas: Loss at a point: $L(x) = k*(x-t)^2$

where,

k = loss coefficient

x = measured value

t = target value

Average Loss of a sample set: L = k*(s^2 + (pm - t)^2)

where,
s = standard deviation of sample

pm = process mean

Total Loss = Avg. Loss * number of samples

For example: A medical company produces a part that has a hole measuring 0.5" + 0.050". The tooling used to make the hole is worn and needs replacing, but management doesn't feel it necessary since it still makes "good parts". All parts pass QC, but several parts have been rejected by assembly. Failure costs per part is $45.00 Using the loss function, explain why it may be to the benefit of the company and customer to replace or sharpen the tool more frequently. Use the data below:

Measured					Value
0.459	0.478	0.495	0.501	0.511	0.527
0.462	0.483	0.495	0.501	0.516	0.532
0.467	0.489	0.495	0.502	0.521	0.532
0.474	0.491	0.498	0.505	0.524	0.533
0.476	0.492	0.500	0.509	0.527	0.536

Solution:

The average of the points is 0.501 and the standard deviation is about 0.022.

find k,

using L(x) = k * (x-t)^2

$45.00 = k * (0.550 - 0.500)^2

k = 18000

next,

using the Average loss equation: L=k * (s^2 + (pm - t)^2)

L = 18000 * (.022^2 + (.501 - .500)^2) = 8.73

So the average loss per part in this set is $8.73.

For the loss of the total 30 parts produced,

= L * number of samples

= $8.73 * 30

= $261.90

From the calculations above, one can determine that at 0.500", no loss is experienced. At a measured value of 0.501", the loss is $0.018, and with a value of 0.536", the loss would be as much as $23.00.

Even though all measurements were within specification limits and the average hole size was 0.501", the Taguchi loss shows that the company lost about $261.90 per 30 parts being made. If the batch size was increased to 1000 parts, then the loss would be $8730 per batch. Due to variation being caused by the old tooling, the department is losing a significant amount of money.

From the chart, we can see that deviation from the nominal could cost as much as $0.30 per part. In addition we would want to investigate whether this kind of deviation would compromise the integrity of the final product after assembly to the point of product failure.

UNIT –V QUALITY SYSTEMS

Need for ISO 9000:

ISO 9000 is needed to unify the quality terms and definitions used by industrialized nations and use terms to demonstrate a supplier's capability of controlling its processes.

Benefits of an ISO:

- Fewer on-site audit by customers.
- Increased market share.
- Improved quality, both internally and externally.
- Improve product and service quality levels from suppliers.
- Greater awareness of quality by employees.
- A documented formal system.
- Reduced operating costs

ISO 9000 Series of Standards:

ISO 9000, "Quality Management and Quality Assurance Standards Guidelines for Selection and Use".

ISO 9001, "Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation & Servicing".

ISO 9002, "Quality Systems – "Model for Quality Assurance in Production, Installation & Servicing".

ISO 9003 , "Quality Systems – "Model for Quality Assurance in Final Inspection and Test".

ISO 9004-1, "Quality Management and Quality System Elements – Guidelines".

Requirements of ISO 9001:

- Scope
- Normative Reference
- Terms and Definitions
- Quality Management System
- Management Responsibility
- Resource Management
- Product Realization
- Measurement, Analysis & Improvement

QUALITY SYSTEM:

Organizational Structure Procedures, Processes and Resources needed to implement Quality Management ISO 9001: 2000

WHAT IS IT? – WHAT DOES IT DO?

- A Model for Quality Management Systems
- Defines Minimum Requirements for QM Systems
- Provides a base line for Assessment and Certification

COMMON SENSE MANAGEMENT

ISO 9001: 2000 – SCOPE

General

- Needs to demonstrate consistency
- Aims to enhance Customer Satisfaction

Application

- Generic and intended to be applicable to all Organizations, Type, Size and Product
- Requirements that are not applicable can be considered for exclusion

FOUR ABSOLUTES OF QUALITY

- QUALITY IS CONFORMANCE TO REQUIREMENTS

  Do what you said you would do

- THE SYSTEM FOR PRODUCING QUALITY IS PREVENTION NOT APPRAISAL

  Solve Problems permanently

- THE PERFORMANCE STANDARD IS ZERO DEFECTS

  Right First Time and Every Time

- QUALITY IS MEASURED BY THE COST OF NON-ONFORMANCE

  Repair / Rework is paid for out of Profits

QUALITY CONTROL – QUALITY ASSURANCE

- Quality Control is REACTIVE whereas Quality Assurance is PROACTIVE

- Quality Control deals with DETECTION Quality Assurance deals with PREVENTION

i.e. All the planned and systematic actions necessary to prevent problems and ensure confidence that the product will satisfy the requirements for quality

QUALITY ASSESSMENT

Comparison of a Quality Management System with the requirement system with the requirements of a standard or standards to determine the degree of compliance with the specified requirements

QUALITY ASSURANCE

Part of Quality Management, focused on providing confidence that Quality requirements will be fulfilled ISO 9000 : 2000

QUALITY MANAGEMENT SYSTEMS

Management System to direct and control an Organization with regard to Quality ISO 9000 : 2000

QUALITY AUDIT

Systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled ISO 19011 : 2002

AUDIT CRITERIA

Set of policies, procedures or requirements

AUDITS

Objectives

- Determination of Compliance with specified Requirements
- Identification of Weakness
- Management Tool for Improvement
- Planned and Independent
- Defined Standards and / or Procedures
-

AUDIT OBJECTIVES

- To determine Compliance or Non-Conformity of the Quality System elements with specified requirements
- To determine the effectiveness of the implemented Quality System in meeting Quality objectives

- To afford an opportunity to improve the Quality System
- To meet regulatory Requirements
- To Permit the listing of the Audited Organization in the Register of audited Companies

AUDITS

1st PARTY **INTERNAL**

- Required by ISO and Other Standards
- Any Trained personnel can be used
- Documentation Awareness
- Timing / Timescales easily adjusted to suit individuals
- Advice / Assistance with corrective actions
- Must not replace responsibility for Quality

AUDITS

2nd PARTY **EXTERNAL**

- Supplier or Sub-Contractor approval
- Quality Personnel-Role
- Choice of Standards
- Timing / Timescales more important
- Team Leader's Authority
- The power of the contract

AUDITS

3rd PARTY **EXTRINSIC**

- Totally Independent
- International / National Standards
- Qualified or Registered Assessors
- Timing / Timescales very important
- Team Leader only Recommends

CONDUCT OF THE AUDIT

- Enter the area
- Introductions by guide
- Explain what you want to see
- Investigate to the depth necessary
- No problems found, move on
- Don't keep on auditing until problems are found

SPECIFIED REQUIREMENTS

- Customer requirements
- Quality system requirements

–Manuals

–Procedures / work instructions

- Quality standard
- Legal requirements – statutory, regulatory or industry body
- Regulations of registration body

AUDIT PROGRAMME RESPONSIBILITIES

Those assigned the responsibility for managing the audit programme should

- Establish the objective and extent of the audit programme

- Establish the responsibilities and procedures, and ensure resources are provided
- Ensure the implementation of the audit programme
- Ensure that appropriate audit programme records are maintained, and
- Monitor, review and improve the audit programme

AUDIT PROGRAMME RESOURCES

When identifying resources for the audit programme, consideration should be given to

- Financial resources necessary to develop, implement, manage and improve audit activities
- Audit techniques
- Process to achieve and maintain the competence of auditors, and to improve auditor performance
- The availability of auditors and technical experts having competence appropriate to the particular audit programme objectives
- The extent of the audit programme and
- Traveling time, accommodation and other auditing needs

AUDIT PROGRAMME PROCEDURES

Audit programme procedures should address the following

- Planning and scheduling audits
- Assuring the competence of auditors and audit team leaders
- Selecting appropriate audit teams and assigning their roles and responsibilities
- Conducting audits
- Conducting audit follow-up, if applicable
- Maintaining audit programme records
- Monitoring the performance and effectiveness of the audit programme
- Reporting to top management on the overall achievements of the audit programme

AUDIT PROGRAMME IMPLEMENTATION

The implementation of an audit programme should address the following:

- Communicating the audit programme to relevant parties
- Coordinating and scheduling audits and other activities relevant to the audit programme
- Establishing and maintaining a process for the evaluation of the auditors and their continual professional development
- Ensuring the selection of audit teams
- Providing necessary resources to the audit teams
- Ensuring the conduct of audits according to the audit programme
- Ensuring the control of records of the audit activities
- Ensuring review and approval of the audit reports, and ensuring their distribution to the audit client and other specified parties
- Ensuring audit follow-up, if applicable

AUDIT PROGRAMME RECORDS

Records should be maintained to demonstrate the implementation of the audit programme and should include the following:

- Records related to individual audits, such as
- Audit plans
- Audit reports
- Nonconformity reports
- Corrective and preventive action reports, and
- Audit follow-up reports, if applicable

•Results of audit programme review

•Records related to audit personnel covering subjects such as

–Auditor competence and performance evaluation

–Audit team selection, and

–Maintenance and improvement of competence

AUDIT PROGRAMME MONITORING AND REVIEWING

The audit programme review should consider, for example

- Results and trends from monitoring
- Conformity with procedures
- Evolving needs and expectations of interested parties
- Audit programme records
- Alternative or new auditing practices, and
- Consistency in performance between audit teams in similar situations

AUDITOR ATTRIBUTES

•Must be proficient in sector

•Proficient in auditing Top Management

•Proficient in legal requirements

•Understand the process

•Understand the interaction of process

•Team player

Local Requirements

•Culture

•Practices

•Approach

Auditors must be flexible to -

- Changing situations
- Differing Management styles
- Differing Management / Employee levels

Auditors must be competent in -

- Reasoning of Non-Conformities
- Evaluating effectiveness of corrective action

AUDITORS RESPONSIBILITIES

- Developing the audit schedule
- Ensure team is always punctual
- The agreed programme is adhered to
- Valid restrictions are observed
- Team members complete designated tasks
- Confidentiality is preserved
- Arguments are avoided
- No criticism is leveled at individuals
- Chairs all meetings:- opening, review, team and closing
- Summarize findings
- Makes recommendation
- Files audit report

AUDITOR DUTIES

- Support the team leader
- Prepare checklist
- Arrive on time
- Participate at opening meeting
- Carry out assigned tasks
- Keep to the timetable
- Document all findings
- Keep auditee informed
- Assist team leader with reports
- Safeguard all documents

AUDITOR TRAINING

Auditor Training should consider the following:

- Knowledge & Understanding of the standards used to Audit Quality Systems
- Audit Techniques such as Examining, Questioning, Evaluating and Reporting
- Additional skills needed to manage an audit
    - E.g.: Planning, Organizing, Communicating and Directing
    - COMMUNICATION
        - The imparting, conveying or exchanging of ideas, knowledge etc. whether by speech, writing or sings.
        - Ensure that the message given is received and understood
        - Message content
            - Words spoken
            - Verbal style and sound
            - Non-verbal

                Facial expression

                Body language

OPEN QUESTIONS

Tell me:

- Who (does it)
- What (is done)
- Where (is it done)
- Why (is it done)
- When (does it get done)
- How (is it done; often is it done)
- Show me

THE AUDIT CYCLE

PREPARATIONS

- Documentation Review
- Preliminary visit
- Audit Planning

PERFORMANCE

- ❖ Opening Meeting
- ❖ Gathering Information

THE AUDIT CYCLE

- ❖ Team Meetings
- ❖ Non-Conformity Reporting
- ❖ Closing Meeting

FOLLOW-UP ACTIONS

- ❖ Audit Report
- ❖ Corrective Action Verification
- ❖ Surveillance

THE OPENING MEETING

- Introductions
- Confirm Standard, Scope and Audit Authority
- Confirm Audit Plan and Other arrangements
- Outline Audit Method
- Confirm Guides and their Authority
- Confirm Confidentiality
- Staff / Employee Issues
- Any Relevant Questions
- Close Meeting

TEAM MEETINGS

- Discuss the Findings of Team
- Team Leader Agrefs:

– Non-Conformities
– Wording
– Categorization

- Resolve any Issues
- Identify any modifications to the programme as a result of the findings

OBJECTIVE

- Ensure that the Team presents a unified
- response at the wash-up meeting

WASH-UP MEETINGS

- Presentation of findings to Date
- Resolution of any issues
- Agree Non-Conformity Categorization
- Obtain signatures and possible corrective action completion dates
- Monitor Audit Progress
- Monitor Auditor / Company interrelationships
- Keep everyone informed. No surprises at the closing meeting

CLOSING MEETING AGENDA

- Thank Company and Guides
- Confirm Standard and Scope
- Disclaimer
- Confirm Confidentiality
- Define Categories of Non-Conformities
- Questions Deferred

CLOSING MEETING AGENDA

- Findings Presented

- Team Leaders Summary
- Recommendations
- Questions Answered
- Corrective Action Dates Agreed
- Close Meeting

RECOMMENDATIONS

The Company's Quality System:

- Meets the Requirements of ISO 9001:2000 Registration to the agreed scope will be recommended
- Will meet the requirements of ISO 9001:2000 Registration will be deferred until the completion and verification of the necessary corrective actions
- Does not meet the requirements of ISO 9001: 2000 Registration cannot be recommended

FOLLOW-UP ACTIONS

- Deferred Registration

  Close out or Down rate all outstanding Major / Hold point Non-Conformities. Clear as many Minor / On-Going improvements as possible

- Routine Surveillance visits
- Re-Registration

AUDIT REPORT

- Report Identification
- Purpose, Objective and Scope of the Audit
- Details of Auditors, Dates etc
- Reference documents (e.g. Quality Manual, Procedures)
- Summary of Audit Results as declared at the Closing Meeting

  AUDIT REPORT
- Details of all Non-Conformities and Observations
- Reference to any additional supporting Evidence
- Recommendations
- Conclusions
- Distribution

NOTE TAKING

Recording the objective evidence:

- Admissible statements
- Document numbers and issue/revision levels
- Identifiers
- Departments
- Name of auditee
- Notes could be used as reference for:
  - –Immediate investigation
  - –Investigation later

–Use by a colleague

–Subsequent audits

- Notes must therefore be:

  –Legible

  –Retrievable

- Notes taken during an audit are a record of:
- The audit sample taken
- What was reported
- What was observed
- Notes may be referenced by subsequent auditors

NONCONFORMITY

A situation where there is likelihood that nonconforming product or service will occur, or where the benefits of the management standard are not being realized, because of the absence of, or lack of adherence to a procedure

NONCONFORMITY OCCURS

- Non fulfillment of a requirement
- Specified requirements

–conditions of contract

–quality standard

–quality manual

–procedures

–legal regulatory requirements

NONCONFORMITY MEANS

- Manual is not conforming with the quality standard

(intent)

- Practice is not in line with the intent
  (implementation)

- Practice is not effective
  (effectiveness)

OBJECTIVE EVIDENCE

- Data supporting the existence or verity of something – ISO 9000 : 2000
- May be obtained through observation, measurement, test or other means
- May be stated or (preferably) documented
- Can be verified

ESTABLISH THE FACTS

- Get help form the auditee
- Discuss concerns
- Verify the findings
- Record all the evidence:
  –exact observation
  –where, what, etc…
- Establish why a nonconformity or otherwise
- State who (if relevant) – preferably by job title
  - Use auditee's terminology
  - Make it retrievable
  - Make it helpful
  - Make it concise

CONSIDER THE SERIOUSNESS

Two questions to be answered -

- What could go wrong if the nonconformity remains uncorrected
- What is the likelihood of such a thing going wrong?

PURPOSE OF NCR'S

- To convey your findings to the company in a clear, concise and accurate way so that they know exactly what needs to be done
- To provide a record that gives an accurate picture which can subsequently be reviewed remotely from the company
- To ensure that another auditor can follow up the corrective action on your findings just as easily as you would yourself

NCR WORDING

- Report exactly what you observed
- Give a factual report, not a commentary or opinion
- Write legibly – If you can't – then print
- Choose your words with care for easy reading
- Avoid the use of adjectives and adverbs
- Try to use words and phrases taken from the chosen paragraph of the standard
- Choose the requirement paragraph with care as a guide to corrective action
- Establish "TRACEABILITY" in your report. Be specific – Quote Details
- Report accurately – But no personal criticism.
- Be sure that your report is based on "UNSHAKEABLE" facts.

CERTIFICATION

Audit against the Requirements of ISO 9000 : 2000 by an accredited certification body which approves then registers or certifies the supplier resulting in:

- Issue of a Certificate
- Entry in the DTI Register
- Use of LOGO on Literature

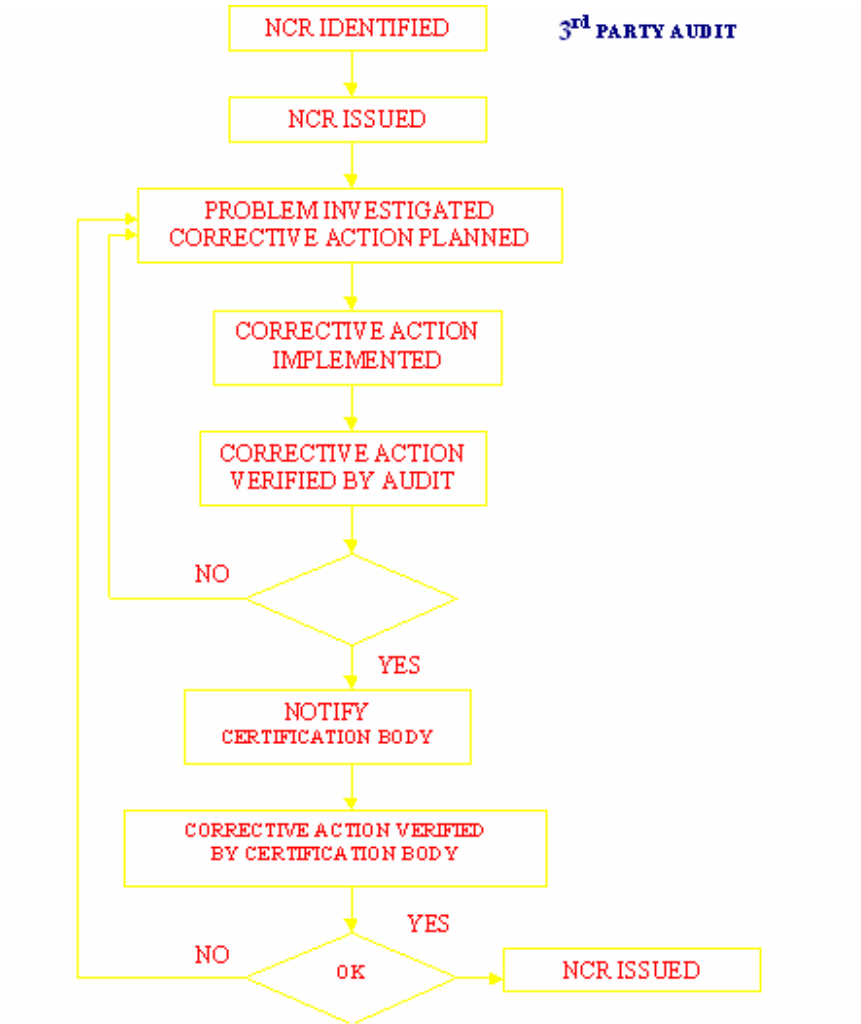
NOTE

CERTIFICATION BODIES DO NOT ACCREDITATE SUPPLIERS

ACCREDITATION

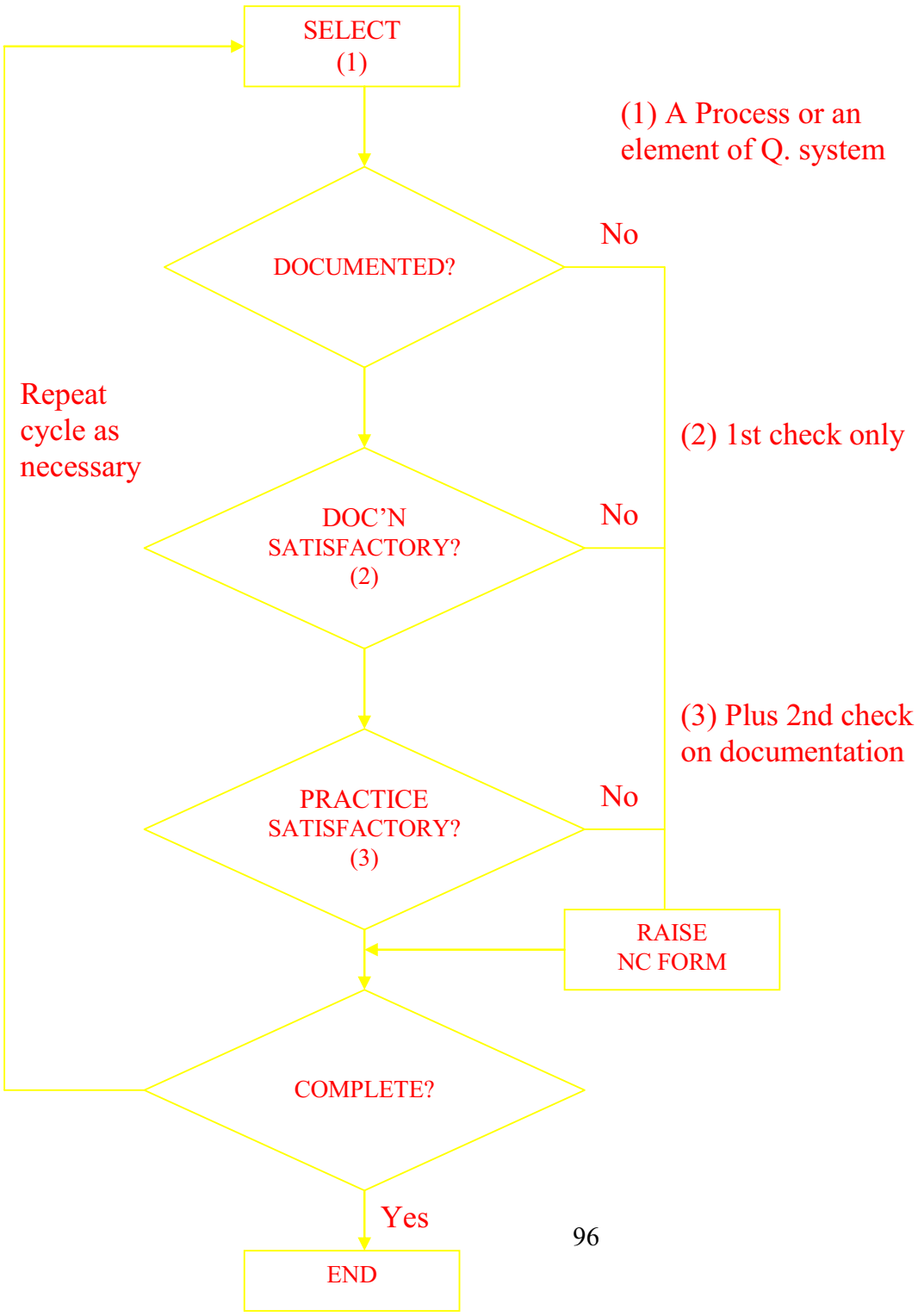
The term Accreditation in the context of Quality Systems is used to denote certification bodies who's ability to audit against the requirements of ISO 9000 has been independently audited by a National Authority using agreed criteria

NCR CORRECTIVE ACTION CYCLE



FOR MAJOR NCR CORRECTIVE ACTION WILL BE VERIFIED BY AN ADDITIONAL FOLLOW UP VISIT.

MINOR NCRs MAY BE VERIFIED AT A SUBSEQUENT SURVEILLANCE VISIT.


SELECT
(1)
(1) A Process or an element of Q. system
DOCUMENTED?
No
Repeat cycle as necessary
(2) 1st check only
DOC'N SATISFACTORY? (2)
No
(3) Plus 2nd check on documentation
PRACTICE SATISFACTORY? (3)
No
RAISE NC FORM
COMPLETE?
Yes
END

NON COMPLIANCE REPORT

NON-COMPLIANCE REPORT

STANDARD :	AREA :	NCR NO. :

NON COMPLIANCE : (To be filled by Assessor)

PROPOSED CORRECTIVE ACTION : (To be filled by Assessee)

Assessor	Assessee	MR	Date

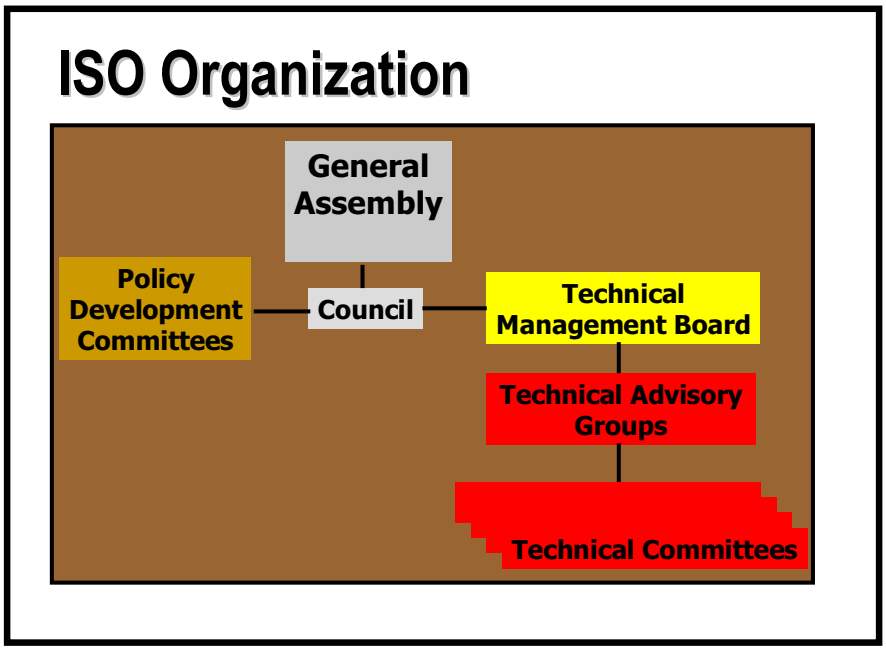
IMPLEMENTED CORRECTIVE ACTION :
(To be filled by Assessor)

ROOT CAUSE ANALYSIS :
(To be filled by Assessee)

Assessor	Assessee	MR	Date

FOLLOW UP COMMENTS : (To be filled by Assessor)

ISO 14000



ISO 9000

Benefits of ISO 14000

a. Global

- Facilitate trade and remove trade barriers
- Improve environmental performance of planet earth
- Build consensus that there is a need for environment management and a common terminology for EMS.

b. Organizational

- Assuring customers of a commitment to environmental management
- Meeting customer requirements
- Maintaining a good public / community relations image
- Satisfying investor criteria and improving access to capital
- Obtaining insurance at reasonable cost
- Increasing market share that results from a competitive advantage
- Reducing incidents that result in liability

- Improving defense posture in litigation
- Conserving input materials and energy
- Facilitating the attainment of permits and authorization
- Improving industry/government relations

Requirements of ISO 14001:

i. General requirements
ii. Environmental policy
iii. Planning
iv. Implementation and operation
v. Checking and corrective action
vi. Management review

Seven elements for the implementation & operations of ISO 14001:

a) Structure and responsibility
b) Training, awareness and competency
c) Communication
d) EMS documentation
e) Documentation control
f) Operational control
g) Emergency preparedness and response

Four elements for the checking & corrective action of ISO 14001 are:

a) Monitoring and measuring
b) Nonconformance and corrective and preventative action
c) Records
d) EMS audit

ISO Registration:

Other quality systems:

i. QS-9000
ii. TE-9000
iii. AS9000

Objectives of the internal audit:

a) Determine the actual performance conforms to the documented quality systems.
b) Initiate corrective action activities in response to deficiencies.
c) Follow up on noncompliance items of previous audits.
d) Provide continued improvement in the system through feedback to Management.
e) Cause the auditee to think about the process, thereby creating possible Improvements.

Elements for the planning of ISO 14001:

a) Environmental aspects;
b) Legal and other requirements;
c) Objectives and targets;
d) Environmental Management Programs;

Evaluation Standards:

Organizational Evaluation Standards:

- Environmental Management System
- Environmental Auditing
- Environmental Performance Evaluation

Product Evaluation Standards:

- Environmental Aspects in Product Standards
- Environmental Labeling
- Life-Cycle Assessment

Quality Audits :

Quality Audits examine the elements of a quality management system in order to evaluate how well these elements comply with quality system requirements.

Different methods of actual audit:

i. Examination of documents

ii. Observation of activities

iii. Interviews