

UNIT I - TOTAL QUALITY MANAGEMENT

Total Quality Management (TQM) is an enhancement to the traditional way of doing business.

- Total - Made up of the whole
- Quality - Degree of Excellence a Product or Service provides.
- Management - Art of handling, controlling, directing etc.

TQM 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.

DEFINING QUALITY :

Quality can be quantified as follows

$$Q = P / E$$

where,

- Q = Quality
- P = Performance
- E = Expectation

DIMENSIONS OF QUALITY :

Dimension	Meaning and Example
Performance	Primary product characteristics, such as the brightness of the picture
Features	Secondary characteristics, added features, such as remote control
Conformance	Meeting specifications or industry standards, workmanship
Reliability	Consistency of performance over time, average time of the unit to fail
Durability	Useful life, includes repair
Service	Resolution of problems and complaints, ease of repair
Response	Human – to – human interface, such as the courtesy of the dealer
Aesthetics	Sensory characteristics, such as exterior finish
Reputation	Past performance and other intangibles, such as being ranked first

QUALITY PLANNING

The following are the important steps for quality planning.

1. Establishing quality goals.
2. Identifying customers.
3. Discovering customer needs.
4. Developing product features.
5. Developing process features.
6. Establishing process controls and transferring to operations.

IMPORTANT POINTS TO BE NOTED WHILE QUALITY PLANNING :

1. Business, having larger market share and better quality, earn returns much higher than their competitors.
2. Quality and Market share each has a strong separate relationship to profitably.
3. Planning for product quality must be based on meeting customer needs, not just meeting product specifications.
4. For some products. We need to plan for perfection. For other products, we need to plan for value.

QUALITY COSTS

1. PREVENTION COST

- Marketing / Customer / User.
- Product / Service / Design Development.
- Purchasing
- Operations (Manufacturing or Service)
- Quality Administration.

2. APPRAISAL COST

- Purchasing Appraisal Costs.
- Operations Appraisal Costs
- External Appraisal Costs
- Review of Test and Inspection Data
- Miscellaneous Quality Evaluations

3. INTERNAL FAILURE COST

- Product or Service Design Failure Costs (Internal)
- Purchasing Failure Costs
- Operations (Product or Service) Failure Costs

4. EXTERNAL FAILURE COST

- Complaint Investigations of Customer or User Service
- Returned Goods

- Retrofit and Recall Costs
- Warranty Claims
- Liability Costs
- Penalties
- Customer or User Goodwill
- Lost Sales

ANALYSIS TECHNIQUES OF QUALITY COST

- The purpose of quality cost analysis is to determine the cost of maintaining a certain level of quality.
- Such activity is necessary to provide feedback to management on the performance of quality assurance and to assist management in identifying opportunities.

INDEX NUMBERS :

Index Numbers are often used in a variety of applications to measure prices, costs (or) other numerical quantities and to aid managers in understanding how conditions in one period compare with those in other periods.

- A simple type of index is called a **RELATIVE INDEX**.

QUARTER	COST IN RS.
1	2000
2	2200
3	2100
4	1900

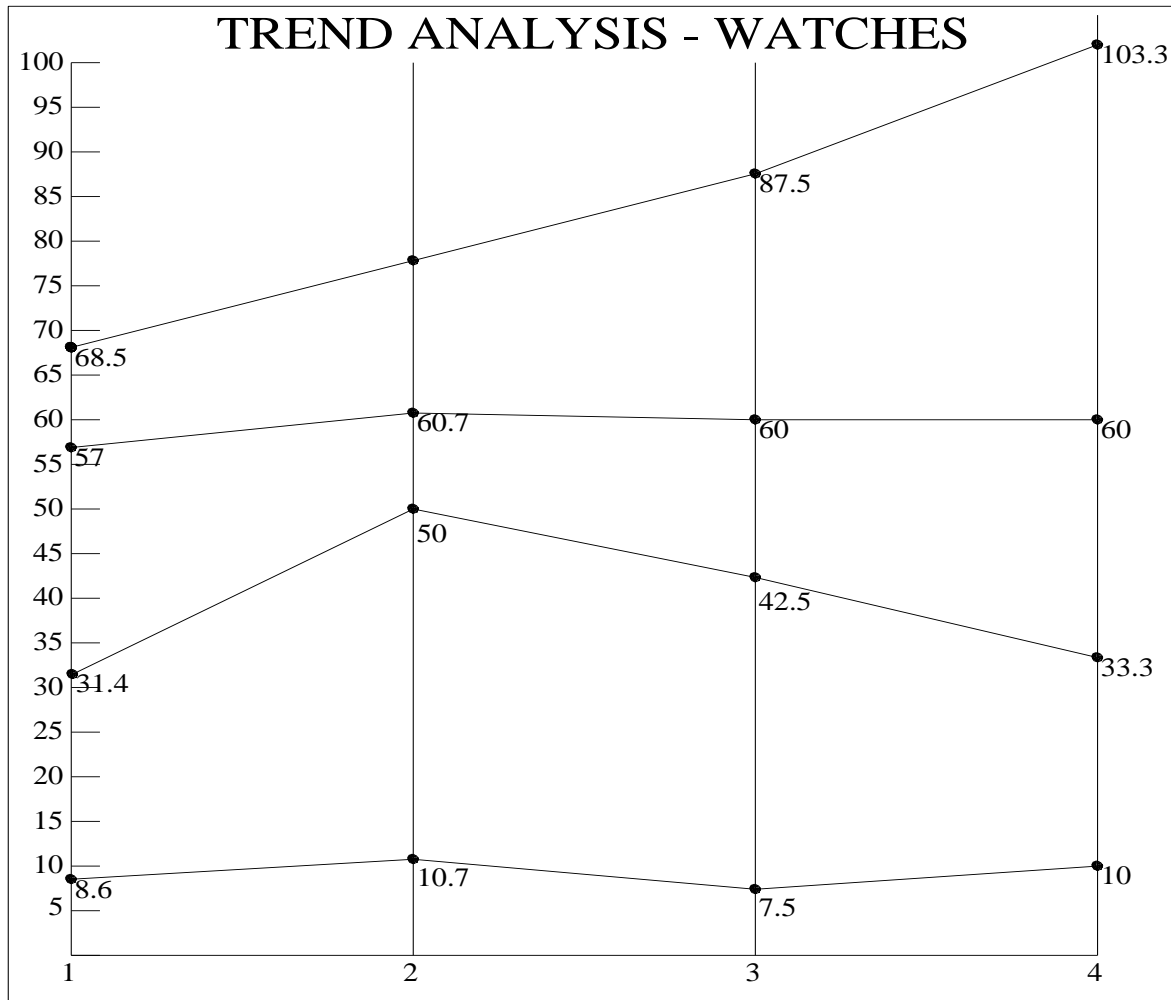
Cost Index in quarter t = (Cost in quarter t / Base period cost) x 100

QUARTER	COST RELATIVE INDEX
1	$(2000/2000) \times 100 = 100$
2	$(2200/2000) \times 100 = 110$
3	$(2100/2000) \times 100 = 105$
4	$(1900/2000) \times 100 = 95$

TREND ANALYSIS :

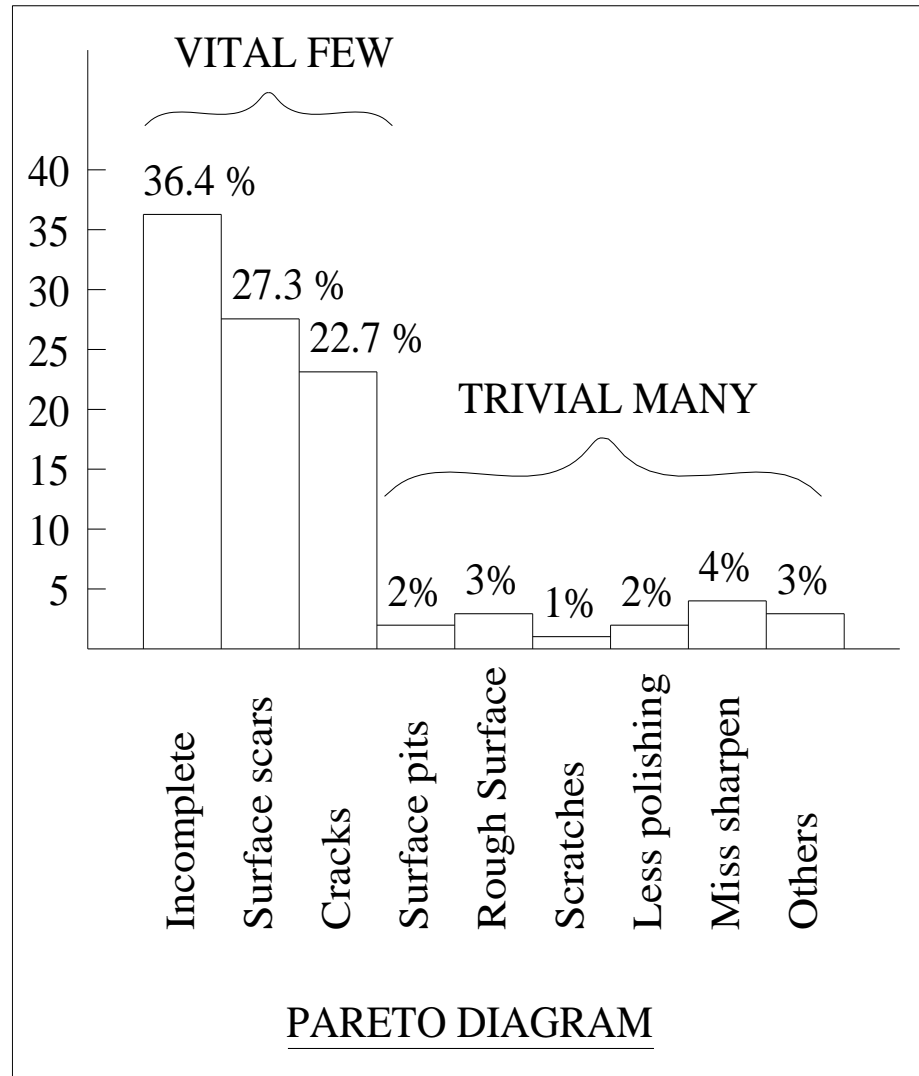
- Good visual aids are important communication tools.
- Graphs are particularly useful in presenting comparative results to management.

Trend Analysis is one where Time-to-Time comparisons can be made which illustrates the changes in cost over time.



PARETO ANALYSIS :

- Joseph Juran observed that most of the quality problems are generally created by only a few causes.
- For example, 80% of all internal failures are due to one (or) two manufacturing problems.
- Identifying these “vital few” and ignoring the “trivial many” will make the corrective action give a high return for a low money input.



SIX BASIC CONCEPTS OF TOTAL QUALITY MANAGEMENT

1. Management Commitment
2. Customer Focus
3. Involvement and utilization of entire work force
4. Continuous Improvement
5. Treating Suppliers as Partners
6. Establish Performance Measures for the processes

NEW AND OLD CULTURES :

Quality Element	Previous State	TQM
Definition	Product Oriented	Customer Oriented
Priorities	Second to service and cost	First among equals of service and cost
Decisions	Short term	Long term
Emphasis	Detection	Prevention
Errors	Operations	System
Responsibility	Quality control	Everyone
Problem Solving	Managers	Teams
Procurement	Price	Life cycle costs, Partnership
Manager's Role	Plan, assign, control and enforce	Delegate, coach, facilitate and mentor

GURUS OF TQM :

SHEWHART	-	Control chart theory
	-	PDCA Cycle
DEMING	-	Statistical Process Control
JURAN	-	Concepts of SHEWHART
	-	Return on Investment (ROI)
FEIGANBAUM	-	Total Quality Control
	-	Management involvement
	-	Employee involvement
	-	Company wide quality control
ISHIKAWA	-	Cause and Effect Diagram
	-	Quality Circle concept
CROSBY	-	"Quality is Free"
	-	Conformance to requirements
TAGUCHI	-	Loss Function concept
	-	Design of Experiments

OBSTACLES IN IMPLEMENTING TQM :

- 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
- Failure to continually improve

BENEFITS OF TQM :

- Improved quality
- Employee participation
- Team work
- Working relationships
- Customer satisfaction
- Employee satisfaction
- Productivity
- Communication
- Profitability
- Market share

LEADERSHIP

A leader is one who instills purposes, not one who controls by brute force. He strengthens and inspires the followers to accomplish shared goals.

Leaders

- Shape the Organization's value
- Promote the Organization's value
- Protect the Organization's value and
- Exemplifies the Organization values

CHARACTERISTICS OF QUALITY LEADERS :

1. They give priority attention to external and internal customers and their needs.
2. They empower, rather than control, subordinates.
3. They emphasis improvement rather than maintenance.
4. They emphasis prevention.
5. They emphasis collaboration rather than competition.
6. They train and coach, rather than direct and supervise.
7. They learn from the problems.
8. They continually try to improve communications.
9. They continually demonstrate their commitment to quality.
10. They choose suppliers on the basis of quality, not price.
11. They establish organizational systems to support the quality effort.
12. They encourage and recognize team effort.

LEADERSHIP CONCEPTS :

A leader should have the following concepts

1. People, Paradoxically, need security and independence at the same time.
2. People are sensitive to external and punishments and yet are also strongly self - motivated.
3. People like to hear a kind word of praise. Catch people doing something right, so you can pat them on the back.
4. People can process only a few facts at a time; thus, a leader needs to keep things simple.
5. People trust their gut reaction more than statistical data.
6. People distrust a leader's rhetoric if the words are inconsistent with the leader's actions.

THE 7 HABITS OF HIGHLY EFFECTIVE PEOPLE :

1. Be Proactive
2. Begin with the End in mind
3. Put First Things First
4. Think Win – Win
5. Seek First to Understand, then to Be Understood
6. Synergy
7. Sharpen the Saw (Renewal)

ROLE OF SENIOR MANAGEMENT

1. Management by Wandering Around (MBWA).
2. Strategy of problem solving and decision making.
3. Strong information base.
4. Recognition and Reward system.
5. Spending most of the time on Quality.
6. Communication.
7. Identify and encourage potential employee.
8. Accept the responsibility.
9. To play a role model.
10. Remove road blocks.
11. Study TQM and investigate how TQM is implemented elsewhere.
12. Establish policies related to TQM.
13. Establish 'priority of quality' and 'customer satisfaction' as the basic policy.
14. Assume leadership in bringing about a cultural change.
15. Check whether the quality improvement programmes are conducted as planned.
16. Become coaches and cheer leaders to implement TQM.
17. Generate enthusiasm for TQM activities.
18. Visit other companies to observe TQM functioning.
19. Attend TQM training programme.
20. Teach others for the betterment of society and the surroundings.

QUALITY COUNCIL

A quality council is established to provide overall direction.

The council is composed of

- Chief Executive Officer
- Senior Managers
- Coordinator or Consultant
- A representative from the Union

Duties of the council are

- Develop the core values, vision statement, mission statement and quality policy statement
- Develop the strategic long term plan with goals and Annual Quality Improvement Program with objectives
- Create the total education and training plan
- Determine and monitor the cost of poor quality
- Determine the performance measures
- Determine projects those improve the process
- Establish multifunctional project and work group teams
- Revise the recognition and rewards system

A typical meeting agenda will have the following items

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

Within three to five years, the quality council activities will become ingrained in the culture of the organization.

QUALITY STATEMENTS

VISION STATEMENT :

- It is a short declaration of what an organization aspires to be tomorrow.

Example :

Disney Theme Park	-	Happiest place on earth
Polaroid	-	Instant photography

- Successful visions provide a guideline for decision making

MISSION STATEMENT :

It answers the following questions

- Who we are?
- Who are the customers?
- What we do?
- How we do it?

It describes the function of the organization. It provides a clear statement of purpose for employees, customers & suppliers

A simpler mission statement is

“To meet customers transportation and distribution needs by being the best at moving their goods on time, safely and damage free”

- National Railways

QUALITY POLICY STATEMENT :

It is guide for everyone in the organization as to how they should provide products and services to the customers.

Common characteristics are

- Quality is first among equals
- Meet the needs of the internal & external customers
- Equal or exceed competition

- Continuously improve the quality
- Utilize the entire workforce

STRATEGIC QUALITY PLANNING

Goals – Long term planning (Eg : Win the war)
Objectives – Short term planning (Eg : Capture the bridge)

Goals should

- Improve customer satisfaction, employee satisfaction and process
- Be based on statistical evidence
- Be measurable
- Have a plan or method for its achievement
- Have a time frame for achieving the goal
- Finally, it should be challenging yet achievable

SEVEN STEPS TO STRATEGIC QUALITY PLANNING :

1. Customer needs
2. Customer positioning
3. Predict the future
4. Gap analysis
5. Closing the gap
6. Alignment
7. Implementation

DEMING PHILOSOPHY

1. Create and publish the Aims and Purposes of the organization.
2. Learn the New Philosophy.
3. Understand the purpose of Inspection.
4. Stop awarding business based on price alone.
5. Improve constantly and forever the System.
6. Institute Training.
7. Teach and Institute Leadership.
8. Drive out Fear, Create Trust and Create a climate for innovation.
9. Optimize the efforts of Teams, Groups and Staff areas.
10. Eliminate exhortations for the Work force.
- 11a. Eliminate numerical quotas for the work force.
- 11b. Eliminate Management by objectives.
12. Remove Barriers THAT ROB PEOPLE OF PRIDE OF WORKMANSHIP.
13. Encourage Education and Self-improvement for everyone.
14. Take action to accomplish the transformation.

TQM IMPLEMENTATION :

- Begins with Management Commitment
- Leadership is essential during every phase of the implementation process and particularly at the start
- Senior Management should develop an implementation plan
- Timing of the implementation process is very important
- Formation of Quality Council
- Active involvement of Middle Managers and First Line Supervisors is essential
- Early discussions with the Union is a must
- Communicate TQM to the entire organization
- Training on quality awareness and problem solving
- Customer, Employee and Supplier surveys must be conducted to benchmark
- The council establishes the project teams and work groups and monitors their progress

UNIT II – TQM PRINCIPLES

CUSTOMER SATISFACTION

CUSTOMER PERCEPTION OF QUALITY :

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

FEEDBACK (INFORMATION COLLECTING TOOLS):

Feedback enables organization to

- Discover customer satisfaction
- Discover relative priorities of quality
- Compare performance with the competition
- Identify customer needs
- Determine opportunities for improvement

Listening to the voice of the customer can be accomplished by numerous information collecting tools.

1. Comment Card
2. Customer Questionnaire

	<u>Highly Satisfied</u>		<u>Neutral</u>	<u>Highly Dissatisfied</u>	
1. Trash removal	5	4	3	2	1
2. Personal hygiene	5	4	3	2	1
3. Romance	5	4	3	2	1
4. Thoughtfulness	5	4	3	2	1
5. Listening skills	5	4	3	2	1
6. Faithfulness	5	4	3	2	1
7. Respect for Mother – in - law	5	4	3	2	1
8. Overall, how satisfied are you with your marriage?	5	4	3	2	1

To make surveys more useful, it is best to remember eight points

- Clients and Customers are not the same
- Surveys raise customers expectations
- How you ask a question will determine how the question is answered
- The more specific the question, the better the answer
- You have only one chance and only 15 minutes
- The more time you spend in survey development, the less time you will spend in data analysis and interpretation
- Who you ask is as important as what you ask
- Before the data are collected, you should know how you want to analyse and use the data

3. Focus Groups

These groups are very effective for gathering information on customer expectations and requirements.

4. Toll – Free Telephone Numbers

5. Customer Visits

6. Report Card

7. The Internet and Computers

8. Employee Feedback

9. Mass Customization

USING CUSTOMER COMPLAINTS :

Actions an organization can take to handle complaints are as follows

- Investigate customers experiences by actively getting feed back, both positive and negative, and then acting on it promptly
- Develop procedures for complaint resolution that include empowering front – line personnel.
- Analyze complaints, but understand that complaints do not always fit into neat categories.
- Work to identify process and material variations and then eliminate the root cause. “More inspection” is not corrective action.
- 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 complaint report to the quality council for their evaluation and, if needed, the assignment of process improvement teams.
- Identify customers' expectations beforehand rather than afterward through complaint analysis.

SERVICE QUALITY

Customer service is the set of activities an organization uses to win and retain customer's satisfaction. It can be provided before, during, or after the sale of the product or exist on its own.

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 physical spaces.

Customer Care

6. Meet the customer's expectations.
7. Get the customer's 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 area.

Communication

13. Optimize the trade – off between time and personal attention.
14. Minimize the number of contact points.
15. Provide pleasant, knowledgeable and enthusiastic employees.
16. Write document in customer friendly language.

Front-Line people

17. Hire people who like people.
18. Challenge them to develop better methods.
19. Give them the 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 people.
25. Strive for continuous process improvement.

CHARACTERISTICS AND EXPECTATIONS :

Characteristic	Expectation
Delivery	Delivered on schedule in undamaged condition
Installation	Proper instructions on setup, or technicians supplied for complicated products
Use	Clearly-written training manuals or instructions provided on proper use
Field repair	Properly-trained technicians to promptly make quality repairs
Customer Service	Friendly service representatives to answer questions
Warranty	Clearly stated with prompt service on claims

CUSTOMER RETENTION

It means “retaining the customer” to support the business. It is more powerful and effective than customer satisfaction.

For Customer Retention, we need to have both “Customer satisfaction & Customer loyalty”.

The following steps are important for customer retention.

1. Top management commitment to the customer satisfaction.
2. Identify and understand the customers what they like and dislike about the organization.
3. Develop standards of quality service and performance.
4. Recruit, train and reward good staff.



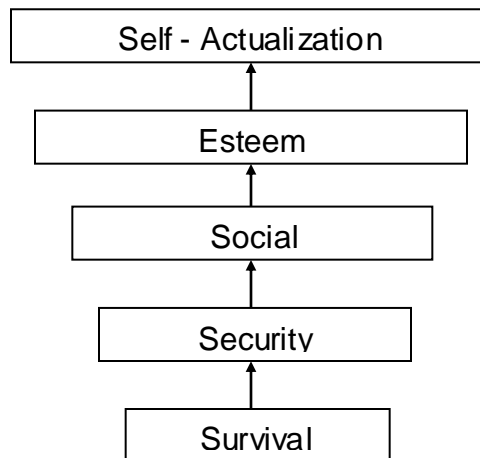
5. Always stay in touch with customer.
6. Work towards continuous improvement of customer service and customer retention.
7. Reward service accomplishments by the front-line staff.
8. Customer Retention moves customer satisfaction to the next level by determining what is truly important to the customers.
9. Customer satisfaction is the connection between customer satisfaction and bottom line.

EMPLOYEE INVOLVEMENT

- Employee involvement is one approach to improve quality and productivity.
- It is a means to better meet the organization's goals for quality and productivity.

MOTIVATION

MASLOW'S HIERARCHY OF NEEDS :



EMPLOYEE WANTS :

Factor	Employee Rating	Manager Rating
Interesting work	1	5
Appreciation	2	8
Involvement	3	10
Job security	4	2
Good Pay	5	1
Promotion/ growth	6	3
Good working conditions	7	4
Loyalty to employees	8	7
Help with personal problems	9	9
Tactful discipline	10	6

ACHIEVING A MOTIVATED WORK FORCE :

The building of a motivated work force is for the most part an indirect process. Concepts to achieve a motivated work force are as follows:

1. Know thyself.

2. Know your employees.
3. Establish a positive attitude.
4. Share the goals.
5. Monitor progress.
6. Develop interesting work.
 - Job rotation
 - Job enlargement
 - Job enrichment
7. Communicate effectively
8. Celebrate success.

EMPLOYEE SURVEYS :

Employee surveys help managers assess the current state of employee relations, identify trends, measure the effectiveness of program implementation, identify needed improvements, and increase communication effectiveness.

- STEP 1 : The Quality Council to create a multifunctional team
- STEP 2 : The Team will develop survey instrument
- STEP 3 : Administer the survey
- STEP 4 : Results are compiled and analyzed
- STEP 5 : Determine areas for improvement

EMPOWERMENT

Empowerment is investing people with authority. It's purpose is to tap the enormous reservoir of potential contribution that lies within every worker.

The two steps to empowerment are

1. To arm people to be successful through coaching, guidance and training.
2. Letting people do by themselves.

The principles of empowering people are given below.

1. Tell people what their responsibilities are.
2. Give authority.
3. Set standards for excellence.

4. Render training.
5. Provide knowledge and information.
6. Trust them.
7. Allow them to commit mistakes.
8. Treat them with dignity and respect.

Three dimensions of empowerment are

- Capability
- Alignment and
- Trust

TEAMS

- Employee involvement is optimized by the use of teams.
- A **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 individual interests and opinions to fulfill the objectives or goals of the group.

WHY TEAMS WORK :

1. Many heads are more knowledgeable than one.
2. The whole is greater than the sum of its members.
3. Team members develop a rapport which each other.
4. Teams provide the vehicle for improved communication.

TYPES OF TEAMS :

1. Process improvement team.
2. Cross – functional team.
3. Natural work teams.
4. Self – Directed / Self – Managed work teams.

CHARACTERISTICS OF SUCCESSFUL TEAMS :

- | | |
|-------------------------------|------------------------------------|
| 1. Sponsor | 2. Team Charter |
| 3. Team Composition | 4. Training |
| 5. Ground Rules | 6. Clear Objectives |
| 7. Accountability | 8. Well-Defined decision procedure |
| 9. Resources | 10. Trust |
| 11. Effective Problem Solving | 12. Open Communication |
| 13. Appropriate Leadership | 14. Balanced Participation |
| 15. Cohesiveness | |

TEAM MEMBER ROLES :

TEAM LEADER

- Ensures the smooth and effective operation of the team.
- Facilitates the team process.
- Serves as a Contact Point.
- Organizes the implementation of changes.
- Prepares the meeting agenda.

FACILITATOR

- Supports the leader.
- Focuses on the team process.
- Acts as a resource to the team.
- Provides feedback to the team.

RECORDER

- Documents the main ideas of the team's discussion, the issues raise, decisions made, action items etc.
- Presents the documents and distributes the MOM.
- Participates as a team member.

TIMEKEEPER

- Ensures that the team maintains the schedule.
- Participates as a team member.

TEAM MEMBER

- Contributes best, without reservation.
- Respects other people's contributions.
- Listens carefully and asks questions.
- Works for consensus on decisions.
- Supports the decision of the team.
- Understands and is committed to the team objectives.
- Respects and is tolerant of individual differences.
- Acknowledges and works through conflict openly.
- Carries out assignments.

DECISION MAKING METHODS :

1. Non-decision.
2. Unilateral decision.
3. Handclasp decision.
4. Minority-rule decision.
5. Majority-rule decision.
6. Consensus.

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.
- Project scope too large.
- Project objectives are not significant.
- No clear measures of success.
- No time to do improvement work.

RECOGNITION AND REWARD

Recognition is a process by which management shows acknowledgement of an employee's outstanding performance.

Various ways for Recognition and Rewards are

1. Recognition can be expressed using verbal and written praise.
2. Rewards may be in the form of certificates and plaques.
3. Reward is normally in the form of cinema tickets, dinner for family etc.
4. The financial compensation (for recognition) can be paid in terms of increased salaries, commissions, gain sharing etc.
5. The efforts of employees can be recognized by promotions, special job assignments etc.
6. A letter of appreciation from the CEO or the Top Management will increase the employee's involvement.
7. Reward may be delayed but recognition should be in a timely basis.
8. Rewards should be appropriate to the improvement level.
9. People like to be recognized than any reward.
10. Special forms of recognition include pictures on the bulletin board, articles in news letters, letter to families etc.
11. Supervisors can give on-the-spot praise for a job which is done well.

EFFECTS OF RECOGNITION AND REWARD SYSTEM :

1. Recognition and reward go together for letting people know that they are valuable members for the organization.
2. Employee involvement can be achieved by recognition and reward system.
3. Recognition and reward system reveals that the organization considers quality and productivity as important.
4. It provides the organization an opportunity to thank high achievers.
5. It provides employees a specific goal to achieve.
6. It motivates employees to improve the process.
7. It increases the morale of the workers.

PERFORMANCE APPRAISAL

The performance appraisal is used to let employees know how they are performing. The performance appraisal becomes a basis for promotions, increase in salaries, counseling and other purposes related to an employee's future.

IMPORTANCE OF PERFORMANCE APPRAISALS :

1. It is necessary to prevail a good relationship between the employee and the appraiser.
2. Employee should be informed about how they are performing on a continuous basis, not just at appraisal time.
3. The appraisal should highlight strength and weakness and how to improve the performance.
4. Employee should be allowed to comment on the evaluation and protest if necessary.
5. Everyone should understand that the purpose of performance appraisal is to have employee involvement.
6. Errors in performance evaluations should be avoided.
7. Unfair and biased evaluation will render poor rating and hence should be eliminated.

BENEFITS OF EMPLOYEE INVOLVEMENT :

Employee involvement improves quality and increases productivity because

- Employees make better decisions using their expert knowledge of the process
- Employees are better able to spot and pin-point areas for improvement.
- Employees are better able to take immediate corrective action.
- Employee involvement reduces labour / management friction.
- Employee involvement increases morale.
- Employees have an increased commitment to goals because they are involved.

CONTINUOUS PROCESS IMPROVEMENT

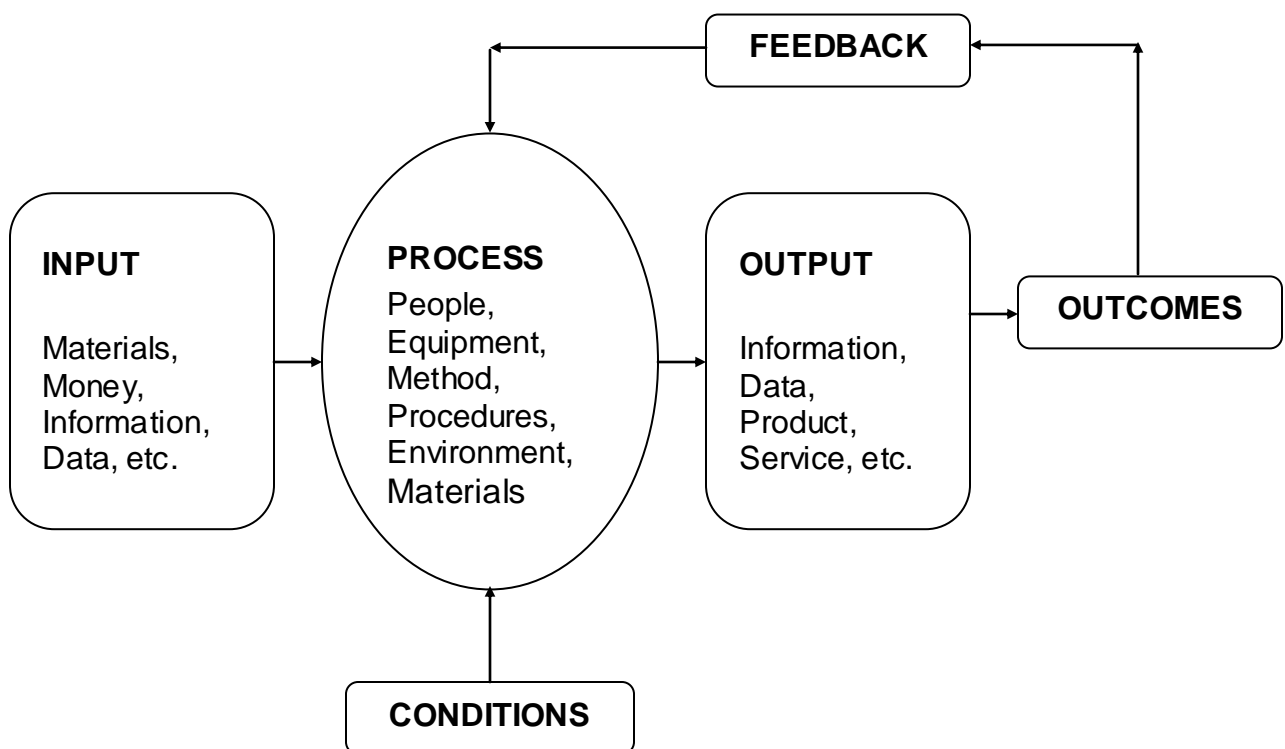
Continuous process improvement is designed to utilize the resources of the organization to achieve a quality-driven culture.

Improvement is made by

- Viewing all work as process.
- Making all process effective, efficient and adaptable.
- Anticipating changing customer needs.
- Controlling in-process performance using measures such as scrap reduction, control charts etc.
- Eliminating waste and re-work.
- Eliminating non-value added activities.
- Eliminating non-conformities.
- Using Benchmarking.
- Incorporating learned lessons into future activities.
- Using technical tools such as SPC, benchmarking, experimental design, QFD etc.

PROCESS :

Process refers to business and production activities of an organization.



Input / Output Process Model

There are five basic ways for 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.

THE JURAN TRILOGY

1. PLANNING

- Determine internal & external customers.
- Their needs are discovered.
- Develop product / service features.
- Develop the processes able to produce the product / service features.
- Transfer plans to operations.

2. CONTROL

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

It consists of the following steps

1. Determine items to be controlled.
2. Set goals for the controls.
3. Measure actual performance.
4. Compare actual performance to goals.
5. Act on the difference.

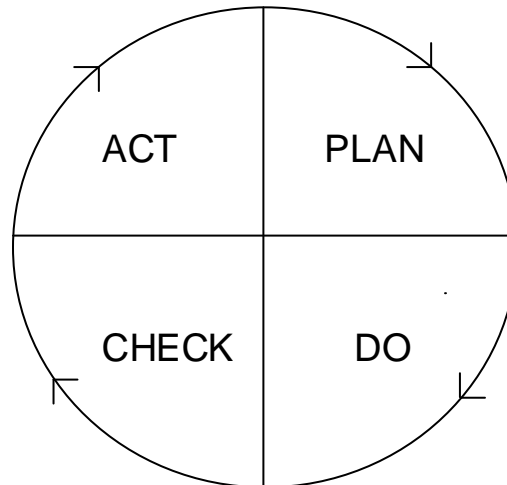
3. IMPROVEMENT

Aims to attain levels of performance that are higher than current levels.

It consists of the following steps

- Establishment of quality council.
- Identify the improvement projects.
- Establish the project teams with a project leader.
- Provide the team with the resources.

THE PDCA CYCLE :



PROBLEM SOLVING METHOD :

1. IDENTIFY THE OPPORTUNITY

- Identify the Problem
 - Pareto analysis of external alarm signals.
 - Pareto analysis of internal alarm signals.
 - Proposals from key insiders.
 - Proposals from suggestion schemes.
 - Field study of user's needs.
 - Comments of key people outside the organization.
 - Customer surveys.
 - Employee surveys.
 - Brainstorming by work groups.
- Form the Team
 - Team should be selected.
 - Goals and milestones are established.
- Define the Scope.

Criteria for a good problem statement is as follows

- It clearly describes the problem.
- It states the effect.
- It focuses on what is known, unknown etc.
- It emphasizes the impact on the customer.

2. ANALYZE THE CURRENT PROCESS

The objective is to understand the process and how it is currently performed.

Step 1 : The team to develop a process flow diagram.

Step 2 : The target performance measures are defined.

Step 3 : Collection of all available data and information.

Common items of data and information are

- | | |
|-------------------------|----------------------------|
| 1. Customer information | 2. Design information |
| 3. Process information | 4. Statistical information |
| 5. Quality information | 6. Supplier information |

3. DEVELOP THE OPTIMAL SOLUTION(S)

This phase has the objective of establishing potential and feasible solutions and recommending the best solution to improve the process.

- Creativity plays the major role, and brainstorming is the principal technique.
- There are three types of creativity:
 - Create new processes
 - Combine different processes
 - Modify the existing process

4. IMPLEMENT CHANGES

This phase has the objective of preparing the implementation plan, obtaining approval and implementing the process improvements.

- Approval of the quality council.
- Obtain the advice and consent of departments, functional areas, teams, individuals etc.
- Monitor the activity.

5. STUDY THE RESULTS

This phase has the objective of monitoring and evaluating the change by tracking and studying the effectiveness of the improvement efforts.

6. STANDARDIZE THE SOLUTION

- Institutionalize by positive control of the process.
- The quality peripherals – the system, environment and supervision must be certified.
- Operators must be certified.

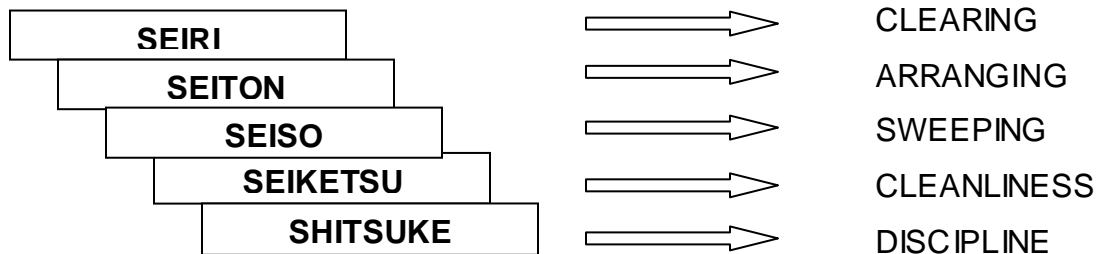
7. PLAN FOR THE FUTURE

The objective is to achieve improved level of process performance.

- Regularly conduct reviews of progress by the quality council.
- Establish the systems to identify area for future improvements.
- Track performance with respective internal & external customers.
- TQM tools and techniques are used to improve quality, delivery and cost.

5-S : HOUSEKEEPING

5-S MEANS EVERYTHING IN ITS PLACE



- There can be no TQM without 5-S.
- A dirty factory cannot produce quality products.
- Clutter hides problems. A neat workplace promotes easy discovery of abnormalities.

5-S CONTRIBUTES TO	SAFETY
	QUALITY
	PRODUCTIVITY

5-S FACILITATES	VISUAL CONTROL
--------------------	----------------

The First S : SEIRI : CLEARING

Take out unnecessary items and throw them away

Factory Floor

- ◆ Machines to be scrapped
- ◆ Rejected material
- ◆ Expired goods
- ◆ Broken tools, pallets, bins, trolleys.
- ◆ Old notices

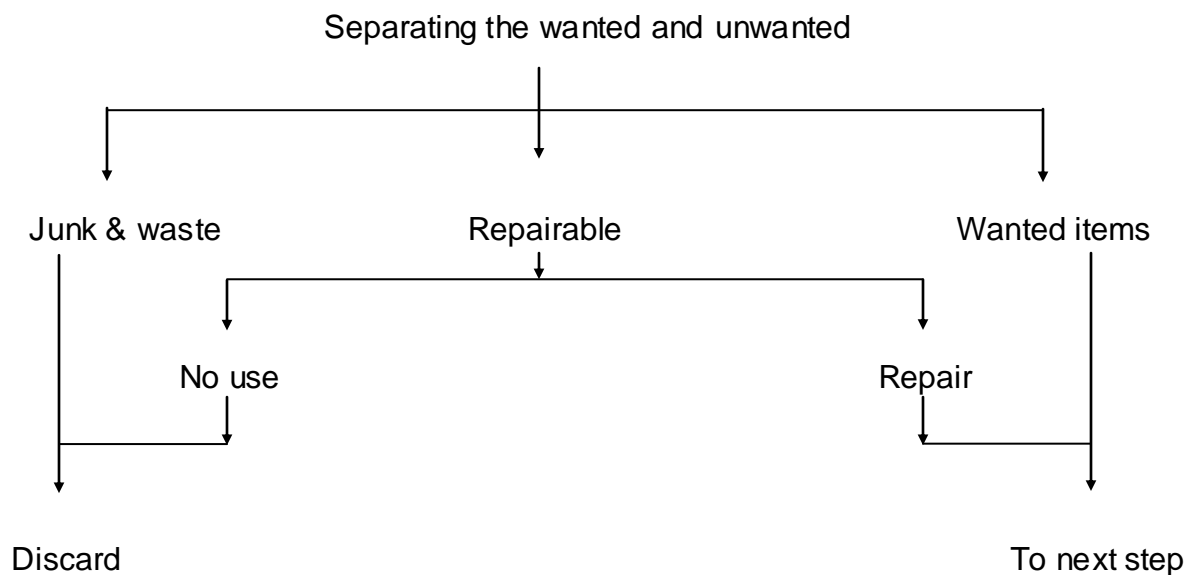
Office

- ◆ Used / Broken pens
- ◆ Useless paper
- ◆ Old diaries
- ◆ Broken furnitures

Home

- ◆ Broken toys
- ◆ Old clothes
- ◆ Broken suitcases

Flow Chart :



Consequences of not practicing SEIRI :

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

The Second S : 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 the floor

Office

- ◆ Unlabelled file cabinet
- ◆ Cluttered drawer, shelves, book cases, tables
- ◆ Records & documents Not arranged well
- ◆ File heaps and papers

Home

- ◆ Clutter
- ◆ No orderly arrangement in the rooms

Consequences of not practicing SEITON :

- Things are seldom available when needed.
- Items are “lost” in stores.
- Items – defectives and good ones get mixed up.
- Accidents or near-accidents occur due to clutter.
- Visual control of the shop floor is not possible.
- Sometimes, production is lost because an item required is available but cannot be found.
- In some offices, Critical Excise records or tax records may not be traceable. This can lead to finance loss, prosecution or embarrassment.

The Third S : SEISO : SWEEPING

Sweep your workplace thoroughly so that there is no dust anywhere.

Factory Floor

- ◆ Dirty machines
- ◆ Dust on product parts, R.Mtls.
- ◆ Dirty jigs, fixtures
- ◆ Dirty walls, roofs
- ◆ Littered floor

Office

- ◆ Dirty table & furniture
- ◆ Dirty office equipments
- ◆ Littered floor
- ◆ Dirty windows

Home

- ◆ Dirty furniture, floor, window, grills, bookshelves.

Consequences of not practicing SEISO :

- Most machines are affected by dust & dirt and hence their performance may go down.
- Dust and dirt on products, materials, packing boxes etc. will affect either their performance quality or their aesthetic look.
- Unpleasant to work in.

The Fourth S : SEIKETSU : CLEANLINESS

Washing with a strong overtone of keeping things disinfected as well as free of hazardous chemicals.

Factory Floor

- ◆ Handling hazardous chemicals
- ◆ Control of fumes, hazardous dust.
- ◆ Disinfecting, Personal hygiene

Office

- ◆ Free of pests
- ◆ Personal hygiene

Home

- ◆ Pest control
- ◆ Personal 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 cleaning a place makes the workplace pleasant.
- Personal hygiene is essential for healthy workforce.

The Fifth S : SHITSUKI : DISCIPLINE

Discipline especially with regard to safety rules and punctuality.

Consequences of not practicing SEIKETSU :

- If discipline is not practiced, then the first 4-S would backslide.
- Lack of Shitsuki means not following the standards. Then, all activities related to safety and quality will be affected.

IMPLEMENTING 5-S

1. Top Management resolve and training.
2. Formation of a 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 in each priority area.
8. Implementing the plan.
9. Verifying results.
10. Standardizing.
11. Establishing full control.
12. Looking for further improvements.

KAIZEN

Kaizen is a Japanese word for the philosophy that defines management's roles in continuously encouraging and implementing small improvements involving everyone. It focuses on simplification by breaking down complex progress into their sub – processes and then improving them.

The Kaizen improvement focuses on the use of :

- Value – added and non – value work activities.
- Muda, which refers to the seven classes of waste – over-production, delay, transportation, processing, inventory, wasted motion, and defective parts.
- Principles of motion study and the use of cell technology.
- Principles of materials handling and use of one – piece flow.
- Documentation of standard operating procedures.
- The five S's for workplace organization.
- Visual management.
- Just – in – time principles.
- Poka – Yoke.
- Team dynamics.

RE-ENGINEERING

It is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical measures of performance.

SUPPLIER PARTNERSHIP

The suppliers should be treated as partners to achieve the same quality level as attained within the organization.

The following forces need Supplier Partnership to improve quality, reduce costs and increase market share.

- Deming Philosophy (Deming's 4th point)
- Just-in-time
- Continuous process improvement
- ISO 9000

CUSTOMER – SUPPLIER RELATIONS :

Dr. Kaoru Ishikawa has given ten principles of customer-supplier relations. They are

1. Both the customer and supplier are fully responsible for the control of quality.
2. Both the customer and supplier should be independent of each other.
3. The customer is responsible for providing the supplier with clear and sufficient requirements so that the customer can know precisely what to produce.
4. Both the customer and supplier should enter into a non-adversarial contract.
5. The supplier is responsible for providing the quality that will satisfy the customer.
6. Both the customer and supplier should decide the method to evaluate the quality of the product or services.
7. Both the customer and supplier should establish in the contract the method by which they can reach an amicable settlement in case of any dispute.
8. Both the customers and supplier should continually exchange information.
9. Both the customer and supplier should perform business activities.
10. Both the customer and supplier should have the best interest of the end user in mind.

PARTNERING

Partnering is a relationship between two or more parties based upon trust, dedication to common goals.

The benefits of partnering are

- Improved quality
- Increased efficiency
- Lower cost
- Increased opportunity for innovation
- Continuous improvement

The three key elements to a partnership relationship are

- Long term commitment
- Trust
- Shared Vision

SOURCING

The three types of sourcing are

- Sole sourcing
- Multiple sourcing
- Single sourcing

SUPPLIER SELECTION

The suppliers should be selected with the following ten conditions

1. The supplier should understand clearly the management philosophy of the organization.
2. The supplier should have stable management system.
3. The supplier should maintain high technical standards.
4. The supplier should provide the raw materials and parts which meet quality specifications required by the purchaser.
5. The supplier should have the required capability in terms of production.
6. The supplier should not leak out the corporate secrets.
7. The supplier should quote right price and should meet the delivery schedule. The supplier should be accessible with respect to transportation and communication.
8. The supplier should be sincere in implementing the contract provisions.
9. The supplier should have an effective quality system such as ISO / QS 9000.
10. The supplier should be renowned for customer satisfaction.

SUPPLIER CERTIFICATION :

A certified supplier is one which, after extensive investigation, is found to supply material of such quality that is not necessary to perform routine testing.

The Eight criteria for supplier certification are

1. No product related lot rejections for atleast 1 year.
2. No non-product related rejections for atleast 6 months.
3. No production related negative incidents for atleast 6 months.
4. Should have passed a recent on-site quality system evaluation.
5. Having a fully agreed specifications.
6. Fully documented process and quality system.
7. Timely copies of inspection and test data.
8. Process that is stable and in control.

SUPPLIER RATING :

Supplier Rating is done

- To obtain an overall rating of supplier performance.
- To communicate with suppliers regarding their performance.
- To provide each supplier with a detailed and true record of problems for corrective action.
- To enhance the relationship between the buyer and the supplier.

RELATIONSHIP DEVELOPMENT :

For establishment of supplier relationship, the following are necessary.

- (a) Partnering
- (b) Supplier selection
- (c) Principles of customer / supplier relations
- (d) Certification
- (e) Periodic rating

For relationship development, the following are necessary.

- (a) Inspection
 - 100% inspection
 - Sampling
 - Audit
 - Identity check
- (b) Training
- (c) Teams
- (d) Recognition and Reward

PERFORMANCE MEASURES

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 and reveal trend.
- To identify the processes to be improved.
- To determine the process gains and losses.
- To compare the actual performance with standard performance.
- To provide information for individual and team evaluation.
- To determine overall performance of the organization.
- To provide information for making proper decisions.

WHAT SHOULD BE MEASURED?

Human resources

1. Lost time due to accidents, absenteeism.
2. Employee turnover.
3. Employee satisfaction index.
4. Training cost per employee.
5. Number of grievances.

Customers

1. Number of complaints from customers.
2. Number of on-time deliveries.
3. Warranty data.
4. Dealer satisfaction.

Production

2. Inventory.
3. SPC Charts.
4. Amount of scrap / rework.
5. Machine down time.

Research and Development

2. New product time to market.
3. Design change orders.
4. Cost estimating errors.

Suppliers

2. On-time delivery.
3. Service rating.
4. Quality performance.
5. Average lead time.

Marketing / Sales

2. Sales expense to revenue.
3. New product sales to total sales.
4. New 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 function

- Quality
- Cost
- Flexibility
- Reliability
- Innovation

PERFORMANCE MEASURE PRESENTATION :

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.

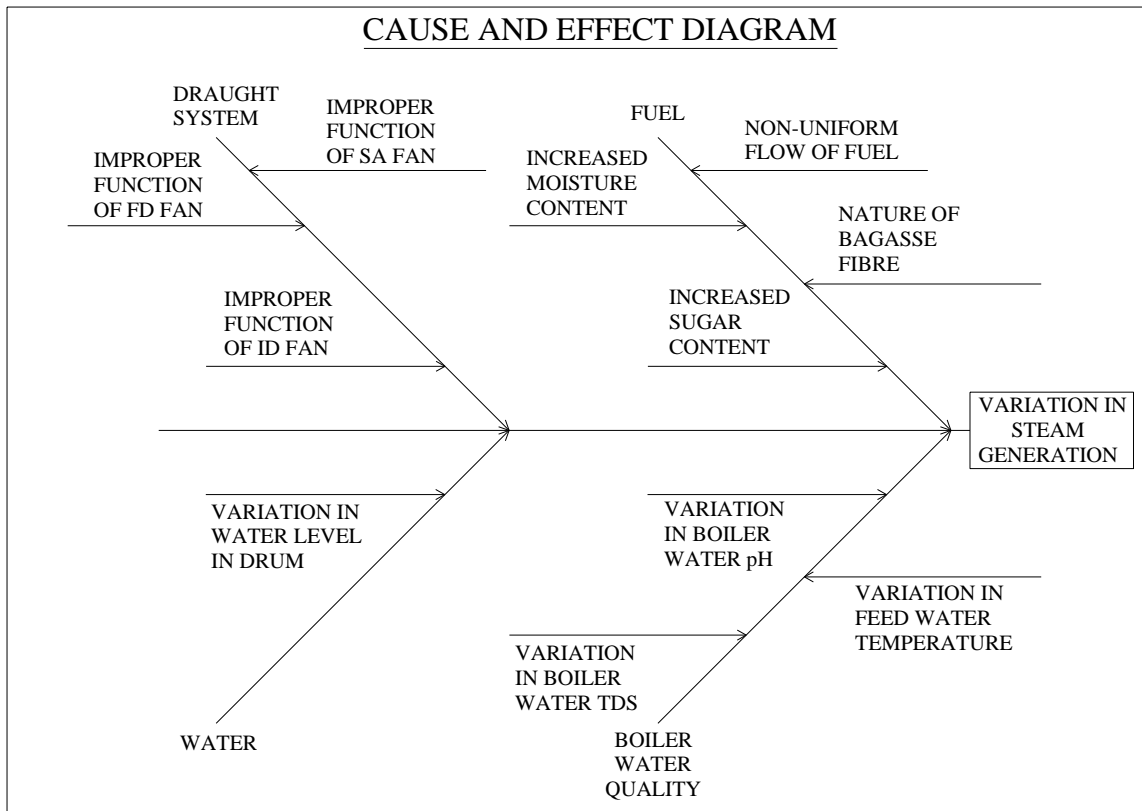
In MBNQA, five categories are analyzed. They are

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

UNIT III – STATISTICAL PROCESS CONTROL

TQM TOOLS (SEVEN TOOLS OF QUALITY)

1. PARETO DIAGRAM
2. FLOW DIAGRAM
3. CAUSE AND EFFECT DIAGRAM



STEPS IN CONSTRUCTING A CAUSE & EFFECT DIAGRAM :

- a. Define the problem or effect to be analyzed.
- b. Form the team to perform the analysis. Often the team will uncover potential causes through brainstorming.
- c. Draw the effect box and the centerline.
- d. Specify the major potential cause categories and join them as boxes connected to the centerline.
- e. Identify the possible causes and classify them into the categories in step d. Create new categories, if necessary.
- f. Rank order the causes to identify those that seem most likely to impact the problem.
- g. Take corrective action.

4. CHECK SHEETS

CHECK SHEET						
Product : Bicycle						
Nonconformity Type	Check					Total
Blister						21
Light spray						15
Drips						25
Others						25
TOTAL						86

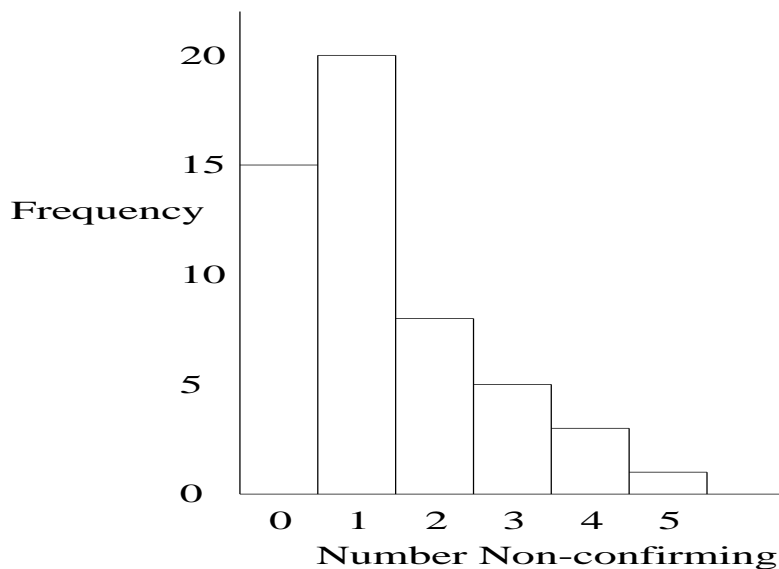
5. HISTOGRAM

Number of Errors

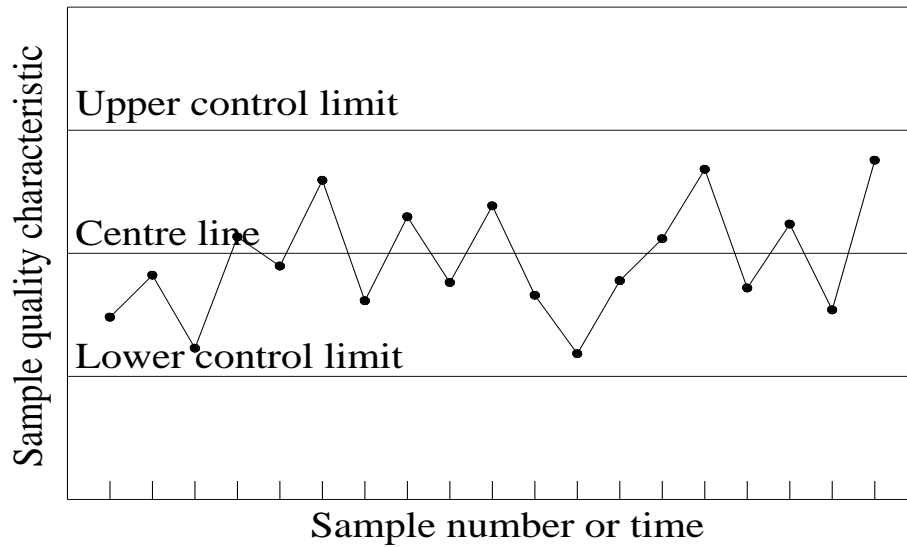
0	1	3	0	1	0	1	0
1	5	4	1	2	1	2	0
1	0	2	0	0	2	0	1
2	1	1	1	2	1	1	
0	4	1	3	1	1	1	
1	3	4	0	0	0	0	
1	3	0	1	2	2	3	

Tally of Number of Errors

Number Non-conforming	Tabulation	Freq.
0		15
1		20
2		8
3		5
4		3
5		1



6. CONTROL CHARTS



A typical control chart

7. SCATTER DIAGRAM

In scatter diagram, three types of co-relations exist.

1. Positive correlation.
2. Negative correlation.
3. No correlation.

NEW MANAGEMENT TOOLS

1. WHY, WHY

2. FORCED FIELD ANALYSIS

- Define the objective.
- Determine criteria for evaluating the effectiveness of the improvement action.
- Brainstorm the forces.
- Prioritize the forces from greatest to least.
- Take action.

Objective : Stop Smoking

Promoting Forces	Inhibiting Forces
Poor Health Smelly Clothing Poor Example Cost Impact on Others	Habit Addiction Taste Stress Advertisement

3. NOMINAL GROUP TECHNIQUE

4. AFFINITY DIAGRAM

5. INTER-RELATIONSHIP DIGRAPH

6. TREE DIAGRAM

7. MATRIX DIAGRAM

8. PRIORITIZATION MATRICES

9. PROCESS DECISION PROGRAM CHART

10. ACTIVITY NETWORK DIAGRAM

STATISTICAL FUNDAMENTALS

Statistics is defined as the science that deals with the collection, tabulation, analysis, interpretation and presentation of quantitative data.

Data collected for quality control purposes are obtained by direct observation and are classified as

1. Variables (Measurable quality characteristics like length measured in metres)
2. Attributes (Quality characteristic which are classified as either **conforming** (or) **non-conforming** to specifications, such as “go & no-go” gauge).

MEASURES OF CENTRAL TENDENCY AND DISPERSION

There are two important analytical methods of describing a collection of data as

1. Measures of central tendency.
2. Measures of dispersion.

A measure of central tendency of a distribution is a numerical value that describes how the data tend to build up in the centre. There are three measures in quality as

1. Average
2. Median
3. Mode

Average is the sum of observations divided by the number of observations.

$$\text{Average} = \bar{X} = \frac{\sum_{i=1}^{i=n} X_i}{n}$$

where, n = number of observations
 X_i = observed value

Median is the value which divides a series of ordered observations so that the number of items above it is equal to the number of items below it.

Mode is the value which occurs with the greatest frequency in a set of numbers. Mode can again classified as

- No mode
- Uni mode
- Bi mode
- Multimode

Measure of dispersion describes how the data are spread out on each side of the central value.

The two measures of dispersion are

1. Range
2. Standard Deviation

Range is the difference between the largest and smallest values of observations in a series of numbers.

$$\text{Range} = R = X_h - X_l$$

Where,

R	=	Range
X_h	=	highest observation in a series
X_l	=	lowest observation in a series

Standard Deviation measures the spreading tendency of the data. Larger the standard deviation, greater the variability of data.

$$S = \sqrt{\frac{\sum_{i=1}^{i=n} (X_i - \bar{X})^2}{n - 1}}$$

where

S	=	sample standard deviation
X_i	=	observed value
n	=	number of observations

POPULATION AND SAMPLE

In order to construct a frequency distribution of the outer diameter of shafts, a small portion (or) sample is selected to represent all the shafts. The population is the whole collection of shafts.

The population may be an hour's production, a week's production, 10000 pieces and so on.

It is not possible to measure all of the population. Hence, we go for sampling. Sampling becomes necessary

1. When it is impossible to measure the entire population.
2. When it is more expensive to observe all the data.
3. When the required inspection destroys the product.
4. When a test of the entire population may be too dangerous as in the case of new medical drug.

\bar{X}	is for sample average or sample mean.
μ	is for population mean.
S	is for sample standard deviation.
σ	is for population standard deviation.

NORMAL CURVE

Normal curve is common type of population. The normal curve is symmetrical, unimodal, bell – shaped distribution with the mean, median and mode all having the same value.

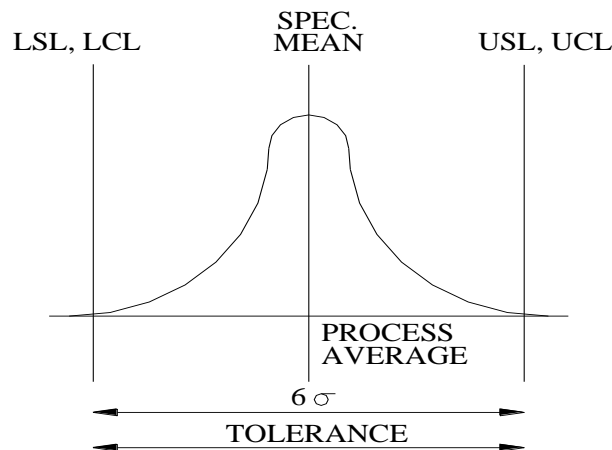


Figure 3.2 : Normal curve tolerance limits

CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES

Variation is a law of nature because no two natural items in any category are the same. Variations are due to the following reasons.

1. Chance causes or Natural causes.
2. Assignable causes.

Chance causes of variation are inevitable. Chance causes affect almost every production process and are inherent in the process. They are purely random, unidentifiable sources of variations.

Hence, when only chance causes are present in a process, the process is said to be in Statistical Control.

Assignable causes result in unnatural variations. The sources of variations may be due to

- Equipments
- Materials
- Environment
- Operator etc.

The **Control chart** is used to look at variations, seek assignable causes and chance causes. The control chart is a line chart with control limits.

All control charts have three basic components.

1. A centre line, usually the mathematical average of all the samples plotted.
2. Upper and Lower Control Limits that define the constraints of common cause variations.
3. Performance data plotted over time.

A typical control chart is a graphic display of a quality characteristic that has been measured or computed from a **sample** versus **sample number** or **time**. If the process is in control, nearly all of the sample points will fall between **Upper Control Limit (UCL)** and **Lower Control Limit (LCL)**.

CONTROL CHART FOR VARIABLES

1. Mean chart – \bar{X} chart & Range Chart – R Chart

$$\bar{\bar{X}} = \frac{\sum \bar{X}}{N}$$

$$\bar{R} = \frac{\sum R}{N}$$

Where, N = Total number of observations.
n = Sample size (for finding out the value of A_2 and D_4 and D_3 from the table)

Control limits for the charts are given by the following equation.

\bar{X} – Chart

$$CL = \bar{\bar{X}}$$

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \cdot \bar{R}$$

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \cdot \bar{R}$$

R - Chart

$$CL = \bar{R}$$

$$UCL_R = D_4 \cdot \bar{R}$$

$$LCL_R = D_3 \cdot \bar{R}$$

2. Mean chart – \bar{X} chart & Standard Deviation chart – S Chart

$$\bar{\bar{X}} = \frac{\sum \bar{X}}{N}$$

$$\bar{S} = \frac{\sum S}{N}$$

Where, N = Total number of observations.
n = Sample size (for finding out the value of A_3 and B_4 and B_3 from the table)

Control limits for the charts are given by the following equation.

\bar{X} - Chart

$$CL = \bar{\bar{X}}$$

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_3 \cdot \bar{S}$$

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_3 \cdot \bar{S}$$

S - Chart

$$CL = \bar{S}$$

$$UCL_S = B_4 \cdot \bar{S}$$

$$LCL_S = B_3 \cdot \bar{S}$$

CONTROL CHART FOR ATTRIBUTES

1. p chart
2. np chart
3. c chart
4. u chart

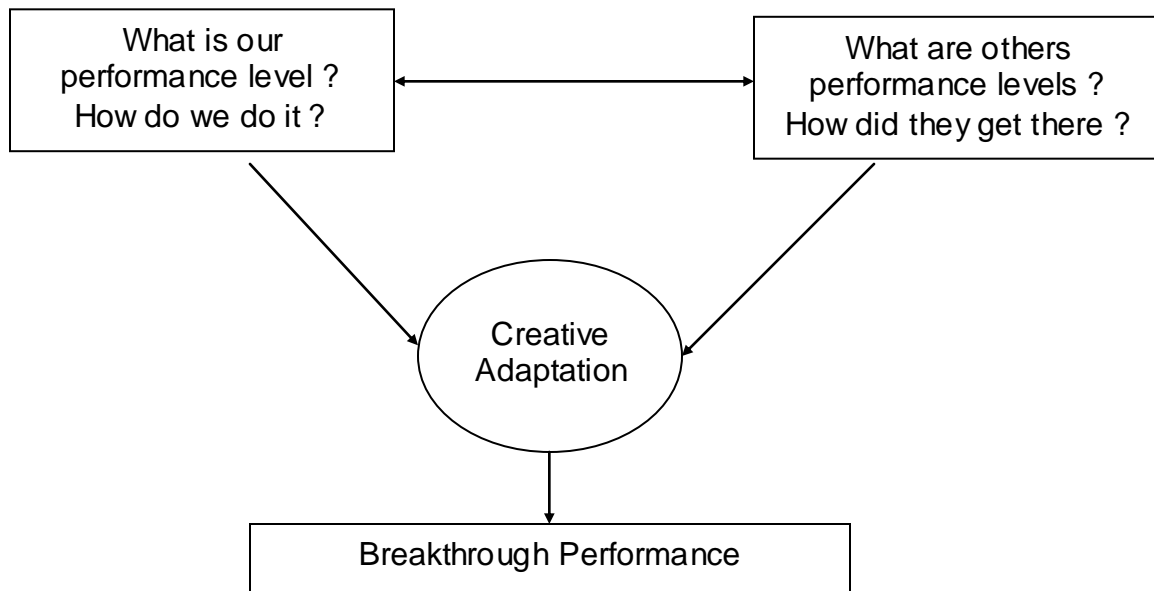
UNIT IV – TQM TOOLS

BENCHMARKING

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices.

- Benchmarking is a systematic search for the best practices, innovative ideas, and highly effective operating procedures.

BENCHMARKING CONCEPT



REASONS TO BENCHMARK :

- It is a tool to achieve business and competitive objectives
- It can inspire managers (and Organizations) to compete
- It is time and cost effective
- It constantly scans the external environment to improve the process
- Potential and useful technological breakthroughs can be located and adopted early

PROCESS OF BENCHMARKING

The following six steps contain the core techniques of Benchmarking

1. Decide what to benchmark

- Benchmarking can be applied to any business or production process
- The strategy is usually expressed in terms of mission and vision statements

- Best to begin with the mission and critical factors
- Choosing the scope of the Benchmarking study
- Pareto analysis – what process to investigate
- Cause and Effect diagram – for tracing outputs back

2. Understand current performance

- Understand and document the current process
- Those working in the process are the most capable of identifying and correcting problems
- While documenting, it is important to quantify
- Care should be taken during accounting information

3. Plan

- A benchmarking team should be chosen
- Organizations to serve as the benchmark need to be identified
- Time frame should be agreed upon for each of the benchmarking tasks

There are three types of benchmarking

- a. Internal
- b. Competitive
- c. Process

4. Study Others

Benchmarking studies look for two types of information

- How best the processes are practiced
- Measurable results of these practices

Three techniques for conducting the research are

- Questionnaires
- Site visits
- Focus groups

5. Learn from the data

Answering a series of questions like

- Is there a gap between the organization's performance and the performance of the best-in-class organizations?
- What is the gap? How much is it?
- Why is there a gap? What does the best-in-class do differently that is better?
- If best-in-class practices were adopted, what would be the resulting improvement?

Benchmarking studies can reveal three different outcomes

- Negative gap
- Parity
- Positive gap

6. Using the findings

The objective is to close the gap. For this

- Findings must be communicated to the people within the organization
- Action plans must be developed to implement new processes

Groups that must agree on the change

- Process owners
- Upper management

Steps for the development and execution of action plans are

1. Specify tasks
2. Sequence tasks
3. Determine resources needs
4. Establish task schedule
5. Assign responsibility for each task
6. Describe expected results
7. Specify methods for monitoring results

PITFALLS AND CRITICISMS OF BENCHMARKING :

- Idea of copying others
- It is not a cure or a business philosophy
- Some process have to be benchmarked repeatedly
- It is not a substitute for innovation

QUALITY FUNCTION DEPLOYMENT

- Quality Function Deployment is a planning tool used to fulfill customer expectations.
- Quality Function Deployment focuses on customer expectations or requirements, often referred to as voice of the customer.

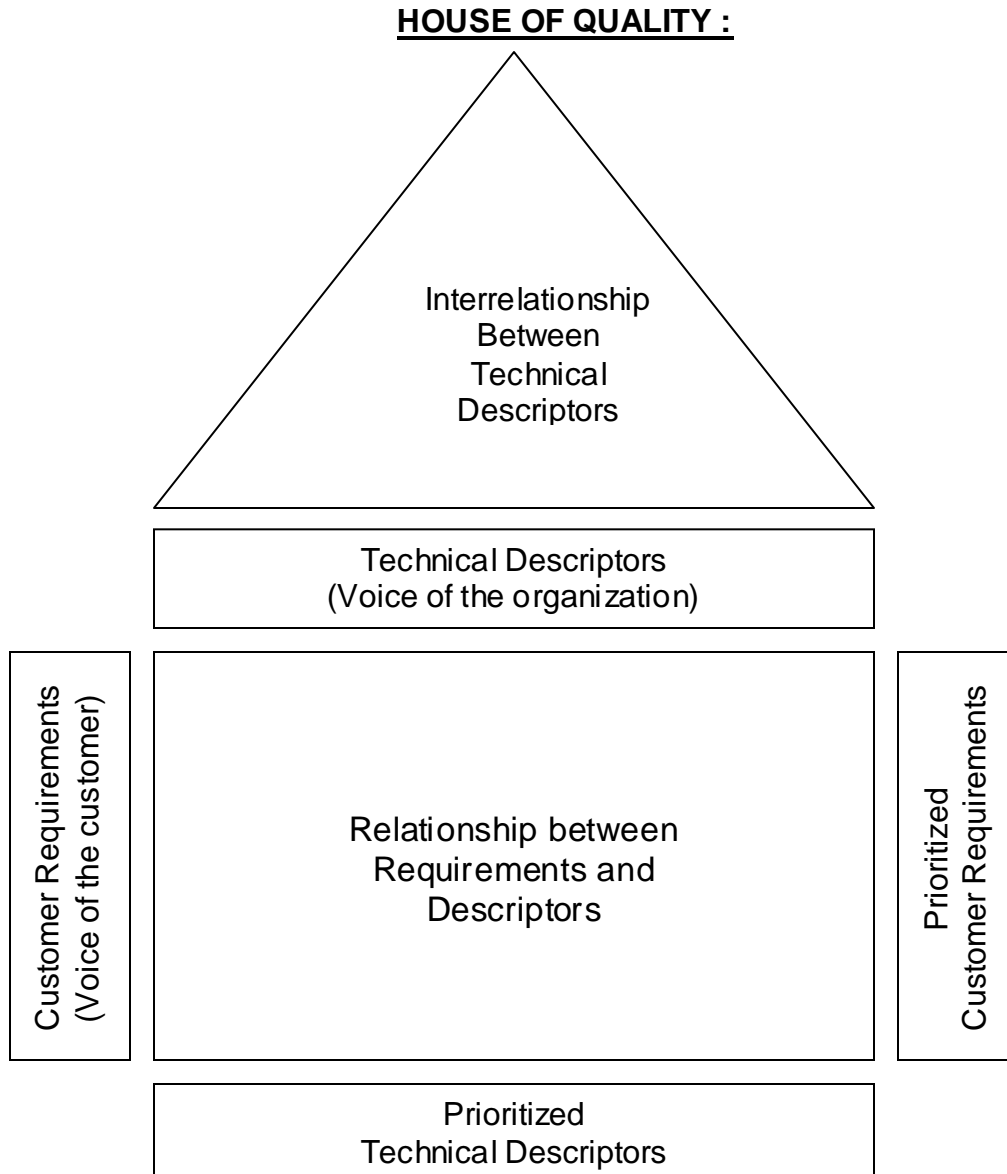
QFD TEAM :

There are two types of teams namely

1. Team for designing a new product
2. Team for improving an existing product

BENEFITS OF QFD :

1. Improves Customer satisfaction
 - Creates focus on customer requirements
 - Uses competitive information effectively
 - Prioritizes resources
 - Identifies items that can be acted upon
2. Reduces Implementation Time
 - Decreases midstream design changes
 - Limits post introduction problems
 - Avoids future development redundancies
3. Promotes Team Work
 - Based on consensus
 - Creates communication
 - Identifies actions
4. Provides Documentation
 - Documents rationale for design
 - Adds structure to the information
 - Adapts to changes (a living document)



THE STEPS IN BUILDING A HOUSE OF QUALITY ARE :

1. List Customer Requirements (WHAT's)
2. List Technical Descriptors (HOW's)
3. Develop a Relationship Matrix Between WHAT's and HOW's
4. Develop an Inter-relationship Matrix between HOW's
5. Competitive Assessments
 - a. Customer Competitive Assessments
 - b. Technical Competitive Assessments
6. Develop Prioritized Customer Requirements
7. Develop Prioritized Technical Descriptors

TAGUCHI'S QUALITY LOSS FUNCTION

Taguchi's Quality Loss Function concept combines cost, target and variation in one metric with specifications being of secondary importance.

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

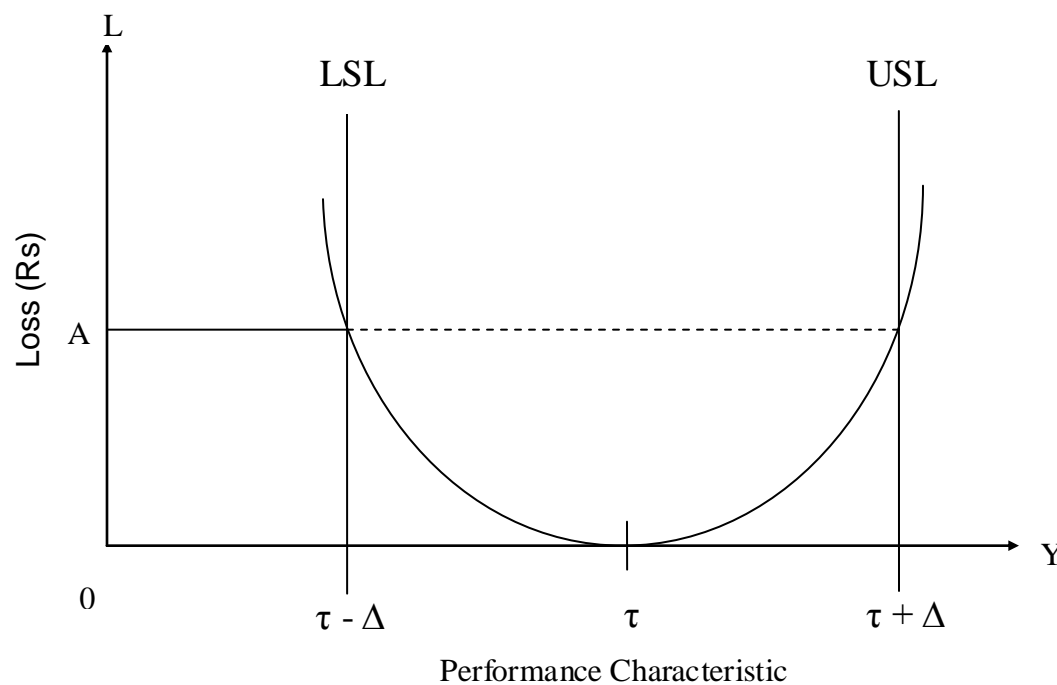
- **CUSTOMERS PERCEIVE QUALITY AS MEETING THE TARGET RATHER THAN JUST MEETING THE SPECIFICATIONS.**

There are three common quality loss functions

1. Nominal - the - best.
2. Smaller - the - better.
3. Larger - the - better.

NOMINAL – THE – BEST :

Although Taguchi developed so many loss functions, many situations are approximated by the quadratic function which is called the **Nominal – the – best** type.



Quadratic Loss Function

The quadratic function is shown in figure. In this situation, the loss occurs as soon as the performance characteristic, y , departs from the target τ .

At τ , the loss is Rs. 0.

At LSL (or) USL, the loss is Rs. A.

The quadratic loss function is described by the equation $L = k (y - \tau)^2$.

Where,

L = cost incurred as quality deviates from the target.

y = Performance characteristic

τ = target

k = Quality loss coefficient.

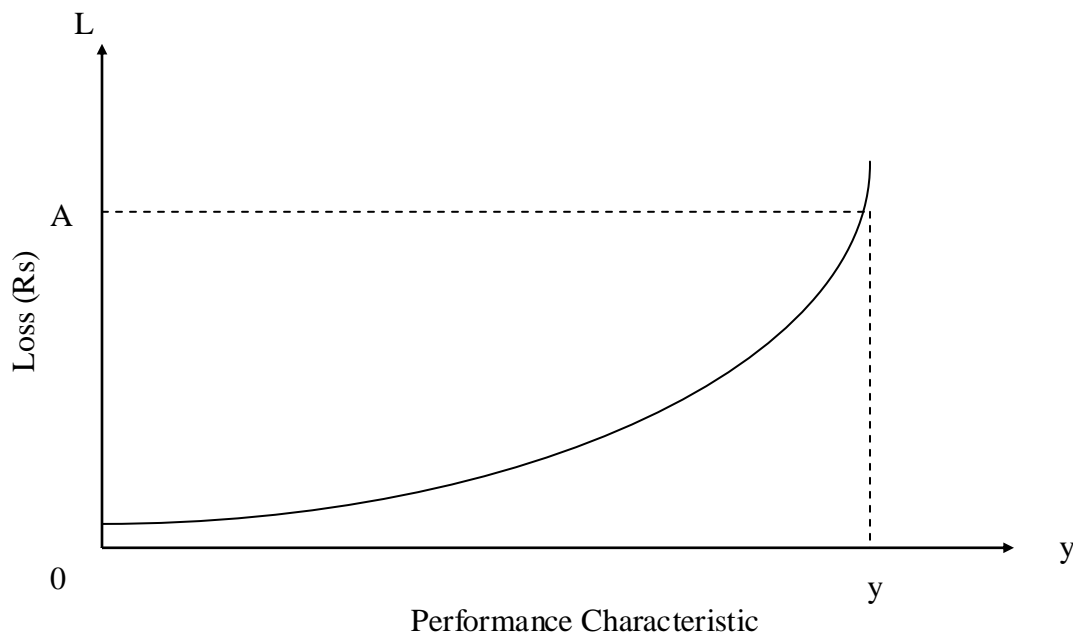
The loss coefficient is determined by setting $\Delta = (y - \tau)$, the deviation from the target. When Δ is the USL (or) LSL, the loss to the customer of repairing (or) discarding the product is Rs. A.

Thus,

$$K = A / (y - \tau)^2 = A / \Delta^2 .$$

SMALLER – THE – BETTER :

The following figure shows the smaller – the – better concepts.



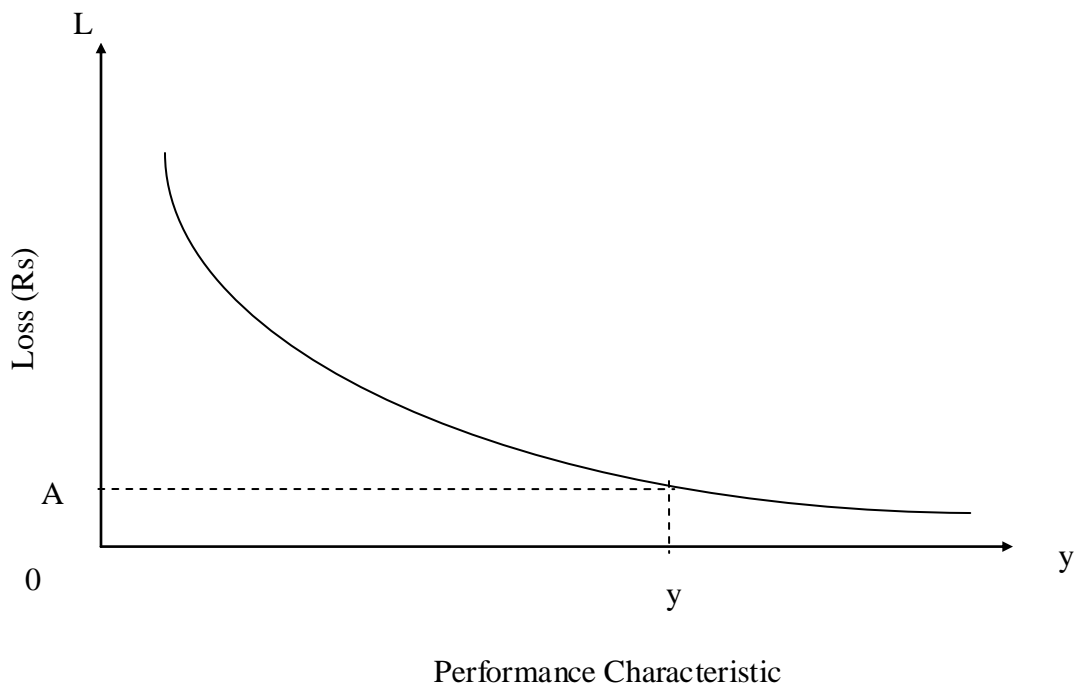
Smaller-the-better

The target value for **smaller – the – better** is 0. There are no negative values for the performance characteristic.

The radiation leakage from a microwave appliance, the response time for a computer, pollution from an automobile, out of round for a hole etc. are the performance characteristics for this concept.

LARGER – THE – BETTER :

The following figure shows the concept of the Larger – the – better.



Larger-the-better

In the Larger – the – better concept, the target value is ∞ (infinity), which gives a **zero loss**. There are no negative values and the worst case is at $y = 0$. Actually, larger – the – better is the reciprocal of smaller – the – better. The performance characteristics in Larger – the – better are bond strength of adhesives, welding strength etc.

TOTAL PRODUCTIVE MAINTENANCE (TPM)

Total Productive Maintenance (TPM) is defined as keeping the running plant and equipment at its highest productive level with the co-operation of all areas of the organization.

Predictive and Preventive maintenance are essential to building a foundation for a successful TPM environment. **Predictive Maintenance** is the process of using data and statistical tools to determine when a piece of equipment will fail. **Preventive Maintenance** is the process of periodically performing activities such as lubrication on the equipment to keep it running.

OBJECTIVES OF TPM :

1. To maintain and improve equipment capacity.
2. To maintain equipment for life.
3. To use support from all areas of the operation.
4. To encourage input from all employees.
5. To use teams for continuous improvement.

TPM PHILOSOPHY – CONCEPT OF TPM :

Total Productive Maintenance (TPM) is an extension of the Total Quality Management (TQM) philosophy to the maintenance function.

TPM has the following steps:

1. Management should learn the new philosophy of TPM.
2. Management should promote the new philosophy of TPM.
3. Training should be funded and developed for everyone in the organization.
4. Areas of needed improvement should be identified.

Loss measurements to identify improvement needs are

- Down time losses
- Reduced speed losses
- Poor quality losses

5. Performance goals should be formulated.
6. An implementation plan should be developed.
7. Autonomous work groups should be established.

FAILURE MODE AND EFFECTS ANALYSIS

FMEA 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.

It is a group of activities comprising the following :

1. Recognize the potential failure of a product or process.
2. Identify actions that eliminate / reduce the potential failure.
3. Document the process.

Two important types of FMEA are

- Design FMEA
- Process FMEA

INTENT OF FMEA :

- Continually measuring the reliability of a machine, product or process.
- To detect the potential product - related failure mode.
- FMEA evaluation to be conducted immediately following the design phase.

BENEFITS OF FMEA:

- Having a systematic review of components failure modes to ensure that any failure produces minimal damage.
- Determining the effects of any failure on other items.
- Providing input data for exchange studies.
- Determining how the high-failure rate components can be adapted to high-reliability components.
- Eliminating / minimizing the adverse effects that failures could generate.
- Helping uncover the misjudgements, errors etc.
- Reduce development time and cost of manufacturing.

FMEA TEAM :

Engineers from

- Assembly
- Manufacturing
- Materials
- Quality
- Service
- Supplier
- Customer

FMEA DOCUMENTATION :

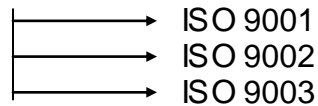
The purpose of FMEA documentation is

- To allow all involved Engineers to have access to others thoughts
- To design and manufacture using these collective thoughts (promotes team approach)

UNIT V – QUALITY SYSTEMS

ISO 9000 STANDARDS

ISO 9000



ISO 9001

Design, Development, Production, Installation & Servicing

ISO 9002

Production, Installation & Servicing

ISO 9003

Inspection & Testing

ISO 9004

Provides guidelines on the technical, administrative and human factors affecting the product or services.

BENEFITS OF ISO 9000 STANDARDS :

- Achievement of international standard of quality.
- Value for money.
- Customer satisfaction.
- Higher productivity.
- Increased profitability
- Improved corporate image
- Access to global market
- Growth of the organization
- Higher morale of employees

CLAUSES (ELEMENTS) OF ISO 9000 (During the year 1987)

- 4.1 Management Responsibility
- Adequate resources for the verification activities
 - Need for trained personnel
 - Work and verification activities including audits
 - A Management Representative to be identified
 - Review the Quality System performance and customer complaints periodically

- 4.2 Quality System
- 4.3 Contract review
- 4.4 Design Control
- 4.5 Documents Control
- 4.6 Purchasing
- 4.7 Purchaser – Supplied Product
- 4.8 Product Identification and Traceability
- 4.9 Process Control
- 4.10 Inspection and Testing
- 4.11 Inspection Measuring and Test Equipment
- 4.12 Inspection and Test Status
- 4.13 Control of Non – Conforming Product
- 4.14 Corrective Action
- 4.15 Handling, Storage, Packaging and Delivery
- 4.16 Quality Records
- 4.17 Internal Quality Audits
- 4.18 Training
- 4.19 Servicing
- 4.20 Statistical Techniques

CLAUSES (ELEMENTS) OF ISO 9000 (During the year 2000)

- 1. Scope
- 2. Normative Reference
- 3. Terms and Definitions
- 4. Quality Management System (QMS)
 - General Requirements
 - Documentation
- 5. Management Responsibility
 - Management Commitment
 - Customer Focus
 - Quality Policy
 - Planning
 - Responsibility, Authority and Communication
 - Management Review
- 6. Resource Management
 - Provision of Resources
 - Human Resources
 - Infrastructure
 - Work Environment
- 7. Product Realization
 - Planning of Product Realization
 - Customer related processes
 - Design and Development
 - Purchasing
 - Production and Service Provision
 - Control of Monitoring and Measuring devices
- 8. Monitoring and Measurement
 - General
 - Monitoring and Measurement

Control of Non-Conforming Product
Analysis of Data
Improvement

IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM :

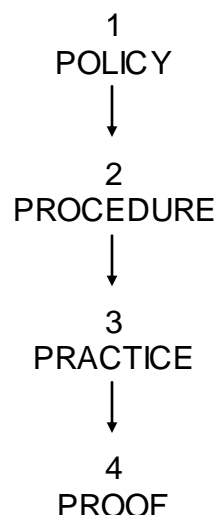
1. Top Management Commitment
2. Appoint the Management Representative
3. Awareness
4. Appoint an Implementation Team
5. Training
6. Time Schedule
7. Select Element Owners
8. Review the Present System
9. Write the Documents
10. Install the New System
11. Internal Audit
12. Management Review
13. Pre-assessment
14. Registration

PITFALLS OF SUCCESSFUL IMPLEMENTATION :

1. Using a generic documentation program or another organization's documentation program
2. Over-documentation or documentation that is too complex
3. Using External Consultants without involvement
4. Neglecting to obtain top management's involvement
5. Developing a system that does not represent what actually occurs

DOCUMENTATION

In every organization, the quality system must be documented properly. The documentation of the system can be seen as a hierarchical format as shown.



QUALITY AUDITING

The term Audit refers to a regular examination and checking of accounts or financial records, settlement or adjustment of accounts.

It also refers to checking, inspection and examination of Production Processes.

PURPOSE OF QUALITY AUDIT :

- To establish the adequacy of the system.
- To determine the effectiveness of the system.
- To afford opportunities for system analysis.
- To help in problem solving.
- To make decision making easier etc.

TYPES OF QUALITY AUDIT :

1. First – Party Audit.
2. Second – Party Audit.
3. Third – Party Audit.

Quality audit can also be classified on the basis of the area taken into account for the audit such as

- System Audit.
- Process Audit.
- Product Audit.
- Adequacy Audit.
- Compliance Audit.

ISO 14000 – ENVIRONMENTAL MANAGEMENT SYSTEM

The overall aim of the Environmental Management systems is **to provide protection to the environment and to prevent pollution.**

- The success of ISO 9000 along with increased emphasis on Environmental issues were instrumental in ISO's decision to develop Environmental Management Standards.
- In 1991, ISO formed the Strategic Advisory Group on the Environment (SAGE) which led to the formation of Technical Committee (TC) 207 in 1992.
- Mission of TC207 is to develop standards for an Environmental Management System (EMS) which was identified as ISO 14000.
- TC 207 has Established six sub-committees
 1. Environmental Management System (EMS)
 2. Environmental Auditing (EA)
 3. Environmental labeling (EL)
 4. Environmental Performance Evaluation (EPE)
 5. Life-Cycle Assessment (LCA)
 6. Terms & Definitions

Environmental Management System (EMS) :

EMS has two Evaluation Standards. They are

1. Organization Evaluation Standards
2. Product Evaluation Standards

REQUIREMENT OF ISO 14001

There are six elements

1. GENERAL REQUIREMENTS

- EMS should include policy, planning implementation & operation, checking & corrective action, management review.

2. ENVIRONMENTAL POLICY (Should be based on mission)

- The policy must be relevant to the organization's nature.
- Management's Commitment (for continual improvement & preventing pollution).
- Should be a framework (for Environmental objectives & Targets).
- Must be Documented, Implemented, & Maintained.

3. PLANNING

- Environmental Aspects
- Legal & other Requirements

- Objectives & Targets
- Environmental Management Programs

4. IMPLEMENTATION & OPERATION

- Structure & Responsibility
- Training, Awareness & Competency
- Communication
- EMS Documentation
- Document Control
- Operational Control
- Emergency Preparedness & Response

5. CHECKING & CORRECTIVE ACTION

- Monitoring & Measuring
- Nonconformance & Corrective & Preventive action
- Records
- EMS Audit

6. MANAGEMENT REVIEW

- Review of objectives & targets
- Review of Environmental performance against legal & other requirement
- Effectiveness of EMS elements
- Evaluation of the continuation of the policy

BENEFITS OF ENVIRONMENTAL MANAGEMENT SYSTEM :

GLOBAL BENEFITS

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

ORGANIZATIONAL BENEFITS

- Assuring customers of a commitment to environmental management
- Meeting customer requirement
- Improve public relation
- Increase investor satisfaction
- Market share increase
- Conserving input material & energy
- Better industry/government relation
- Low cost insurance, easy attainment of permits & authorization

BEST OF LUCK
