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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

SPR1402 - TOTAL QUALITY MANAGEMENT

UNIT – I – Introduction – SPR1402

Definition of quality – Dimensions of quality – Quality planning – Quality costs – Analysis techniques for quality costs – Basic concepts of total quality management – Historical review – Principles of TQM – Leadership – Concepts – Role of senior management – Quality council – Quality statements –Strategic planning – Deming philosophy – Barriers to TQM implementation

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 same products. We need to plan for perfection. For other products, we need to plan for value.

QUALITY COSTS

- Quality costs are defined as those costs associated with the non- achievement of product/service quality as defined by the requirements established by the organization and its contracts with customers and society.
- Quality costs is a cost for poor product of service.

ELEMENTS OF QUALITYCOST:

- Cost of prevention
- Cost of appraisal
- Cost of internal failures
- Cost of external failures.

ANALYSIS OF QUALITY COSTS:

- Trend analysis
- Pareto analysis

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 Cost

- 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 Good will
- 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

Table No.1 Simple Index

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

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

Table No.2 Cost Relative Index

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

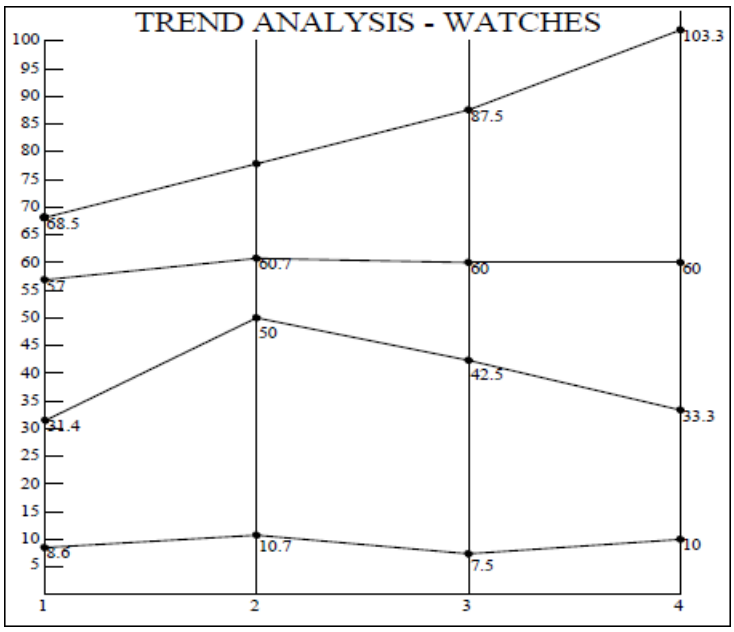

Figure1.1 Trend Analysis -Watches

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.

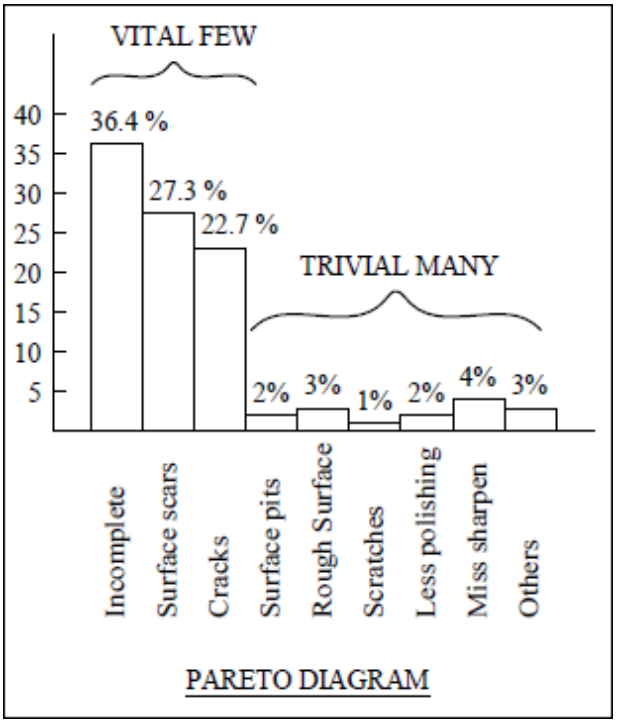

Figure 1.2. Pareto Diagram

BASIC CONCEPTS OF TOTAL QUALITY MANGEMENT:

- Top Management commitment to quality in all aspects
- Customers focus of the organisation
- Process focus and improvement
- Measurement of Performance
- Employee involvement and empowerment
- Continuous Improvement
- Bench Marking
- Teams
- Supplier Teaming
- Training of employees
- Inventory management
- Communication
- Quality cost

PILLARS OF TQM:

- Problem solving discipline
- Interpersonal skills
- Teamwork
- Quality Improvement Process

PRINCIPLES OF TQM:

- Customer‟s requirements must be met the first time, every time.
- There must be agreed requirements, for both internal and external customers.
- Everybody must be involved, from all levels and across all functions.
- Regular communication with staff at levels is must. Two way communication at all levels must be promoted.
- Identifying training needs and relating them with individual capabilities and requirements is must.
- Top management‟s participation and commitment is must.
- A culture of continuous improvement must be established.
- Emphasis should be placed on purchasing and supplier management every job must add value.
- Quality improvement must eliminate wastes and reduce total cost. There must be a focus on the prevention of problems.
- A culture of promoting creativity must be established.
- Performance measure is a must at organization, department and individual levels.
- It helps to asses and meet objectives of quality.
- There should be focus on team work.

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

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 relationship
- Customer satisfaction
- Employee satisfaction
- Productivity
- Communication

- Profitability
- Market Share

LEADERSHIP:

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.

LEADERSHIP ROLES:

1. Producer role.
2. Director role.
3. Coordinator role roles.
4. Checker role.
5. Stimulator role.
6. Mentor role.
7. Innovator role.
8. Negotiator role

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 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 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

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

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: in 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:

- Customer needs
- Customer positioning
- Predict the future
- Gap analysis

- Closing the gap
- Alignment
- Implementation

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

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.
11) Eliminate numerical quotas for the work force.
12) Eliminate Management by objectives.
13) Remove Barriers that rob people of pride of workmanship.
14) Encourage Education and Self-improvement for everyone. Take action to accomplish the transformation.

UNIT- I

INTRODUCTION

PART – A (2 MARKS)

1. Define Total Quality?
2. Define Quality?
3. What are the Dimensions of Quality?
4. Give the Basic Concepts of TQM?
5. Give the Principles of TQM?
6. Give the Obstacles associated with TQM Implementation?
7. Give the Analysis Techniques for Quality Costs?
8. Define Quality Costs?
9. Give the primary categories of Quality cost?
10. Give the typical cost bases?
11. How will you determine the optimum cost?
12. State the Quality Improvement Strategy?
13. Define Quality Planning?
14. Give the Objectives of TQM?
15. What is needed for a leader to be effective?
16. What is the important role of senior management?
17. What are the general duties of a quality council?
18. What does a typical meeting agenda contain after establishing the TQM?
19. What are the various quality statements?
20. Give the basic steps to strategic quality planning?
21. What is a quality policy?

PART-B

1. What is the quality cost? Explain the techniques used for quality cost
2. Explain the principles of TQM
3. Explain the Deming's Philosphy
4. Explain the barriers to TQM Implementation
5. Explain the concepts of Leadership

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SPR1402 - TOTAL QUALITY MANAGEMENT

UNIT – II – TQM Principles – SPR1402

Customer satisfaction – Customer perception of quality – Customer complaints – Service quality –Customer retention – Employee involvement – Motivation, empowerment, teams, recognition and reward – Performance appraisal – Benefits – Continuous process improvement – Juran trilogy – PDSA cycle – 5S – Kaizen – Supplier partnership – Partnering – Sourcing – Supplier selection – Supplier rating – Relationship development – Performance measures – Basic concepts – Strategy –Performance measure.

CUSTOMER SATISFACTION:

Customer satisfaction, a business term, is a measure of how products and services supplied by a company meet or surpass customer expectation. It is seen as a key performance indicator within business and is part of the four of a balanced scorecard.

Figure 2.1 Customer Satisfaction

In a competitive marketplace where businesses compete for customers, customer satisfaction is seen as a key differentiator and increasingly has become a key element of business strategy

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

Customer compliants

- Satisfied
- Dissatisfied Customer
- Totally dissatisfied customer Contributes to be monitored

FEEDBACK (INFORMATION COLLECTING TOOLS):

Feedback enables organization to

- Discover Customer Satisfaction
- Discover relative priorities of quality
- Compare the performance with the competition
- Identify the 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

	Highly Satisfied	**Neutral**	**Highly Dissatisfied**
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 analysis and to make surveys more useful, it is best to remember eight points

- Clients and customers are not same
- Surveys raise customer satisfaction
- The more specific the question the better the answer
- You have only one chance and only 15 minutes
- The more time you have spend in the survey development the less time you have spend in the data analysis and interpretation.

- Who you ask is most important than what you ask
- Before the data are collected, you should know how you have to analyze and use the data.

3. Focus Groups

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

4.Toll – Free Telephone Numbers

5.Customer Visits

6.Report Card

7.The Internet and Computers

8.Employee Feedback

9.Mass Customization

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

LEADERSHIP

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 means better to meet the organisation goals for quality and productivity.

MOTIVATION :MASLOW'S HIERARCHY OF NEEDS:

Self - Actualization

↑

Esteem

↑

Social

↑

Security

↑

Survival

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 if 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

Employee involvement is creating an environment in which people have an impact on decisions and actions that affect their jobs. Tell: the supervisor makes the decision and announces it to staff. The supervisor provides complete direction.

Sell: the supervisor makes the decision and then attempts to gain commitment from staff by "selling" the positive aspects of the decision.

Consult: the supervisor invites input into a decision while retaining authority to make the final decision herself.

Join: the supervisor invites employees to make the decision with the supervisor. The supervisor considers her voice equal in the decision process.

To round out the model, I add the following.

Delegate: the supervisor turns the decision over to another party.

SEVEN RULES OF MOTIVATION:

#1 Set a major goal, but follow a path. The path has mini goals that go in many directions. When you learn to succeed at mini goals, you will be motivated to challenge grand goals.

#2 Finish what you start. A half finished project is of no use to anyone. Quitting is a habit. Develop the habit of finishing self-motivated projects.

#3 Socialize with others of similar interest. Mutual support is motivating. We will develop the attitudes of our five best friends. If they are losers, we will be a loser. If they are winners, we will be a winner. To be a cowboy we must associate with cowboys.

#4 Learn how to learn. Dependency on others for knowledge supports the habit of procrastination. Man has the ability to learn without instructors. In fact, when we learn the art of self-education we will find, if not create, opportunity to find success beyond our wildest dreams.

#5 Harmonize natural talent with interest that motivates. Natural talent creates motivation, motivation creates persistence and persistence gets the job done.

#6 Increase knowledge of subjects that inspires. The more we know about a subject, the more we want to learn

about it. A self-propelled upward spiral develops.

#7 Take risk. Failure and bouncing back are elements of motivation. Failure is a learning tool.

No one has ever succeeded at anything worthwhile without a string of failures.

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
- 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 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.

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 and management friction.
- Employee involvement increases morale
- Employees have an increased commitment to goals because they are involved

Continous process improvement

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

Figure 2.2a Continous process improvement

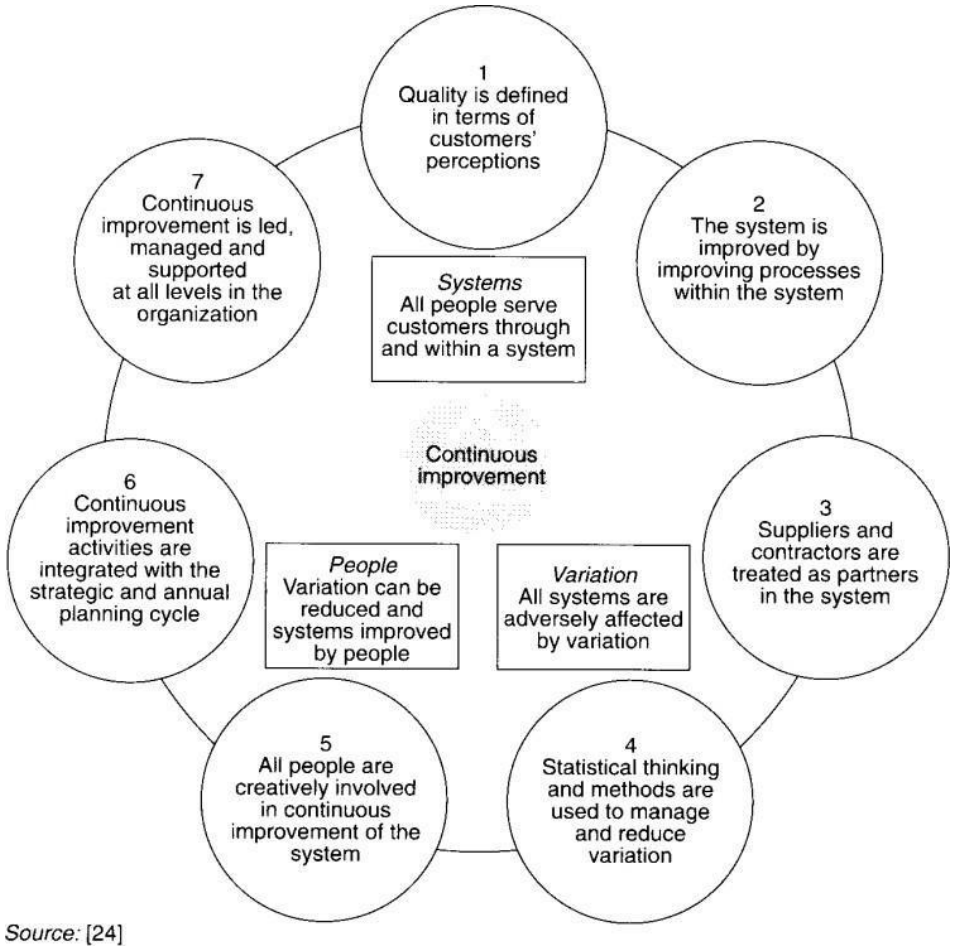


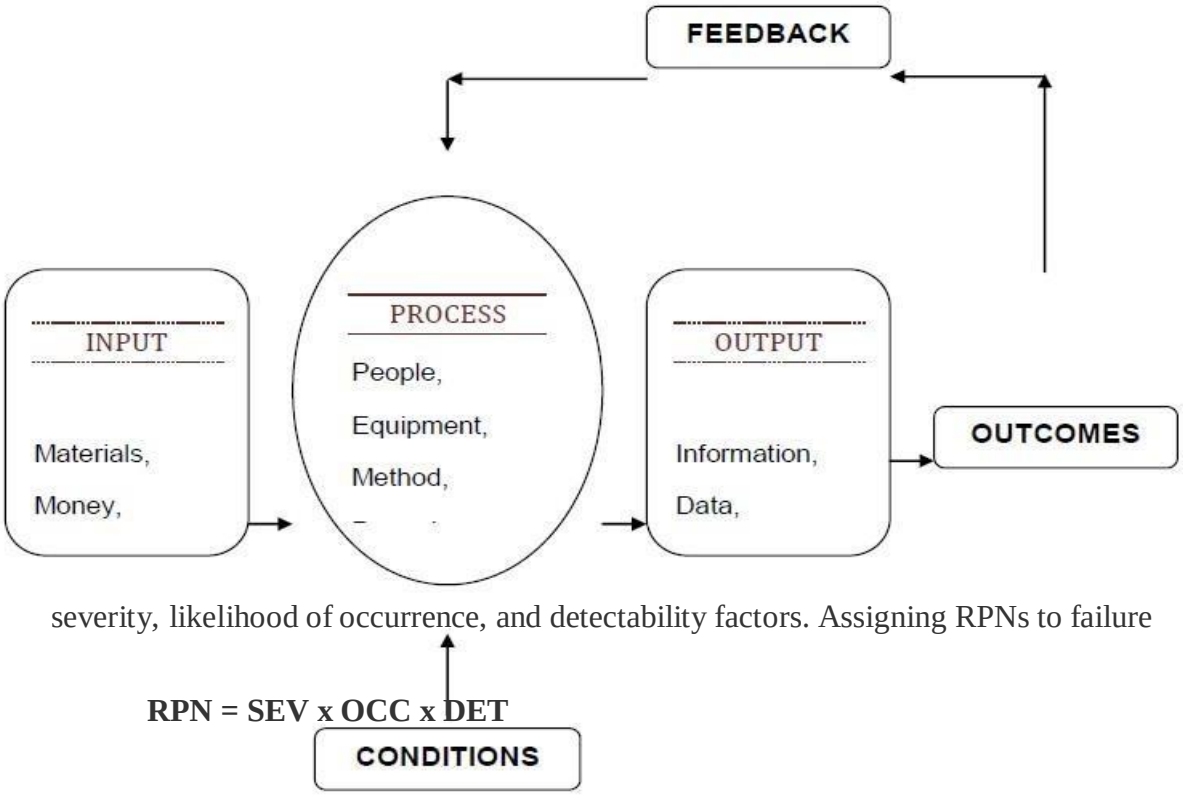
Figure 2.2b Continous Process Improvement

Improvement is made by

- Viewing all work as process
- Making all process are effective, efficient and adaptable
- Controlling in process performance using measures such as scrap reduction and control charts etc
- Eliminating waste and rework
- Eliminating nonvalue added activities
- Eliminating non-conformities
- Using Bench marking
- Incorporating learned lessons into future activities
- Using technical tools such as SPC, Benchmarking, Experimental design, QFD

PROCESS :

- Process refers to business and production activities of an organization



severity, likelihood of occurrence, and detectability factors. Assigning RPNs to failure

RPN = SEV x OCC x DET

CONDITIONS

Figure 2.3 Input/output Processes Model

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 the internal and external customer
- There needs are discovered
- Develop Product and 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
- Establish the project teams with a project leader
- Provide the team with resources

THE PDCA CYCLE:

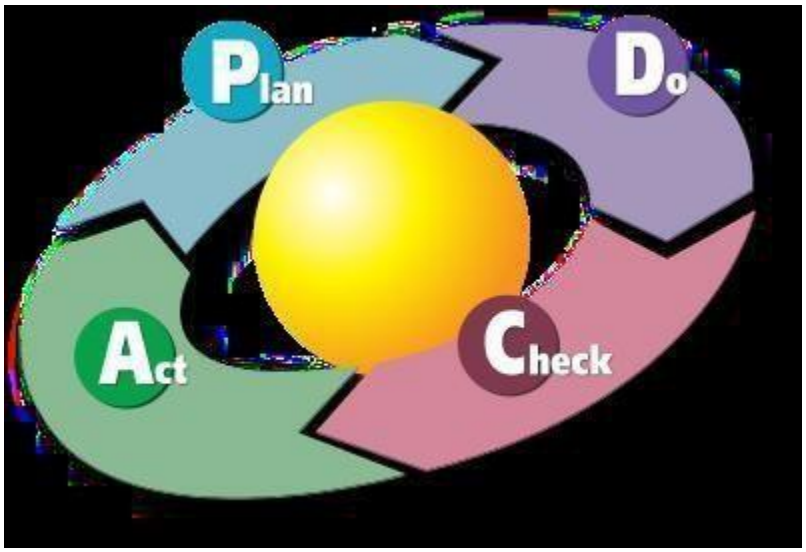


Figure 2.3 PDCA Cycle

PROBLEM SOLVING METHOD

1. IDENTIFY THE OPPORTUNITY

- Identify the problem
- Pareto analysis of external alarm signals
- Pareto analysis of internal alarm signals
- Proposal from key insiders
- Proposal from suggestion schemes
- Field study of user needs
- Comments of key people outside the organisation
- Customer survey
- Employer surveys
- Brainstorming by working 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 and unknown etc
- It emphasis 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
- Ther 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 quality council

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

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

- Instituionalize 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

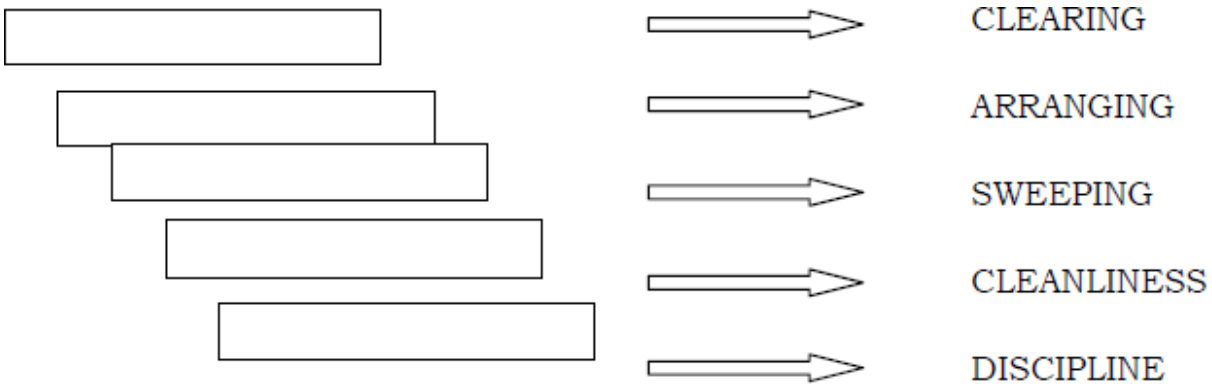
The objective is to achieve improved level of process performance.

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

Figure 2.4 PDSA Cycle

5-S : HOUSEKEEPING

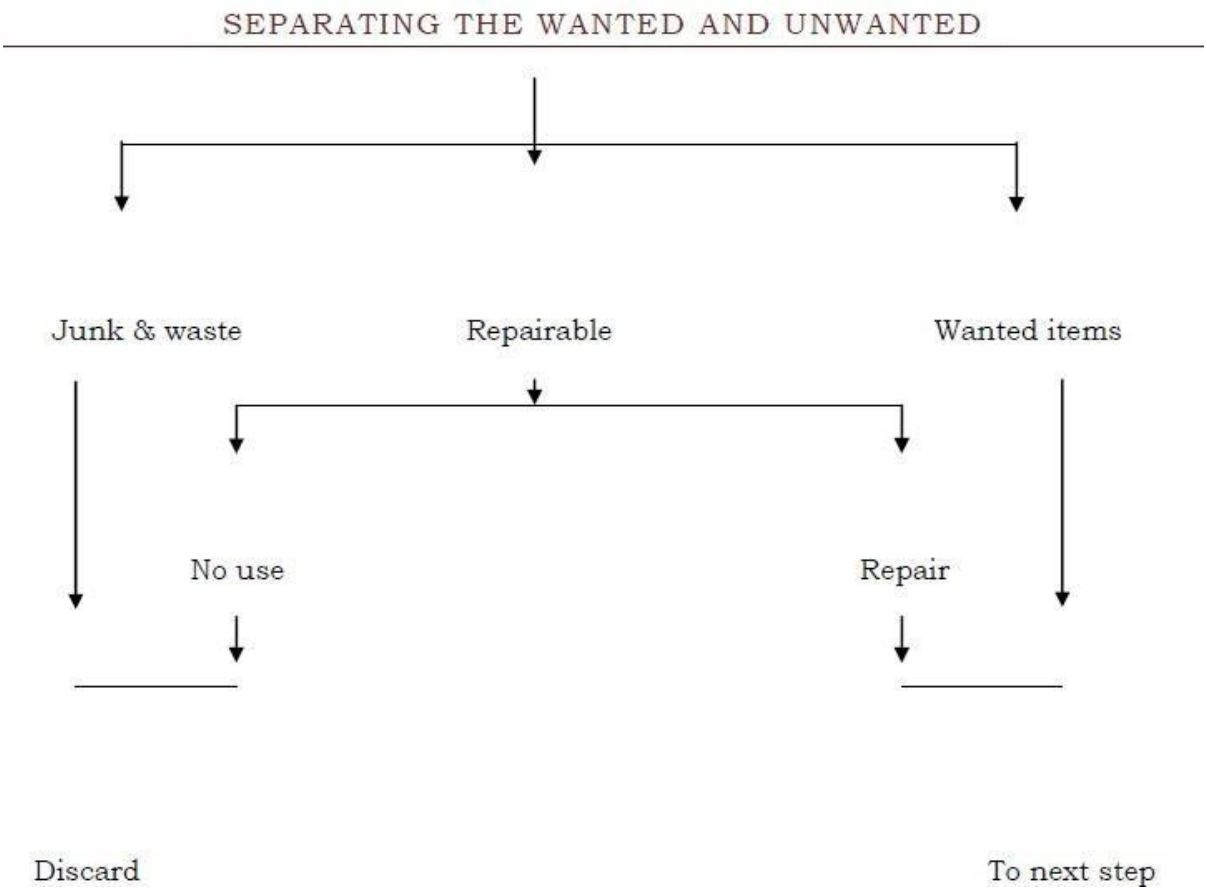
5-S MEANS EVERYTHING IN ITS PLACE



There can be no TQM without 5-S.

- A dirty factory cannot produce quality products
- A neat workplace promotes easy discovery of abnormalities

Flow Chart :



CONSEQUENCES OF NOT PRACTICING SEIRI :

- The unwanted clutter up the place and 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	Office	Home
♦ Unlabelled tool crib	♦ Unlabelled file cabinet	♦ Clutter
♦ Cluttered shelves lockers etc.	♦ Cluttered drawer, shelves, book cases, tables	♦ No orderly arrangement in the rooms
♦ Stores – no clear location system.	♦ Records & documents Not arranged well	
♦ Things on the floor	♦ File heaps and papers	

THE THIRD S: SEISO: SWEEP

- Sweep Your Workplace Thoroughly So That There Is No Dust Anywhere

Factory Floor	Office	Home
♦ Dirty machines	♦ Dirty table & furniture	♦ Dirty furniture, floor, window, grills, bookshelves.
♦ Dust on product parts, R.Mtls.		
♦ Dirty jigs, fixtures	♦ Dirty office equipments	
♦ Dirty walls, roofs	♦ Littered floor	
♦ Littered floor	♦ Dirty windows	

THE FOURTH S: SEIKETSU: CLEANLINES

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

Factory Floor	Office	Home
♦ Handling hazardous chemicals ♦ Control of fumes, hazardous dust. ♦ Disinfecting, Personal hygiene	♦ Free of pests ♦ Personal hygiene	♦ Pest control ♦ Personal hygiene

THE FIFTH S : SHITSUKI : DISCIPLINE

Discipline especially with regard to safety rules and Consequences of not practicing SEIKETSU :

- If the discipline is not practised then the first 4S will back slide
- Lack of shitsuki means not following the standards, Then all activites related to quality and safety 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.

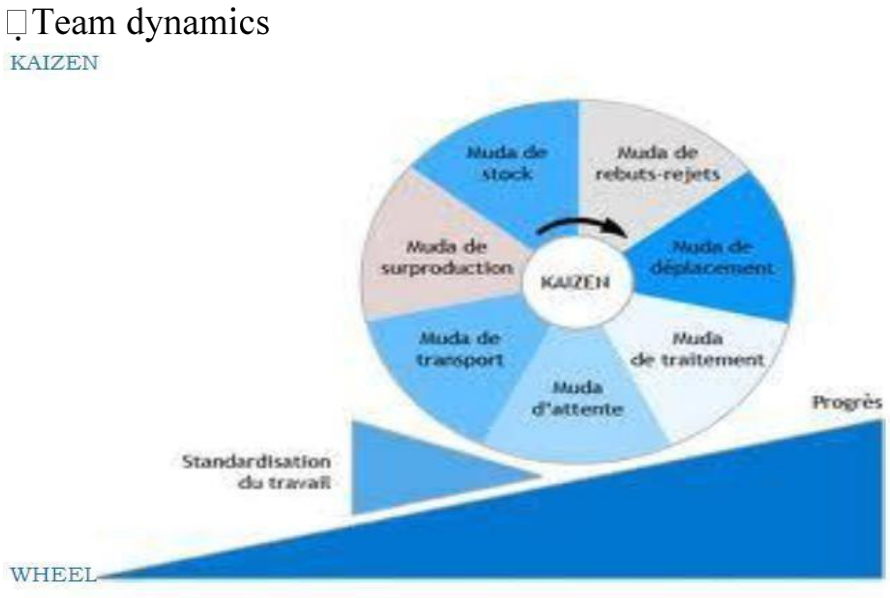


Figure 2.5 Kaizen

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's philosophy
- Just-in-time

- Continous process improvement
- ISO 9000

CUSTOMER – SUPPLIER RELATIONS:

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

1. Both the customer and supplier are fully responsible for the control ofquality.
2. Both the customer and supplier should be independent of each other.
3. The customer is responsible for providing the supplier with clear and
4. Sufficient requirements so that the customer can know precisely what to Produce
5. Both the customer and supplier should enter into a non-adversarial contract.
6. The supplier is responsible for providing the quality that will satisfy the customer.
7. Both the customer and supplier should decide the method to evaluate the quality of the product or services.
8. 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.
9. Both the customers and supplier should continually exchange information.
10. Both the customer and supplier should perform business activities.
11. 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
- Improved efficiency
- Lower cost
- Increased opportunity for Innovation
- Continous improvement

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

RELATIONSHIP DEVELOPMENT

For establishment of supplier relationship, the following are necessary.

(a) Partnering

(b) Supplier selection

(c) Principles of customer / supplier relations

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

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

RESEARCH AND DEVELOPMENT

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

SUPPLIERS

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

MARKETING / SALES

1. Sales expense to revenue.
2. New product sales to total sales.
3. 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- II

TQM PRINCIPLES

PART – A (2 MARKS)

1. What is a mission statement?
2. What is a vision statement?
3. What are the important factors that influenced purchases?
4. Give the need for a feedback in an organization?
5. List the tools used for feedback?
6. What are the activities to be done using customer complaints?
7. What are the elements of customer service?
8. Define Customer Retention?
9. Define Employee Involvement?
10. State Maslow‟ s Hierarchy of Needs?
11. State Frederick Herzberg‟ s Two-factor theory?
12. What does an employee want?
13. What are the concepts to achieve a motivated work force?
14. Define Empowerment?
15. What are the three conditions necessary to create the empowered environment?
16. What are the types of teams?
17. What are the characteristics of successful teams?
18. What are the decision-making methods?
19. What are the stages of team development?
20. Give some common team problems?
21. What are the common barriers to team progress?
22. Give the steps involved in training process?
23. Define Recognition and Reward?

24. What are the types of appraisal formats?
25. What are the benefits of employee involvement?
26. What are the basic ways for a continuous process improvement?
27. What are the three components of the Juran Trilogy?
28. What are the steps in the PDSA cycle?
29. What are the phases of a Continuous Process Improvement Cycle?
30. Define 5S?
31. What is a Kaizen?
32. What are the three key elements to a partnering relationship?
33. What are the three types of sourcing?
34. What are the ten conditions for the selection and evaluation of suppliers?
35. What are the characteristics used to measure the performance of a particular process?
36. Give the six basic techniques for presenting performance measures
37. Give the usage of an effective recognition and reward system?
38. How will you improve the performance appraisal system?
39. What are the typical measurements frequently asked by managers and teams?

PART – B

1. Explain Juran trilogy for Continuous Process Improvement? (16)
2. Explain the PDSA cycle? (16)
3. Explain Kaizen principle? (16)
4. Explain how the employee will be involved in doing a process? (16)

UNIT – III – Total Quality Management – SPR1402

UNIT 3 QUALITY CONTROL TECHNIQUES

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

1. SEVEN TOOLS FOR QUALITY

1. **Cause-and-effect diagram** (also called Ishikawa or fishbone diagrams): Identifies many possible causes for an effect or problem and sorts ideas into useful categories.
2. **Check sheet**: A structured, prepared form for collecting and analyzing data; a generic tool that can be adapted for a wide variety of purposes.
3. **Control chart**: Graph used to study how a process changes over time. Comparing current data to historical control limits leads to conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation).
4. **Histogram**: The most commonly used graph for showing frequency distributions, or how often each different value in a set of data occurs.
5. **Pareto chart**: A bar graph that shows which factors are more significant.
6. **Scatter diagram**: Graphs pairs of numerical data, one variable on each axis, to look for a relationship.
7. **Stratification**: A technique that separates data gathered from a variety of sources so that patterns can be seen (some lists replace stratification with flowchart or run chart).

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.

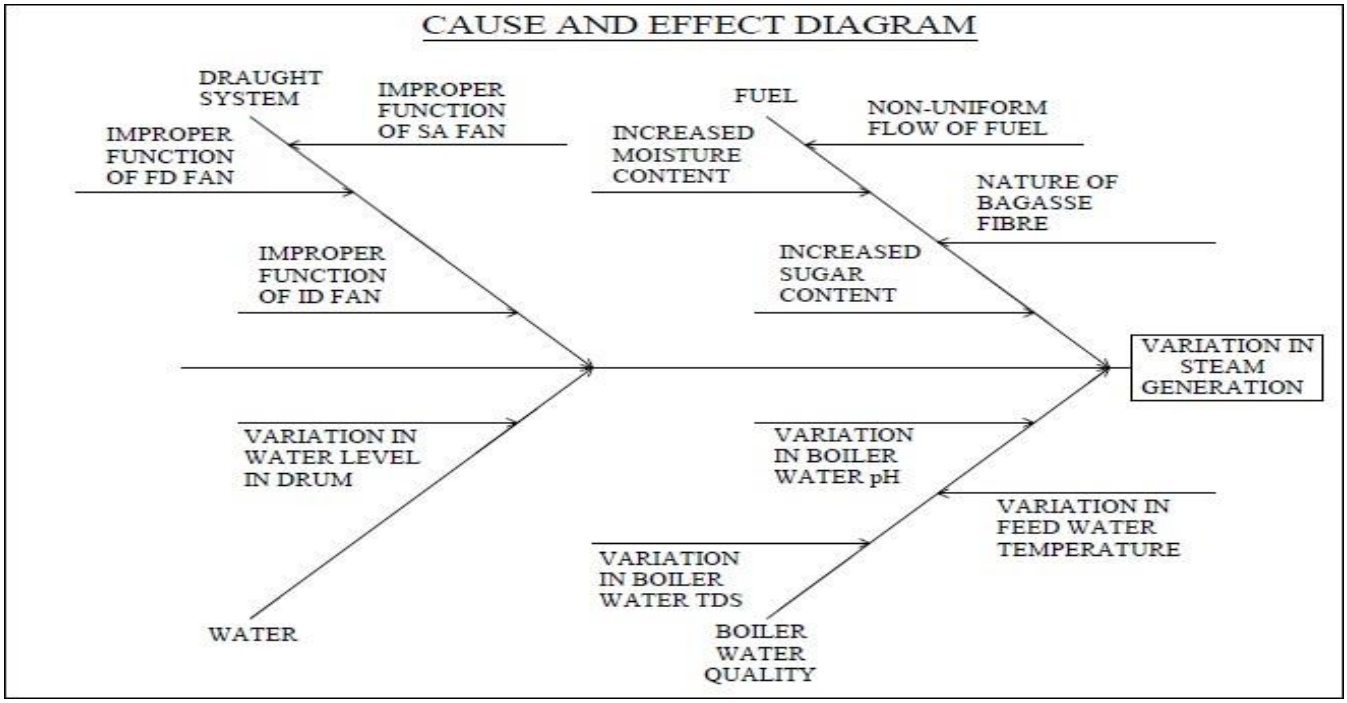
c. Draw the effect box and the center line.

d. Specify the major potential cause categories and join them as boxes connected to the center line.

e. Identify the possible causes and classify them into the categories in step d. Create new categories, if necessary.

f. Rank orders the causes to identify those that seem most likely to impact the problem.

g. Take corrective action



CHECK SHEETS

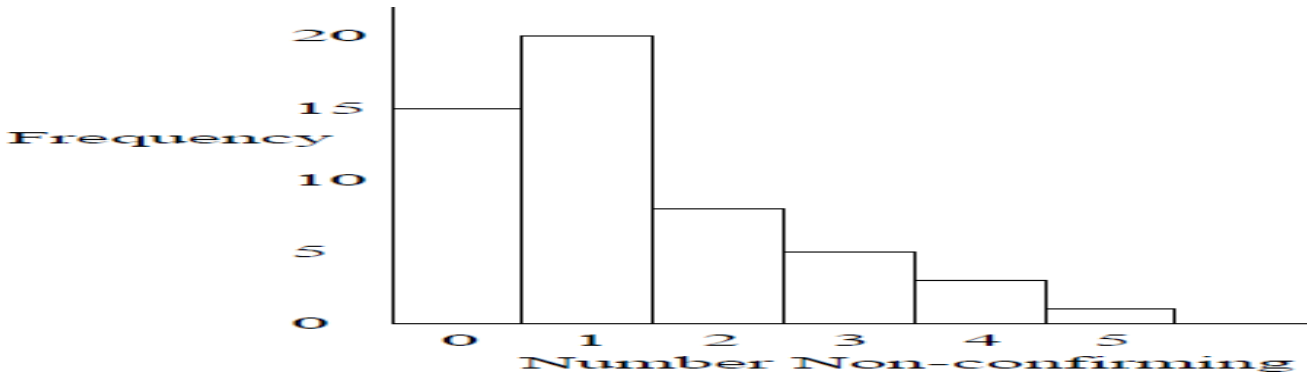
CHECK SHEET

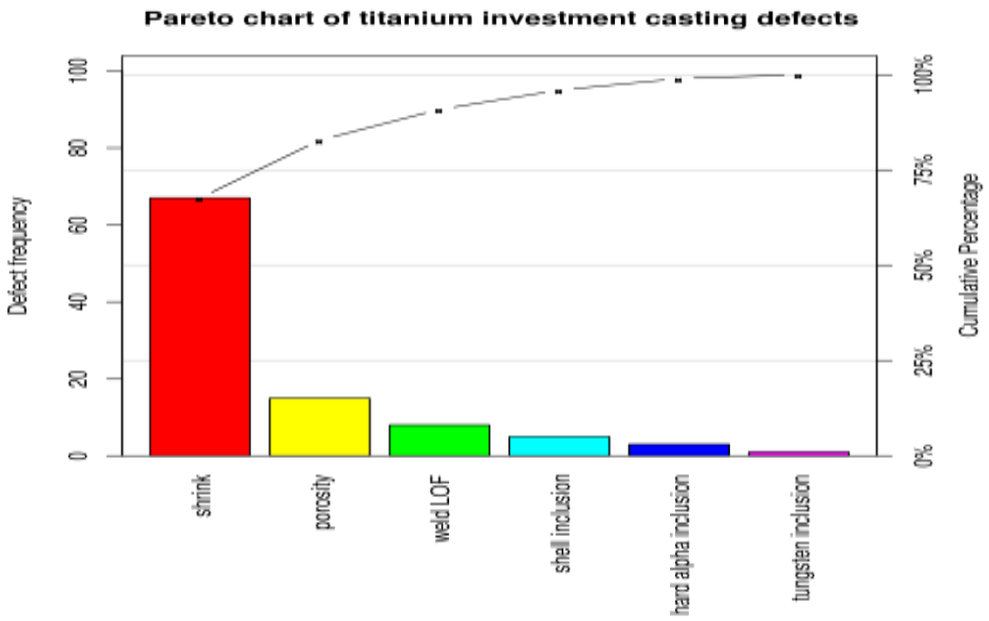
Product : Bicycle

Nonconformity Type	Check	Total
Blister	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ I	21
Light spray	~~IIII~~ ~~IIII~~ ~~IIII~~	15
Drips	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~	25
Others	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~	25
	TOTAL	86

5. **HISTOGRAM**

NUMBER OF ERRORS	TALLY OF 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	Number Non-conforming / Tabulation / Freq. 0 ~~IIII~~ ~~IIII~~ ~~IIII~~ 15 1 ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ 20 2 ~~IIII~~ III 8 3 ~~IIII~~ 5 4 III 3 5 I 1





2. The New seven tools

- Affinity Diagram [KJ method]
- Interrelationship diagram.
- Tree diagram.
- Prioritization matrix.
- Matrix diagram or quality table.
- Process decision program chart.
- Activity network diagram.

Affinity Diagram [KJ method]

Affinity diagrams are a special kind of brainstorming tool that organize large amount of disorganized data and information into groupings based on natural relationships.

It was created in the 1960s by the Japanese anthropologist Jiro Kawakita. It is also known as KJ diagram, after Jiro Kawakita. An affinity diagram is used when:

1. You are confronted with many facts or ideas in apparent chaos.
2. Issues seem too large and complex to grasp.

Interrelationship diagram

Interrelationship diagrams (IDs) displays all the interrelated cause-and-effect relationships and factors involved in a complex problem and describes desired outcomes. The process of creating

an interrelationship diagram helps a group analyze the natural links between different aspects of a complex situation.

Tree diagram

This tool is used to break down broad categories into finer and finer levels of detail. It can map levels of details of tasks that are required to accomplish a goal or solution or task. Developing a tree diagram directs concentration from generalities to specifics.

Prioritization matrix

This tool is used to prioritize items and describe them in terms of weighted criteria. It uses a combination of tree and matrix diagramming techniques to do a pair-wise evaluation of items and to narrow down options to the most desired or most effective. Popular applications for the prioritization matrix include return on investment (ROI) or cost–benefit analysis (investment vs. return), time management matrix (urgency vs. importance), etc.

Matrix diagram or quality table

This tool shows the relationship between two or more sets of elements. At each intersection, a relationship is either absent or present. It then gives information about the relationship, such as its strength, the roles played by various individuals or measurements. The matrix diagram enables you to analyze relatively complex situations by exposing interactions and dependencies between things. Six differently shaped matrices are possible: L, T, Y, X, C, R and roof-shaped, depending on how many groups must be compared.

Process decision program chart

A useful way of planning is to break down tasks into a hierarchy, using a tree diagram. The process decision program chart (PDPC) extends the tree diagram a couple of levels to identify risks and countermeasures for the bottom level tasks. Different shaped boxes are used to highlight risks and identify possible countermeasures (often shown as "clouds" to indicate their uncertain nature). The PDPC is similar to the failure modes and effects analysis (FMEA) in that both identify risks, consequences of failure, and contingency actions; the FMEA also rates relative risk levels for each potential failure point.

Activity network diagram

This tool is used to plan the appropriate sequence or schedule for a set of tasks and related subtasks. It is used when subtasks must occur in parallel. The diagram helps in determining the critical path (longest sequence of tasks). The purpose is to help people sequentially define, organize, and manage a complex set of activities.

3. 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 and Multi mode

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.

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.

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, uni modal, bell – shaped distribution with the mean, median and mode all having the same value.

4. 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 equipment, 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 – X chart & Range Chart – R Chart

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

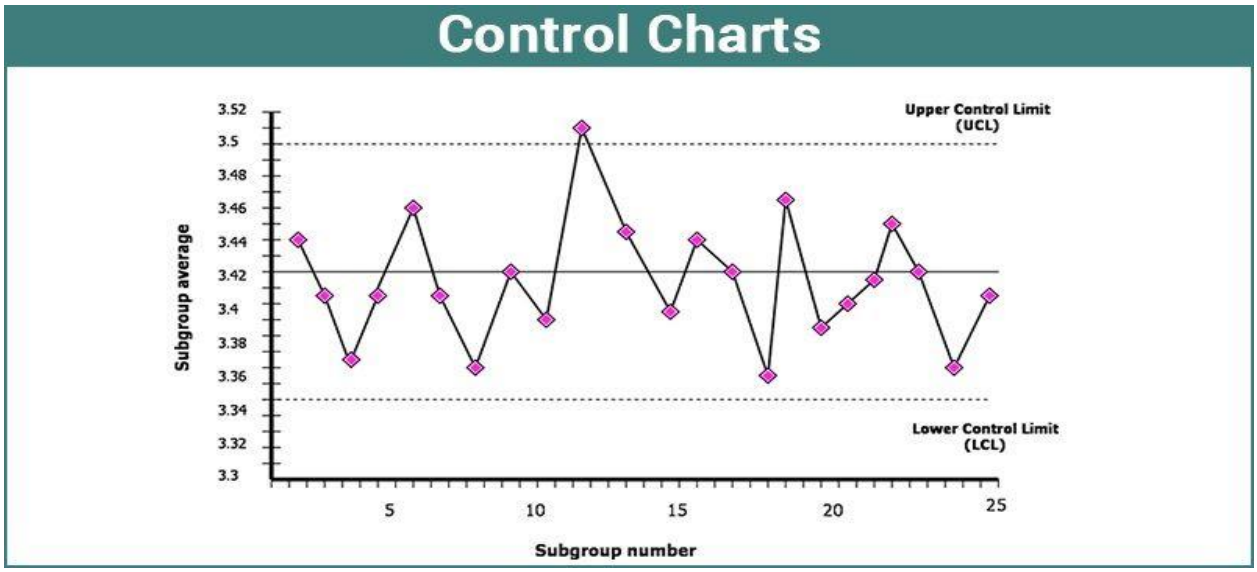
Where, N = Total number of observations.

n = Sample size (for finding out the value of A_2 and D_4 and D_3 from the table)

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

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

X – CHART	R - CHART
$CL = \bar{\bar{X}}$	$CL = \bar{R}$
$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 . \bar{R}$	$UCL_R = D_4 . \bar{R}$
$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 . \bar{R}$	$LCL_R = D_3 . \bar{R}$



CONTROL CHART FOR ATTRIBUTES

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

Attribute Charts are a set of control charts specifically designed for Attributes data (i.e. counts data). Attribute charts monitor the process location and variation over time in a single chart.

The family of Attribute Charts include the:

np-Chart: for monitoring the number of times a condition occurs, relative to a constant sample size, when each sample can either have this condition, or not have this condition

p-Chart: for monitoring the percent of samples having the condition, relative to either a fixed or varying sample size, when each sample can either have this condition, or not have this condition

c-Chart: for monitoring the number of times a condition occurs, relative to a constant sample size, when each sample can have more than one instance of the condition.

u-Chart: for monitoring the percent of samples having the condition, relative to either a fixed or varying sample size, when each sample can have more than one instance of the condition.

$$\bar{p} = \frac{\Sigma np}{\Sigma n} = \frac{76}{4000} = .019$$

$$1-\bar{p} = .981$$

$$\bar{p} \times (1-\bar{p}) = .019 \times .981 = .018639$$

$$\frac{\bar{p} \times (1-\bar{p})}{n} = \frac{.018639}{200} = .000093195$$

$$\sqrt{\frac{\bar{p} \times (1-\bar{p})}{n}} = \sqrt{.000093195} = .0096538$$

$$3\sqrt{\frac{\bar{p} \times (1-\bar{p})}{n}} = 3 \times .0096538 = .029$$

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

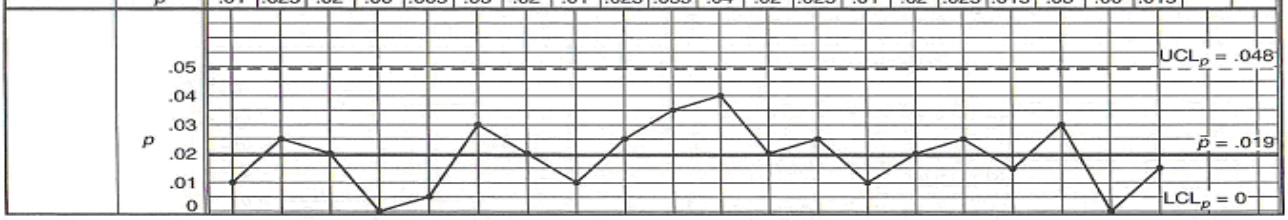
$$= .019 + .029 = .048$$

$$LCL_p = .019 - .029$$

$$= -.01$$

$$= 0 \text{ (because of negative value)}$$

Date																				
Checker																				
n	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
np	2	5	4	0	1	6	4	2	5	7	8	4	5	2	4	5	3	6	0	3
p	.01	.025	.02	.00	.005	.03	.02	.01	.025	.035	.04	.02	.025	.01	.02	.025	.015	.03	.00	.015



The completed *p* chart

$$\overline{np} = \frac{\Sigma np}{k} = \frac{76}{20} = 3.8$$

$$\bar{p} = \frac{\overline{np}}{n} = \frac{3.8}{200} = .019$$

$$1-\bar{p} = .981$$

$$\overline{np} \times (1-\bar{p}) = 3.8 \times .981 = 3.7278$$

$$\sqrt{\overline{np} \times (1-\bar{p})} = \sqrt{3.7278} = 1.931$$

$$3\sqrt{\overline{np} \times (1-\bar{p})} = 3 \times 1.931 = 5.793$$

$$UCL_p = \overline{np} + 3\sqrt{\overline{np} \times (1-\bar{p})}$$

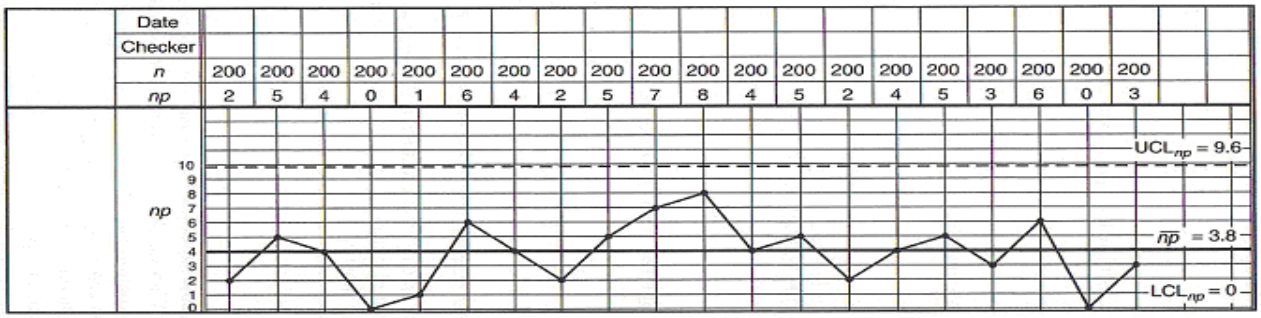
$$= 3.8 + 5.8 = 9.6$$

$$LCL_p = \overline{np} - 3\sqrt{\overline{np} \times (1-\bar{p})}$$

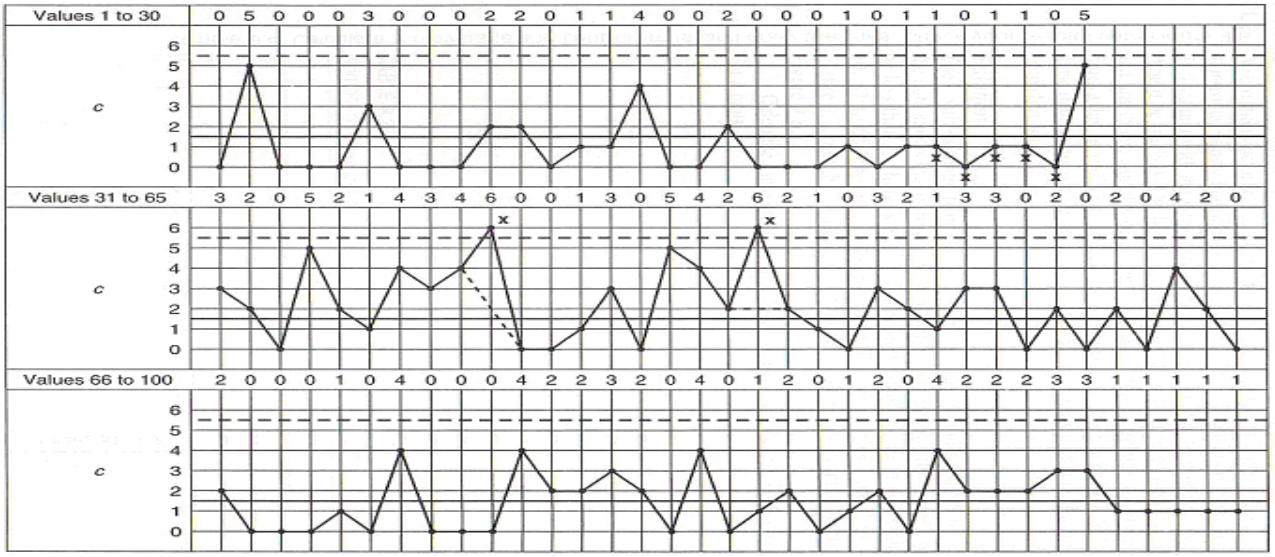
$$= 3.8 - 5.8 = -2$$

$$= 0 \text{ if negative}$$

Date																				
Checker																				
n	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	
np	2	5	4	0	1	6	4	2	5	7	8	4	5	2	4	5	3	6	0	3



The completed *np* chart



The completed *c* chart

$$\bar{u} = \frac{\Sigma c}{\Sigma n} = \frac{266}{200} = 1.33$$

$$\frac{\bar{u}}{n} = \frac{1.33}{10} = .133$$

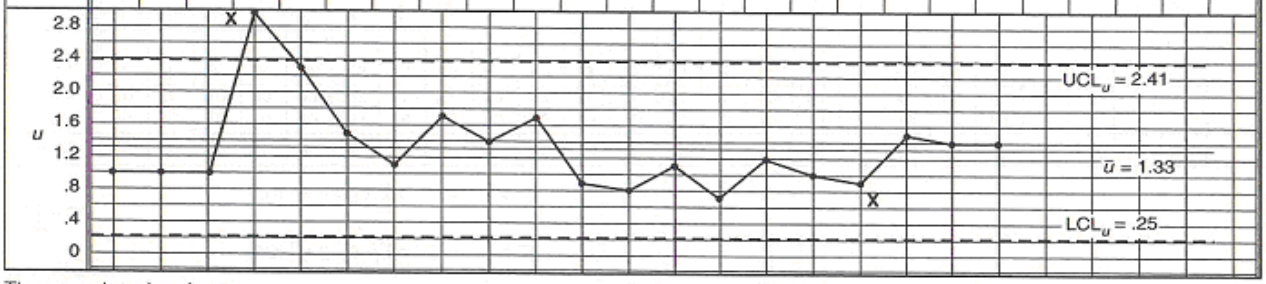
$$\sqrt{\frac{\bar{u}}{n}} = \sqrt{.133} = .36$$

$$3\sqrt{\frac{\bar{u}}{n}} = 3 \times .36 = 1.08$$

$$UCL_u = \bar{u} + 3\sqrt{\frac{\bar{u}}{n}} = 1.33 + 1.08 = 2.41$$

$$LCL_u = \bar{u} - 3\sqrt{\frac{\bar{u}}{n}} \quad 1.33 - 1.08 = .25$$

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
c	10	10	10	30	23	15	11	17	14	17	9	8	11	7	12	10	9	15	14	14
u	1	1	1	3	2.3	1.5	1.1	1.7	1.4	1.7	.9	.8	1.1	.7	1.2	1	.9	1.5	1.4	1.4



The completed *u* chart

PROCESS CAPABILITY INDEX (*CP*, *CPK*)

These calculators compute the process capability index which shows the process potential of meeting the specifications. Enter the process parameters and specifications in one of the following tables, depending on whether you have a double-sided or single-sided specification

Index	Equation	Definition
Cp	(USL - LSL)/6σ	Process capability for two-sided specification limits; does not take into account where the process is centered (i.e., what the process average ($\overline{X}$) is).
Cpu	$Cpu = \frac{USL - \overline{X}}{3\sigma}$	Process capability based on the upper specification limit.
Cpl	$Cpl = \frac{\overline{X} - LSL}{3\sigma}$	Process capability based on the lower specification limit.
Cpk	Minimum of Cpu, Cpl	Process capability for two-sided specification limits taking into account where the process is centered.

5. SIX SIGMA

Six Sigma actually has its roots in a 19th Century mathematical theory, but found its way into today's mainstream business world through the efforts of an engineer at Motorola in the 1980s. Now heralded as one of the foremost methodological practices for improving customer satisfaction and improving business processes, Six Sigma has been refined and perfected over the years into what we see today.

Six Sigma ranks among the foremost methodologies for making business processes more effective and efficient. In addition to establishing a culture dedicated to continuous process improvement, Six Sigma offers tools and techniques that reduce variance, eliminate defects and help identify the root causes of errors, allowing organizations to create better products and services for consumers.

While most people associate Six Sigma with manufacturing, the methodology is applicable to every type of process in any industry. In all settings, organizations use Six Sigma to set up a management system that systematically identifies errors and provides methods for eliminating them.

People develop expertise in Six Sigma by earning belts at each level of accomplishment. These include White Belts, Yellow Belts, Green Belts, Black Belts and Master Black Belts.

How Six Sigma Began

In the 19th century, German mathematician and physicist Carl Fredrich Gauss developed the bell curve. By creating the concept of what a normal distribution looks like, the bell curve became an early tool for finding errors and defects in a process.

In the 1920s, American physicist, engineer and statistician Walter Shewhart expanded on this idea and demonstrated that "sigma imply where a process needs improvement," according to "The Complete Business Process Handbook: Body of Knowledge From Process Modeling to BPM Vol. 1" by Mark von Rosing, August-Wilhelm Scheer and Henrik von Scheel.

In the 1980s, Motorola brought Six Sigma into the mainstream by using the methodology to create more consistent quality in the company's products, according to "Six Sigma" by Mikel Harry and Richard Schroeder.

Motorola engineer Bill Smith eventually became one of the pioneers of modern Six Sigma, creating many of the methodologies still associated with Six Sigma in the late 1980s. The system is influenced by, but different than, other management improvement strategies of the time, including Total Quality Management and Zero Defects.

Does it work? Motorola reported in 2006 that the company had saved $17 billion using Six Sigma.

What Six Sigma Means

Experts credit Shewhart with first developing the idea that any part of process that deviates three sigma from the mean requires improvement. One sigma is one standard deviation.

The Six Sigma methodology calls for bringing operations to a "six sigma" level, which essentially means **3.4 defects for every one million opportunities**. The goal is to use continuous process improvement and refine processes until they produce stable and predictable results.

Six Sigma is a data-driven methodology that provides tools and techniques to define and evaluate each step of a process. It provides methods to improve

efficiencies in a business structure, improve the quality of the process and increase the bottom-line profit.

The Importance of People in Six Sigma

A key component of successful Six Sigma implementation is buy-in and support from executives. The methodology does not work as well when the entire organization has not bought in.

Another critical factor is the training of personnel at all levels of the organization. White Belts and Yellow Belts typically receive an introduction to process improvement theories and Six Sigma terminology. Green Belts typically work for Black Belts on projects, helping with data collection and analysis. Black Belts lead projects while Master Black Belts look for ways to apply Six Sigma across an organization.

Methodologies of Six Sigma

There are two major methodologies used within Six Sigma, both of which are composed of five sections, according to the 2005 book "JURAN Institute Six Sigma Breakthrough and Beyond" by Joseph A. De Feo and William Barnard.

DMAIC: The DMAIC method is used primarily for improving existing business processes. The letters stand for:

Define the problem and the project goals

Measure in detail the various aspects of the current process

Analyze data to, among other things, find the root defects in a process

Improve the process

Control how the process is done in the future

DMADV: The DMADV method is typically used to create new processes and new products or services. The letters stand for:

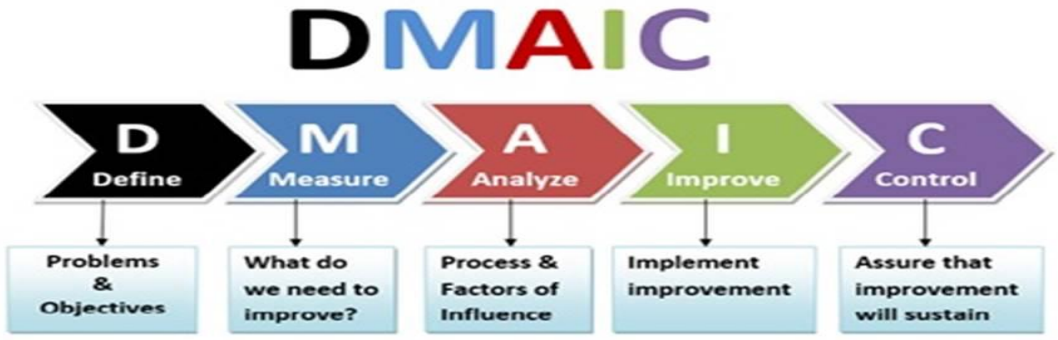
Define the project goals

Measure critical components of the process and the product capabilities

Analyze the data and develop various designs for the process, eventually picking the best one

Design and test details of the process

Verify the design by running simulations and a pilot program, and then handing over the process to the client



UNIT- III (Questions)

Part A

1. Give the objectives of the attribute charts?
2. Give the objectives of the attribute charts?
3. Define Six Sigma Problem Solving Method?
4. What are the new seven management tools?
5. Give the seven tools of quality?
6. Give the usage of C&E diagrams?
7. Define Six Sigma?
8. What are the various histogram shapes?
9. Differentiate Population & Sample?
10. Give the sources of variation?
11. Define Run chart?
12. Define Control chart?
13. What are the various patterns of scatter diagrams?

14. What is the procedure for constructing the tree diagram?
15. Give at least five standard formats of matrix diagram?
16. What are the benefits of an activity network diagram?

PART – B

1. Explain the QC or SPC tools?
2. Explain the Seven Management Tools?
3. Plot the control chart for variables and attributes
4. Explain the concepts of Six Sigma?

UNIT – IV – Total Quality Management – SPR1402

UNIT 4 TQM TOOLS

Benchmarking – Reasons for Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, Failure Mode and Effect Analysis (FMEA) – Stages of FMEA.

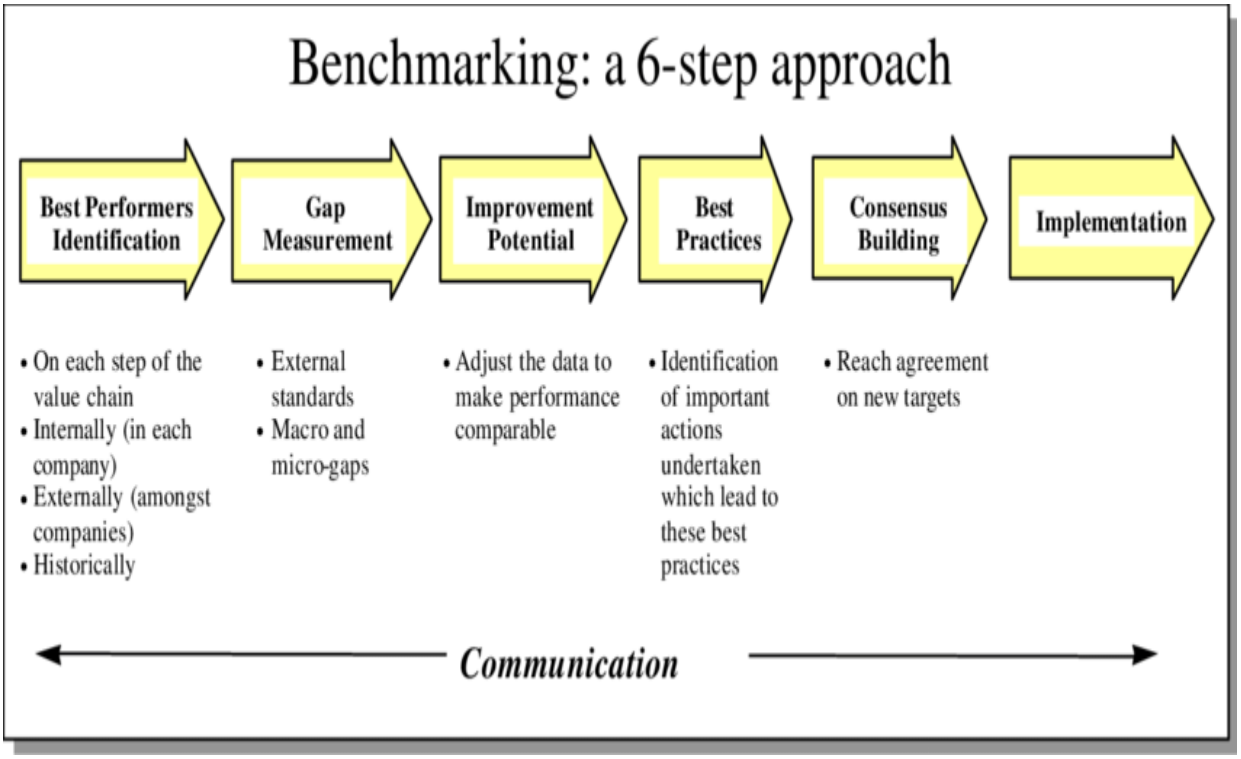
1. BENCHMARKING

Benchmarking is the practice of comparing business processes and performance metrics to industry bests and best practices from other companies. Dimensions typically measured are quality, time and cost. Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or defects per unit of measure) resulting in a metric of performance that is then compared to others.

Benchmarking is a process of measuring the performance of a company's products, services, or processes against those of another business considered to be the best in the industry, aka "best in class." The point of benchmarking is to identify internal opportunities for improvement. By studying companies with superior performance, breaking down what makes such superior performance possible, and then comparing those processes to how your business operates, you can implement changes that will yield significant improvements.

That might mean tweaking a product's features to more closely match a competitor's offering, or changing the scope of services you offer, or installing a new customer relationship management (CRM) system to enable more personalized communications with customers.

There are two basic kinds of improvement opportunities: continuous and dramatic. Continuous improvement is incremental, involving only small adjustments to reap sizeable advances. Dramatic improvement can only come about through reengineering the whole internal work process.



Benchmarking is a simple, but detailed, six-step process:

- Choose a product, service, or internal department to benchmark
- Determine which best-in-class companies you should benchmark against – which organizations you'll compare your business to
- Gather information on their internal performance, or metrics

- Compare the data from both organizations to identify gaps in your company's performance
- Adopt the processes and policies in place within the best-in-class performers

Benchmarking will point out what changes will make the most difference, but it's up to you to actually put them in place.

Key Benefits

In addition to helping companies become more efficient and profitable, benchmarking has other benefits, too, such as:

- Improving employee understanding of cost structures and internal processes
- Encouraging team-building and cooperation in the interests of becoming more competitive
- Enhancing familiarity with key performance metrics and opportunities for improvement company-wide

In essence, benchmarking helps employees understand how one small piece of a company's processes or products can be the key to major success, just as one employee's contributions can lead to a big win.

Importance of Benchmarking

The goal of your business should be to grow, improve processes, increase quality, decrease costs, and earn more money. Benchmarking is one of many tools you can use as part of any continuous improvement model used within your organization.

Consistent benchmarking can help you:

- Improve processes and procedures.
- Gauge the effectiveness of past performance.

- Give you a better idea of how the competition operates, which will help you to identify best practices to increase performance.
- Increase efficiency and lower costs, making your business more profitable.
- Improve quality and customer satisfaction.

Types of benchmarking

There are many different types of benchmarking that fall into three primary categories: internal, competitive, and strategic.

Internal benchmarking

If other teams or organizations within your company have established best practices in processes similar to yours, internal benchmarking involves analyzing what they are doing so you can find areas where you can improve and be more efficient. For example, you could compare the performance of one warehousing and shipping site against another warehousing and shipping site. The site with superior performance simply needs to share their processes and procedures so that the entire company benefits from increased performance.

Competitive benchmarking

This type of benchmarking is a comparison of products, services, processes, and methods of your direct competitors. This type gives you insight into your position within your industry and what you may need to do to increase productivity. For example, you can compare the customer satisfaction of a competitor's product to yours. If your competitor is getting better customer reviews, you need to analyze what the difference is and figure out how to improve the quality of your product.

Strategic benchmarking

this type of benchmarking when you need to look beyond your own industry to identify world-class performance and best practices so you can look for ways to adapt their methods to your procedures and processes. For example, seeing a need to improve performance, Southwest Airlines turned to NASCAR to analyze how pit crews are able to service race cars so quickly.

They realized that it all depends on each pit crew member's ability to perform clearly defined tasks within specific time intervals—12 to 16 seconds if all four tires need to be changed and the car needs to be fueled. As a result, Southwest Airlines changed and streamlined processes for gate maintenance, plane cleaning, and passenger boarding.

8 steps in the benchmarking process (Detailed)

1. Select a subject to benchmark

Executives and other senior management should be involved in deciding which processes are critical to the company's success. The processes should then be prioritized based on which metrics are most important to all stakeholders. After prioritizing, select and define the measures you want to collect.

2. Decide which organizations or companies you want to benchmark

Determine if you are going to benchmark processes within your own company, a competitor, or a company outside of your industry.

It may be hard to collect all the data you want if you benchmark a direct competitor. So you should select several different organizations to study in order to get the data you need. Gather information from several sources to get the most detailed information about the organization you select to study.

3. Document your current processes

Map out your current processes so you can identify areas that need improvement and more easily compare against the chosen organization.

4. Collect and analyze data

This step is important—but it can prove difficult when you are trying to gather data from a competitor because a lot of that information may be confidential. Gather information through

research, interviews, casual conversations with contacts from the other companies, and with formal interviews or questionnaires.

You can also collect secondary information from websites, reports, marketing materials, and news articles. However, secondary information may not be as reliable.

After you have collected enough data, get all stakeholders together to analyze the data.

5. Measure your performance against the data you've collected

Look at the data you've collected side by side with the metrics you gathered from your analysis of your own processes. You may want to layer your performance metrics on top of your process diagrams or map out your competitor's processes to more easily see where you're falling behind.

As you analyze the comparisons, try to identify what causes the gaps in your process. For example, do you have enough people and are they sufficiently trained to perform assigned tasks? Brainstorm ideas to effectively and efficiently fill those gaps.

6. Create a plan

Create a plan to implement changes that you have identified as being the best to close performance gaps. Implementation requires total buy-in from the top down. Your plan must include clearly defined goals and should be written with the company's culture in mind to help minimize any pushback you may get from employees.

7. Implement the changes

Closely monitor the changes and employee performance. If new processes are not running smoothly as expected, identify areas that need to be tweaked. Make sure all employees understand their jobs, are well trained, and have the expertise to complete their assigned tasks.

Document all processes and make sure all employees have access to documentation and instructions so that all are on the same page working toward the same goal.

8. Repeat the process

After successfully implementing a new process, it's time to find other ways to improve. Review the new processes you've implemented and see if there are any changes that need to be made. If everything is running smoothly, look to other areas or more ambitious projects that you may want to benchmark and start the process again.

2. Quality Functional Deployment

Quality Function Deployment (QFD) is a means of eliciting user (customer) requirements (the "Voice of the Customer") and turning them into system requirements in engineering language.

The QFD method was developed in Japan in the late 1960s by Professors Shigeru Mizuno and Yoji Akao of the Tokyo Institute of Technology. The Bridgestone Tire Company developed the first large scale application in 1966, using the initial, rather unweildy format based on fishbone analysis.

The method soon moved on to using a matrix format, as it was found to be easier and better able to handle more complex situations. The rows represent customer needs or requirements and the columns are various functional requirements or quality characteristics, with the matrix indicating the strength of correlation (or lack of correlation) between the two.

Thus if one establishes what the customer's requirements are, ideally by direct contact with the customer, rather asking your own engineers what they think the might be, they can then be related to design requirements.

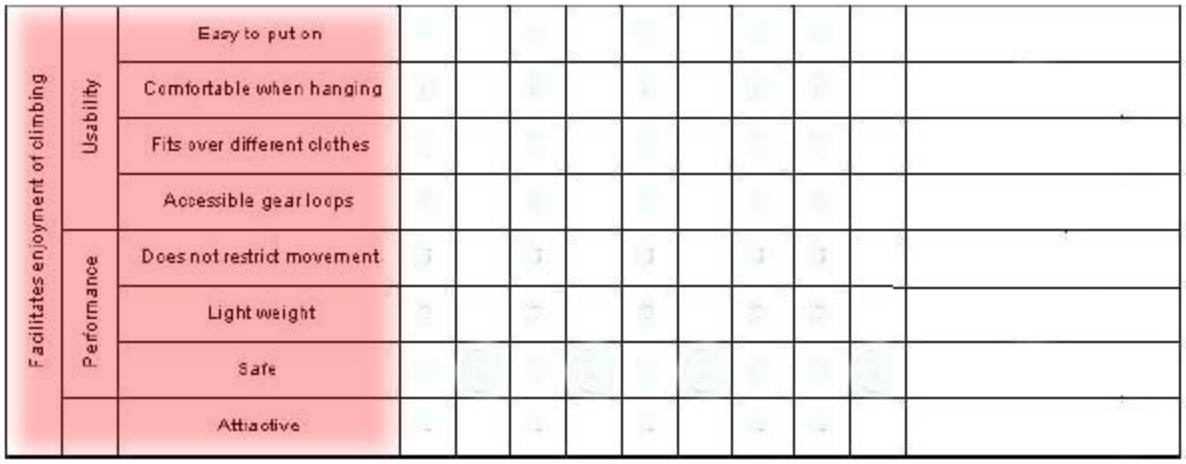
The name "House of Quality" came about because the original rectangular matrix also has a triangular matrix on top of it, which looks like a roof and makes the whole diagram look like a house.

The house of quality first appeared in 1972 in the design of an oil tanker by Mitsubishi Heavy Industries, but became well known in the west due to the publication of a paper called 'The House of Quality' by John R. Hauser & Don Clausing, Don in the Harvard Business Review in May 1988.

Steps to the House of Quality

Step 1: Customer Requirements – "Voice of the Customer"

The first step in a QFD project is to determine what market segments will be analyzed during the process and to identify who the customers are. The team then gathers information from customers on the requirements they have for the product or service. In order to organize and evaluate this data, the team uses simple quality tools like Affinity Diagrams or Tree Diagrams.



Step 2: Regulatory Requirements

Not all product or service requirements are known to the customer, so the team must document requirements that are dictated by management or regulatory standards that the product must adhere to.

Step 3: Customer Importance Ratings

On a scale from 1 – 5, customers then rate the importance of each requirement.

Facilitates enjoyment of climbing	Usability	Easy to put on	2									
		Comfortable when hanging	5									
		Fits over different clothes	1									
		Accessible gear loops	3									
	Performance	Does not restrict movement	5									
		Light weight	3									
		Safe	5									
		Attractive	2									

Step 4: Customer Rating of the Competition

Understanding how customers rate the competition can be a tremendous competitive advantage. In this step of the QFD process, it is also a good idea to ask customers how your product or service rates in relation to the competition. There is re modeling that can take place in this part of the House of Quality. Additional rooms that identify sales opportunities, goals for continuous improvement, customer complaints, etc., can be added.

Step 5: Technical Descriptors – "Voice of the Engineer"

The technical descriptors are attributes about the product or service that can be measured and benchmarked against the competition. Technical descriptors may exist that your organization is already using to determine product specification, however new measurements can be created to ensure that your product is meeting customer needs.

Step 6: Direction of Improvement

As the team defines the technical descriptors, a determination must be made as to the direction of movement for each descriptor.

Step 7: Relationship Matrix

The relationship matrix is where the team determines the relationship between customer needs and the company's ability to meet those needs. The team asks the question, "what is the strength

of the relationship between the technical descriptors and the customers needs?" Relationships can either be weak, moderate, or strong or carry a numeric value of 1, 3 or 9.

Step 8: Organizational Difficulty

Rate the design attributes in terms of organizational difficulty. It is very possible that some attributes are in direct conflict. Increasing the number of sizes may be in conflict with the companies stock holding policies, for example.

Step 9: Technical Analysis of Competitor Products

To better understand the competition, engineering then conducts a comparison of competitor technical descriptors. This process involves reverse engineering competitor products to determine specific values for competitor technical descriptors.

Step 10: Target Values for Technical Descriptors

At this stage in the process, the QFD team begins to establish target values for each technical descriptor. Target values represent "how much" for the technical descriptors, and can then act as a base-line to compare against.

Step 11: Correlation Matrix

This room in the matrix is where the term House of Quality comes from because it makes the matrix look like a house with a roof. The correlation matrix is probably the least used room in the House of Quality; however, this room is a big help to the design engineers in the next phase of a comprehensive QFD project. Team members must examine how each of the technical descriptors impact each other. The team should document strong negative relationships between technical descriptors and work to eliminate physical contradictions.

Step 12: Absolute Importance

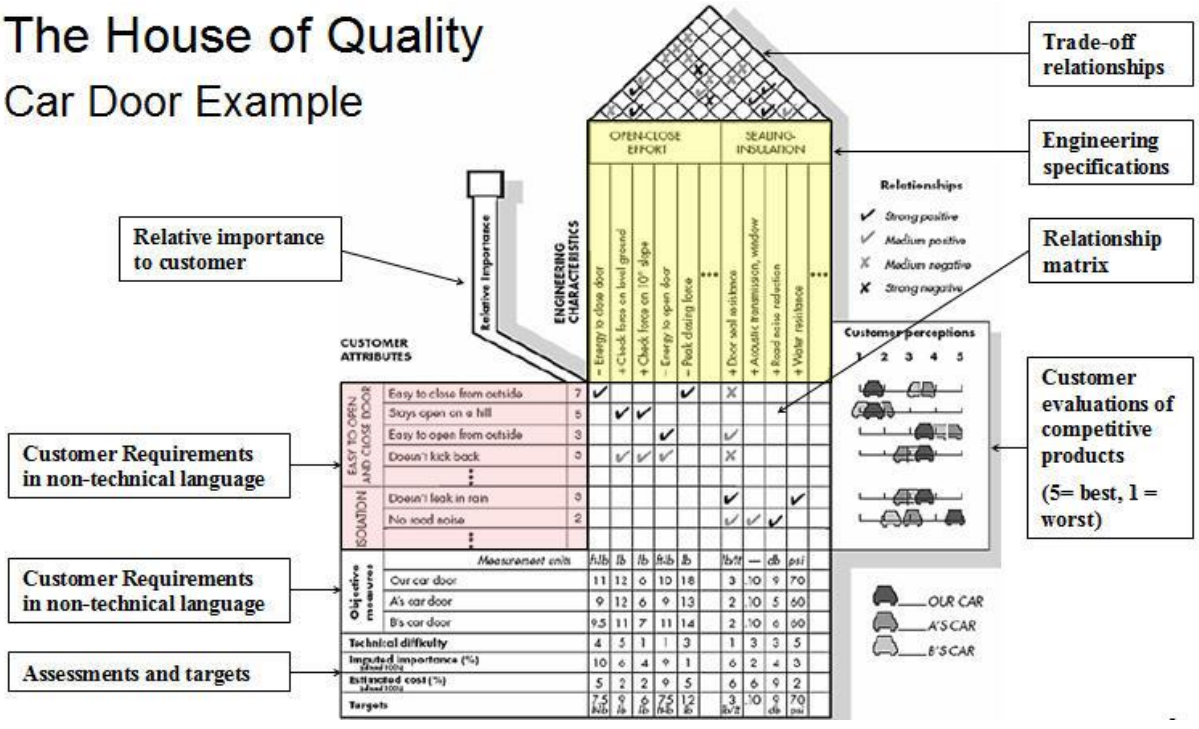
Finally, the team calculates the absolute importance for each technical descriptor. This numerical calculation is the product of the cell value and the customer importance rating. Numbers are then added up in their respective columns to determine the importance for each technical descriptor

The Next stage

The above process is then repeated in a slightly simplified way for the next three project phases. A simplified matrix involving steps 1, 2, 3, 5, 6, 7, 9 & 11 above is developed. The main difference with the subsequent phases however, is that in Phase 2 the process becomes a translation of the voice of the engineer in to the voice of the part design specifications. Then, in phase 3, the part design specifications get translated into the voice of manufacturing planning. And finally, in phase 4, the voice of manufacturing is translated into the voice of production planning.

QFD is a systematic means of ensuring that customer requirements are accurately translated into relevant technical descriptors throughout each stage of product development. Therefore, meeting or exceeding customer demands means more than just maintaining or improving product performance. It means designing and manufacturing products that delight customers and fulfill their unarticulated desires. Companies growing into the 21st century will be enterprises that foster the needed innovation to create new markets.

QFD Case Study



3. TAGUCHI'S QUALITY LOSS FUNCTION

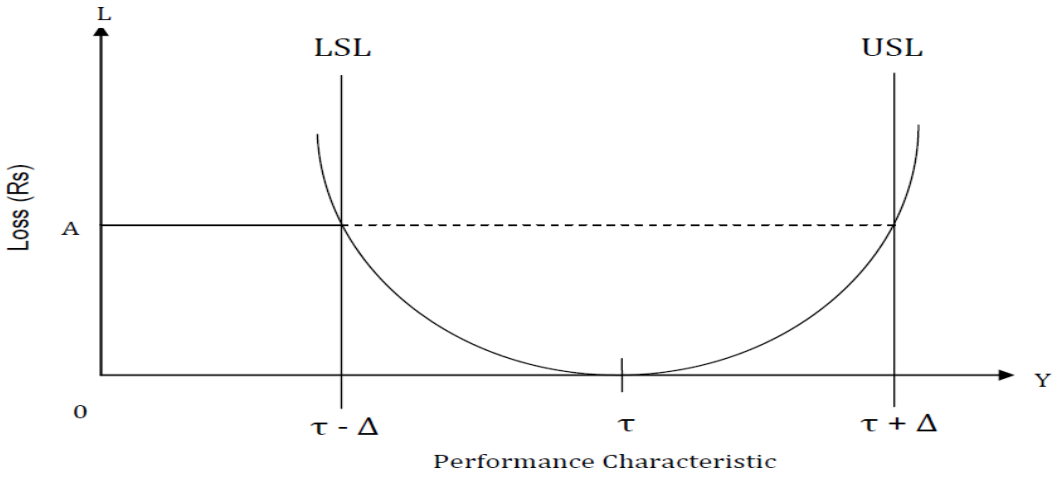
Taguchi's Quality Loss Function concept combines cost, target and variation in one metric with specifications being of secondary importance. Taguchi has defined quality as the loss imparted to society from the time a product is shipped. Societal losses include failure to meet customer requirements, failure to meet ideal performance and harmful side effects.

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.



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 - τ) 2. Where,

L = cost incurred as quality deviates from the target. y = Performance characteristic

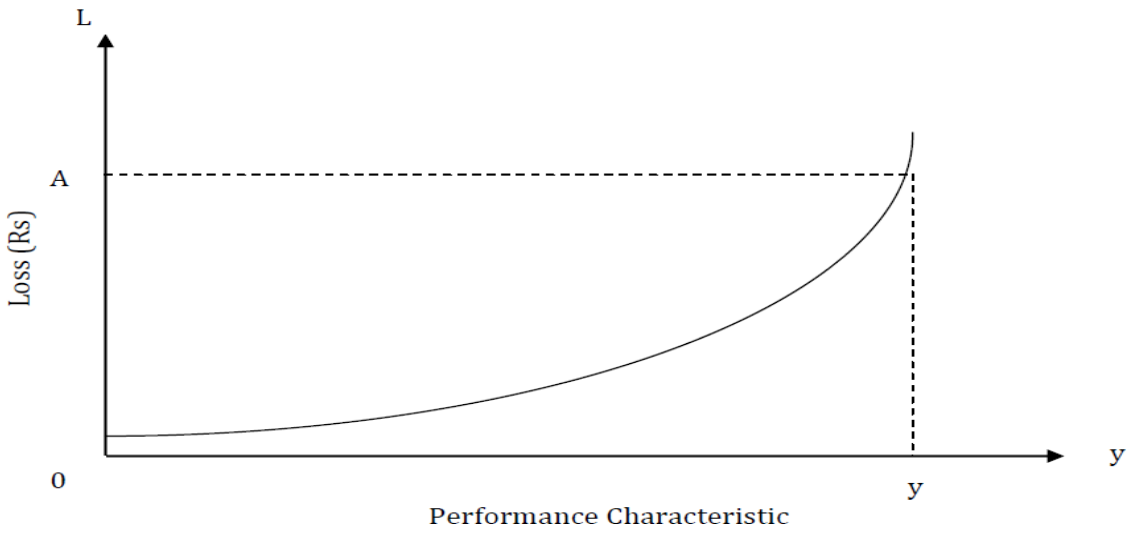
τ = target

k = Quality loss coefficient.

The loss coefficient is determined by setting Δ = (y – τ), 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 – τ)2 = A / Δ2 .

SMALLER – THE – BETTER :



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

4. 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 :

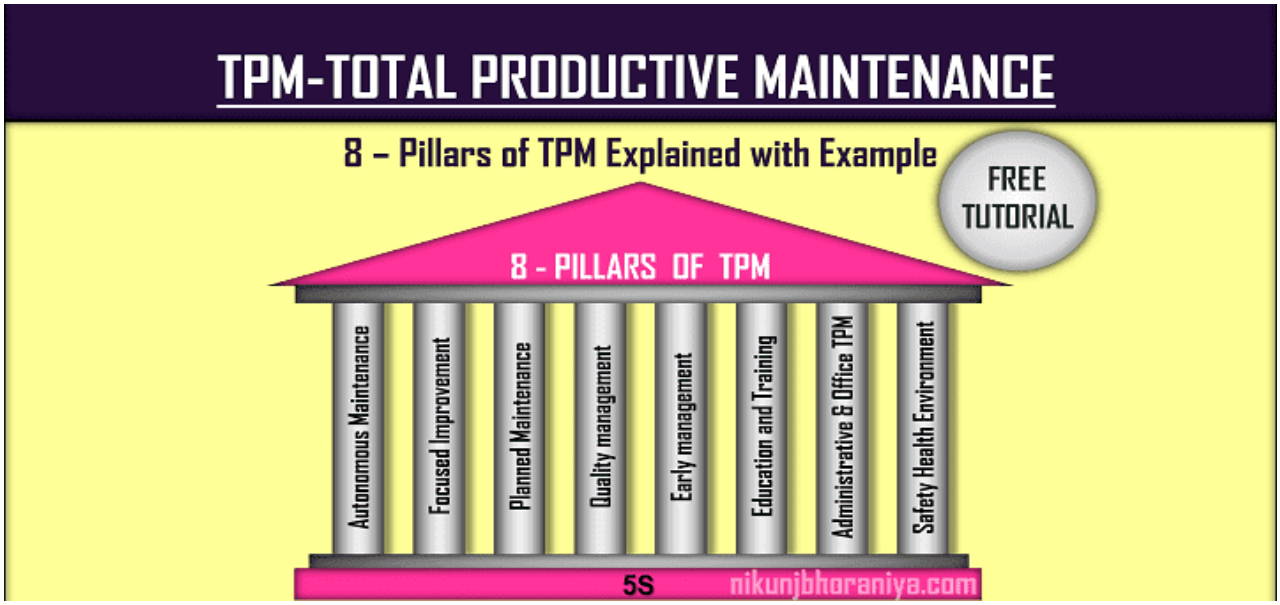
1. To maintain and improve equipment capacity.
2. To maintain equipment for life.
3. To use support from all areas of the operation.
4. To encourage input from all employees.
5. To use teams for continuous improvement.

The Eight Pillars of TPM

Total Productive Maintenance (TPM) is a set of strategic initiatives focusing on maintaining and improving production and quality systems through the machines, equipment, processes and employees that add value to an organization.

TPM has eight pillars that are mainly aimed at proactively improving the reliability of machines.

People are at the center of this system and must be continuously trained to identify and eliminate waste.



1. Focused Improvements (Kaizen)

Kaizen is a continuous improvement process that helps organisations to improve quality and productivity by identifying, analyzing and eliminating Non-Value Adding activities.

Teams are formed with people in various departments/functions of the company. The problems/issues related to the equipment are identified and improvement goals are set in kaizen event.

During the events, the participants map the current state as a baseline performance measure on which they will compare any future performance after improvement. The team works together and come up with the analysis of the root cause of the problems and implement solutions and ensure that they are sustained.

2. Autonomous Maintenance

Autonomous Maintenance activity is done by the operators and it creates a ownership with the machine. The operator of the machine is responsible for daily cleaning and minor maintenance activities.

Skill levels of workers increase as they understand the general working of equipment thus achieving the multi-skilling objective of a lean organization

Capital investments reduce because the organization has reliable equipment. The lifespan of machines increase as deterioration of machine is checked through constant monitoring and maintenance.

3. Planned Maintenance

Planned maintenance / Preventive Maintenance happens before the machine breaks down. This is planned considering various factors like the machine failure rate, age of the machine, etc.

Production functions should build up some inventory to allow for the planned maintenance to be carried out as they have prior information of when these activities are scheduled.

4. Early Equipment Maintenance (EEM)

Early equipment maintenance is to build in high efficiency from the design stage. EEM will help to design equipment in a way that it is easy to operate and maintain and is delivered to site in a condition that is equal to autonomous maintenance standards.

The productivity as well as output quality of the machinesis also guaranteed from the very first day when the equipment is commissioned.

Below factors to be considered in EEM

- Ease of cleaning, lubrication and inspection
- Accessibility of equipment parts
- Make the machines easier to operate (ergonomic aspects)
- Making it easier for the change-over (Easy clamping, Quick adjustment settings, etc)
- Feedback mechanisms to alert defective products (Visual Indicators)
- Increased safety features

5. Quality Maintenance

This TPM pillar addresses improves quality by ensuring equipment is able to detect and prevent errors during production. By detecting errors during production, processes become reliable to produce the right components in the first time and this reduces the Cost of Poor

Quality (COPQ). Using lean tools such autonomation (jidoka) and andon lights, machines detect and report any abnormal conditions, thereby releasing the operators from the tedious monitoring.

6. Training and Education

TPM Education and Training pillar is a companywide initiative that involves all levels in the organization from the operators to senior managers

Through training, operators' skills levels are raised to the point where they are able to carry out basic maintenance activities that were previously done by the maintenance team.

The maintenance team members are taught higher level skills such as preventive maintenance and analytical skills to help them become more proactive in problem solving.

Managers also learn the TPM skills so as to become competent mentors to their juniors as well as be involved in coaching programs.

7. Safety, Health & Environment

The Health, Safety and Environment pillar of Total Productive Maintenance ensures that all workers are provided with an environment that is safe and the unsafe conditions are eliminated.

In a safe environment, employees attitude towards work changes dramatically resulting in productivity, Quality and Delivery Performance improvements.

The teams will work towards making machines safe to use for the operators by putting in place machine guards, Standard Operating Procedures (SOP), use of personal protective equipment and first-aid kits in the work area. Each of these measures are aimed at improving the safety of the machines so as to have a more productive work-force.

8. Office TPM

Make all supportive functions to understand and apply the principles of lean in their own operations. This makes it easy for them to provide efficient service to the Value Adding processes.

The TPM principles can also be applied as stand-alone techniques to improve the efficiency of these supportive functions. For example, if the administrative functions are able to

improve their order processing procedures, then the materials will get to the shop-floor in a flawless manner which will have a positive effect on the workflow.

5. FAILURE MODE EFFECTIVE ANALYSIS

Failure Modes and Effects Analysis (FMEA) is a systematic, proactive method for evaluating a process to identify where and how it might fail and to assess the relative impact of different failures, in order to identify the parts of the process that are most in need of change. FMEA includes review of the following:

Steps in the process

1. Failure modes (What could go wrong?)
2. Failure causes (Why would the failure happen?)
3. Failure effects (What would be the consequences of each failure?)

Teams use FMEA to evaluate processes for possible failures and to prevent them by correcting the processes proactively rather than reacting to adverse events after failures have occurred. This emphasis on prevention may reduce risk of harm to both patients and staff. FMEA is particularly useful in evaluating a new process prior to implementation and in assessing the impact of a proposed change to an existing process.

Steps in FMEA

Process Failure Mode and Effects Analysis must be done in a step-wise fashion since each step builds on the previous one. Here's an overview of the 10 steps to a Process FMEA.

STEP 1: Review the process

- Use a process flowchart to identify each process component.
- List each process component in the FMEA table.
- If it starts feeling like the scope is too big, it probably is. This is a good time to break the Process Failure Mode and Effects Analysis into more manageable chunks.

STEP 2: Brainstorm potential failure modes

- Review existing documentation and data for clues about all of the ways each component can failure.

- The list should be exhaustive – it can be paired down and items can be combined after this initial list is generated.
- There will likely be several potential failures for each component.

STEP 3: List potential effects of each failure

- The effect is the impact the failure has on the end product or on subsequent steps in the process.
- There will likely be more than one effect for each failure.

STEP 4: Assign Severity rankings

- Based on the severity of the consequences of failure.

STEP 5: Assign Occurrence rankings

- Rate the severity of each effect using customized ranking scales as a guide.

STEP 6: Assign Detection rankings

- What are the chances the failure will be detected prior to it occuring.

STEP 7: Calculate the RPN

- Severity X Occurrence X Detection

STEP 8: Develop the action plan

- Decide which failures will be worked on based on the Risk Priority Numbers. Focus on the highest RPNs.
- Define who will do what by when.

STEP 9: Take action

- Implement the improvements identified by your Process Failure Mode and Effects Analysis team.

STEP 10: Calculate the resulting RPN

- Re-evaluate each of the potential failures once improvements have been made and determine the impact of the improvements.

Case Study

Failure Modes and Effects Analysis (FMEA): The Heart of an Equipment Maintenance Plan

The primary purpose of an equipment maintenance plan (EMP) in a manufacturing facility is to minimize the impact of unplanned events on safety, the environment, and business profitability. The reliability tool best serving as a vehicle to achieve and sustain EMP goals is the failure modes and effects analysis (FMEA). Optimum long-term cost of ownership is typically a result of an effectively facilitated and thoroughly implemented FMEA.

Initial Groundwork

The first step in laying the groundwork for an FMEA-based reliability improvement effort is to identify candidate equipment. The preferred method is by criticality analysis, a tool used to evaluate how equipment failures impact organizational performance in order to systematically rank plant assets for the purpose of work prioritization, material classification, preventative maintenance / predictive maintenance (PM/PdM) development, and reliability improvement initiatives.

The criticality analysis is a team effort which requires cross-functional input from Operations, Maintenance, Engineering, and Materials Management groups; and representation from the Environmental Health and Safety (EH&S) organization. This team will identify a prioritized list for EMP development.

Next, ensure that design criteria, existing maintenance tasks, operating strategies and past experiences are available for inputs to the subsequent FMEA. These are typically found in:

- Equipment Files & Drawings
- Failure Reporting and Corrective Action System (FRACAS)
- Safety Event Tracking
- Asset Utilization Database
- Computerized Maintenance Management System (CMMS)

- Reliability Near-Miss Tracking
- Process Database

After the candidate equipment is identified and front-end information is gathered, develop an FMEA project charter that clearly defines the following:

- Problem & Goal Statements
- Value Proposition
- Scope & Boundaries
- Team Members (Roles & Responsibilities)
- Deliverables
- Project Timeline

Conduct the FMEA

FMEAs are not developed in a vacuum – they are typically conducted by a diverse team with different views and expertise of the equipment and processes under investigation. Be sure to include front-line operators and maintenance specialists on the team, and include the process owner as an ad-hoc member.

The first step in conducting the FMEA is to build a functional block diagram (FBD), which shows how different components interact with each other and which describes each component and its function. The FBD shows major components as blocks connected together by lines that indicate the relationships of components and which establish a structure around which the FMEA can be developed. The FBD should always be included with the FMEA.

Next, calculate the baseline Overall Equipment Effectiveness (OEE) and the associated financial impact for the equipment targeted for improvement. Three years of historic data are ideal but as little as one year can suffice. The FMEA project charter is updated with the baseline OEE and target OEE including the value proposition. There are three OEE factors to consider in its calculation:

- OEE = Availability x Performance x Quality
    - Availability = Operating Time ÷ Planned Production Time
    - Performance = (Total Pieces ÷ Operating Time) ÷ Ideal Run Rate
    - Quality = Good Pieces ÷ Total Pieces

FMEA Phase 1 Analysis – Definition and Identification

Once the team has identified the focus equipment's functions and measured baseline reliability, the team can proceed to Phase 1 of the FMEA analysis. The elements of Phase 1 analysis are defined in terms of equipment function and functional failure, as detailed in the FBD, along with each component failure modes, root causes, effects of failure and current-state controls.

There are many types of FMEA and different versions, but we'll use the pump system FMEA shown in Figure 1 for illustration:

- **Equipment Function** - List the functions of the equipment being studied
- **Functional Failure** - List the situation in which the functions would be considered lost. Most functions will have more than one loss condition
- **Component** - A grouping of parts into some identifiable package that will perform at least one significant function, typically an item identified in the FBD
- **Potential Failure Mode(s)** - The manner by which a possible failure is observed; it generally describes the way the failure occurs or its observable characteristics
- **Potential Effect(s) of Failure** - Describe what will happen if the failure mode occurs
- **Potential Cause(s) of Failure** - Try to anticipate the cause of the failure mode described
- **Current Controls** - What are we doing now (the current state) that prevents, mitigates, or detects the previous cause
- **Current Process Frequency** – How frequent are the current process controls done?

Figure 1. Example FMEA Phase 1 Analysis

Failure Modes and Effects Analysis Phase #1 – Pump System Example

EQUIPMENT FUNCTION	FUNCTIONAL FAILURE	COMPONENT	POTENTIAL FAILURE MODE(S)	POTENTIAL EFFECT(S) OF FAILURE	POTENTIAL CAUSE(S) OF FAILURE	CURRENT CONTROLS	CURRENT PROCESS KNOWN FREQUENCY
Provide Process Flow	Loss of Process Flow	Motor	Seized Bearings	Total Loss of Capacity	Lack of Lubrication	Lube Motor Bearings	6M
Provide Process Flow	Degraded Process Flow	Impeller	Reduced Discharge Pressure	Partial Loss of Capacity	Normal Wear	Overhaul Pump	2Y

The next step in Phase 1 analysis is to identify potential failure modes and their effects, root causes, and detection processes. Brainstorm all possible failure modes, including those that have occurred and rare problems. Then, for each failure mode listed, associate all possible

causes. Ask “why” until the root cause is revealed. Review all potential causes of failure, and identify actions already taking place to eliminate the causes of failure. Also, identify how the causes of failure are currently detected and intervention tasks and their frequencies to reduce the severity of the effects on the production process.

This step typically involves some form of condition monitoring or alarms systems to alert the operator in the early stages of failure. Potential failure modes, root causes, failure effects and detectability can be further explored using a variety of supplementary reliability tools:

- Brainstorming – Explores potential failure modes, causes and their effects
- 5-Why Analysis – Drills down to root causes
- Fishbone Diagram – Analyzes cause and effect relationships
- Data Mining – Quantitatively measures the effects of failure

FMEA Phase 2 Analysis – Quantifying, Prioritizing and Mitigating Risk

To begin Phase 2 analysis, the team quantifies the risk of each failure mode under the current control process. Risk is measured using a risk priority number (RPN) that is the product of severity, likelihood of occurrence, and detectability factors. Assigning RPNs to failure modes helps the team prioritize areas to focus on and can also help in assessing opportunities for improvement.

For every failure mode identified (see Figure 2), the team should answer the following questions and assign the appropriate score:

RPN = SEV x OCC x DET

- **Severity (SEV) -** If this failure mode occurs, what impact would the failure have on EH&S, Capacity, or Cost? Assign a score between 1 and 10, with 1 meaning “no impact” and 10 meaning “extreme impact”.
- **Likelihood of Occurrence (OCC) -** How likely is it that this failure mode will occur? Assign a score between 1 and 10, with 1 meaning “very unlikely to occur” and 10 meaning “very likely to occur”.
- **Likelihood of Detection (DET) -** If this failure mode occurs, how likely is it that the failure will be detected? Assign a score between 1 and 10, with 1 meaning “very likely to be detected” and 10 meaning “very unlikely to be detected”.

There is no value above which it is mandatory to take action or below which the failure mode is exempt from action. However, start with the top 20% RPNs and prioritize using the following guidelines:

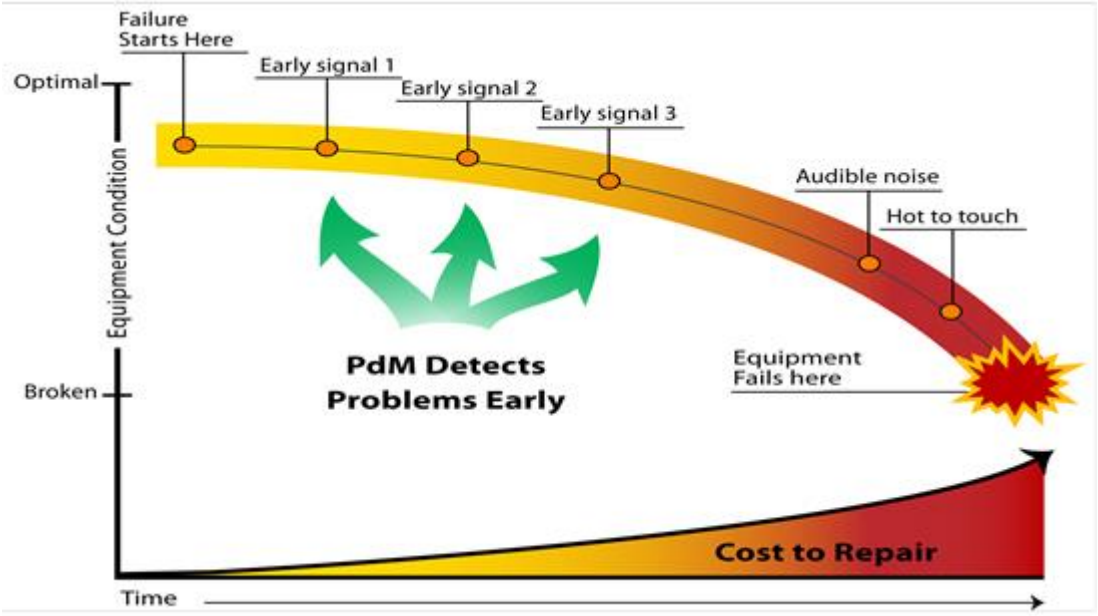
- Severity (SEV) is given the most weight when assessing risk.
- Severity and Occurrence (SEV x OCC) combination would then be considered.

Failure Modes and Effects Analysis Phase #2 – Pump System Example

RISK ASSESSMENT (AS IS)				RECOMMENDED IMPROVEMENTS/ACTIONS	RECOMMENDED IMPROVEMENT PROCESS FREQUENCY	RESPONSIBILITY/ DATE	RISK ASSESSMENT (TO BE)			
SEV	OCC	DET	RPN				SEV	OCC	DET	RPN
6	5	3	90	Include on Vibration and IR Route	3M	PdM Tech/ 1Q14	6	3	2	36
4	6	5	120	Monitor Flow and Discharge Pressure	1W	Operator/ 1W14	4	6	3	72

The next step in Phase 2 analysis is to minimize risk by utilizing the team's expertise to brainstorm ways of reducing the severity, likelihood of occurrence, or detectability of the failure. Include the process owner in developing the improvements, as this will prove invaluable when negotiating roadblocks in their implementation.

Define risk mitigation tasks and their respective frequencies for the top 20% RPNs, and prioritize the implementation of those tasks that provide maximum value by either detecting failure at the start of its potential failure (PF) curve (see Figure 3) or by preventing a failure from occurring in the first place through re-design efforts.



Potential mitigation tasks, frequencies, their potential value, and ownership can be further explored using a variety of supplementary reliability tools:

- Brainstorming – Explores potential risk reduction tasks
- Cost/Benefit Analysis – Assists the team to select optimum solutions
- Potential Failure Curves – Maps failure development
- RACI Chart – Aligns roles and responsibilities

Selected tasks are assigned ownership to the appropriate functions including detailed responsibilities and timing. New RPNs are calculated using the projected severity, likelihood of occurrence, or detectability factors and added to the FMEA.

QUESTIONS

PART – A

1. Define Benchmarking?
2. Enumerate the steps to benchmark?
3. What are the types of benchmarking?
4. What is a QFD?
5. What are the benefits of QFD?
6. What are the steps required to construct an affinity diagram?
7. What are the parts of house of quality?
8. What are the stages of FMEA?
9. What are the goals of TPM?
10. Give the seven basic steps to get an organization started toward TPM?
11. What are the major loss areas?
12. What are the phases of QFD process?
13. What are the several types of FMEA?
14. Define TPM?

PART – B

1. Explain the Bench marking Process and reasons to Benchmark?
2. Explain the QFD process?
3. Explain the House of Quality in Quality Function Deployment?
4. What is FMEA? Explain the stages of FMEA?

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SCHOOL OF MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

SPR1402 – TOTAL QUALITY MANAGEMENT

UNIT – V –Quality Systems –SPR1402

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case studies of TQM implementation in manufacturing and service sectors including IT.

QUALITY SYSTEM

Quality system is the organizational structure, responsibilities, procedures, processes and resources for implementing quality management

Function of quality system

- System is well understood and effective
- Product will satisfy customer expectation
- Emphasis is placed on problem-prevention rather than dependence on detection after occurrence

NEED FOR ISO 9000

- Quality and standardization are two essential pre requisite for an organization to market its product and service in the competitive business environment
- Ever increasing pressure to provide better quality of product led to the development of quality standard

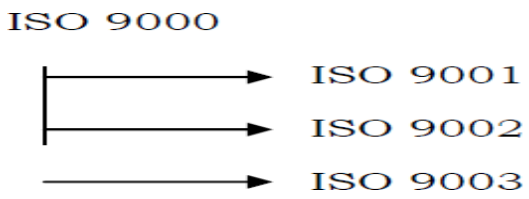
OBJECTIVES OF ISO 9000

- To achieve, maintain and seek to continuously improve product quality in relationship to requirement
- To improve the quality of operation to continually meet customer and
- stakeholders stated and implied needs
- To provide confident to internal management and other employee that quality requirement are being fulfilled.

BENEFITS OF ISO 9000

- If forms a solid foundation for improvement , consistency and profitability
- It provides good platform for continuous quality improvement
- It provides a status symbol for organization and act as powerful marketing tool
- It increases potential market share

ISO 9000 FAMILY OF STANDARDS



ISO 9001

Figure 5.1 ISO 9000:2000 QMS

ISO9001

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

QUALITY MANAGEMENT PRINCIPLES OF ISO 9000:2000

1. Customer Focus

   Organization depend on their customer and therefore should understood current and future customer needs, should meet customer requirement, and strive to exceed customer expectation

2. Leadership

   Leaders established unity of purpose and direction of organization .they should create and maintain the internal environment in which people can become fully involved in achieving the organization objectives

3. Involvement of People

   People at all levels are the essence of an organization and their full involvement enables their ability to be used for organization benefit

4. Process Approach

   Desired result is achieved more efficiently when activities and related resources are managed as a process

5. System Approach to Management

   Identifying, understanding and managing inter related processes as a system Contributes to the organization effectiveness and efficiency in achieving its objectives

6. Continual Improvement

   Continual improvement of organization's overall performance should be a permanent objective of organization

7. Factual Approach to Decision

   Effective decisions are based on the analysis of data and information

8. Mutually Beneficial Supplier Relationship

   An organization and its supplier are interdependent and a mutually beneficial relationship enhances the ability of both to create value

IMPLEMENTATION OF QUALITY SYSTEM

1. Top Management Commitment

   Most important step in implementing a quality system is to get the full support of upper Management.

2. Appoint the Management Representative

   Management representative is responsible for co-ordinating the implementation and maintenance of the quality system

3. Awareness

   The implementation of the quality system requires involvement of all members in the organization, the members should understand the process and implications of ISO program

4. Appoint an Implementation Team

   Implementation team should be formed and team should identify the QMS processes and their sequence and interaction

5. Training

   It can be accomplished through in-house training programs, seminars, workshops

6. Time Schedule

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

7. Select Element Owner

   Implementation team selects owner for each of the system elements.many of these owners will be members of the implementation team.

8. Review the Present System

   Review of the present quality system should be performed. This is a gap analysis and can be performed by the element owners and their teams or by an external consultant

9. Write the Document

   Written quality policy and procedure manuals should be prepared. This should be done by the employee who performs the job.

10. Install The New System

    Policies, procedures and work instruction should be integrated into the day-to-day working of the organization

11. Internal Audit

    This ensures that the system is working effectively and to provide management with information for the comprehensive management review

12. Management Review

    Management review must be conducted in order to determine the effectiveness of the

system in achieving the stated quality goals

13. Preassessment

It is optional step. if a good job has been done on the previous steps, them Preassessment is not necessary.

14. Registration

Registration activity includes, choosing a register, submitting an application and conducting the registrar system audit

15. Award of ISO 9000 Certificate

After accepting the application and setting a time frame for registration, the registrar will review the quality system documentation. Based on the satisfactory report of the assessment team, ISO certificate will be granted to the organization.

DOCUMENTATION OF QUALITY SYSTEM

Proper documentation is the pre-requisite for implementing quality system. documentation serves as a reference for the management , staff and other agencies whose involvement is essential for implementation of the quality system.

Advantage of documentation

- Serve as reference
- Bring about clarity of objectives and targets
- Provides standardization in work procedure
- Brings about consistency in operation
- Develops confidence amongst employee

DOCUMENTS TO BE PREPARED

1. Quality Policy Manual

Quality policy manual is the first level of documentation. This is the document that defines 'whatwill be done and why'

Policy manual communicates the quality policy and objectives of an organization

2. Quality System Procedures

Second level of documentation is the quality procedures. These procedures describe the

method that will be used to implement and perform the stated policies Procedures define who should perfrom specific tasks , when the task should be done
and where documentation will be made

3. Work Instruction

It gives detail of how individual work processes are carried out within a company. work instruction should also specify how the work should be done and who should undertake the work and what record are to be maintained

4. Records

Records provide evidence of activity having een performed in compliance with quality system procedure. It is used to provide traceability of action taken on a specific product of batch of product

BENEFITS OF DOCUMENTATION

Documentation regularize the method of performing the day-to-day activities

- It provide formats for standardizing practices
- It provides reference for assessing degree of enforcement in practice
- It demonstrates the ISO quality system certification

QUALITY AUDITING

Quality auditing defined as "a systematic and independent examination to determine wheather quality activities and related results comply with planned arrangements, whether these arrangements are implemented effectively and whether these are suitable to achieve objectives Quality auditing should be carried out in order to verify whether a quality system is effective and suitable.

Types of audit

1. First Party Audit

   This refers to an internal audit where the auditee is its own client i.e audit is done by an organization, working on itself

2. Second Party Audit

   This refers to audit by one organization on another organization. This type of audit isnormally done on a supplier by a customer

3. Third Party Audit

   This refers to audit by an independent organization on a supplier, for accreditation purpose.

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

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

NEED FOR QUALITY AUDIT

1. To determine the conformity or non-conformity of the quality system element with regard to specified requirement
2. To determine the effectiveness of the implemented quality system in meeting specified
3. quality objectives
4. To meet regulatory requirements, if applicable
5. To permit the listing of the audited organisation's quality system in a register for third party certification.

QS 9000

QS 9000 is a set of quality system requirement recently adopted by members of the automotive industry. objectives of QS000 is to develop fundamental quality system based oncontinuous improvement , direct prevention , reduction of variation and waste elimination in theautomobile supply chain

APPLICATION OF QS 9000

It is applied to all internal and external suppliers of

- Production material
- Production or service parts
- Heat treating , painting ,plating or finished services

CONTENT OF QS 9000

Section –I:ISO 9000 based requirements

It includes the exact text of ISO 9001 with the addition of automotive trucking requirements.

Section-II: Automotive Sector Specific Requirement

This section includes common requirement for all automotive supplies which is ,

Production –part approved process

Continuous improvement

Manufacturing capability

Section-III: Customer Specific Requirement

It deals with the specific requirement of each customer over and above requirement specified in section-ii

Documents required for QS9000 programme

1. QS 9000 quality system requirement
2. Advanced product quality planning and control plan
3. Failure mode and effect analysis
4. Measurement system analysis
5. Fundamental statistical process control

ISO 14000

ISO 14000 standards are a set of norms for environmental management system either at organization and process level or product level. Overall objectives of ISO 14000 environmental management standard is to encourage environment protection and pollution prevention while taking into account the economic needs of society.

NEED OF ISO 14000

ISO 14000 standards bring a world wide focus to the environment, encouraging a cleaner, safer, healthier world for all. This will ensure that there are no conflicts between regional interpretation of good environmental practice.

ISO 14000 registration may become the primary requirement for doing business in many regions or industries.

TERMINOLOGY USED IN ISO 14000

1. Environment:

   It is defined as the global surrounding in which an organization operates and include air , water, land, natural resource and their interaction.

2. Environmental Aspects:

   It is defined as an element of an organization activities products, or service that can interact with the environment

3. Environmental Impact

   It is defined as any change, whether adverse or beneficial resulting from an organization activity services.

4. Environmental Objective

   It is an overall environmental goal, arising from the policy statement that an organization sets for itself

5. Environmental Target

   It is a detailed performance requirement and should be quantified when practical

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 and implementation, operation, checking and corrective action, management review.

2. ENVIRONMENTAL POLICY

- The policy must be relevant to organization
- Management commitment for continual improvement and preventing pollution
- Should be a frame work
- Must be documented, Implemented and Maintained

3. PLANNING

- Environmental Aspects
- Legal and other requirements
- Objectives and Targets
- Environmental Management Programs

4. IMPLEMENTATION AND OPERATION:

- Structure and Responsibility
- Training, Awareness and Competency
- Communication
- EMS documentation
- Document Control
- Operation Control
- Emergency preparedness and Response

6. CHECKING AND CORRECTIVE ACTION

- Monitoring and Measuring
- Nonconformance corrective and preventive action
- Records
- EMS Audits

7. MANAGEMENT REVIEW

- Review of objectives and Targets
- Review of environmental performance
- Effectiveness of EMS Elements
- Evaluation of Continuation of Policy

BENEFITS OF EMS:

Organizational benefits:

- Assuring customers of a commitment to environmental management
- Meeting customer Requirment
- Improve Public relation
- Increase Investor Satisfaction
- Market share Increase
- Conserving Input material and energy
- Better Industry and government action
- Low cost insurance, easy attainments of permits and authorization

Unit V –Quality Systems

Part A (2 Marks)

1. Give the ISO 9000 Series of Standards?
2. What is the need for ISO 9000?
3. Give some other quality systems?
4. Give the objectives of the internal audit?
5. What are the requirements of ISO 14001?
6. What are the benefits of ISO 14000?
7. What are the four elements for the checking & corrective action of ISO 14001?
8. What are the seven elements for the implementation & operations of ISO 14001?
9. What are the four elements for the planning of ISO 14001?
10. Give the types of Organizational Evaluation Standards?
11. Give the types of Product Evaluation Standards?
12. Define Quality Audits?
13. Analyze TQM?
14. What are the benefits of ISO?
15. Give the ISO 9001 requirements?
16. What are the methods of actual audit?

Part B (16 Marks)

1. Explain the elements of ISO 9000:2000? (16)
2. Explain the implementation and documentation of Quality System? (16)
3. Explain the requirements of ISO 14000? (16)
4. Explain the Benefits of ISO 14000? (16)
5. Discuss about ISO 9000:2000 Quality Systems? (16)
6. Why is ISO 9000 important? Explain briefly. (16)