ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES:: RAJAMPET
(An Autonomous Institution)

DEPARTMENT OF MECHANICAL ENGINEERING

LECTURE NOTES

TOTAL QUALITY MANAGEMENT
[20A37OT]

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PrescribedTextbooks:
1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.

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1.Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2.Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3.Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4.Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:
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Unit – 1: Introduction

Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

Introduction to TQM:

The name itself is sufficient to describe everything but a bit more clarification will add to a base for the description. Total quality management is a management's approach towards the quality; it can be in regard to products, customer satisfaction and employees' satisfaction. The concept of TQM was developed by an American W. Edwards Deming and i.e. why it is called as Deming's concept of TQM. He introduced this concept for improving the quality of various products and services. Earlier it was just related with the quality of products which an organization is producing but now other concepts like marketing, finance design, customer service has also joined the area. This means that, now good numbers of things are there to manage. TQM works on one belief that mistakes can be avoided and defects can be prevented and management should believe in watching each and every step.

TQM talks about the satisfaction of customer, supplier, employees etc. and it requirescontinuous improvement. If the workers of an organization are efficiently working then their moralewill go up. TQM works effectively if the organization works in a family manner. Here management islike a father, employees are the children and manager is like mother and as father and mother takes care for their home collectively the same way , management and managers are supposed to take carefor their organization with the help of tool called TQM.

Total quality management is called 'total' because entire organization is involved, 'Quality' means degree of excellence and 'management' inliteral sense means getting things done by others. In a TQM effort, all members of an organizationparticipate in improving processes, products, services and the culture in which they work. The earlierintroduced quality management concept is now taken over by Total quality management. To haveeffective TQM the first requirement is strong internal motivation and emotional involvement forimplementation. So the concept of TQM talks about adopting the new policy, creating qualityproducts, eliminate defects, estimate for breakdown, accidents etc… Hence TQM should be purposedriven so first the whole organization should be willing to accept the change then only TQM canactually affect the organization in a positive way.

Quality Concept:

Quality does not mean an expensive product. On contrary it is fitness for use of theproduct.

Need for quality:

The need for quality was felt, during World War II due to the unprecedented need for manufacture goods. From them on methodologies for assuring quality in products and services evolved continuously finally lead to TQM.

Definition of Quality:

- Quality is defined as the predictable degree of uniformity and dependability,at low cost Suited to the market. (Deming).
- Quality is defined as fitness for use (Juan).
- Quality is defined as conformance to requirements (Crosby).

- Quality is totality of the characteristics of entity that bear on its ability to satisfy stated and implied needs (ISO).
- Defining Quality: Quality can be quantified as follows

$$Q = P / E$$

Where, Q = Quality
P = Performance
E = Expectation

Quality is not fine-tuning your product at the final stage of manufacturing, before packaging and shipping. Quality is in-built into the product at every stage from conceiving –specification & design stages to prototyping –testing and manufacturing stages.

Dimensions of Quality:

- Dimensions of quality in terms of physical product are as below;

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

- Dimensions of quality in terms of service product are as below;

1. Reliability : Refers to the dependability of the service providers and theirability to keep their promises.
2. Responsiveness : Refers to the reaction time of the service.
3. Assurance : Refers the level of certainty a customer has regarding thequality of the service provided.
4. Empathy : Being able to understand the needs of the customer as anindividual.
5. Tangibles : Similar to the physical characteristics of quality of products.
6. Other Dimensions: Time, Courtesy, Timeliness, consistency, accuracy, credibility and security.

Quality Planning:

Quality planning implies the ability to anticipate situations and prepare actions to bring about the desired outcome.

- 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.

In quality planning it is important to prevent defects by:

- Selecting proper materials.

- Training and indoctrinating people in quality.
- Planning a process that ensures the appropriateoutcome.

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 for 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 cost is a cost for poor product of service.

Types of Quality costs:

1. Cost of prevention
2. Cost of appraisal
3. Cost of internal failures
4. Cost of external failures

1. Cost of prevention:

Prevention costs include those activities which remove and prevent defects from occurring in the production process. Included are such activities as quality planning, production reviews, training, and engineering analysis, which are incurred to ensure that poor quality is not produced.

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

2. Cost of appraisal:

Those costs incurred to identify poor quality products afterthey occur but before shipment to customers. E.g.: Inspection, activity.

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

3. Cost of internal failures:

Those incurred during the production process.Include such items as machine downtime, poor qualitymaterials, scrap, and rework.

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

4. **Cost of external failures:**

Those incurred after the product is shipped.External failure costs include returns and allowances,warranty costs, and hidden costs of customer dissatisfactionand lost market share.

- Complaint Investigations of Customer or User Service
- Returned Goods
- Retrofit and Recall Costs
- Warranty Claims
- Liability Costs
- Penalties
- Customer or User Goodwill
- Lost Sales

Analysis Techniques of Quality Costs:

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.

Analysis of Quality Costs can be done by two methods:

- Trend analysis
- Pareto analysis

Index Numbers:

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

- A simple type of index is called a Relative Index.

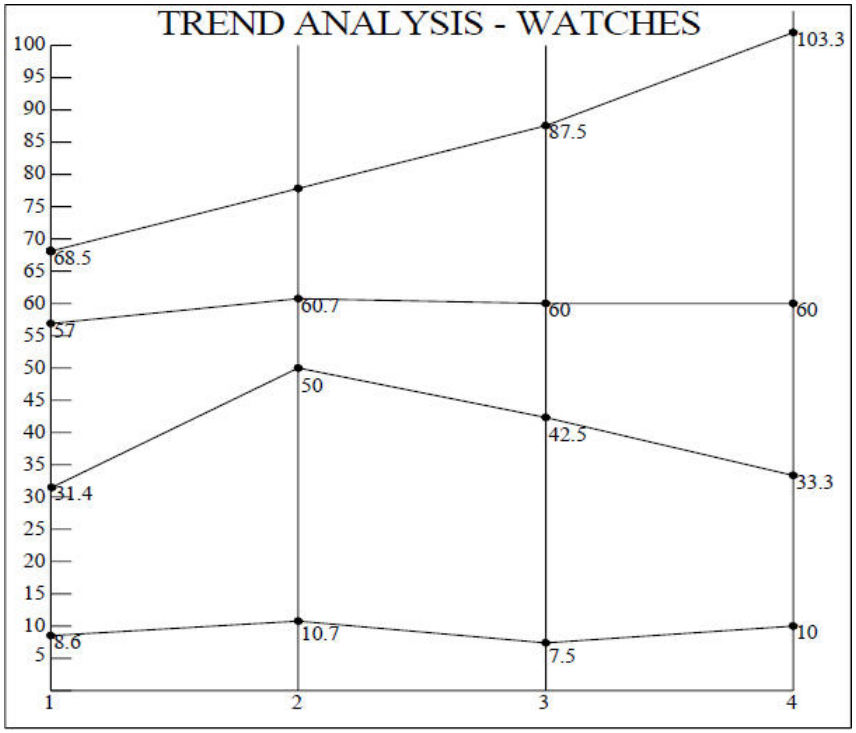
Quarter	Cost in Rs.
1	2000
2	2200
3	2100
4	1900

Cost Index in quarter‘t’ = (Cost in quarter‘t’ / Base period cost) X 100

Quarter	Cost Relative Index
1	(2000/2000) x 100 = 100
2	(2200/2000) x 100 = 110
3	(2100/2000) x 100 = 105
4	(1900/2000) x 100 = 95

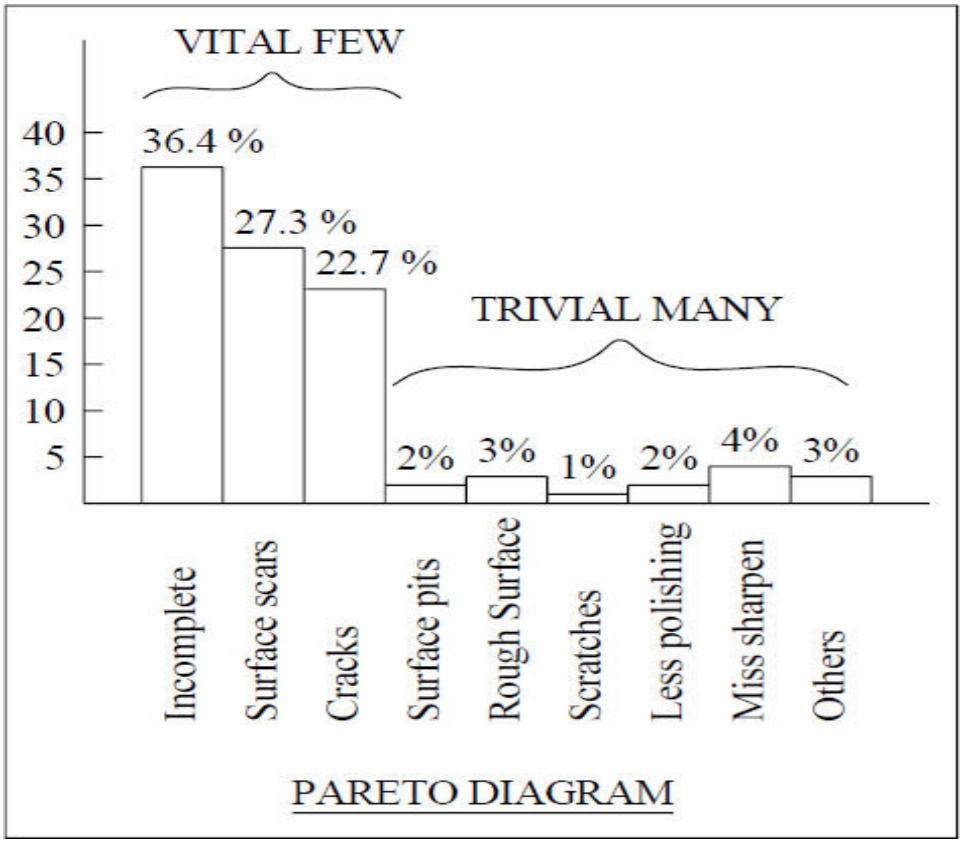
Trend Analysis:

- Good visual aids are important communication tools.
- Graphs are particularly useful in presenting comparative results to management.
- Trend Analysis is one where Time-to-Time comparisons can be made whichillustrates the changes in cost over time.



Pareto Analysis:

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



Benefits of Quality:

- Higher customer satisfaction
- Reliable products/services
- Better efficiency of operations
- More productivity & profit
- Better morale of work force
- Less wastage costs
- Less Inspection costs
- Improved process
- Spread of happiness & prosperity
- Better quality of life for all.

Definition of TQM:

- Total Quality Management (TQM) is an enhancement to the traditional way of doing business.
- TQM is and art of managing the whole to achieve excellence.

  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.
- TQM is defined as both philosophy and a set of guiding principles that represent the foundation of continuously improving organization.
- Total Quality Management is an effective system for integrating the quality development, quality maintenance and quality improvement efforts of various groups in an organization continuously, so as to enable marketing, engineering, production and service at the most economic levels which allow for full customer satisfaction.

TQM Evolution:

- Stage-1: Custom-built: Articles/Products having considerable controlover Quality**.**
  Ex: Craftsmen & Artisans - Sculptors, working with metals & other materials
- Stage-2: Mass Production: Products with less control over Quality.
  Ex: Shampoo, pens, toys etc...
- Stage-3: Quality control Department in Factories.
- Stage-4: TQM-based Production facility – enhancing the organization through Quality techniques to better achieveorganization's goals.
  Ex: Productivity and Profitability withminimum wastage.
- Stage-5: ISO Quality Management Systems.

Characteristics of TQM:

The above definitions revealed the following characteristics of TQM:

1. TQM is a customer oriented.
2. TQM required a long term commitment for continuous improvement of all processes.
3. TQM is teamwork.
4. TQM requires the leadership of top management and continuous involvement.
5. TQM is a strategy for continuous improving performance at all levels and in all areas of responsibility.

Basic Concepts of TQM:

1. **Management Involvement** – Participate in quality program, develop quality council, direct participation.
2. **Focus on customer** – who is the customer – internal and external, voice of the customer, do it right first time and every time.
3. **Involvement and utilization of entire work force** – All levels of Management.
4. **Continuous improvement** – Quality never stops, placing orders, bill errors, delivery, minimize wastage and scrap etc.
5. **Treating suppliers as partners** – no business exists without suppliers.
6. **Performance measures** – creating accountability in all levels.

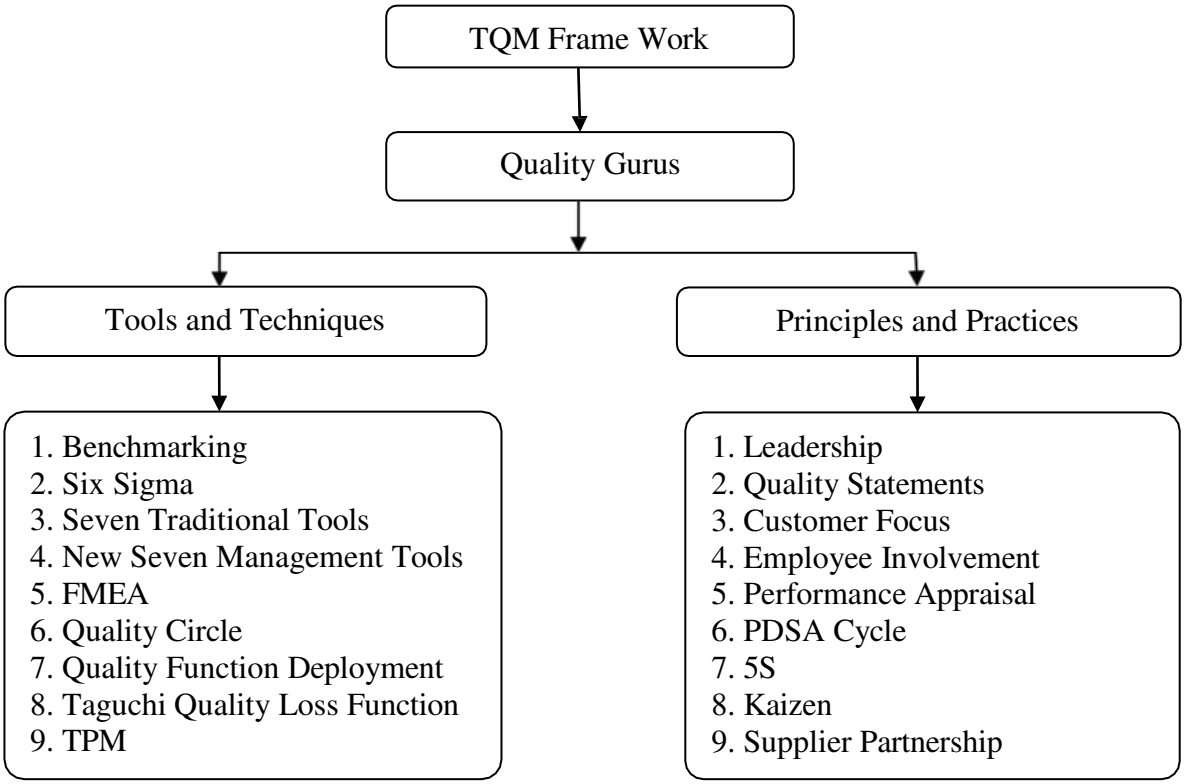
Elements of TQM:

A framework summarizing the important elements of TQM discussed in this text.

- Three elements of TQM include:

1. **Philosophical Elements**: The philosophical elements of TQM stress the operation of the company using quality as theintegrating element.
2. **Generic Tools**: The generic tools consist of various statistical process control (SPC) methods that are used forproblem solving and continuous improvement by quality teams. Quality function deployment istypically used by managers to drive the voice of the customer into the organization.
3. **Tools of the QC Department**: The Tools of the QC department consist of statistical quality control (SQC) methods such assamplingplans, process capability and Taguchi methods.

TQM Frame Work:



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Unit – 2: Historical Review

Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation,Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

Quality Council:A quality council is established to provide overall direction. The Quality Council typically approves new programs and monitors their implementation and subsequent reviews; assesses significant changes, and audits the quality assurance mechanisms within companies, organisations and institutions. Since this activity is always tertiary appraisal, it is fundamentally an audit function.

Quality Council Composition: The council is composed of,

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

Duties of theQuality Council: The duties of quality 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

Meeting Agenda of Quality Council: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: Threeelements of quality statements are,

1) **Vision Statement**
2) **Mission Statement**
3) **Quality Policy Statement**

1) Vision Statement:

- The vision statement is a short declaration what anorganization aspires to be tomorrow.
- A vision statement, on the other hand, describes how the future will look if the organization achieves its mission.

- The vision statement should be coined in such a way that the leaders and the employees working in the organization should work towards the achievements of the vision statement.
- Successful visions are timeless, inspirational, and become deeply shared within the organization, such as:
    - IBM's Service
    - Apple's Computing for the masses
    - Disney theme park's the happiest place on the earth
- Vision Statement of 'Annamacharya Institute of Technology & Sciences', an autonomous institution, Rajampet is *"We impart futuristic technical education and instill high patterns of discipline through our dedicated staff who set global standards, making our students technologically superior and ethically strong, who in turn shall improve the quality of life of the human race".*

2) Mission Statement:

- A mission statement concerns what an organization is all about.
- The statement answers the questions such as:
    - Who we are?
    - Who are our customers?
    - What do we do?
    - How do we do it?
- This statement is usually one paragraph or less in length, easy to understand, and describes the function of the organization.
- It provides clear statement of purpose for employees, customers, and suppliers.
- An example of mission statement is:
    - *"To meet customers transportation and distribution needs by being the best at moving their goods on time, safely and damage free" – National Railways.*
- Mission statement of 'Annamacharya Institute of Technology & Sciences', an autonomous institution, Rajampet is *"Our mission is to educate students from the local and rural areas and from other states so that they become enlightened individuals, improving the living standards of their families, industry and society. We provide individual attention, world-class quality of Technical education and take care of character building".*

3) Quality Policy Statement:

- It is guide for everyone in the organization as to how they should provide products and services to the customers.
- It should be written by the CEO with feedback from the workforce and be approved by the quality council. A quality policy is a requirement of ISO 9000.
- A simple quality policy is:
    - *Xerox is a quality company. Quality is the basic business principle for Xerox. Quality means providing our external and internal customers with innovative products and services that fully satisfy their requirements. Quality is the job of every employee.*
- 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:

- Strategic quality planning is a systematic approach to quality assurance and improvement plans at the top levels of an organization and linking them with business strategy.
- The process starts with the principles that quality and customer satisfaction are the center of an organization's future. It brings together all the key stakeholders.
- The strategic planning can be performed by any organization.
- It can be highly effective, allowing the organizations to do the right thing at the right time, every time.

Types of Strategic Quality Planning:

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

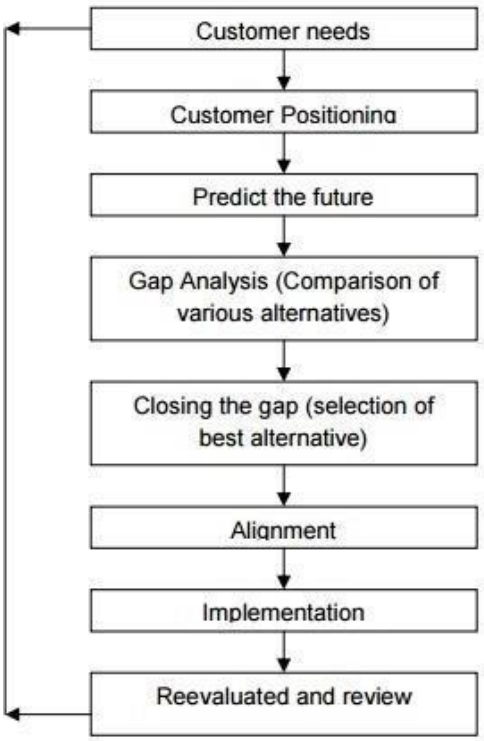
Goals of Strategic quality planning should,

- 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: In order to integrate quality with the strategic planning process, a systematic and sequential procedurehas to be adopted. There are seven basic steps to strategic process planning. They are,

Step 1: Customer Needs:-

The basic step is the identification of customers and their wants and needs. An organization must seek its customers' requirements, expectations and assess future trends before developing a strategic plan.



Step 2: Customer Position:-

The second step requires the planners to determine its positioning with regards to itscustomers. Various alternatives such as whether the organization should give up, maintain or expandmarket position should be considered. In order to become successful, the organization shouldconcentrate and consolidate its position in its areas of excellence.

Step 3: Predict the Future:-

Next, the planners must predict future conditions that will affect their product or service: To help predicting the future, the tools such as demographics, economic forecasts, and technical assessments or projections may be used.

Step 4: Gap Analysis:-

In this step, the planners must identify the gaps between the current state and the future state of the organization. This concept is also known as value stream mapping. For identifying the gaps, an analysis of the core values and concepts and other techniques may be used.

Step 5: Closing the Gaps:-

Now the planners should develop a specific plan to close the gaps. This process is also termed as Process improvement. By assessing the relative importance and relative difficulty of each gap, planners can close the gaps.

Step 6: Alignment:-

Now the revised plan should be aligned with the mission, vision, and core values and concepts of the organization. Organization should embrace quality as an essential ingredient in their vision, mission, and objectives.

Step 7: Implementation:-

In order to implement the action plan, resources must be allocated to collecting data, designing changes, and overcoming resistance to change. Also the planners should monitor and assess the result of the strategic plan.

Since quality is a continuous improvement process, one has to reassess and renew the strategic plans periodically. So it is a cyclic process.

Deming Philosophy:

- Dr. W. EdwardsDeming, an American engineer, statistician and management consultant. Deming is often considered the father of modernquality control.
- Dr. W. Edwards Deming's outlook on quality was simple but radical. He asserted that organizations that focused on improving quality would automatically reduce costs while those that focused on reducing cost would automatically reduce quality and actually increase costs as a result. He outlined his ideas simply in his theory of management, now known as The Deming Theory of Profound Knowledge.
- The 14 key points of his philosophy are evidence of Deming's thought leadership. Each of these points is covered in greater detail in his writings, particularly in his book Out of the Crisis.
- It's interesting to note that some of his points are now part of generally-accepted management theory.
- They are a Complete Management Philosophy in 14 Points
    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. a. Eliminate numerical quotas for the work force.
    b. Eliminate Management by objectives.
12. Remove Barriers that rob people of pride ofworkmanship.
13. Encourage Education and Self-improvement for everyone.
14. Take action to accomplish the transformation.

Barriers of Implementing TQM:

1. Lack of Management Commitment.
2. Inability to change Organizational culture.
3. Improper planning.
4. Lack of continuous training and education.
5. Incompatible organizational structure and isolated individuals and departments.
6. Ineffective measurement techniques and lack of access to data and results.
7. Paying inadequate attention to internal and external customers.
8. Inadequate use of empowerment and teamwork.
9. Failure to continually improve.
10. Competitive markets.
11. Lack of leadership for quality.
12. Resistance of the workforce.

Benefits of TQM:

Customer satisfaction oriented benefits:

1. Improvement in product quality
2. Improvement in product design
3. Improvement in production flow
4. Improvement in employee morale and quality consciousness
5. Improvement in product service
6. Improvement in market place acceptance

Economic improvement oriented benefits:

1. Reduction in operating costs
2. Reduction in operating losses
3. Reduction in field service costs
4. Reduction in liability exposure

Leadership:

"Leadership is lifting of man's visions to higher sights, the raising of man's performance to a higher standard, the building of man's personality beyond its normal limitations".

The success of quality management is to a greater extent is influenced by the quality of the leadership. Peter Drucker, the eminent management thinker and writer quotes: "Leadership is lifting of man's visions to higher sights, the raising of man's performance to a higher standard, the building of man's personality beyond its normal limitations".Leadership is the process of influencing others towards the accomplishment of goals. Leader triggers the will to do, show the direction and guide the group members towards the accomplishmentof the company's goal.

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.

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.

Functions of Leaders:

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

The 7 Habits of Highly Effective Leaders:

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.

Contributions of 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, Companywide quality control
- ISHIKAWA - Cause and Effect Diagram, Quality Circle concept
- CROSBY - "Quality is Free", Conformance to requirements
- TAGUCHI - Loss Function concept, Design of Experiments

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Unit – 3: TQM Principles

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, CustomerRetention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – JuranTrilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating,Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure - Casestudies.

Customer Satisfaction:

- The most important asset of any organization is its customers.
- Satisfied customers pay their bills promptly which greatly improves cash flow – the lifeblood of any organization.
- Customer's experience of a product or a service is multifaceted and so hard to Determine.
- It needs to be measured individually to get an accurate total picture of customer satisfaction.
- Customer satisfaction should not be viewed in a vacuum.
    - For example, a customer may be satisfied with a product or service and therefore rate the product orservice highly in a survey and yetsame customer may buy anotherproduct.
- Similarly customer's views about a product or service are useless if customer's views about competitor's products are not understood.
- The value customer's places on the product compared to another may be a better indication of customer loyalty.

Who are the Customers?

The customers are:

1. The most important people in the business.
2. Not dependent on the organization. The organization depends on them.
3. Not an interruption to work but are the purpose of it.
4. Doing a favour when they seek business and not vice-versa.
5. A part of business, not outsiders.
6. Life blood of the business.
7. People who come with their needs and jobs.
8. Deserve the most courteous and attentive treatment.

Why to do Customer Focus:

Customer is the King. "Quality what the customer wants" It emphasis on the customer. Customer satisfaction must be the primary goal of any organization, therefore it is essential that every employee in the organization understands the importance of the customer. A satisfied customer will led to increased profits.

Types of Customers:

Customers are two types. They are:

1. Internal customers
2. External customers.

1. **Internal Customers:**

- The customers inside the company are called internal customers.
- As there is a flow of work, product and service in the organization, each department is dependent on the other. In this, each department or each quality management unit is considered as a customer by the previous department and as a supplier for the next department. Similarly every person in a process is considered as a customer of the preceding operation. This explains the concept of internal customer.

2. **External Customers**

- The customers outside the company are called external customers.

- In other words, an external customer is the one:
  - who uses the product or service ;
  - who purchases the product or service; or
  - Who influences the sale of the product or service?

Customer satisfaction is not an objective but a feeling or attitude. Since it is subjective it is not easy to measure. There are so many facets to a customer experience with a product and service that need to be measured individually to get the accurate picture of 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.

Customer Perception of Quality:

As per 'American Society for Quality (ASQ)' survey on end user perceptions of important factors that influenced purchases on the following factors about a product quality and service.

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

Customer complaints:

Customer complaint is an expression of dissatisfaction with a product/service, either orally or in writing from an internal or external customer. A customer may have a genuine cause for complaint, although some complaints may be made as a result of a misunderstanding or an unreasonable expectation of a product or services.

Customer Satisfaction analysis helps the organization in the following ways:

1. A totally satisfied customer contributes to revenue of the company.
2. A totally dissatisfied customer decrease revenue.

Using Customer Complaints:

Actions an organization can take to handle complaints are as follows;

- Investigate customer's experiences by actively getting feedback, both positive and negative, and then acting on it promptly.
- Develop procedures for complaint resolution that include empowering front – line personnel.
- Analyze complaints, but understand that complaints do not always fit into neat categories.
- Work to identify process and material variations and then eliminate the root cause. "More inspection" is not corrective action.
- When a survey response is received, a senior manager should contact the customer and strive to resolve the concern.
- Establish customer satisfaction measures and constantly monitor them.
- Communicate complaint information, as well as the results of all investigations and solutions, to all people in the organization.
- Provide a monthly complaint report to the quality council for their evaluation and, if needed, the assignment of process improvement teams.
- Identify customers' expectations beforehand rather than afterward through complaint analysis.

Customer Feedback: Customer feedback is required for the following reasons.

1. To discover customer dissatisfaction
2. To identify the customer needs
3. To discover relative priories of quality

4. To compare performance with competition
5. To determine opportunities for improvement.

Tools of Customer Complaints:

a. Comment card
b. Customer Questionnaire
c. Focus Groups
d. Toll Free telephone
e. Customer Visit
f. Report Card
g. Internet & Computers
h. Employee Feedback.
i. Mass customization

Service Quality – Customer Service:

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;

a) Organization:

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

b) Customer Care:

1. Meet the customer's expectations.
2. Get the customer's point of view.
3. Deliver what is promised.
4. Make the customer feel valued.
5. Respond to all complaints.
6. Over – respond to the customer.
7. Provide a clean and comfortable customer reception area.

c) Communication:

1. Optimize the trade – off between time and personal attention.
2. Minimize the number of contact points.
3. Provide pleasant, knowledgeable and enthusiastic employees.
4. Write document in customer friendly language.

d) Front-Line people:

1. Hire people who like people.
2. Challenge them to develop better methods.
3. Give them the authority to solve problems.
4. Serve them as internal customers.
5. Be sure they are adequately trained.
6. Recognize and reward performance.

e) Leadership:

1. Lead by example.
2. Listen to the front-line people.
3. Strive for continuous process improvement.

Seven Service Quality Gaps:

1. *Knowledge gap:* Learn what customers expect.
2. *Standards gap :* Specify SQ standards that reflect expectations.
3. *Delivery gap:* Ensure service performance meets standards.
4. *Internal Communications gap:* Ensure that communications promises are realistic.
5. *Perceptions gap:* Educate customers to see reality of service quality delivered.
6. *Interpretation gap:* Pretest communications to make sure message is clear and unambiguous.
7. *Service gap:* Close gaps 1 to 6 to meet customer expectations consistently.

Customer Retention:

It means "retaining the customer" to support the business. It is more powerful and effective than customer satisfaction. For Customer Retention, we need to have both "Customer satisfaction & Customer loyalty".

The following steps are important for customer retention.

1. Top management commitment to the customer satisfaction.
2. Identify and understand the customers what they like and dislike about the organization.
3. Develop standards of quality service and performance.
4. Recruit, train and reward good staff.
5. Always stay in touch with customer.
6. Work towards continuous improvement of customer service and customer retention.
7. Reward service accomplishments by the front-line staff.
8. Customer Retention moves customer satisfaction to the next level by determining what is truly important to the customers.
9. Customer satisfaction is the connection between customer satisfaction and bottom line.

Employee Involvement:

- Employee involvement is one approach to improve quality and productivity.
- It is a means to better meet the organization's goals for quality and productivity.
- It is a participative process that uses the input of employees to increase their commitment to the organizations success.
- The direct participation of staff to help an organization fulfill its mission and meet its objectives by applying their own ideas, expertise and efforts towards solving problems and making decisions.
- Regular participation of employee in deciding how work is done, making suggestion for improvement, goal setting, planning and monitoring of their performance.
- Improved organizational decision making capability.
- Improved attitude regarding work.
- Substantially improved employee wellbeing.
- Reduced costs through elimination of waste and reduced product cycle times.
- Empowerment, job satisfaction, creativity, commitment and motivation, as well as intent to stay.
- Increased employee productivity across industries.

Motivation:

The forces within the individual thataccount for the level, direction, and persistence ofeffort expended at work.

- Reward - a work outcome of positive value to theIndividual.
- Extrinsic rewards - valued outcomes given tosomeone by another person.
- Intrinsic rewards - valued outcomes that occurnaturally as a person works on a task.

Concept of Motivation:

a. Scott defines, "Motivation means a process of stimulating people to accomplish desired goals."

b. Edwin B. Flippo defines, “Motivation is the process of attempting to influence others to do your will through the possibility of reward.”
c. In simple words, motivation is the process of inducing people inner drives and action towards certain goals and committing his energies to achieve these goals.

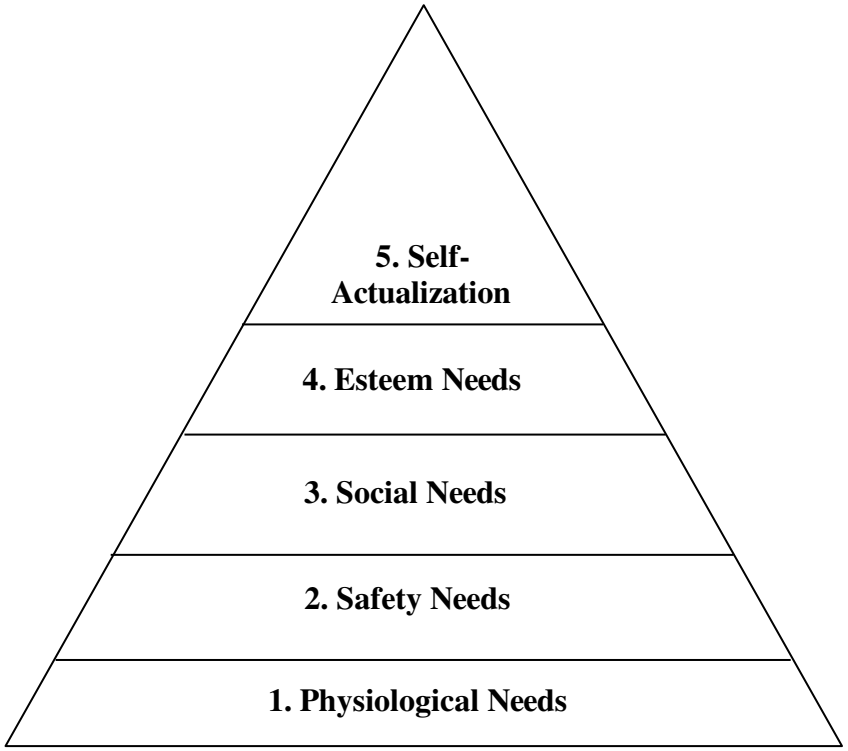
Importance of Motivation:

a. Motivation improves employee involvement.
b. Motivation promotes job satisfaction and thus reduces absenteeism and turnover.
c. Motivation helps in securing a high level of performance and hence enhances efficiency and productivity.
d. Motivation creates a congenial working atmosphere in the organization and thus promotes interpersonal cooperation.

Theories of Motivation:

Though there are many theories of motivation, the Maslow’s hierarchy of needs theory and Herzberg’s two factor theories are more important from our subject of view.

1) Maslow’s Hierarchy of Needs:



Maslow has set up a hierarchy of five levels of basic needs. Beyond these needs, higher levels of needs exist. These include needs for understanding, esthetic appreciation and purely spiritual needs. In the levels of the five basic needs, the person does not feel the second need until the demands of the first have been satisfiedor the third until the second has been satisfied, and so on.

Maslow's basic needs are as follows:

1. Physiological Needs (or) Basic Needs:

These are biological needs. They consist of needs for oxygen, food, water,and a relatively constant body temperature. They are the strongest needs because if a person were deprived of all needs, the physiological ones would come first in the person's search for satisfaction.

2. Safety Needs (or) Security Needs:

When all physiological needs are satisfied and are no longer controlling thoughts and behaviors, the needs for security can become active. Adults have little awareness of their security

needs except in times of emergency or periods of disorganization in the social structure (such as widespread rioting). Children often display the signs of insecurity and the need to be safe.

3. Social Needs (or) Needs of Love, Affection and Belongingness:

When the needs for safety and for physiological well-being are satisfied, the next class of needs for love, affection and belongingness can emerge. Maslow states that people seek to overcome feelings of loneliness and alienation. This involves both giving and receiving love, affection and the sense of belonging.

4. Needs for Esteem:

When the first three classes of needs are satisfied, the needs for esteem canbecome dominant. These involve needs for both self-esteem and for the esteem aperson gets from others. Humans have a need for a stable, firmly based, high levelof self-respect, and respect from others. When these needs are satisfied, the personfeels self-confident and valuable as a person in the world. When these needs arefrustrated, the person feels inferior, weak, helpless and worthless.

5. Needs for Self-Actualization:

All of the foregoing needs are satisfied, then and only then are the needs for self-actualization activated. Maslow describes self-actualization as a person's need to be and do that which the person was "born to do." "A musician must make music, an artist must paint, and a poet must write." These needs make themselves felt in signs of restlessness. The person feels on edge, tense, lacking something, in short, restless. If a person is hungry, unsafe, not loved or accepted, or lacking self-esteem, it is very easy to know what the person is restless about. It is not always clear what a person wants when there is a need for self-actualization.

The hierarchic theory is often represented as a pyramid, with the larger, lower levels representing the lower needs, and the upper point representing the need for self-actualization. Maslow believes that the only reason that people would not move well in direction of self-actualization is because of hindrances placed in their way by society. He states that education is one of these hindrances.

2) Herzberg's Two Factor Theory:

This theory is also called motivation-hygiene theory.This theory is based on two factors:

1. Motivation factors or satisfiers, and
2. Hygiene factors or dissatisfiers.

1. Motivational factors:

1. Achievement
2. Recognition
3. Work itself
4. Responsibility
5. Advancement and growth

2. Hygiene factors:

1. Supervisors
2. Working conditions
3. Interpersonal relationship
4. Pay and security
5. Company policy and administration

According to Herzberg, maintenance or hygiene factors are necessary tomaintain a reasonable level of satisfaction among employees. These factors do notprovide satisfaction to the employees but their absence will dissatisfy them.Therefore these factors are called dissatisfiers.

On the other hand, motivational factors create satisfaction to the workers at the time of presence but their absence does not cause dissatisfaction. It can be noted that Herzberg's dissatisfiers are roughly equivalent to Maslow's lower levels, and the motivators are similar to the Maslow's upper levels.

Thus the knowledge of motivation is required for any organization to understand the utilization of employee involvement.

Achieving a Motivated Work Force:

The building of a motivated work force is for the most part an in-direct 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

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

Empowerment:

Concept of Empowerment:

Empowerment is the opposite of helplessness or dependency. An empowered person does notfeel incapable of doing the things that he considers important for the well-being of his organization.There are no constraints that he perceives to be externally imposed. In other words, being empoweredimplies that the person acts from a state of autonomy, doing what he knows is the right thing to dounder a given set of circumstances.

It is understood that empowerment is dependent upon two factors:

i. An individual's personal choices; and
ii. The organization climate that can either encourage dependency or foster autonomy.

Empowerment Defined:

1. According to Webster's Dictionary, the verb - empower means 'to give the means, ability or authority'. Therefore empowerment in work setting involves giving people the means, abilityand authority to do something they have not done before.
2. An operation definition of empowerment: "Empowerment is an environment in which peoplehave the ability, the confidence, and the commitment to take the responsibility and ownership to improve the process and initiate the necessary steps to satisfy customer requirements withinwell-defined boundaries in order to achieve organizational values and goals."

The two steps to empowerment are;

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

Three dimensions of empowerment are

1. Capability
2. Alignment and
3. Trust

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.

Characteristics of Empowered Employees:

1. They feel responsible for their own task.
2. They are given a free hand in their work.
3. They balance their own goals with those of the organization.
4. They are well trained, equipped, creative, and customer oriented.
5. They are critical, have self-esteem, and are motivated.
6. They are challenged and encouraged.
7. They monitor and improve their work continuously.
8. They find new goals and change challenges.

Therefore, it is important to empower individuals and teams at all levels of the organization toachieve the continuous improvement process.

Team:

- 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:

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.

Need for Teamwork:

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:** In order to have effective liaison with the quality council, there should be a sponsor. The sponsor is a person from the quality council; he is to provide support to the organization.
2. **Team Charter:** A team charter is a document that defines the team's mission, boundaries, the background of the problem, the team's authority and duties, and resources. It also identifies the members and their assigned roles – leader, recorder, time keeper and facilitator.
3. **Team Composition:** The size of the team should not exceed ten members except in the case of natural work teams or self-directed teams. Teams should be diverse by having members with different skills, perspective and potential. Wherever needed, the internal and external customers and suppliers should be included as a team member.
4. **Training:** The team members should be trained in the problem-solving techniques, team dynamics and communication skills.
5. **Ground Rules:** The team should have separate rules of operation and conduct. Ground rules should be discussed with the members, whenever needed it should be reviewed and revised.
6. **Clear Objectives:** The objective of the team should be stated clearly. Without the clear objective, the team functions are not to be effective.
7. **Accountability:** The team performance is accountable. Periodic status report of the team should be given to the quality council. The team should review its performance to determine possible team process weaknesses and makeimprovements.
8. **Well-defined Decision Procedures:** The decision should be made clearly at theright time by the team.
9. **Resources:** The adequate information should be given to the team whereverneeded. The team cannot be expected to perform successfully without thenecessary tools.
10. **Trust:** Management must trust the team to perform the task effectively. Theremust also be trust among the members and a belief in each other.
11. **Effective Problem-Solving:** Problem-solving methods are used to make theeffective decision.
12. **Open Communication:** Open communication should be encouraged i.e.,everyone feels free to speak in the team whatever they are thinking, without anyinterruptions.
13. **Appropriate Leadership:** Leadership is important in all the team. Leader is aperson who leads the team, motivates the team and guides the team in a properdirection.
14. **Balanced Participation:** Everyone in a team should be involved in the team'sactivities by voicing their opinions, lending their knowledge and encouraging othermembers to take part.
15. **Cohesiveness:** Members should be comfortable working with each other andact as a single unit, not as individuals or subgroups.

Elements of Effective Team Work:

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

Stages of Team Development:

Each term takes some time to start functioning effectively towards problem solving. Each team goes through six distinct stages in its development. These are farming, storming, norming, performing maintenance and evaluating.

1. **Farming stage:** When a team is created, it consists of group of individuals and team work does not exist at this stage. Team's purpose, members' roles, acceptance of roles, authority and process of functioning are learnt in the formation process.
2. **Storming stage:** Initial agreements and role allocations are challenged and reestablished at this stage of team development. At this stage, hostilities and personal needs often emerge which may be resolved.
3. **Norming stage:** During norming stage of team development, formal and informal relationships get established among team members. Openness and cooperation have been observed as signs of team's behavior.
4. **Performing stage:** At this stage, the team starts operating in successful manner. Trust, openness, healthy conflict and decisiveness of a group's performance can be reached at this stage.
5. **Maintenance stage:** Functioning of team does not deteriorate overtime. At thisstage, the performance of teamwork at the earlier stage will be maintained forsome period of time.
6. **Evaluating stage:** At this stage, team's performance is to be evaluated in viewof the set targets. Both self-evaluation and management-based evaluation form thisstage of team development.

Team Member Roles:

Team Leader

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

Facilitator

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

Recorder

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

Timekeeper

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

Team Member

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

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:

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

Continuous Process Improvement:

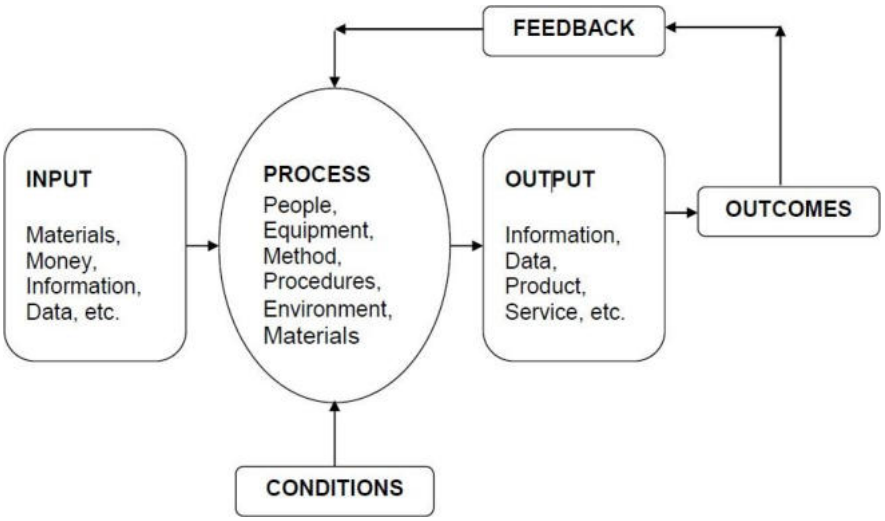
Continuous process improvement is designed to utilize the resources of the organization to achieve a quality-driven culture.

Improvement is made by;

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

Process:

Process refers to business and production activities of an organization.



Input / Output Process Model:

There are five basic ways for improvement.

1. Reduce resources.
2. Reduce errors.
3. Meet or exceed expectations of downstream customers.
4. Make the process safer.
5. Make the process more satisfying to the person doing it.

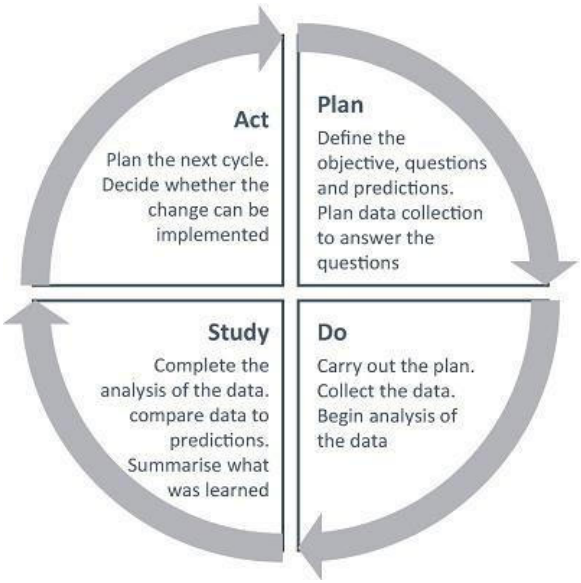
The Juran Trilogy:

J.M. Juran developed the idea of trilogy. Trilogy shows how an organization can improve every aspect by better understanding of the relationship between processes that plan, control and improve quality as well as business results.

1. **Planning:**
   - Determine internal & external customers.
   - Their needs are discovered.
   - Develop product / service features.
   - Develop the processes able to produce the product / service features.
   - Transfer plans to operations.
2. **Control:** Control is used by operating forces to help meet the product, process and service requirements. It consists of the following steps
   1. Determine items to be controlled.
   2. Set goals for the controls.
   3. Measure actual performance.
   4. Compare actual performance to goals.
   5. Act on the difference.
3. **Improvement:** Aims to attain levels of performance that are higher than current levels. It consists of the following steps
   - Establishment of quality council.
   - Identify the improvement projects.
   - Establish the project teams with a project leader.
   - Provide the team with the resources.

PDSA Cycle:

The basic Plan – Do – Study – Act cycle was originally developed by Walter A. Shewart. But it was popularized by Edward Deming and that's why it is often called the ***Deming Cycle*** or ***DemingWheel.*** It is an effective continuous improvement technique.



What is PDSA Cycle?

- PDSA stands for Plan, Do, Study, and Act. It is a model for testing ideas that you think may create improvement.
- It is an extremely practical, common sense based approach that is easy to understand.
- It can be used to test ideas for improvement quickly and easily based on existing ideas, research, feedback, theory, review, audit, etc.
- It encourages starting with small changes, which can build into large improvements in the service through successive quick cycles of change.
- Illustrates the PDSA cycle.

Phases of PDSA Cycle

The four phases of PDSA cycle and their descriptions are presented in Table.

Phases	Description
1. Plan	• Define the problem • Analyze the causes and draft an action plan for solving the problem. • Determine the quality objectives and the critical factors. • Define the performance indicators. • Collect and analyze the necessary process data. • Generate possible solutions • Select the most feasible solution; and work it out.
2. Do	• First, implement the plan on a limited scale or conduct an experiment to test the proposed improvement. Collection data is hereby essential. • Train all involved employees in the use of quality improvement methods and techniques. • Describe the process which is considered for improvement and form project teams to lead the process.
3. Study	• Evaluate the trial project with the performance indicators. • Verify whether the improvement has been successful or not.
4. Act	• Act to implement proven improvements. The choices are: introduce the plan, adjust or reject it. • The improvements are documented in standard procedures so all employees are well-informed on how to handle in future. • Usually, the cycle will be repeated under the different circumstances and conditions to test how consistent the results are?

Benefits of the PDSA Cycle:

The benefits of the PDSA cycle can be experienced in the following areas:

- Daily routine management – for the individual and / or the team.
- Problem-solving process.
- Project management
- Continuous development
- Vendor development
- Human resources development
- New product development
- Process trials

Kaizen:

Kaizen is a Japanese word where KAI = Change, ZEN = Good, 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.

Kaizen was originally introduced tothe West by Masaaki Imai in his book Kaizen: The Key to Japan's Competitive Success in 1986.

Kaizen is continuous improvement that is based on certain guiding principles:

1. Good processes bring good results
2. Go see for yourself to grasp the current situation
3. Speak with data, manage by facts
4. Take action to contain and correct root causes of problems
5. Work as a team
6. Kaizen is everybody's business

Kaizen Wheel:

The Kaizen improvement focuses on the use of:

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

Supplier Partnership:

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

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

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

Customer – Supplier Relations:

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

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

Partnering:

Partneringis a defined as a continuing relationship, between a buying firm and supplying firm, involving a commitment over an extended time period, an exchange of information, andacknowledgement of the risks and rewards of the relationship. The relationship between customer andsupplier should be based upon trust, dedication to common goals and objectives, and anunderstanding of each party's expectations and values.

The benefits of partnering are

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

Key Elements to Partnering:

The three important elements to achieve the customer / supplier partnering relationship are

1. Long-term commitment:Long-term commitment provides both customer and supplier the muchneeded environment to achieve the planned objectives. Because to set up and solve the problem ofcontinuous improvement, both parties may require the sufficient time.
2. Trust:Mutual trust between two parties forms the basis for a strong working relationship. Trustenables the partners to effectively combine their resources and knowledge. It results in a 'win-win'situation for both partners.
3. Shared Vision:Both the customers and suppliers have the common goal i.e., to satisfy the enduser. In order to ensure this goal, both particles should share and understand their goals andobjectives.

Sourcing:

The three types of sourcing are:

1. Sole Sourcing:Sole sourcing is the use of only one supplier for the organization. The organization does nothave any choice. It is forced to use only one supplier.This forced situation is because of the following factors: patents, technical specifications, rawmaterial location, only one organization producing the item, etc.…
2. Multiple Sourcing:Multiple sourcing is the use of two or more suppliers for an item.The basic concept of multiple sourcing is that competition will result in better quality,lower costs, and better service. (The selection of suppliers from various alternatives is based on theirperformance in terms of prices, quality and delivery.
3. Single Sourcing:Single sourcing is the use of one supplier for an item when several sources are available. Itleads to long-term partnering relationship.

Supplier Selection:

The suppliers should be selected with the following ten conditions

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

10. The supplier should be renowned for customer satisfaction.

Supplier Certification:

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

The Eight criteria for supplier certification are

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

Supplier Rating:

Supplier Rating is done

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

Relationship Development:

For establishment of supplier relationship, the following are necessary.

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

For relationship development, the following are necessary.

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

Performance Measures:

Performance measures are required for the managers for managing an organization perfectly. Performance measures are used to achieve the following objectives.

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

What Should Be Measured?

Human resources

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

Customers

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

Production

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 for Performance measuring:

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

======XXX======

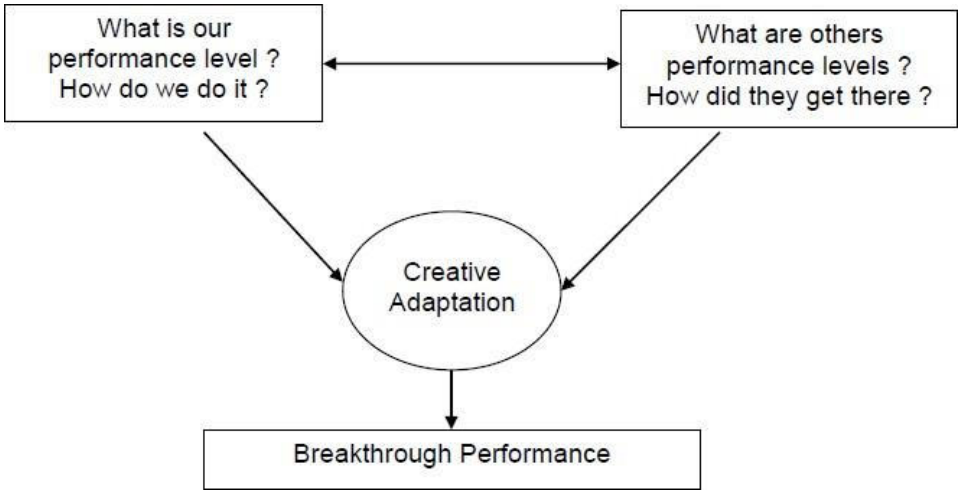
Unit – 4: TQM Tools

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of SixSigma, New Seven management tools, Case studies.

Benchmarking:

Benchmarking is a systematic method by which organizations can measure themselves against the best industry practices. Benchmarking is a systematic search for the best practices, innovative ideas, and highly effective operating procedures.

Bench Marking Concept



Reasons to Benchmark:

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

Process of Benchmarking:

The following six steps contain the core techniques of Benchmarking,

1. Decide what to benchmark
   - Benchmarking can be applied to any business or production process.
   - The strategy is usually expressed in terms of mission and vision statements.
   - Best to begin with the mission and critical factors
   - Choosing the scope of the Benchmarking study
   - Pareto analysis – what process to investigate
   - Cause and Effect diagram – for tracing outputs back.
2. Understand current performance
   - Understand and document the current process
   - Those working in the process are the most capable of identifying and correcting problems
   - While documenting, it is important to quantify
   - Care should be taken during accounting information.
3. Plan
   - A benchmarking team should be chosen
   - Organizations to serve as the benchmark need to be identified
   - Time frameshould be agreed upon for each of the benchmarking tasks

4. Study Others
    - Benchmarking studies look for two types of information
        - How best the processes are practiced
        - Measurable results of these practices
    - Three techniques for conducting the research are
        - Questionnaires
        - Site visits
        - Focus groups
5. Learn from the data

Answering a series of questions like

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

6. Using the findings

The objective is to close the gap. For this

- Findings must be communicated to the people within the organization
- Action plans must be developed to implement new processes
- Groups that must agree on the change
- Process owners
- Upper management

Types of benchmarking:

There are three types of benchmarking

1. Internal
2. Competitive
3. Process

Steps for the development and execution of action plans are

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

Pitfalls and Criticisms of Benchmarking:

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

Quality Function Deployment:

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

QFD Team:

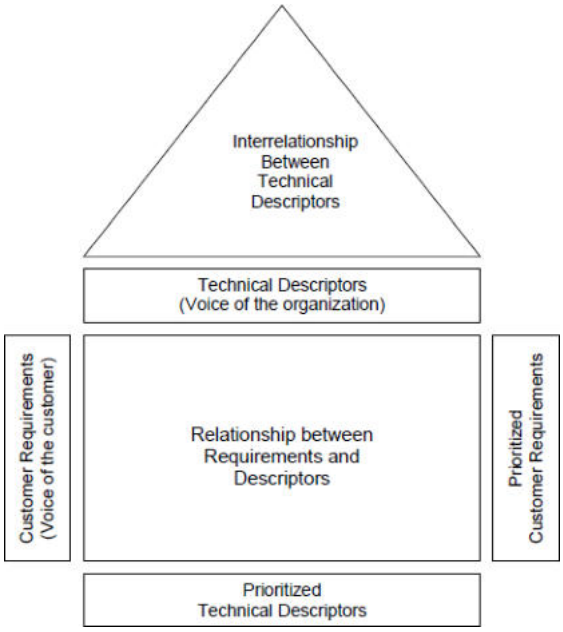
There are two types of teams namely

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

Benefits of QFD:

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

House of Quality:



The Steps in Building a House of Quality are:

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

Taguchi's Quality Loss Function:

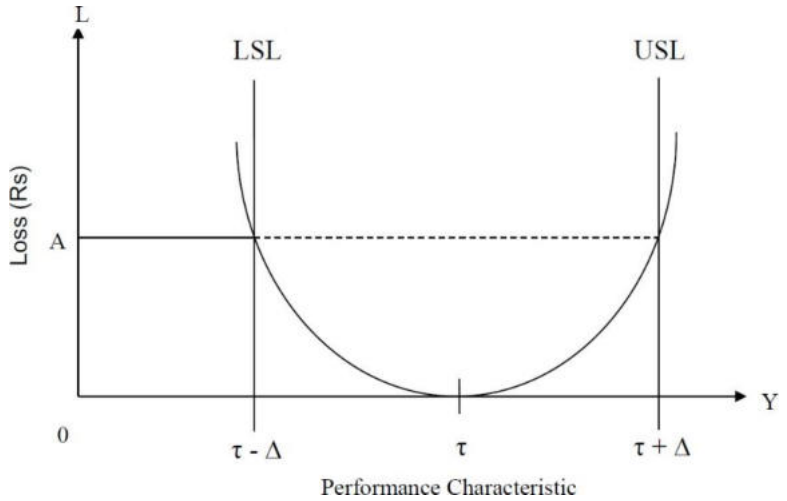
Taguchi's Quality Loss Function concept combines cost, target and variation in one metric with specifications being of secondary importance. Taguchi has defined quality as the loss imparted to society from the time a product is shipped. Societal losses include failure to meet customer requirements, failure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

Customers Perceive Quality as Meeting the Target Rather Than Just Meeting theSpecifications

There are three common quality loss functions

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

1. 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.



Performance Characteristic

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

At τ, the loss is Rs. 0.

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

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

Where,

L = cost incurred as quality deviates from the target.

y = Performance characteristic

τ = target

k = Quality loss coefficient.

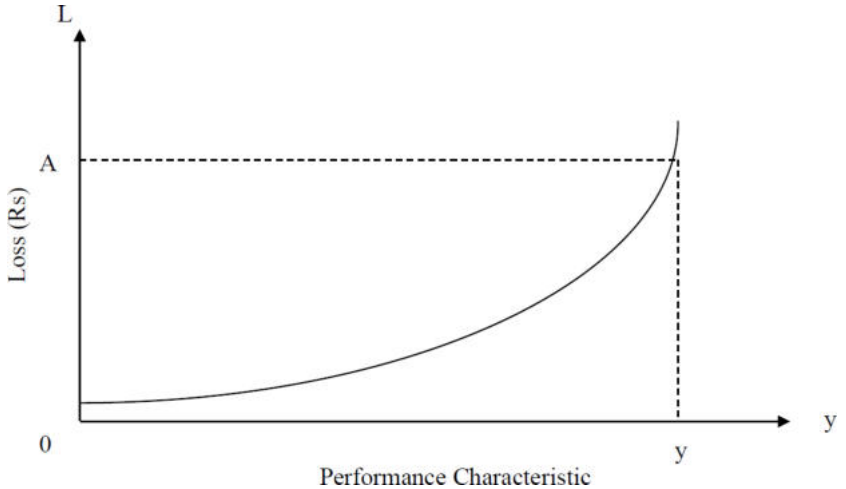
The loss coefficient is determined by setting $\Delta = (y - \tau)$, the deviation from the target. When Δ is the USL (or) LSL, the loss to the customer of repairing (or) discarding the product is Rs. A.

Thus,

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

2. Smaller – The – Better:

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



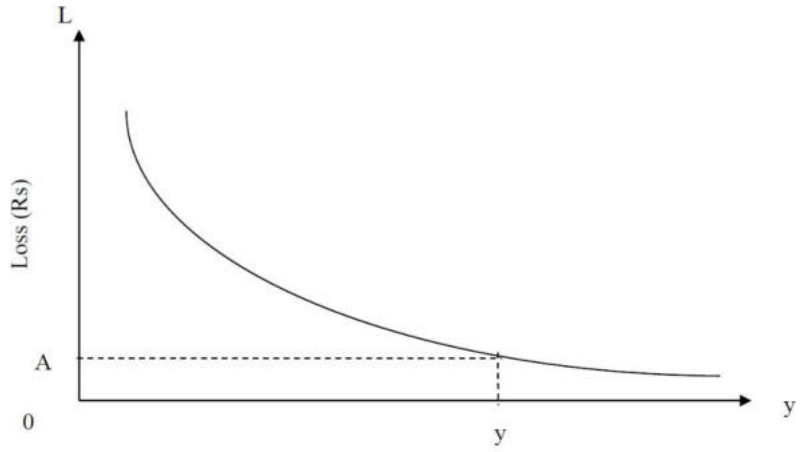
Performance Characteristic

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.

3. Larger – The – Better:

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



Performance Characteristic

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

Total Productive Maintenance (TPM)

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

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

Objectives of TPM:

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

TPM Philosophy – Concept of TPM:

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

TPM has the following steps:

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

Loss measurements to identify improvement needs are

- Down time losses
- Reduced speed losses

- Poor quality losses

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

Failure Mode and Effects Analysis:

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

Failure mode and effect analysis also known as risk analysis is a preventive measure to systematically display the causes, effects, and possible actions regarding observed failures.

Objectives of FEMA:

1. The objective of FEMA is to anticipate failures and prevent them from occurring. FEMA prioritizes failures and attempts to eliminate their causes.
2. FEMA is an engineering technique is used to define, identify and eliminate known and or potential failures, problems, errors which occur in the system, design, process and service before they reach the customer.
3. FEMA is a before the event action and is done when existing systems products processes are changed or redesigned.
4. FEMA is a never ending process improvement tool.

Types of FMEA are

1. System FEMA
2. Design FEMA
3. Process FEMA
4. Service FEMA
5. Equipment FEMA
6. Maintenance FEMA
7. Concept FEMA
8. Environmental FEMA

Benefits of FMEA:

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

Stages of FEMA:

1. Specifying possibilities
   a. functions
   b. possible failure modes
   c. root causes
   d. effects
   e. detection/prevention
2. Quantifying risk
   a. probability of cause
   b. severity of effect
   c. effectiveness of control to prevent cause.
   d. risk priority number.

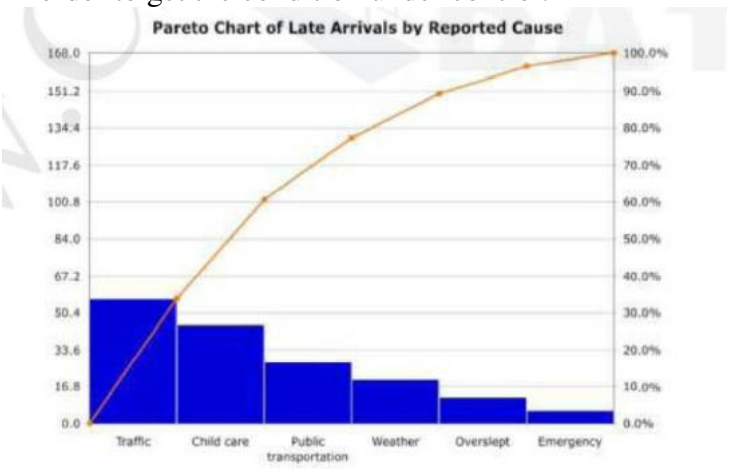
3. Correcting high risk causes
   a. prioritizing work
   b. detailing action
   c. assigning action responsibility
   d. Checks points on completion.
4. Re-evaluation of risk
5. Recalculation of risk priority number

The Seven Tools of Quality:

1. Pareto diagram 2. Flow diagram 3. Cause and effect diagram
4. Check sheets 5. Histogram 6. Control charts 7. Scatter diagram

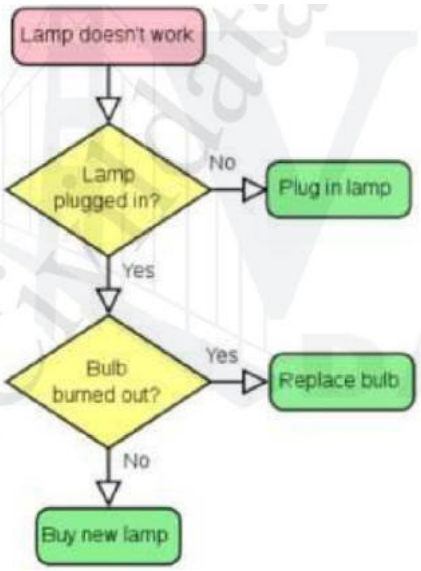
1. Pareto diagram:

Pareto charts are used for identifying a set of priorities. You can chart any number of issues/variables related to a specific concern and record the number of occurrences. This way you can figure out the parameters that have the highest impact on the specific concern. This helps you to work on the propriety issues in order to get the condition under control.



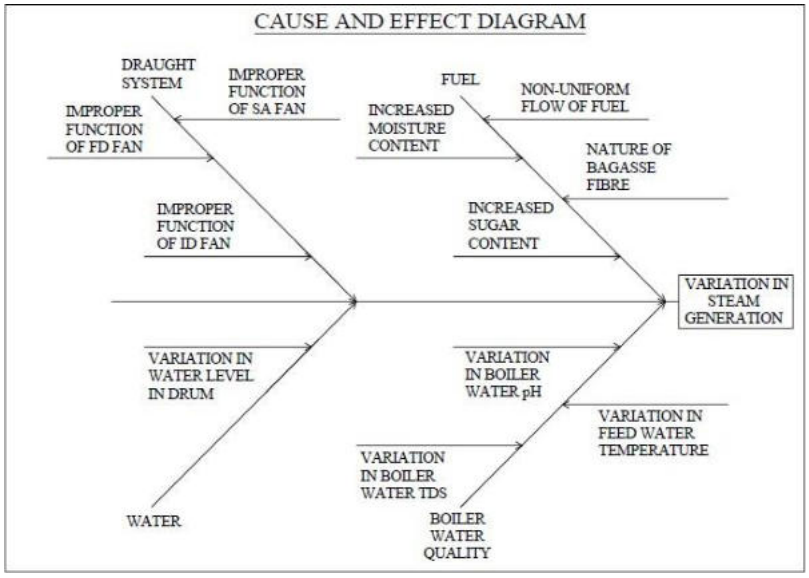
2. Flow Diagram:

This is one of the basic quality tools that can be used for analyzing a sequence of events. The tool maps out a sequence of events that take place sequentially or in parallel. The flow chart can be used to understand a complex process in order to find the relationships and dependencies between events. You can also get a brief idea about the critical path of the process and the events involved in the critical path. Flow charts can be used for any field and to illustrate events involving processes of any complexity. There is specific software tools developed for drawing flow charts, such as MS Vision.



3. Cause and effect diagram

Cause and effect diagrams (Ishikawa Diagram) are used for understanding organizational or business problem causes. Organizations face problems everyday and it is required to understand the causes of these problems in order to solve them effectively. Cause and effect diagrams exercise is usually teamwork. A brainstorming session is required in order to come up with an effective cause and effect diagram. All the main components of a problem area are listed and possible causes from each area is listed. Then, most likely causes of the problems are identified to carry out further analysis.



4. Check sheets:

A check sheet can be introduced as the most basic tool for quality. A check sheet is basically used for gathering and organizing data. When this is done with the help of software packages such as Microsoft Excel, you can derive further analysis graphs and automate through macros available. Therefore, it is always a good idea to use a software check sheet for information gathering and organizing needs. One can always use a paper-based check sheet when the information gathered is only used for backup or storing purposes other than further processing.

Types of check sheet

1. Process distribution check sheets.
2. Defective item check sheets.
3. Defect location check sheet.
4. Defect factor check sheet.

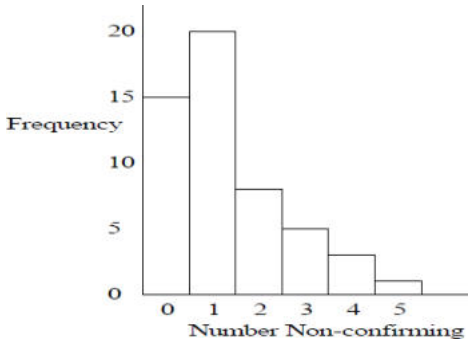
CHECK SHEET

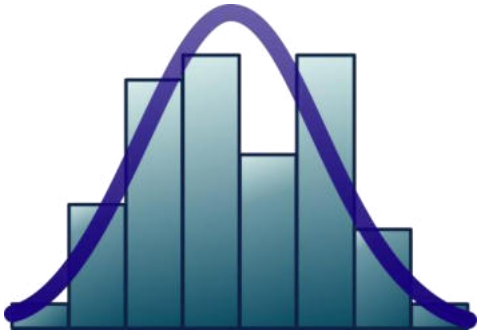
Product : Bicycle

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

5. Histogram:

Histogram is used for illustrating the frequency and the extent in the context of two variables. Histogram is a chart with columns. This represents the distribution by mean. If the histogram is normal, the graph takes the shape of a bell curve. If it is not normal, it may take different shapes based on the condition of the distribution. Histogram can be used to measure something against another thing. Always, it should be two variables. Consider the following example: The following histogram shows morning attendance of a class. The X-axis is the number of students and the Y-axis the time of the day.

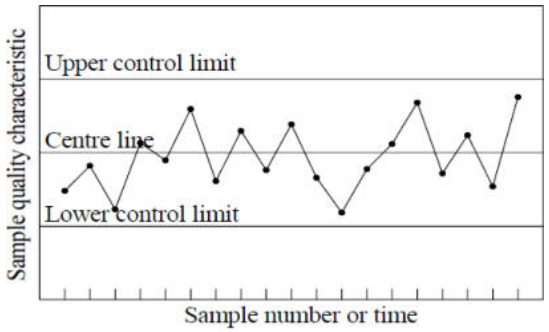




6. Control charts:

Control chart is the best tool for monitoring the performance of a process. These types of charts can be used for monitoring any processes related to function of the organization. These charts allow you to identify the following conditions related to the process that has been monitored.

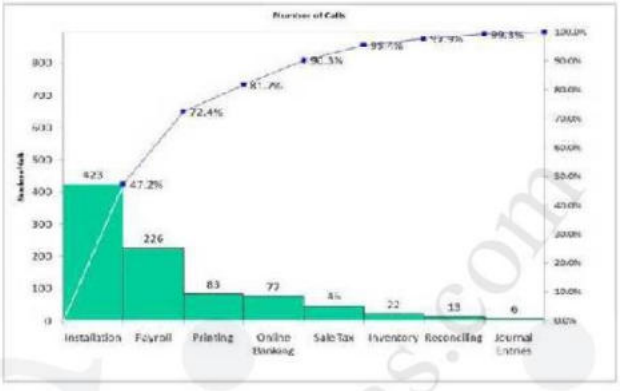
- Stability of the process
- Predictability of the process
- Identification of common cause of variation
- Special conditions where the monitoring party needs to react



A typical control chart

7. Scatter Diagram:

When it comes to the values of two variables, scatter diagrams are the best way to present. Scatter diagrams present the relationship between two variables and illustrate the results on a Cartesian plane. Then, further analysis, such as trend analysis can be performed on the values. In these diagrams, one variable denotes one axis and another variable denotes the other axis.



Process Capability:

A process capability study uses data from an initial run of parts to predict whether a manufacturing process can repeatedly produce parts that meet specifications.

There are 6 different 'measures' that can be used to define how capable a process is of meeting customer requirements. These measures are all related to each other and can be mathematically converted from one measure to another measure.

Short and Long Term Capability:

- Data and the six measures of process capability can represent,
    - Short Term Capability
    - Long Term Capability
- The differences between short and long term capabilities will be covered after an explanation of the different measures of process capability.

Six Sigma:

- Six sigma stands for six standard deviation from mean (sigma is the Greek letter used to represent standard deviation in statistics).
- Six sigma, similar to Zero Defect (ZD), is a philosophical benchmark or standard of excellence proposed by Philip Crosby.
- Six sigma methodology provides the techniques and tools to improve the capability and reduce the defects in any process.
- It was started by Motorola in 1987, in its manufacturing division.
- Six sigma strives for perfection. It allows for only 3.4 defects per million opportunities (or 99.999666 percent accuracy). Here a defect can be anything from a faulty party to an incorrect customer bill
- Six sigma improves the process performance, decrease variation and maintains consistent quality of the process output. This leads to defect reduction and improvements in profits, product quality and customer satisfaction.

The Six Sigma Methodology:

The two main Six Sigma methodologies are DMAIC and DMADV. Each has its own set of recommended procedures to be implemented for business transformation.

DMAIC: DMAIC is a data-driven method used to improve existing products or services for better customer satisfaction.

It is the acronym for the five phases:

D – Define,
M – Measure,
A – Analyse,
I – Improve,
C – Control.

DMAIC is applied in the manufacturing of a product or delivery of a service.

DMADV: DMADV is a part of the Design for Six Sigma (DFSS) process used to design or re-design different processes of product manufacturing or service delivery.

The five phases of DMADV are:

D – Define,
M – Measure,
A – Analyse,
D – Design,
V – Validate.

DMADV is employed when existing processes do not meet customer conditions, even after optimization, or when it is required to develop new methods. It is executed by Six Sigma Green Belts and Six Sigma Black Belts and under the supervision of Six Sigma Master Black Belts.

New Seven Management Tools:

These tools, unlike SPC tools are qualitative tools. Most of these tools do not involve the use of numerical data. . Like all management tools these are judgmental tools. Managers are often called upon to make decisions based on their judgement with help of incomplete information or on subjective issues. Team work and techniques like brainstorming are very essential for best results with such tools.

The seven tools we will see are:

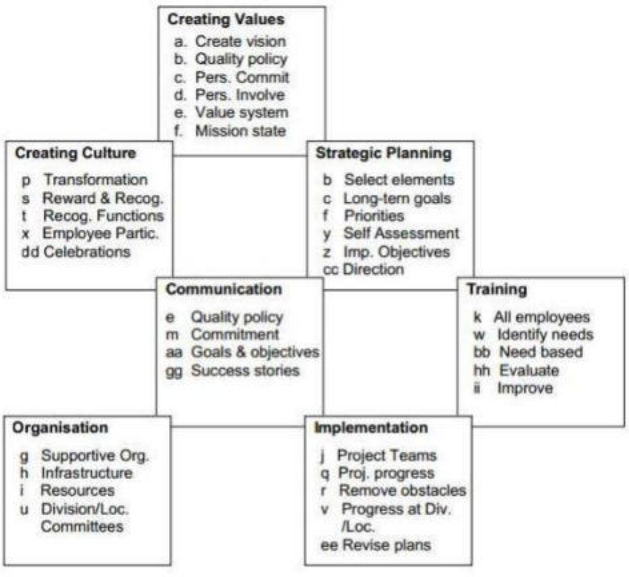
1. Affinity diagram
2. Relations diagram
3. Tree diagram
4. Matrix diagram
5. Matrix data analysis diagram.
6. Process decision programme chart
7. Arrow diagram

1. **Affinity diagram**

The purpose of an affinity diagram is to provide a visual representation of grouping of a large number of ideas or factors or requirements into logical sets of related items to help one organise action plans in a systematic manner.

The steps in the procedure for preparing an affinity diagram are:

1. Decide the subject or the topic
2. Generate a large number of ideas through brainstorming
3. Decide the number of groups and their titles. Create a card for each group. Enter the title of the group at the top of the card.
4. Distribute all the ideas among the cards. If necessary, create new cards for additional groups.
5. Arrange the cards according to the relationship between the groups.
6. Give a name to the affinity diagram.



Distribution of Ideas among Groups
An Example of an Affinity Diagram

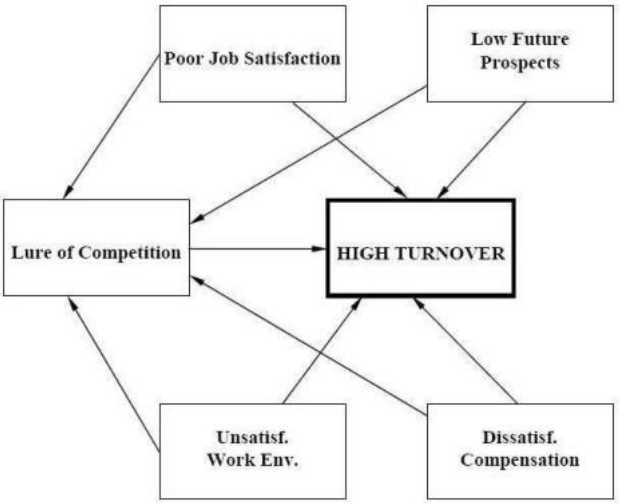
2. **Relations Diagram:**

The purpose of relations diagram is to generate a visual representation of the relations between an effect and its causes as well as the interrelationship between the causes in complex problems.

The steps in the preparation of a relations diagram are:

1. Decide the ‘effect’ or the problem for which causes are to be found. Write is in the centre of the flip chart or a board and enclose it in a dark bordered rectangle. Discuss the subject and confirm the ‘effect’.

2. Brainstorm to identify the immediate causes for the effect first. Enter these in rectangles around the central dark rectangle. Take care to place causes likely to be related to one another in adjacent positions. It is quite possible that the locations of the causes may have to be changed as one progress. Hence a white board is preferable to a flip chart for this exercise. If a flip chart is used, the causes may be written on post-it pads and stuck on the chart so that their location can be changed easily.
3. Connect these immediate causes to the effect by connecting the rectangles of the causes to that of the effect with a line with an arrow pointing towards the effect. Explore the cause and effect relationship among the immediate causes and connect them, keeping in mind that the arrow always points to an effect.
4. Taking each of these immediate causes as an effect, brainstorm to find causes for them one by one. The key question for identifying causes is "why ?". Keep asking the question till the root causes are identified for the immediate, secondary and tertiary causes.
5. Explore the relationship between all the causes and connect the rectangles as in step-3. Show as many relations among different causes as possible. A large number of routes leading to the same root causes provides an indication that the root cause may be an important contributor to the problem.
6. Brainstorm to find the more important root causes and more prominent links leading to the effect. Mark these by making the rectangles and the connecting lines darker.
7. If necessary, rearrange the rectangles in such a way that the connecting lines are short and the diagram compact.
8. Provide a suitable title to the diagram.



An Example of a Relations Diagram

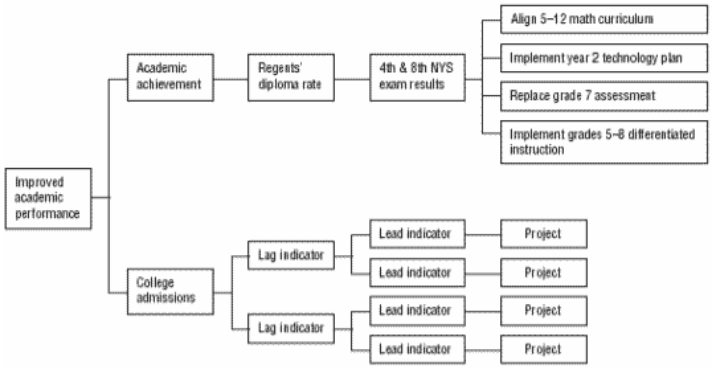
3. **Tree Diagram:**

The purpose of the tree diagram is to explore ways and means to achieve an objective, develop a list of alternate means to reach the desired situation in a sequential order and to present them in a visual form.

The steps in the procedure to develop a tree diagram are:

1. Identify a high priority problem that needs to be solved at the earliest.
2. Prepare an objective statement describing the desired situation or the target solution.
3. Decide the appropriate form of the diagram - cascade or tree as well as direction of flow after a brief discussion. Place the target solution in the dark rectangle.
4. Brainstorm to identify the primary means to achieve the objective. Arrange them in an appropriate order keeping in mind the likely interrelations between them and place them in rectangles at the first level.
5. For each of the primary means, identify secondary means which would be necessary to attain those means. Arrange them in next level boxes.
6. Identify tertiary means required to attain each of the secondary means and place them in a proper order in the next level boxes.

7. Continue the process till the group feels that the end of the line has been reached.
8. If a lower level means is required to attain two higher level means, it may be connected to both. Rearrange the boxes if necessary to make this possible. Use of POST-IT pads can make such a rearrangement simple.
9. Brainstorm to reach a consensus on the relative importance of the last level means to priorities action.
10. Give a suitable title to the diagram. Application The most important application of the tree diagram is for devising solutions for problems. It helps one to develop a systematic step by step strategy to achieve an objective. It is also useful in monitoring the implementation of solutions by taking care of accomplishment of means at different levels.



4. **Matrix Diagram:**

The purpose of a matrix diagram is to explore the existence and the extent of relations between individual items in two sets of factors or features or characteristics and express them in a symbolic form that is easy to understand. The purpose for which the tool is most frequently used is to understand the relation between customer expectations as expressed by the customers and product characteristics as designed, manufactured and tested by the manufacturer.

The steps in the procedure to prepare a matrix diagram are:

1. Decide the two sets of factors for which relations are required to be clarified. Call the set of the main factors 'features' and the set of factors dependent on it counterpart 'characteristics' or characteristics.
2. Divide the features into primary, secondary and tertiary features.
3. Divide the characteristics into primary, secondary and tertiary characteristics.
4. Place the features vertically on the left hand side of the matrix and characteristics horizontally on top of the matrix.
5. Enter the importance of the features on the column after that for the tertiary features.
6. In the main body of the matrix, place symbols at the squares denoting the relationship between the feature and the characteristic meeting at the intersection. The symbols to be used are:
   - Strong relationship
   - Medium relationship
   - Weak relationship

In case there is no relation between the concerned feature and characteristic, leave the square blank to indicate 'no relation'. The relationship should be based on data available with the team or on the results of a brainstorming session which must be confirmed by collecting necessary data.

7. Title the diagram suitably.

		List 2				
		Item A	Item B	Item C	Item D	Item E
List 1	Item 1	⊙	⊙		△	
	Item 2					
	Item 3			○	△	
	Item 4		○	△		
	Item 5	△		△		○
	Item 6		○		⊙	

5. **Matrix data analysis diagram:**

The purpose of matrix data analysis diagram is to present numerical data about two sets of factors in a matrix form and analyse it to get numerical output. The factors most often are products and product characteristics. The purpose then is to analyse the data on several characteristics for a number of products and use the information to arrive at optimum values for the characteristics for a new product or to decide the strong points of a product and use the information for designing a strategy for the promotion of the product.

The procedure for creating a matrix data analysis diagram consists of the following steps:

1. Decide the two factors whose relations are to be analyses.
2. Check the number of individual items in the two factors.
3. Prepare a matrix to accommodate all the items of the two factors.
4. Enter numerical data in the matrix.
5. Give the diagram a suitable title

Characteristics / Importance / Features	P / S / T			Physical Tests								Formula				
				Description			Properties		Foam Height			Detergent		Others		
P	S	T		Col	Cla	Per	SpGr	Visc	Ini	Fin	Den	Typ	%	F.B.	Cond.	Pres.
Appearance	Visual	Col	1	•								o	Δ	Δ		
		Cla.	1		•							Δ	Δ	o		
	Perceived	Perf.	2			•						o	o	o		o
		Sty.	2				o	•					o	Δ		
Functional	Lather	Cop.	3						•	Δ	o	•	•	•		
		Dense	2								•	o	o	•		
		Dur.	1							•		o	o	•		
	Effect	Clean Hair	3									•	o	Δ	o	
		Shiny Hair	2									•	Δ	Δ	o	
		No Tang	3												•	
Misc.	Safe	Eyes	3									o	o	o	o	•
		Hair	3									o	o	Δ	•	•

Key : • - Strong o - Medium Δ - Weak

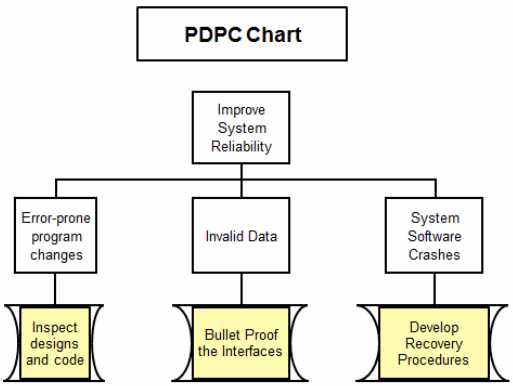
Example of Matrix Diagram – Shampoo Features and characteristics

6. **Process decision programme chart:**

The purpose of process decision programme chart is to prepare for abnormal occurrences with low probability which may otherwise be overlooked and to present the occurrences as well as the necessary countermeasures to guard against such occurrences in the form of a visual chart. The tool forces one to think of the possible obstacles in the smooth progress of a process or a project and then find ways and means to surmount those obstacles to ensure the successful and timely completion of the process or the project. Thus the tool helps one to prepare a contingency plan to achieve the objective if adverse events occur.

The steps in the preparation of a process decision programme chart are :

1. Prepare a 'normal' flowchart of the process with all expected events as steps in the chart.
2. Consider the possibility of the process not going as per the plan due to any abnormal, though less probable, occurrences.
3. Show these occurrences on the flowchart through branching at appropriate locations.
4. Consider how the abnormal occurrence will affect the process and search for ways and means to counter the effect.
5. Show these countermeasures in rectangles connecting the corresponding abnormal occurrence on one side and the process objective or the goal on the other.
6. Give a suitable title to the diagram

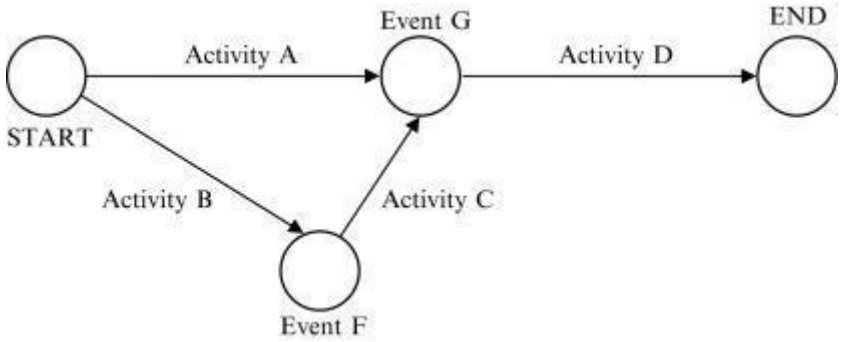


7. **Arrow diagram:**

The purpose of an arrow diagram is to create a visual presentation of the steps of a process or tasks necessary to complete a project with special emphasis on the time taken for these activities. The diagram provides a clear understanding of the schedule of various steps in the process which helps one to monitor the process for ensuring its completion on time.

The steps for preparing an arrow diagram are:

1. List all tasks or activities that need to be accomplished before the completion of the process or the project.
2. Decide which steps are undertaken in series and which steps can be run in parallel.
3. Arrange the activities in a proper sequence.
4. Prepare 'Event Nodes' at the completion of steps and number them. Where the process is bifurcating into two or more parallel streams, more lines will flow from a node and where the parallel streams are merging, two or more steps will lead to a node.
5. Write the description of the step on top of the line or to the left of the line. Decide the time required for completing each step and write it under or to the right of the line.
6. Calculate the earliest time to reach an event node for the start of the process. Where more than one streams are combining, the maximum time taken by a stream is taken into consideration. This time is entered on the top half of the rectangle. This time is related to the starting time of the process which is taken as zero.
7. After the time for all event nodes including the completion of the process or the project is available, one calculates the latest time by which an event node must be reached. This is done by starting at the time of completion and going back step by step. The time is entered on the bottom half of the rectangle. The time indication at all event nodes will appear as : X Y where X is the earliest time by which the event can be completed and Y is the latest time by which the event should be completed.
8. Give a title to the diagram. As the calculation of the time indications is extremely important in the construction of an arrow diagram it is necessary that we understand the procedure well. Let us understand the concept through diagram.



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Unit – 5: Quality Systems

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.

Quality System:

In order to assure the quality of a product, the manufacturer must ensure its quality. So, to ensure this quality it is necessary to make a systematic study and control check at every stage of production. It is also essential to take critical review of efforts and achievements of the company with respect to the quality of the product. Thus it is necessary to develop a standard quality system.

ISO 9000 Standards:

The ISO 9000 system is a quality management system that can be adopted by all types of organizations belonging to government, public, private, (or) joint sectors. The ISO 9000 system shows the way in creating products by preventing deficiencies, instead of conducting expensive post product inspections and rework.

ISO 9000

a. ISO 9001
b. ISO 9002
c. ISO 9003

ISO 9001: Design, Development, Production, Installation & Servicing

ISO 9002: Production, Installation & Servicing

ISO 9003: Inspection & Testing

ISO 9004: Provides guidelines on the technical, administrative and human factors affecting the product or services.

Benefits OF ISO 9000 Standards:

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

Clauses (Elements) of ISO 9000:

1. Scope
2. Normative Reference
3. Terms and Definitions
4. Quality Management System (QMS)
    - 4.1 General Requirements
    - 4.2 Documentation
5. Management Responsibility
    - 5.1 Management Commitment
    - 5.2 Customer Focus
    - 5.3 Quality Policy

5.4 Planning
5.5 Responsibility, Authority and Communication
5.6 Management Review

6. Resource Management
   6.1 Provision of Resources
   6.2 Human Resources
   6.3 Infrastructure
   6.4 Work Environment

7. Product Realization
   7.1 Planning of Product Realization
   7.2 Customer related processes
   7.3 Design and Development
   7.4 Purchasing
   7.5 Production and Service Provision
   7.6 Control of Monitoring and Measuring devices

8. Monitoring and Measurement
   8.1 General
   8.2 Monitoring and Measurement
   8.3 Control of Non-Conforming Product
   8.4 Analysis of Data
   8.5 Improvement

ISO 9000:2000 Quality Systems:

The term ISO 9000 refers to a set of quality management standards. ISO 9000 currently includes three quality standards: ISO 9000:2000, ISO 9001:2000, and ISO 9004:2000. ISO 9001:2000 presents requirements, while ISO 9000:2000 and ISO 9004:2000 present guidelines. ISO's purpose is to facilitate international trade by providing a single set of standards that people everywhere would recognize and respect. The ISO 9000 2000 Standards apply to all kinds of organizations in all kinds of areas. Some of these areas include manufacturing, processing, servicing, printing, forestry, electronics, steel, computing, legal services, financial services, accounting, trucking, banking, retailing, drilling, recycling, aerospace, construction, exploration, textiles, pharmaceuticals, oil and gas, pulp and paper, petrochemicals, publishing, shipping, energy, telecommunications, plastics, metals, research, health care, hospitality, utilities, pest control, aviation, machine tools, food processing, agriculture, government, education, recreation, fabrication, sanitation, software development, consumer products, transportation, design, instrumentation, tourism, communications, biotechnology, chemicals, engineering, farming, entertainment, horticulture, consulting, insurance, and so on.

Implementation of Quality Management System:

1. Top Management Commitment
2. Appoint the Management Representative
3. Awareness
4. Appoint an Implementation Team
5. Training
6. Time Schedule
7. Select Element Owners
8. Review the Present System

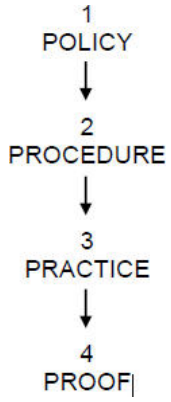
9. Write the Documents
10. Install the New System
11. Internal Audit
12. Management Review
13. Pre-assessment
14. Registration

Pitfalls of Successful Implementation:

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

Documentation:

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



Quality Auditing:

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

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

Purpose of Quality Audit:

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

Types of Quality Audit:

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

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

- System Audit.
- Process Audit.

- Product Audit.
- Adequacy Audit.
- Compliance Audit.

ISO 14000 Standards:

ISO 14000 standard gives the company a background on which to base its Environmental Management System (EMS). This system can be joined with other quality standards and can be implemented together to achieve the organizations environmental targets. The overall aim of the system is to provide protection to environment and to prevent pollution.

Requirement of ISO 14001:

There are six elements

1. General Requirements: EMS should include policy, planning implementation & operation, checking & corrective action, management review.
2. Environmental Policy (Should be based on mission)
    i. The policy must be relevant to the organization's nature.
    ii. Management's Commitment (for continual improvement & preventing pollution).
    iii. Should be a framework (for Environmental objectives & Targets).
    iv. Must be Documented, Implemented, & Maintained
3. Planning
    i. Environmental Aspects
    ii. Legal & other Requirements
    iii. Objectives & Targets
    iv. Environmental Management Programs
4. Implementation & Operation
    i. Structure & Responsibility
    ii. Training, Awareness & Competency
    iii. Communication
    iv. EMS Documentation
    v. Document Control
    vi. Operational Control
    vii. Emergency Preparedness & Response
5. Checking & Corrective Action
    i. Monitoring & Measuring
    ii. Nonconformance & Corrective & Preventive action
    iii. Records
    iv. EMS Audit
6. Management Review
    i. Review of objectives & targets
    ii. Review of Environmental performance against legal & other
    iii. Effectiveness of EMS elements
    iv. Evaluation of the continuation of the policy

Benefits of Environmental Management System:

1. Global Benefits
    a. Facilitate trade & remove trade barrier
    b. Improve environmental performance of planet earth

c. Build consensus that there is a need for environmental management and a common terminology for EMS

2. Organizational Benefits
   a. Assuring customers of a commitment to environmental management
   b. Meeting customer requirement
   c. Improve public relation
   d. Increase investor satisfaction
   e. Market share increase
   f. Conserving input material & energy
   g. Better industry/government relation
   h. Low cost insurance, easy attainment of permits & authorization

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THE END

**** All the Best ****