

GE8077

**TOTAL QUALITY MANAGEMENT**

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**OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES 9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I 9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II 9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

# **GE8077- TOTAL QUALITY MANAGEMENT**

## **UNIT-1 INTRODUCTION**

### **INTRODUCTION – NEED FOR QUALITY**

Till 300 years ago, people used the power of their own muscles, animals or the force of wind and flowing water to do all works. With the invention of the ‘steam engine’ they got a powerful method of running their machines. This provided a tremendous boost to Industry. Goods started getting produced in larger quantities using machines. This led to the beginning of the factory system. The significant change from hand-made goods to machine-made goods, which began in Britain in 18th century, is known as the Industrial Revolution. Why it was called Revolution? Because of the large scale changes it brought about our economy, society and culture. IR soon spread to other nation like Germany, France, and Portugal. As these countries became industrialized, they needed two things:

1. Raw materials for manufacturing and
2. New markets to sell the goods they made.

They found both raw materials as well as new markets to sell their goods in the non- industrialised countries of Asia and Africa. So they started annexing to meet the needs of their new factories. Soon they became jealous of each other, and wanted their own empires to grow. They started fighting among themselves. This finally led to a great war in which several nations of the world were involved. It came to be known as World War- I (August 1914-1918). Millions of soldiers and other people were killed or wounded. Cities were destroyed and there was shortage of food and everything else. In 1939, there was another war, called World War II. It lasted for 6 years and ended in 1945 after USA dropped atomic bombs over two Japanese cities – Hiroshima and Nagasaki. After world war – II, most Japanese companies had to start literally from Scratch. Everyday brought new challenges to managers and workers alike, and everyday meant progress. They observed hard working ability and bringing new-new technologies are not enough need a culture change towards “TOTAL COMMITMENT and TOTAL IMPROVEMENT”. They also felled that human resource of Japan is highest important and precious but they need more training for continuous development. Fortunately Japan called / invited American Experts like Edward Deming, Joseph M.Juran and others in 1950s and early 1960s. In quality movement world wide the Globalization took an important role in 2000. Due to transmission to open economy, a domestic and international competition starts. Gradually TQM considered as the ultimatum for continuous improvement and sustainable growth in present day business.

However, in 21 st century, high growth of economy- the new millennium brought about increased emphasis on worldwide quality and the Internet. Japanese and other world’s business

organization started not only for quality product and services for External customer satisfaction but started satisfying them by trying to achieve the highest business excellence model – Deming Award, Malcolm Baldrige National Quality Award, CII – EXIM Award and TPM Award and others. Thanks – QUALITY

## **EVOLUTION OF QUALITY**

### **1920s**

- ❖ Some of the first seeds of quality management were planted as the principles of scientific management swept through U.S. industry.
- ❖ Businesses clearly separated the processes of planning and carrying out the plan, and union opposition arose as workers were deprived of a voice in the conditions and functions of their work.
- ❖ The Hawthorne experiments in the late 1920s showed how worker productivity could be impacted by participation.

### **1930s**

- ❖ Walter Shewhart developed the methods for statistical analysis and control of quality.

### **1950s**

- ❖ W. Edwards Deming taught methods for statistical analysis and control of quality to Japanese engineers and executives.
- ❖ Joseph M. Juran taught the concepts of controlling quality and managerial breakthrough.
- ❖ Armand V. Feigenbaum's book Total Quality Control, a forerunner for the present understanding of TQM, was published.
- ❖ Philip B. Crosby's promotion of zero defects paved the way for quality improvement in many companies.

### **1968**

- ❖ The Japanese named their approach to total quality companywide quality control.
- ❖ Kaoru Ishikawa's synthesis of the philosophy contributed to Japan's ascendancy as a quality leader.

### **Today**

- ❖ TQM is the name for the philosophy of a broad and systemic approach to managing organizational quality.
- ❖ Quality standards such as the ISO 9000 series and quality award programs such as the Deming Prize and the Malcolm Baldrige National Quality Award specify principles and processes that comprise TQM.

## DEFINITION OF QUALITY

Quality can be quantified as

$$Q = P/E$$

Where Q=Quality

P=Performance

E=Expectations

If Q is greater than 1.0, then the customer has a good feeling about the product or service.

## DIMENSIONS OF MANUFACTURING AND SERVICE QUALITY

The various dimensions of product and service quality are:

- ❖ Performance
- ❖ Features
- ❖ Conformance
- ❖ Reliability
- ❖ Durability
- ❖ Service
- ❖ Response
- ❖ Aesthetics
- ❖ Reputation

*All these nine dimensions can be clearly explained with the example of LCD projector.*

**Performance** - Primary product characteristics, such as the brightness of the picture

**Features** - Secondary characteristics, added features, such as remote control.

**Conformance** - Meeting specifications or industry standards, workmanship.

**Reliability** – Consistency of performance over time, average time for the unit to fail.

**Durability** – Useful life, includes repair

**Service** – Resolution of problems and complaints, ease of repair.

**Response** – Human-to-human interface, such as the courtesy of the dealer.

**Aesthetics** – Sensory characteristics, such as exterior finish

**Reputation** – Past performance and other intangibles, such as being ranked first.

- These dimensions are somewhat independent therefore a product can be excellent in one dimension and average or poor in another.
- Therefore quality products can be determined by using a few of the dimensions of the quality.
- Marketing has the responsibility of identifying the relative importance of each dimension of quality.
- These dimensions are then translated into the requirements for the development of a new product or the improvement of an existing one.

## **BASIC CONCEPTS OF TQM**

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

## **DEFINITION OF TQM**

### **Total Quality Management**

“TQM is the management approach of the organization ,centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society”- **ISO**

### **Meaning**

Total-Made up of the whole

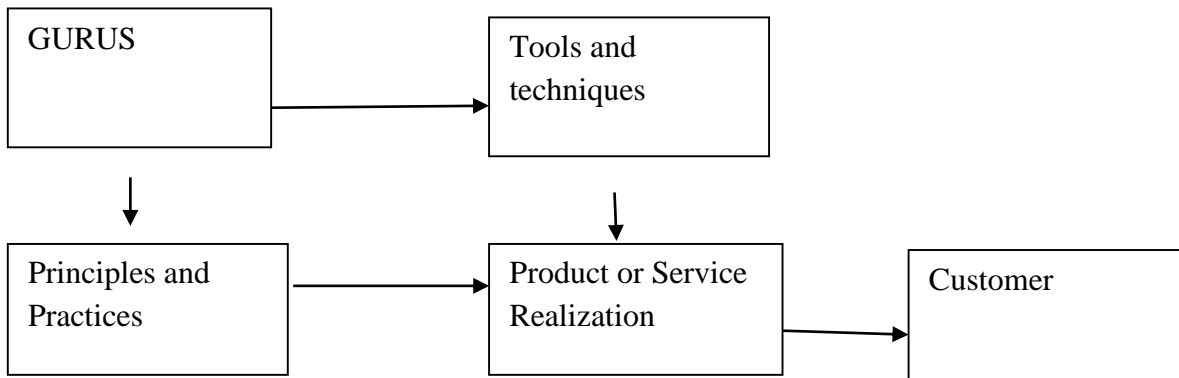
Quality- Degree of excellence a product or service provides.

Management-Act, art or manner of handling, controlling, directing.

## **TQM FRAMEWORK**

- ❖ TQM framework gives the overall structure of the organization.

❖ It consist of



### **Gurus**

- ❖ Shewhart
- ❖ Deming
- ❖ Juran
- ❖ Figenbaum
- ❖ Ishikawa
- ❖ Crosby
- ❖ Taguchi

### **Tools and Techniques**

- ❖ Benchmarking
- ❖ Information Technology
- ❖ Quality Management Systems
- ❖ Environmental Management Systems
- ❖ Quality Function Deployment
- ❖ Quality by Design
- ❖ Failure Mode and Effect Analysis
- ❖ Product and Service Liability
- ❖ Total Productive Maintenance
- ❖ Management tools
- ❖ Statistical Process Control
- ❖ Experimental Design
- ❖ Taguchi's Quality Engineering

### **People and Relationships**

- ❖ Leadership

- ❖ Customer Satisfaction
- ❖ Employee Involvement
- ❖ Supplier Partnership

### **Approach**

- ❖ Continuous Process Improvement

### **Measure**

- ❖ Performance measures

## **CONTRIBUTION OF DEMING**

Deming has given 14 points

### **Create and Publish the Aims and Purposes of the Organization**

- Management must create and publish the aims and purposes of the organization to investors, customers, suppliers, employees, the community and a quality philosophy.
- Organization should develop a long term view of business and set goals according to that.
- In order to achieve these goals resources must be allocated to research, training and continuing education.
- Innovation must be promoted to ensure that the product or service does not become obsolete.

### **Learn the New Philosophy:**

- Top management and everyone in the organization must learn the new philosophy.
- Organization must concentrate on defect prevention rather than defect detection.
- Organizations must give importance to never ending improvement and refuse to accept nonconformance.
- Customer satisfaction is the number one priority because dissatisfied customers will not continue to purchase nonconforming products or services.
- Everyone in the organization including the union must be involved in the quality journey and change his or her attitude about quality.

### **Understand the Purpose of Inspection:**

- Management must understand that the purpose of inspection is to improve the process and reduce its cost.
- For the most part of the organization, mass inspection is costly and unreliable.
- Where ever the inspection is required it should be applied and replaced by never ending improvement process.

- It should be clearly understood that mass inspection is for managing failure and defect prevention is for managing success.

#### **Stop Awarding Business Based on Price Alone:**

- The organization must stop awarding business based on the low bid because price has no meaning without quality.
- The goal is to have single suppliers for each item and to develop a long term relationship of trust and loyalty, thereby providing improved products and services.
- They must follow the materials throughout the life cycle in order to examine how customer expectations are affected and provide feedback to the supplier regarding the quality.

#### **Improve Constantly and Forever the System:**

- Management must take more responsibility in actively finding and correcting problems, so that quality and productivity are continually and permanently improved and costs are reduced.
- The focus is on preventing problems before they happen.
- Responsibilities are assigned to the teams to remove the causes of the problems and continually improve the process.

#### **Institute Training:**

- Each employee must be oriented to the organizations philosophy of never ending improvements.
- Management must allocate resources to train their employees to perform their jobs in the better manner.

#### **Teach and Institute Leadership:**

- Improving Supervision in the organization is the management's responsibility.
- Management must appoint supervisors with training, so that the new philosophy can be implemented.
- Supervisors should create a positive and supportive work environment instead of focusing on negative and fault finding atmosphere.
- All communication must be clear from top management to supervisors to operators.

#### **Drive out Fear, Create trust and Create a Climate for Innovation:**

- Management must encourage open, effective communication and team work.
- Fear is caused because of lack of job security, possible physical harm, performance appraisals, and ignorance of organization goals, poor supervision and not knowing the job.
- Driving out fear will lead to success, for this management must concentrate on workers with adequate training, good supervision, and proper tools to do the job as well removing physical dangers.

- When people are treated with dignity fear can be eliminated and they will work for the general well being of the organization.

### **Optimize the efforts of teams, groups and staff areas:**

- Management must optimize the efforts of teams, groups and staff areas to achieve the aims and purposes of the organization.
- Internally the barriers exist among levels of management, among departments, within departments and among shifts.
- Externally it exists between the organization and its customers and suppliers.
- The barriers exist because of poor communication, ignorance of organization mission and it can be overcome by multifunctional team.

### **Eliminate Exhortations for the Workforce:**

- Exhortations that ask for increased productivity without providing specific improvement methods can handicap an organization.
- They do not produce better product or service because the workers are limited by the system.
- Improvements in the process cannot be made unless the tools and methods are available.

#### **a. Eliminate Numerical Quotas for the Workforce:**

- Quotas and work standards focus on quantity rather than quality.
- Instead of quotas, management must concentrate on methods of improvement.
- They encourage poor workmanship in order to meet their quotas.

#### **b. Eliminate Management by Objective:**

- Instead of management by objective, management must learn the capabilities of the processes and how to improve them.
- Management by numerical goal is an attempt to manage without knowledge of what to do.

### **Remove Barriers that Rob People of Pride of Workmanship:**

- Loss of pride in workmanship exists throughout the organization because
  - ✓ Workers do not know how to relate to organizations mission
  - ✓ They are being blamed for system problems.
  - ✓ Poor designs lead to the production of junk.
  - ✓ Inadequate training is provided.
  - ✓ Punitive supervision exists.
  - ✓ Inadequate or ineffective equipment is provided for performing the required work.

### **Encourage Education and Self Improvement for Everyone:**

- When an organization needs is people who are improving with education, a long term commitment to continuously train and educate people must be made by management.

### **Take Action to Accomplish the Transformation:**

- Management has to accept the primary responsibility for the never ending improvement of the process.
- A cultural change is required from the previous “business as usual” attitude.
- Management must be committed, involved and accessible if the organization is to succeed in implementing the new philosophy.

### **CROSBY'S CONTRIBUTIONS**

Philip Crosby, author of **Quality is Free**. Crosby emphasized meeting customer requirements by focusing on prevention rather than correction.

#### **His "Absolutes" are:**

- (1) Quality is defined as conformance to requirements, not *goodness*;
- (2) The system for achieving quality is prevention, not appraisal;
- (3) The performance standard is zero defects, not *that's close enough*; and
- (4) The measure of quality is the price of non-conformance, not indexes.

#### **14 Principles**

1. Management commitment, that is, top level management must be convinced and committed and communicated to the entire company.
2. Quality improvement team composed of department heads to oversee improvements.
3. Quality measurement is established for every activity.
4. Cost of quality is estimated to identify areas of improvement.
5. Quality awareness is raised among all employees.
6. Corrective action is taken.
7. Zero defects are planned for.
8. Supervisor training in quality implementation.
9. Zero defects day is scheduled.
10. Goal setting for individuals.
11. Error causes are removed by having employees informed management of problems.
12. Recognition is given, but it is non-financial, to those who meet quality goals.
13. Quality councils meet regularly.
14. Do it all over again (i.e., repeat steps one through thirteen).

# CONTRIBUTION OF JURAN

## Juran's Trilogy

- ❖ Quality Planning
- ❖ Quality Control
- ❖ Quality Improvement

### Quality Planning:

- The planning component begins with external customers.
- Once the quality goals are established, marketing determines the external customers and all organizational personnel (managers, members of multifunctional teams or work groups) determine the internal customer.
- Once the customers are determined, their needs are discovered.
- Customer needs has to be stated in their own words, however real needs may differ from stated needs.
- Internal customers may not wish to voice real needs out of fear of the consequences.
- The customer needs which are stated in their view point should be translated to requirements that are understandable to the organization and its suppliers.
- The next step is to develop the product/service features that respond to customer needs, meet the needs of organization and its suppliers.
- The fourth step is to develop the processes able to produce the product or service features.
- Transferring plans to operations is the final step of the planning process.

### Quality Control:

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

### Steps:

- ✓ Determine items/subjects to be controlled and their units of measure.
- ✓ Set goals for control and determine what sensors need to be put in place to measure the product, process or service.
- ✓ Measure actual performance.
- ✓ Compare actual performance to goals.
- ✓ Act on the difference.

### Quality Improvement:

- Aim is to attain the levels of performance that are significantly higher than current levels.
- Process improvements begin with the establishment of quality council.
- Two duties of quality council
  - ✓ Identify the improvement projects
  - ✓ Establish the project teams with a project owner.
- Quality council needs to provide the teams with resources to determine the causes, create solutions and establish controls to hold the gains.
- In the figure juran provides a distinction between sporadic waste and chronic waste
  - ✓ Sporadic waste can be identified and corrected through quality control.

✓ Chronic waste requires an improvement process.

- As solution is found through the improvement process, lessons learned are brought back to the quality planning process, so that new goals may be established for organization.



### Improvement Strategies:

- Repair
- Refinement
- Renovation
- Reinvention

### Repair:

- This strategy is simple; if anything is broken it must be fixed so that it functions as designed.
- If a customer receives a damaged product, a quick fix is required.
- The second level is to identify and eliminate the root causes of the problem and effects a permanent solution.
- Repair strategy does not make the process better than the original design.

### Refinement:

- Improvements to processes, products and services are accomplished on an incremental basis.
- Refinement improves efficiency and effectiveness.
- The change may be so gradual that there is no appearance of change.
- The primary benefit of gradual change is that it produces little resistance from employees.

### Renovation:

- This strategy results in major or breakthrough improvements.
- Innovation and technological advancements are key factors in this approach.
- Eg: Rechargeable batteries

### Reinvention:

- Renovation is the most demanding improvement strategy.
- It is preceded by the feeling that the current approach will never satisfy customer requirements.

- A new product, service, process or activity is developed using teams based on a complete understanding of the customer requirements and expectations.

**Types of Problems:**

- ✓ Compliance
- ✓ Unstructured
- ✓ Efficiency
- ✓ Process design
- ✓ Product design

**BARRIERS TO TQM**

❖ **Lack of Management Commitment**

- There must be a substantial management commitment of management time and organizational resources.
- The purpose must be clearly and continuously communicated to all personnel
- Management must consistently apply the principles of TQM

❖ **Inability to change organizational Culture**

- **Basic Concepts**
  - People change when they want to and to meet their own needs.
  - Never expect anyone to engage in behavior that serves the organizational values unless adequate reason (why) has been given.
  - For change to be accepted, people must be moved from a state of fear to trust.
- Speeches, Slogans, Campaigns are effective only for a short period of time.
- Organization that spend more time on change, only have chances of success.

❖ **Improper Planning**

- All constituents of the organization must be involved in the development of the implementation plan and any modification that occurs as the plan evolves.
- The most important thing is two way communications of ideas by all personnel during the development of the plan and its implementation.
- Customer satisfaction should be the goal rather than the financial or sales goals.

❖ **Lack of continuous training and education**

- Training and education is an ongoing process for everyone in the organization.
- Training and education are most effective when senior management conducts the training on the principles of TQM.

❖ **Incompatible Organizational Structure and Isolated Individuals and Departments.**

- Differences between departments and individuals can create implementation problems.
- The use of multifunctional team will help to break down long-standing barriers.

- Restructuring the organization to meet organization needs is important.
- Individuals who do not embrace the new philosophy can be required to leave the organization.
- ❖ **Ineffective Measurement Techniques and Lack of Access to Data and Results.**
  - Key characteristics of the organization should be measured so that the effective decisions can be made.
  - Access to data and quick retrieval is necessary for effective processes.
- ❖ **Paying Inadequate Attention to Internal and External Customers**
  - Organizations need to understand the changing needs and expectations of their customers.
  - Effective feedback mechanisms that provide data for decision making are necessary for this understanding.
  - When an organization fails to empower individuals and teams, it cannot hold them responsible for producing results.
- ❖ **Inadequate Use of Empowerment and Teamwork**
  - Teams need to have the proper training and at least in the beginning a facilitator.
  - Individuals should be empowered to make decisions that affect the efficiency of their process or the satisfaction of their customers.
- ❖ **Failure to Continually Improve**
  - A lack of continuous improvement of the processes, product or service will even leave the leader of the pack in the dust.

**UNIT-II**  
**TQM PRINCIPLES**  
**LEADERSHIP**

**Definition:**

Leadership has been described as the “process of social influence in which one person can enlist the aid and support of others in the accomplishment of a common task”.

**Alan Keith:** "Leadership is ultimately about creating a way for people to contribute to making something extraordinary happen."

**Ken "SKC" Ogbonnia:** "effective leadership is the ability to successfully integrate and maximize available resources within the internal and external environment for the attainment of organizational or societal goals."

**Ann Marie E. McSwain:** “leadership is about capacity: the capacity of leaders to listen and observe, to use their expertise as a starting point to encourage dialogue between all levels of decision-making, to establish processes and transparency in decision-making, to articulate their own values and visions clearly but not impose them. Leadership is about setting and not just reacting to agendas, identifying problems, and initiating change that makes for substantial improvement rather than managing change.”

*These three definitions talk about certain common things. They are resources, utilization of resources, managing constraints and getting extraordinary results. These definitions also talk about motivating people to work in unison to create results.*

**Concepts of Leadership**

**Stephen R Covey: The 7 Habits of Highly Successful People**

**1. Be Proactive:** Proactive people think beforehand and are ready to face a situation. Reactive people react as per the situation and react on whims and emotions. A proactive person can plan beforehand for an eventuality. If you are well prepared then you can face a situation or solve a problem more efficiently.

**2. Begin with the end in Mind:** “If you don’t know where to go then you will reach nowhere” goes an old saying. Start a task with set goals. Goals are important as they tell you where to go. They help in focusing your approach as well. Remember the famous incident from Mahabharata where Guru Dronacharya asks his disciple about what they could see during target practice. Arjuna gives the most perfect answer as he was focusing on the target. Because of his focused approach Arjuna became one of the best archers of his time.

**3. Put First Things First:** Because of multitude of tasks and assignments one needs to prioritize. This helps in giving more attention to more important things at hand.

**4. Think win-win:** Think about mutual benefits rather than your own benefit alone. Everybody wants to have an upper hand in life and in business dealings. But this is practically not possible. So best way is to find is the middle of the road.

**5. Seek first to understand, then to be understood:** First give other people ample time to express themselves. This will help on many fronts. The other person gets enough opportunity to say what he wants to say. You get an opportunity to understand other's perspective. You get enough time to strategize accordingly.

**6. Synergy:** The best example of team work can be learnt from a pleasant orchestra or 'jugalbandi' in Indian classical music. Especially in Indian classical music you will observe how maestros bury their egos and come out with astounding performances.

**7. Sharpen the Saw:** Skill building or practice is very important. Nobody is perfect and perfection is a thing which can never be achieved in one's lifetime. Moreover, it always pays to practice as much as you can.

## STRATEGIC QUALITY PLANNING

### Seven Steps to Strategic Planning

*There are seven basic steps to strategic quality planning. The process starts with the principle that quality and customer satisfaction are the center of an organizations future. It brings together all the key stakeholders.*

**1. Customer needs:** The first step is to discover the future needs of the customers. Who will they be? Will your customer base change? What will they want? How will the organization meet and exceed expectations?

**2. Customer positioning:** Next, the planners determine where the organization wants to be in relation to the customers. Do they want to retain, reduce, or expand the customer base? Products or services with poor quality performance should be targeted for breakthrough or eliminated. The organization needs to concentrate its efforts on areas of excellence. *No two individual is same, so every type of customer should be treated as per his/her profile. You cannot sell a premium product to a price conscious customer.*

**3. Predict the future:** Next, the planners must look in to their crystal balls to predict future conditions that will affect their product or service. Demographics, economic forecasts and technical assessments or projections are tools that help predict the future. More than one organizations product or service has become obsolete because it failed to foresee the changing technology. *If the top management can foresee the future then it helps enable the organization to prepare for future changes. Let us take example of SONY. With rapid change in technology SONY has changed its product portfolio, so it is now MP3 player instead of Walkman which we get from SONY.*

**4. Gap analysis:** Gap analysis is about the difference between what needs to be done and what are we currently doing. It can give a clue about whether the organization should increase or decrease capacity for a particular product.

**5. Closing the gap:** If there are gaps then long term plans should be about how to fill that gap.

**6. Alignment (with vision and mission):** Whatever quality goals an organization is chalking out it should not lose focus from the long term vision and mission of the organization.

**7. Implementation:** Once every plan about goals is ready then the next step should be to plan about the methodologies of implementation.

## QUALITY STATEMENTS

The quality statements include the

1. Vision statement

2. Mission statement and
3. Quality policy statement.

- ❖ Once developed, they are only occasionally reviewed and updated.
- ❖ They are the part of the strategic planning process.
- ❖ The utilization of the three statements varies considerably from organization to organization.

#### ❖ **Vision Statement**

- The vision is a short declaration of what an organization aspires to be tomorrow.
- It is the ideal state that might never be reached but which we continually strive to achieve.
- Successful visions are timeless, inspirational and become deeply shared within the organization.
- Successful vision provides a guide line for decision making.
- It is important that the leader articulate and act upon the vision and those employees understand the vision and can connect their work with the well-being of the organization.

#### ❖ **Mission Statement**

- The mission statement answers the following questions: who we are, who are the customers, what we do, and how we do it.
- This statement is usually one paragraph or less in length, is easy to understand and describes the function of the organization.
- It provides a clear statement of purpose for employees, customers and suppliers.

#### ❖ **Quality Policy Statement**

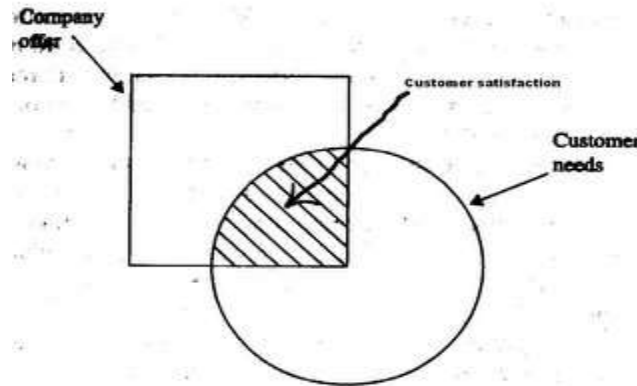
- The quality policy is a guide for everyone in the organization as to how they should provide products and services to the customers.
- It should be written by the CEO with feedback from the workforce and be approved by the quality council.
- Common Characteristics are
  - Quality is first among equals
  - Meet the needs of the internal and external customers
  - Equal or exceed the competition
  - Continually improve the quality
  - Include business and production practices
  - Utilize the entire workforce

## **CUSTOMER SATISFACTION**

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

A simple definition of customer satisfaction is illustrated below

### **Teboul model**



### **Characteristics of customer satisfaction.**

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

### **Types of customers.**

1. Internal customers - each of them receives a product or service and in exchange, provides a product or service.
2. External customers - one who uses the product or service, the one who purchases the product, or the one who influences the sale of the product.

### **CUSTOMER PERCEPTION OF QUALITY.**

In an organization there is no acceptable quality level because the customer's needs, values and expectations are constantly changing and becoming more demanding.

*An American Society for Quality (ASQ) survey reveals the following end-user perception of quality*

1. Performance
2. Features

3. Service
4. Warranty
5. Price
6. Reputation.

### **CUSTOMER COMPLAINTS**

- ❖ Unlike the customer's feedback the customer complaints are reactive, and they are important in gaining data on customer perceptions.
- ❖ A dissatisfied customer can easily become a lost customer because of their frustrations. This customer dissatisfaction becomes a measure for organizational process improvement measures.
- ❖ Every single complaint should be accepted, analyzed, and acted upon to again win over customer's confidence. Since more than 50% of the dissatisfied customers will buy again if they are complaint has been heard and resolved.
- ❖ By adopting a positive approach the complaints can be seen as an opportunity to obtain information and provide a positive service to the customer.

#### **Ways to get customer feedback or complaint**

##### **1. Comment Card**

- ❖ A low cost method of obtaining feedback from customers involves a comment card, which can be attached to the warranty card and included with the product at the time of purchase.
- ❖ The intent of this card is to get simple information such as name, address, age, occupation and what influenced the customer's decision to buy the product.
- ❖ Generally people respond only if something very good or very bad has happened.

##### **2. Customer Questionnaire**

- ❖ A customer questionnaire is a popular tool for obtaining opinion and perceptions about an organization and its products and services
- ❖ However they can be costly and time consuming.
- ❖ Surveys may be administered by mail or telephone.
- ❖ In the questionnaire the customer is asked to furnish answers relating to the quality of product and services.

##### **3. Focus Groups**

- ❖ Customer focus groups are a popular way to get feedback, but they too can be very expensive.
- ❖ These groups are very effective for gathering information on customer expectations and requirements.
- ❖ A group of customers is assembled in a meeting room to answer a series of questions.
- ❖ These carefully structured questions are asked by a skilled moderator.

##### **4. Toll-Free Telephone Numbers**

- ❖ Toll-free telephone numbers are an effective technique for receiving complaint feedback.
- ❖ Organizations can respond faster and more cheaply to the complaint.

##### **5. Customer Visits**

- ❖ **Visit**

## **Handling the customer complaints**

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

## **CUSTOMER RETENTION**

- ❖ Customer retention represents the activities that produce the necessary customer satisfaction which in turn creates the customer loyalty.
- ❖ Customer retention moves customer satisfaction to the next level by determining what is truly important to the customers and making sure that the customer satisfaction system focuses valuable resources on things that are important to the customer.
- ❖ Customer retention is the connection between customer satisfaction and the bottom line.
- ❖ World-class companies know that continuous improvement and customer satisfaction should go hand-in-hand.
- ❖ Improved service to the customer is a costlier affair, so an organization must determine its return on the service investment. For this the important service elements that significantly improve revenues and market share should be determined.
- ❖ One survey indicates, it requires five times of effort to win a new customer than retaining a present customer. In this context customer retention is important for organizational success.

## **EMPLOYEE INVOLVEMENT**

- ❖ Japanese management emphasizes the need to consider employee as a valuable resources rather than treating them as a mere tools for production.
- ❖ Employee involvement is one approach to improve quality and productivity.
- ❖ It is not an replacement for management nor is it the final word in quality improvement, it aims at better meeting of organizational goals at all levels.

## **1.MOTIVATION**

Knowledge of motivation helps us to understand the utilization of employee involvement to achieve process improvement.

### **Theories of Motivation**

He explained the motivation in terms of a hierarchy of needs and that there were five levels. These are survival, security, social, esteem, and self-actualization.



It is important to note that as employees move up the hierarchy, they will immediately revert back to the previous level if they feel threatened.

### HERZBERG'S TWO FACTOR THEORY

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



- ❖ He found that people were motivated by the motivators (intrinsic factors) like recognition, responsibility, achievement, advancement and the work itself.
- ❖ In addition he found that bad feelings were associated with preventable dissatisfiers or hygiene factors (extrinsic factors) like low salary, minimal fringe benefits, poor working conditions, ill-defined organizational policies and mediocre (ordinary) supervision.
- ❖ He also explained that the presence of extrinsic factors (for example good working condition) does not produce any motivation but their absence will create dissatisfaction among employees.
- ❖ In a same manner the absence of intrinsic factors (for example advancement) does not produce any dissatisfaction but their presence will provide strong level of motivation.

### How to motivate work force

1. Know thyself

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

## **2.EMPOWERMENT**

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

An operational definition is as follows:

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

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

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

### **Three conditions are necessary for empowering employees**

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

## **3. TEAMS**

- ❖ Teams are very effective in solving all quality and productivity problems.
- ❖ Team is defined as a group of people working together to achieve common objectives or goals.
- ❖ Teamwork is the cumulative actions of the team during which each member of the team subordinates his interests and opinions to fulfill the objectives or goals of the group.
- ❖ Many heads are better than one, especially in meeting ever-changing customer needs.
- ❖ Each member of the team have special ability that can be used for the problem. Many processes are so complex that one person cannot able solve completely.
- ❖ Based on the synergic effect, whole is greater than sum of its parts. Team work is better than sum of its member contribution.

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

### Types of teams

- Process improvement teams
- Cross-functional teams
- Natural work teams
- Self-directed/ self managed teams

### Characteristics of successful teams

Sponsor

Team charter

Team competition

Training

Clear objectives

Accountability

Well-defined decision procedures

Resources

Trust

Effective problem solving

Open communication

Appropriate leadership

Balanced participation

Cohesiveness.

## 4. RECOGNITION AND REWARD

- ❖ **Recognition** is a form of employee motivation in which the organization publicly acknowledges the positive contributions an individual has made to the success of the organization.
- ❖ This acknowledgement is delivered using verbal and written praise and may include symbolic items such as certificates and plaques.
- ❖ **Reward** is something tangible such as theater tickets, dinner for two, or a cash award to promote desirable behaviour.
- ❖ ***Recognition and reward go together to form a system for letting people know they are valuable members of the organization.***
- ❖ People like to be recognized, either as a team or individually.
- ❖ A persons feeling of achievement, value to the organization, knowing the organization cares and having peer recognition may be more important than any reward.

### Recognition Includes

- ❖ Pictures on the bulletin board
- ❖ Articles in newsletters or newspapers
- ❖ Letters to families

- ❖ Making a presentation to management
- ❖ Passing along compliments from others
- ❖ Personal phone calls or notes
- ❖ Placing positive notes in folders
- ❖ Increased responsibility

## Rewards

### Individual Rewards

- ❖ Better parking space
- ❖ Dinner out
- ❖ Gift certificates
- ❖ Gift to charity in the name of the recipient
- ❖ Washing an employee's car during lunch hour
- ❖ Trips
- ❖ Event tickets

### Group Rewards

- ❖ Includes an outing such as a ball game, bowling and movies
- ❖ Group lunch or dinner

*“Cash awards are also effective motivators for individual and team awards.”*

## 5. PERFORMANCE APPRAISAL

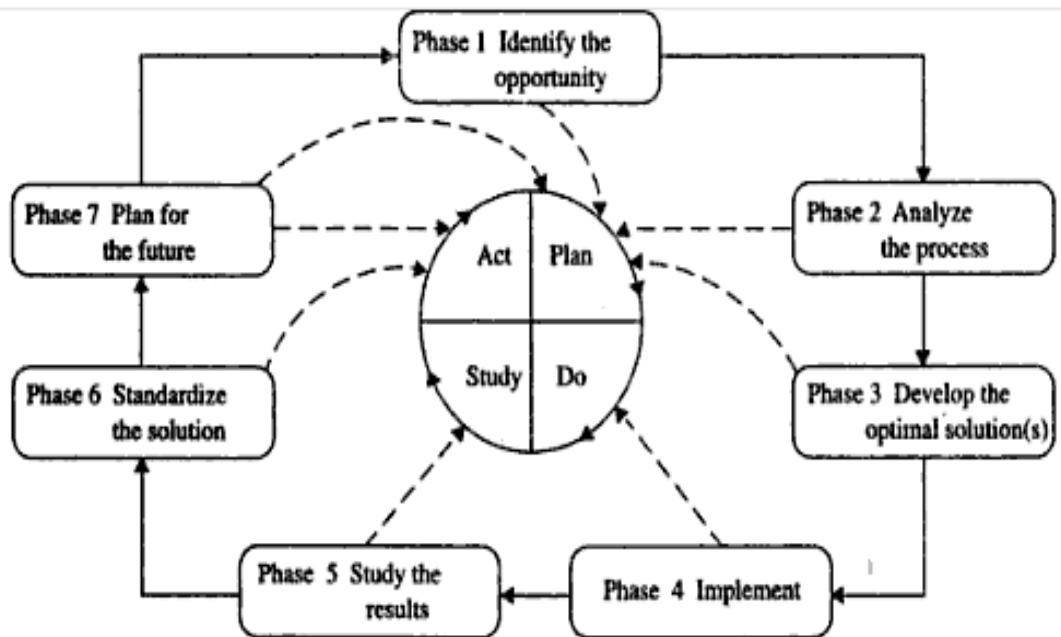
- ❖ The purpose of performance appraisal is to let employees know how they are doing and provide a basis for promotions, salary increases, counseling and other purposes related to an employee's future.
- ❖ There should be a good relationship between the employee and the appraiser.
- ❖ Employees should be made aware of the appraisal process, what is evaluated and how often.
- ❖ Employees should be told how they are doing on a continuous basis and not just at appraisal time.
- ❖ The appraisal should point out strengths and weaknesses as well as how performance can be improved.
- ❖ Appraisal nourish short term performance and destroy

## CONTINUOUS PROCESS IMPROVEMENT

### PDSA CYCLE

- ❖ The concept was first given by Deming and later it was developed by Shewhart.
- ❖ It is also known as **Deming cycle** or **PDCA cycle**.





**Identify the opportunity:**

- The objective of this phase is to identify and prioritize opportunities for improvement.
- It has three parts
  - ✓ Identify the problem
  - ✓ Form the team
  - ✓ Define the scope.

**Analyze the current process:**

- The objective of this phase is to understand the process and how it is currently performed.
- Key activities are to define process boundaries outputs and customers, inputs and suppliers and process flow, determine levels of customer satisfaction and measurements needed, gather data and identify root causes.
- With the help of process flow diagram the team will
  - ✓ Establish performance measures with respect to customer requirements.
  - ✓ Determine data needed to manage the process
  - ✓ Establish regular feedback with customers and suppliers.
  - ✓ Establish measures for quality/cost/time of inputs and outputs.
- Once the target performance measures are established, the team can collect all available data and information.
- Gathering data by the team
  - ✓ Helps confirm that a problem exists
  - ✓ Enables the team to work with facts
  - ✓ Makes it possible to establish measurement criteria for baseline
  - ✓ Enables the team to measure the effectiveness of an implemented solution.
- The team should develop a plan that includes input from internal and external customers and answers the following questions
  - ✓ What problem or operation do we want to learn about?
  - ✓ What are the data used for?

- ✓ How many data are needed?
- ✓ What conclusions can be drawn from the collected data?
- ✓ What action should be taken as a result of the conclusion?

**Develop the optimal solution:**

- The objective of this phase is to establish potential and feasible solution and recommend the best solution to improve the process.
- Once all the information is available the project team begins its search for possible solutions.
- In this phase creativity plays the major role and brainstorming is the principle technique.
- There are three types of creativity
  - ✓ Create new processes
  - ✓ Combine different processes
  - ✓ Modify the existing processes

**Implement Changes:**

- Once the best solution is selected it should be implemented.
- This phase has the objective of preparing the implementation plan, obtaining approval and implementing the process improvements.
- Although the team has the authority in implementing the solution but it has to get approval from the quality council.
- If such approval is needed from the quality council, the team has to give a written or oral report.
- The report should fully describe about
  - ✓ Why will it be done?
  - ✓ How will it be done?
  - ✓ When will it be done?
  - ✓ Who will do it?
  - ✓ Where will it be done?
- The length of the report is determined by the complexity of the change.
- Simple changes may require only an oral report, whereas other changes require a detailed written report.

**Study the Results:**

- This phase has the objective of monitoring and evaluating the change by tracking and studying the effectiveness of the improvement efforts through data collection and review of progress.
- The team should meet periodically during this phase to evaluate the results to see that the problem has been solved or if fine tuning is required.
- If the team is not satisfied, then some of the phases will need to be repeated.

**Standardize the solution:**

- Once the team is satisfied with the change, it must be institutionalized by positive control of process, process certification and operator certification.
- Positive control (positive control) assures that the important variables are kept under control.
- It specifies that what, who, how, where and when of the process and is an updating of the monitoring activity.

**Plan for the future:**

- This phase has the objective of achieving improved levels of process performance.

- Everyone in the organization is involved in a systematic, long term endeavor to constantly improve quality by developing processes that are customer oriented, flexible and responsible.

## **5S PRINCIPLE**

*SEIRI* - Tidiness

*SEITON* - Orderliness

*SEISO* - Cleanliness

*SEIKETSU*-Standardization

*SHITSUKE* - Sustaining the discipline or self-discipline

## **KAIZEN**

- Value added and non-value added work activities.
- Muda: which refers to seven classes of waste-overproduction, delay, transportation, processing, inventory, wasted motion and defective parts
- Principles of motion study and the use of cell technology.
- Documentation of standard operating procedures.
- The five S's for workplace organization.
- Visual management by means of virtual displays that everyone in the plant can use for better communication.
- Just in time principles to produce only the units in the right quantities at the right time and with the right resources.
- POKA-YOKE to prevent or detect errors.
- Team dynamics, which includes problem solving, communication skills and conflict resolution.

## **SUPPLIER PARTNERSHIP**

### **Principles of Customer Supplier Relations By Ishikawa**

- Both the customer and the supplier are fully responsible for the control of quality.
- Both the customer and the supplier should be independent of each other and respect each other's independence.
- The customer is responsible for providing the supplier with clear and sufficient requirements, so that the supplier can know precisely what to produce.
- Both the customer and the supplier should enter in to a non-adversarial contract with respect to quality, quantity, price, delivery method and terms of payments.
- The supplier is responsible for providing the quality that will satisfy the customer and submitting necessary data upon the customer's request.
- Both the customer and the supplier should decide the method to evaluate the quality of product or service to the satisfaction of both parties.
- Both the customer and the supplier should establish in the contract the method by which they can reach an amicable settlement of any disputes that may arise.
- Both the customer and the supplier should continually exchange information sometimes using multi functional teams in order to improve the product or service quality.

- Both the customer and the supplier should perform business activities such as procurement, production and inventory planning, clerical work and systems so that an amicable and satisfactory relationship is maintained.
- When dealing with business transactions, both the customer and the supplier should always have the interest of the end user in mind.

### **Partnering**

- ❖ Partnering is a long term commitment between two or more organizations for the purpose of achieving specific business goals and objectives by maximizing the effectiveness of each participant's resources.

### **3 key elements to a partnering relationship**

- ❖ Long term commitment
- ❖ Trust
- ❖ Shared Vision

### **Sourcing**

- ❖ Sole
- ❖ Multiple
- ❖ Single

### **Supplier Selection is based on**

- ❖ Management philosophy of the organization
- ❖ Stable management of the supplier
- ❖ High technical standards with future technological innovations
- ❖ Raw materials and parts required by the purchaser meet the quality specifications
- ❖ Price is right and the delivery dates can be met
- ❖ Supplier has an effective quality system
- ❖ When supplier has a track record of customer satisfaction and organization credibility.

### **Supplier Rating**

#### **It is based on**

- ❖ Quality
- ❖ On time delivery
- ❖ Service
- ❖ Internal Structure
- ❖ Review reports
- ❖ Customer satisfaction

*Example: General Motors uses the traffic light to rate their suppliers*

*Red- Problem*

*Yellow- Potential Problem*

*Green - Ok*

## **Relationship Development**

The previous topics contribute to the establishment of the relationship and inspection, training, teams, recognition and reward contribute to the maintainability and growth of the relationship

### **1. Inspection**

The goal of inspection is to eliminate, substantially reduce or automate the inspection activity.

4 phases of inspection

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

### **2. Training**

### **3. Team approach**

### **4. Recognition**

**UNIT III**  
**TQM TOOLS AND TECHNIQUES I**

**STATISTICAL PROCESS CONTROL**

Statistical process control (SPC) is the application of statistical methods to the monitoring and control of a process to ensure that it operates at its full potential to produce conforming product. Under SPC, a process behaves predictably to produce as much conforming product as possible with the least possible waste.

**Seven Tools:**

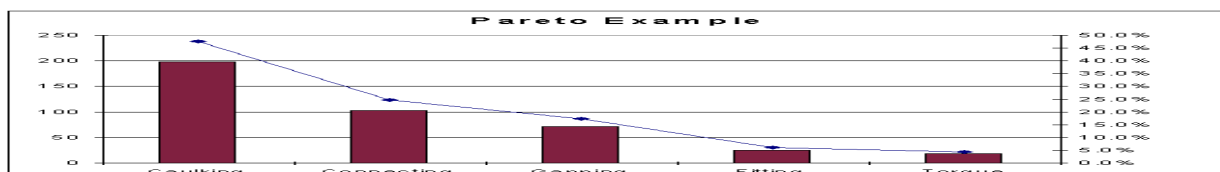
- ❖ Pareto Diagram
- ❖ Process Flow Diagram
- ❖ Cause and Effect diagram
- ❖ Check sheets
- ❖ Histogram
- ❖ Scatter diagram
- ❖ Control charts

**1. PARETO DIAGRAM:**

- ❖ The Pareto diagram is a graphical overview of the process problems, in ranking order of the most frequent, down to the least frequent, in descending order from left to right.
- ❖ Thus, the Pareto diagram illustrates the frequency of fault types.
- ❖ Using a Pareto, you can decide which fault is the most serious or most frequent offender.
- ❖ The basic underlying rule behind Pareto's law is that in almost every case, 80% of the total problems incurred are caused by 20% of the problem cause types; such as people, machines, parts, processes, and other factors related to the production of the product.
- ❖ Therefore, by concentrating on the major problems first, you can eliminate the majority of your problems.
- ❖ The few items that have the largest amount of occurrence is your more frequent problem, than are the many items that only happen once in a while. This is called the "vital few over the trivial many" rule.
- ❖ Quite often, once you cure several of the "big hitters" you also eliminate some of the smaller problems at the same time.

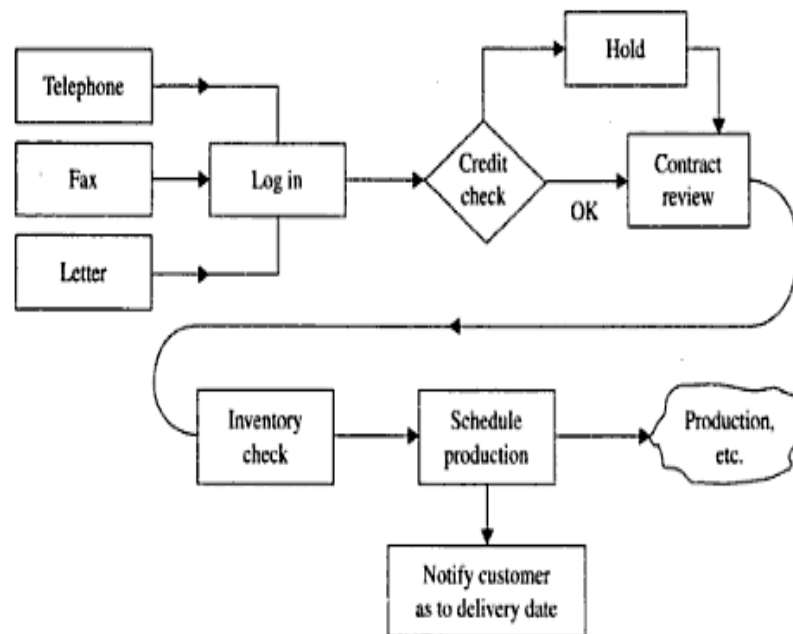
**A PARETO EXAMPLE**

Date:		Number Inspected:	N = 2165
Defective Items	Number of Defectives	Percent of Defects	Percent Distribution of defectives
Caulking	198	9.15%	47.60%
Connecting	103	4.76%	24.76%
Gapping	72	3.33%	17.31%
Fitting	25	1.15%	6.01%
Torque	18	0.83%	4.33%
TOTAL	416	19.21%	100.00%



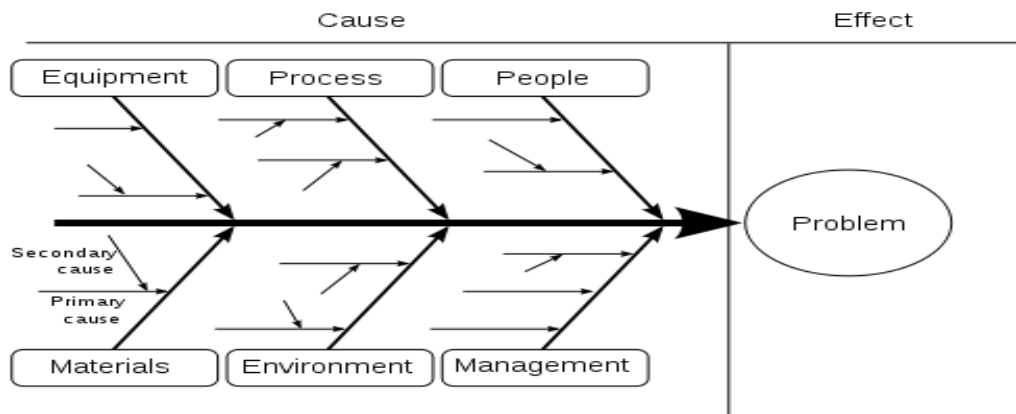
## 2. PROCESS FLOW DIAGRAM:

- ❖ A process flow diagram (PFD) is a diagram commonly used in engineering to indicate the general flow of plant processes and equipment.
- ❖ The PFD displays the relationship between major equipment of a plant facility and does not show minor details such as piping details and designations.
- ❖ For many products and services it may be useful to construct a process flow diagram.
- ❖ These diagrams show the flow of the product and service as it moves through various processing operations.
- ❖ The diagram makes it easy to visualize the entire system, identify potential trouble spots and locate control activities.
- ❖ It answers the question “Who is the next customer”?
- ❖ Improvements can be made by changing, reducing, combining or eliminating steps.



## 3. CAUSE AND EFFECT DIAGRAM:

- ❖ A C&E diagram is a picture composed of lines and symbols designed to represent a meaningful relationship between an effect and its causes.
- ❖ It is also referred to as fishbone diagram because of its shape.
- ❖ For every effect, there are likely to be numerous causes.
- ❖ In C&E diagram the effect is on the right side and causes on the left.
- ❖ The first step in the construction of a C&E diagram is for the project team to identify the effect or quality problem.
- ❖ It is placed on the right side of a large piece of a paper by the team leader.
- ❖ Next the major causes are identified and placed on the diagram.
- ❖ The minor causes require brainstorming by the project team.



#### 4. CHECK SHEETS:

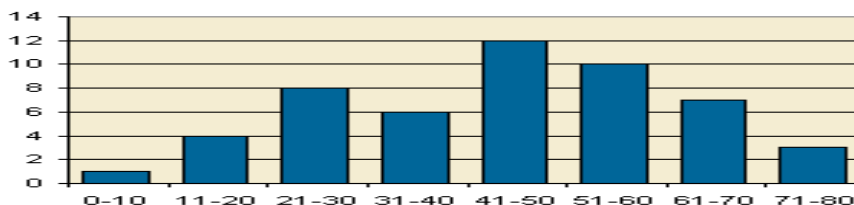
- ❖ The check sheet is a simple document that is used for collecting data in real-time and at the location where the data is generated.
- ❖ The document is typically a blank form that is designed for the quick, easy, and efficient recording of the desired information, which can be either quantitative or qualitative. When the information is quantitative, the check sheet is sometimes called a tally sheet.
- ❖ A defining characteristic of a check sheet is that data is recorded by making marks ("checks") on it.
- ❖ A typical check sheet is divided into regions, and marks made in different regions have different significance.

<b>CHECK SHEET</b>		
Product: Bicycle 32	Number inspected: 2217	
Nonconformity type	Check	Total
Blister	THH THH THH THH I	21
Light spray	THH THH THH THH THH THH THH THH III	38
Drips	THH THH THH THH II	23
Overspray	THH THH I	11
Runs	THH THH THH THH THH THH THH THH THH THH II	47
Others	THH	5
Total		144

- ❖ Data is read by observing the location and number of marks on the sheet.

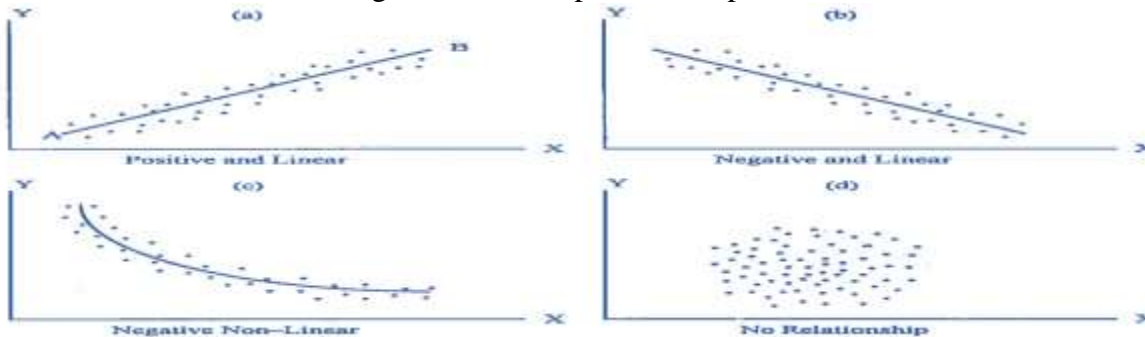
#### 5. HISTOGRAM:

- ❖ A graphical representation, similar to a bar chart in structure, that organizes a group of data points into user-specified ranges.
- ❖ The histogram condenses a data series into an easily interpreted visual by taking many data points and grouping them into logical ranges or bins.
- ❖ Histograms are commonly used in statistics to demonstrate how many of a certain type of variable occurs within a specific range. For example, a census focused on the demography of a country may use a histogram of how many people there are between the ages of 0 and 10, 11 and 20, 21 and 30, 31 and 40, 41 and 50 etc.



## 6. SCATTER DIAGRAM:

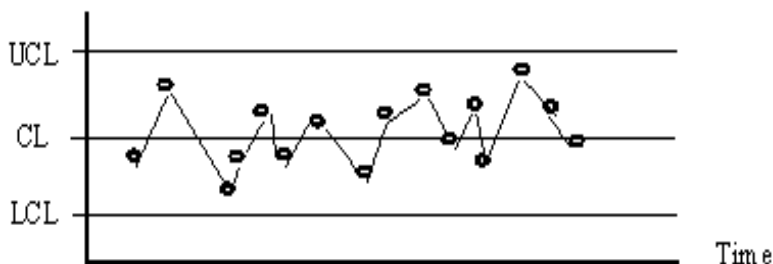
- ❖ A scatter diagram is a tool for analyzing relationships between two variables.
- ❖ One variable is plotted on the horizontal axis and the other is plotted on the vertical axis.
- ❖ The pattern of their intersecting points can graphically show relationship patterns.
- ❖ Most often a scatter diagram is used to prove or disprove cause-and-effect relationships.



## 7) CONTROL CHART:

- ❖ A statistical tool to determine if a process is in control.

Process in Statistical Control



## CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES

### VARIABLE CONTROL CHARTS

1. Deal with items that can be measured.

#### Example

- 1) Weight
- 2) Height
- 3) Speed
- 4) Volume

#### Types:

- X chart: deals with a average value in a process
- R chart: takes into count the range of the values
- MA chart: take into count the moving average of a process

### 2.ATTRIBUTE CONTROL CHART

- ❖ Control charts that factor in the quality attributes of a process to determine if the process is performing in or out of control.

#### Types:

- P chart
- C Chart
- U Chart

**P Chart:** a chart of the percent defective in each sample set.

**C chart:** a chart of the number of defects per unit in each sample set.

**U chart:** a chart of the average number of defects in each sample set.

**Reasons for using Control Charts:**

- Improve productivity
- Make defects visible
- Determine what process adjustments need to be made
- Determine if process is “in” or “out of control”

**SEVEN NEW MANAGEMENT TOOLS**

**The seven new management tools are:**

1. Affinity Diagram
2. Interrelationship Digraph
3. Tree Diagram
4. Matrix Diagram
5. Prioritization Matrices
6. Process Decision Program Chart(PDPC)
7. Activity Network Diagram

**1. Affinity Diagram:**

- This tool takes large amounts of disorganized data and information and enables one to organize it into groupings based on natural relationships
- This diagram allows the team to creatively generate a large number of issues/ideas and then logically group them for problem understanding and possible break through solution.
- The procedure is to state the issue in a sentence, brainstorming using short sentences on self-adhesive notes, post them for the team to see, sort ideas in to logical groups and create concise descriptive headings for each group.
- Large groups should be divided in two smaller groups with appropriate headings.
- Notes, that stand alone could become headers or placed in a miscellaneous category.
- Affinity diagrams encourage team creativity, break down barriers, facilitate breakthroughs and stimulate ownership of the process.

**Figure 1**

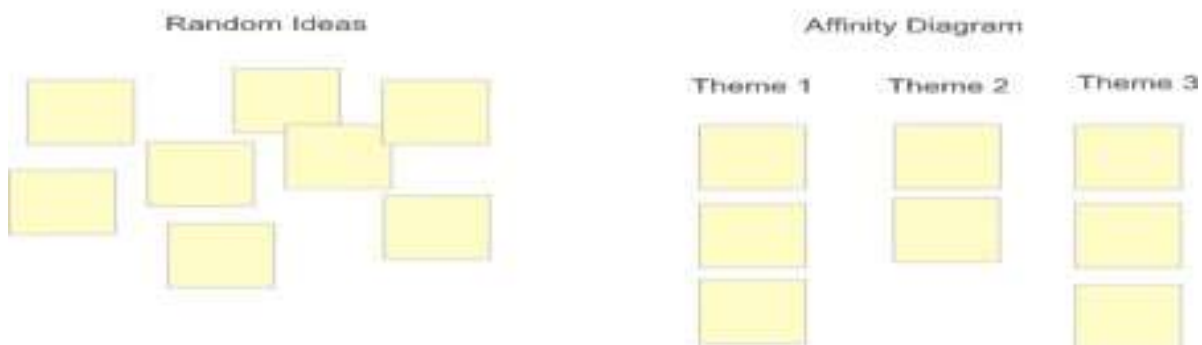


Figure 3

Why is customer service sub-standard?

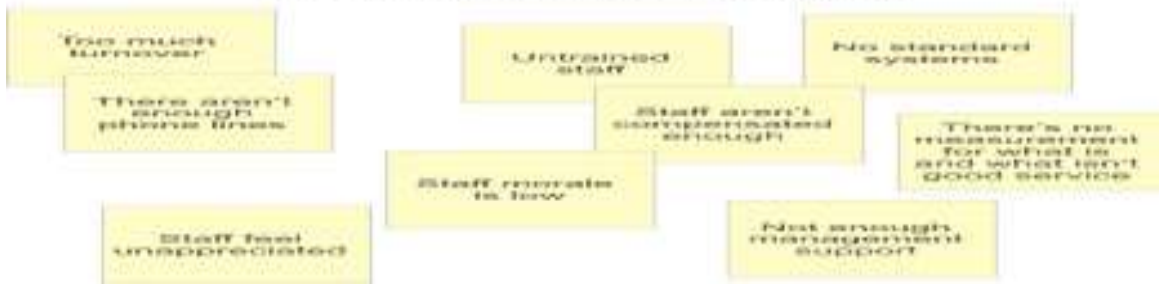


Figure 4

Why is customer service sub-standard?

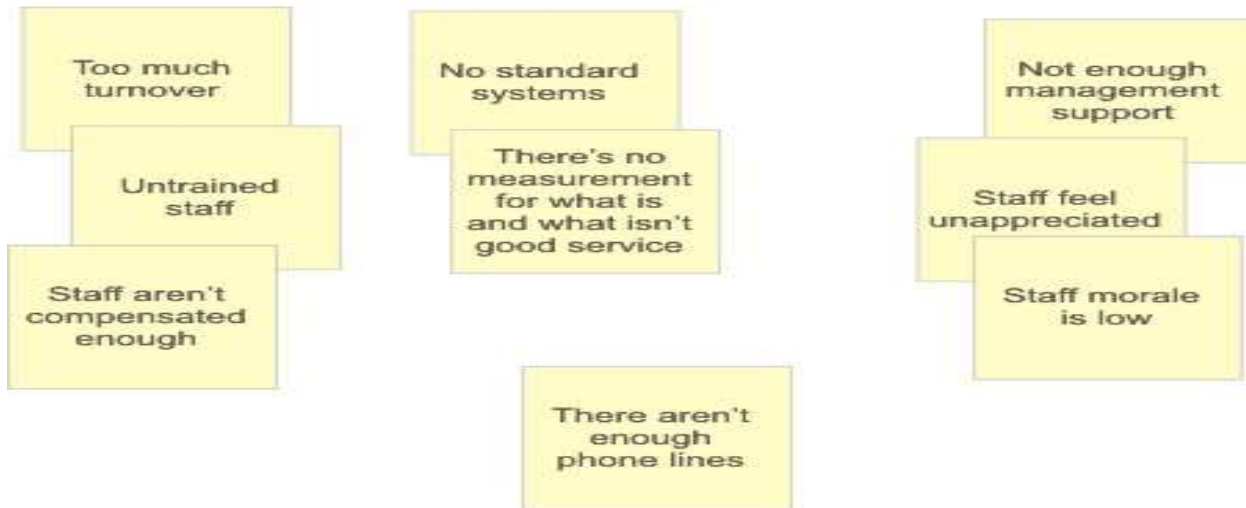
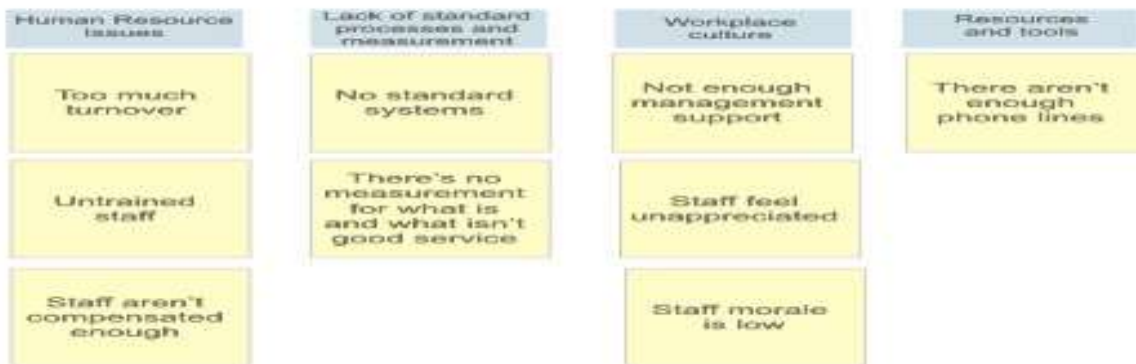


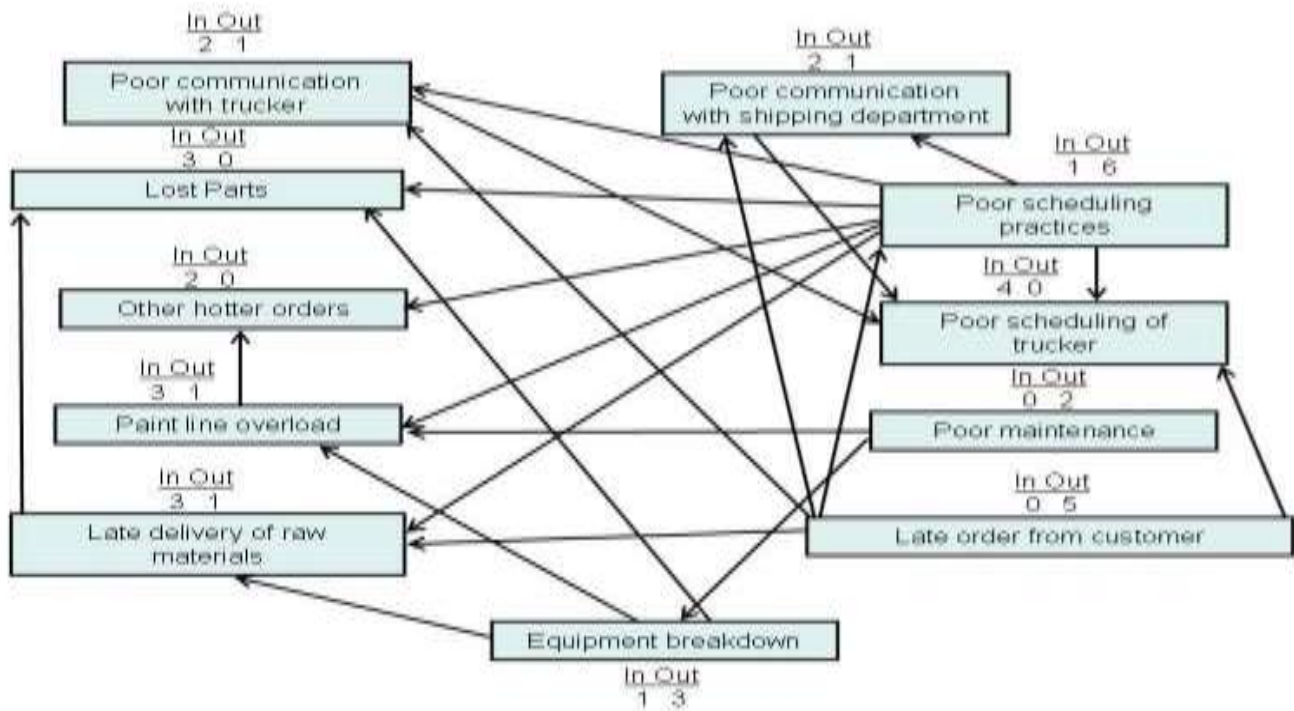
Figure 5

Why is customer service sub-standard?



## 2. Interrelationship Digraph:

- This tool displays all the interrelated cause-and-effect relationships and a factor involved in a complex problem and describes desired outcomes.
- The process of creating an interrelationship digraph helps a group analyze the natural links between different aspects of a complex situation.
- The interrelationship diagram clarifies the interrelationship of many factors of a complex situation.
- It allows the team to classify the cause and effect relationships among all the factors so that the key drivers and outcomes can be used to solve the problem.
- A relationship diagram allows a team to identify root causes from subjective data , systematically explores cause and effect relationship, encourages member to think multi directionally and develops team harmony and effectiveness



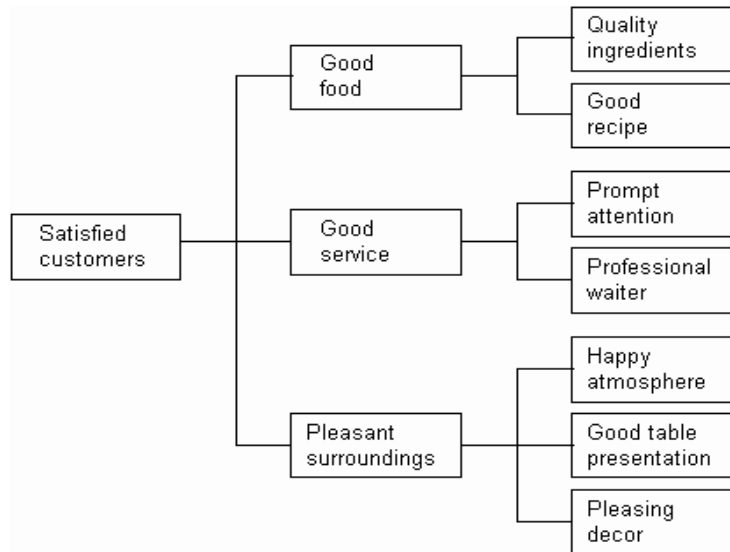
A concern with a high number of output arrows is a driver or key cause. A key cause affects a large number of other items. The above diagram shows the following key causes:

- ❖ Poor scheduling practices' (6 outgoing arrows),
- ❖ Late order from customer' (5 outgoing arrows), and
- ❖ Equipment breakdown (3 outgoing arrows).

A concern with a large number of input arrows is affected by a large number of other concerns. Thus, it could be a source of a quality or performance metric. 'Poor scheduling of the trucker' has 4 input arrows.

### 3. Tree Diagram:

- This tool is used to break down broad categories into finer and finer levels of detail
- This tool is used to reduce any broad objective in to increasing levels of detail in order to achieve the objective.
- The procedure is to first choose an action oriented objective statement from the interrelationship diagram, affinity diagram, and brainstorming.
- Second using brainstorming chooses the major headings.
- The third step is to generate the next level by analyzing the major headings.
- Ask "What needs to be addressed to achieve the objective? Repeat this question at each level.
- Three levels below the objective are usually sufficient to complete the diagram and make appropriate assignments.
- The diagram should be reviewed to determine if these actions will give the results anticipated or if something has been missed.
- The tree diagram encourages team members to think creatively, makes large projects manageable and generates a problem solving atmosphere.



#### 4. Matrix Diagram:

- The matrix diagram allows individuals or teams to identify, analyze and rate the relationship among two or more variables.
- QFD is the best example of the use of matrix diagram.
- There are 5 standard formats
  - ❖ L-Shaped(2 Variables)
  - ❖ T-Shaped(3 Variables)
  - ❖ Y-Shaped(3 Variables)
  - ❖ C-Shaped(3 Variables)
  - ❖ X-Shaped(4 Variables)
- The procedure for the diagram is to first select the factors affecting a successful plan.
- Select the appropriate format Eg: L-Shaped
- Next step is to determine the relationship symbols
- Any symbols can be adopted provided the diagram contains a legend.
- Numerical values are sometimes associated with the symbol as we have seen in QFD.
- The last step is to complete the matrix by analyzing each cell and inserting the appropriate symbol.
- The matrix diagram clearly shows the relationship of the two variables.
- It encourages the team to think in terms of relationships, their strength and any patterns.

Legend		Soft-skills courses					People in Purchasing dept.	Yrs. of service	Social clubs						
		Assess/ness	Team bulding	Negotiation	Listening skills	Group working			Chess	Football	Photography	Pool	Swimming	Tennis	
✓	Course attended	✓	✓				Michael Jordan	2		⊙					
		✓		✓	✓		Richie Valens	5	○		○	△	△		
			✓				Dawn Simmons	10	△				⊙	△	
				✓			Eleri Mair	4							△
					✓		Dave Morgan	3	△						
		✓	✓		✓		Cynthia Place	6			⊙				
		✓					Geraint Morgan	3		○					
		✓	✓		✓	✓	Heledd Eluned	11	⊙	○		△			⊙
							Gwen Uki	9		○					
			✓				Bella Bumpss	5			⊙		○		

Measures are over past three years

#### 5. Prioritization Matrices:

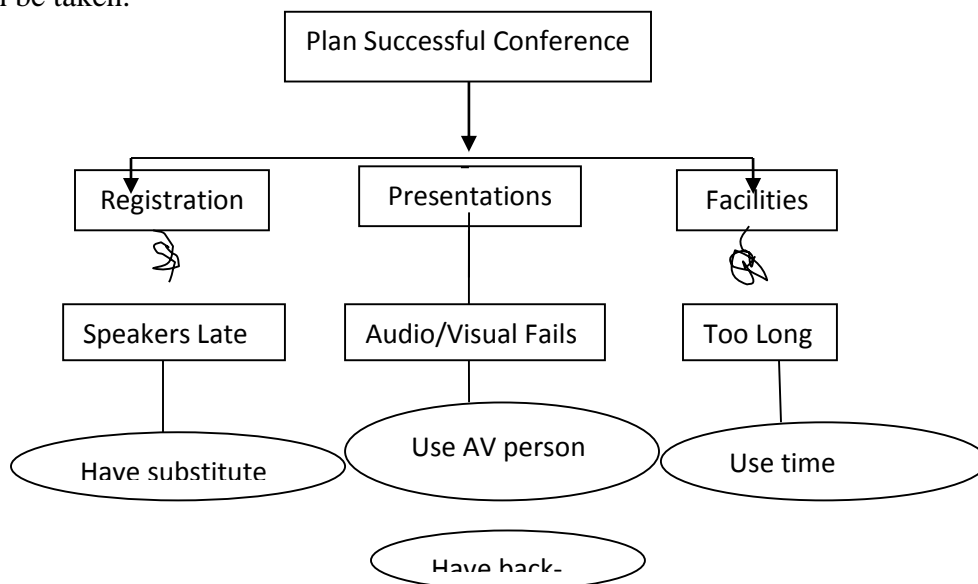
- This tool is used to prioritize items and describe them in terms of weighted criteria.

- It uses a combination of tree and matrix diagramming techniques to do a pair-wise evaluation of items and to narrow down options to the most desired or most effective.
- This tool prioritizes issues, tasks and characteristics based on weighted criteria.
- Once prioritized effective decisions can be made.

Prioritization Matrix				
Issue	Frequency	Importance	Feasibility	Total
No appointments for the afternoon	5	0	0	5
Delays in registration	6	1	5	12
Incomplete laboratory	9	11	6	26
Not enough materials for the lab	3	0	0	3
Broken down ambulance	0	3	0	3
Long waiting time	7	14	15	36
Disrespect of patients	4	6	10	20

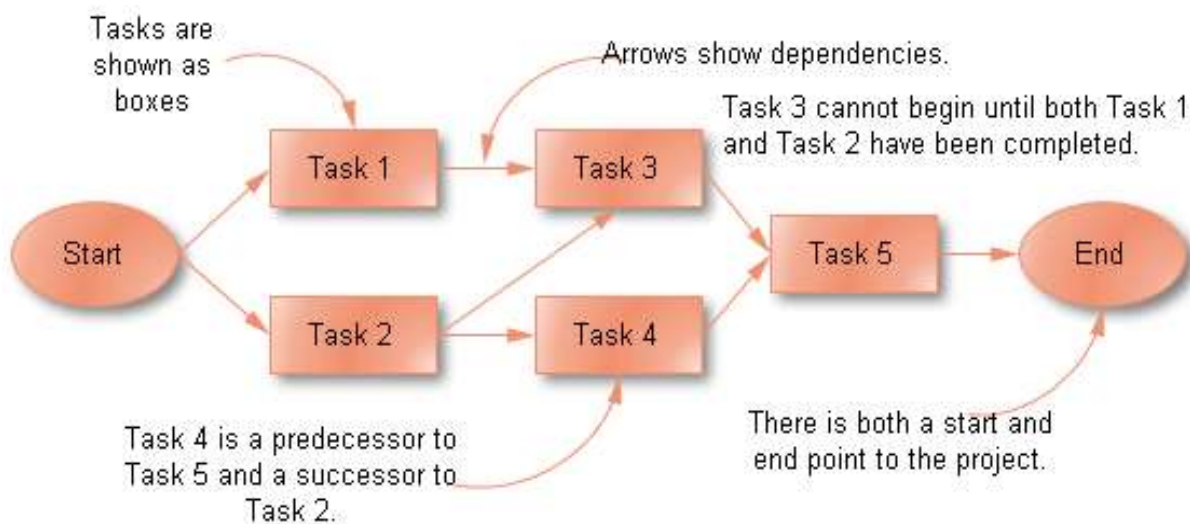
### 6. Process Decision Program Chart (PDPC):

- PDPC helps to avoid surprises and identifies possible counter measures.
- The procedure starts with the team stating the objective.
- The objective here is to plan a successful conference.
- This activity is followed by the first level which has the conference activities of registration, presentation and facilities.
- Only the presentation activity is discussed here.
- In some cases a second level of detailed activities may be used.
- Next the team brainstorms to determine what could go wrong with the conference and these are shown in “What if” level.
- Countermeasures are brainstormed and placed in a balloon in the last level.
- The last step is to evaluate the counter measures and select the optimal ones by placing an O underneath.
- Place an X under those that are rejected.
- PDPC should be used when the task is new or unique, complex or potential failure has great risks.
- This tool encourages team members to think about what can happen to a process and how counter measures can be taken.



## 7. Activity Network Diagram:

- A project network is a graph (flow chart) depicting the sequence in which a project's terminal elements are to be completed by showing terminal elements and their dependencies.
- The work breakdown structure or the product breakdown structure show the "part-whole" relations. In contrast, the project network shows the "before-after" relations.
- The most popular form of project network is activity on node, the other one is activity on arrow.
- The condition for a valid project network is that it doesn't contain any circular references.
- Project dependencies can also be depicted by a predecessor table. Although such a form is very inconvenient for human analysis, project management software often offers such a view for data entry.
- An alternative way of showing and analyzing the sequence of project work is the design structure matrix.



## SIX SIGMA



- ❖ **Six Sigma** is a business management strategy originally developed by Motorola, USA in 1986. Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes.
- ❖ It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization ("Black Belts", "Green Belts", etc.) who are experts in these methods.

- ❖ Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified financial targets (cost reduction and/or profit increase). A six sigma process is one in which 99.99966% of the products manufactured are statistically expected to be free of defects (3.4 defects per million).

**SIX SIGMA IS SEVERAL THINGS**

- A statistical basis of measurement: 3.4 defects per million opportunities
- A philosophy and a goal: as perfect as practically possible
- A methodology
- A symbol of quality

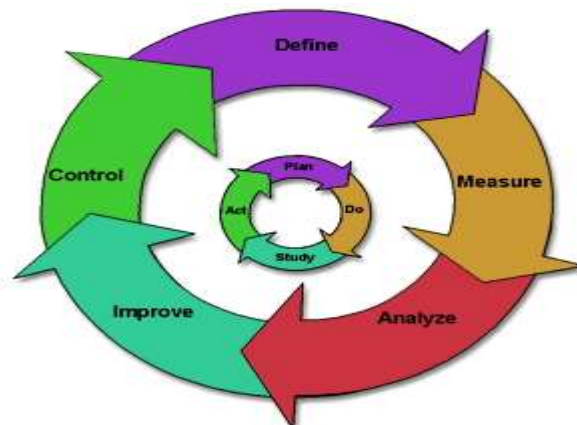
**SIGMA VALUES**

Sigma Level	% Good	PPM/DPMO
2	95.45	45500
3	99.73	2700
4	99.9937	63
5	99.99943	0.57
6	99.999998	0.002

**METHODS:**

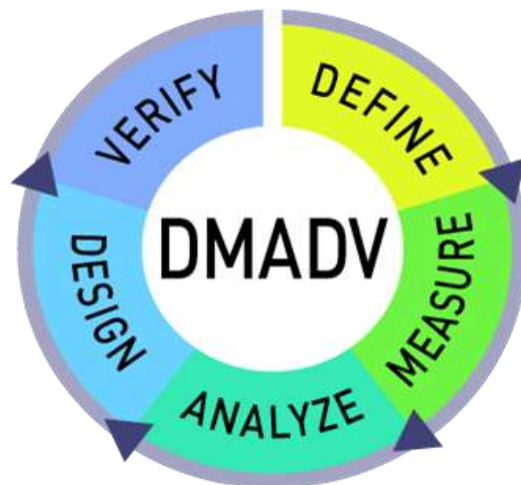
- Six Sigma projects follow two project methodologies inspired by Deming's Plan-Do-Check-Act Cycle.
- These methodologies, composed of five phases each, bear the acronyms DMAIC and DMADV.
- **DMAIC** is used for projects aimed at improving an existing business process.
- **DMADV** is used for projects aimed at creating new product or process designs: DMAIC

**The DMAIC project methodology has five phases:**



- **Define** the problem, the voice of the customer, and the project goals, specifically.
- **Measure** key aspects of the current process and collect relevant data.
- **Analyze** the data to investigate and verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation.
- **Improve** or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- **Control** the future state process to ensure that any deviations from target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process.

### DMADV or DFSS



The DMADV project methodology, also known as DFSS ("Design For Six Sigma"), features five phases:

- **Define** design goals that are consistent with customer demands and the enterprise strategy.
- **Measure** and identify CTQs (characteristics that are **Critical to Quality**), product capabilities, production process capability, and risks.
- **Analyze** to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
- **Design** details, optimize the design, and plan for design verification. This phase may require simulations.
- **Verify** the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

## IMPLEMENTATION:

Six Sigma identifies several key roles for its successful implementation.

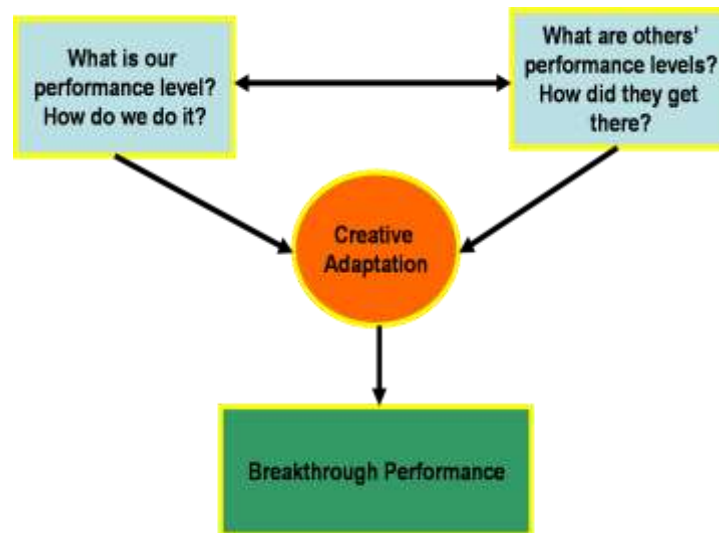
- **Executive Leadership** includes the CEO and other members of top management. They are responsible for setting up a vision for Six Sigma implementation. They also empower the other role holders with the freedom and resources to explore new ideas for breakthrough improvements.
- **Champions** take responsibility for Six Sigma implementation across the organization in an integrated manner. The Executive Leadership draws them from upper management. Champions also act as mentors to Black Belts.
- **Master Black Belts**, identified by champions, act as in-house coaches on Six Sigma. They devote 100% of their time to Six Sigma. They assist champions and guide Black Belts and Green Belts. Apart from statistical tasks, they spend their time on ensuring consistent application of Six Sigma across various functions and departments.
- **Black Belts** operate under Master Black Belts to apply Six Sigma methodology to specific projects. They devote 100% of their time to Six Sigma. They primarily focus on Six Sigma project execution, whereas Champions and Master Black Belts focus on identifying projects/functions for Six Sigma.
- **Green Belts** are the employees who take up Six Sigma implementation along with their other job responsibilities, operating under the guidance of Black Belts.

Some organizations use additional belt colors, such as *Yellow Belts*, for employees that have basic training in Six Sigma tools and generally participate in projects and 'white belts' for those locally trained in the concepts but do not participate in the project team.

### BENCHMARKING

- Benchmarking is a systematic method by which organization can measure themselves against the best industry practices.
- It provides superior performance by providing an organized framework through which organizations learn how the “best in class” do things, understand how these best practices differ from their own and implement change to close the gap.
- The essence of benchmarking is the process of borrowing ideas and adapting them to gain competitive advantage.

## Definition:



## Reasons to benchmark:

- ✓ To achieve business and competitive objectives.
- ✓ To develop organization strengths and reduce weaknesses.
- ✓ To inspire managers to compete
- ✓ It allows goals to be set objectively based on external information
- ✓ Benchmarking is time and cost efficient because the process involves imitation and adaptation rather than pure invention.
- ✓ It provides a working model of an improved process which reduces some of the planning, testing and prototyping efforts.

## Process:

### Six steps:

- ❖ Decide what to benchmark
- ❖ Understand current performance
- ❖ Plan
- ❖ Study others
- ❖ Learn from the data
- ❖ Use the findings

### Step 1: Decide what to benchmark

- ✓ Most organizations have a strategy that defines how the firm wants to position itself and compete in the market place.
- ✓ This strategy is usually expressed in terms of mission and vision statement.
- ✓ Supporting these statements is a set of critical activities which the organization must do successfully to realize its vision.
- ✓ They are often referred as “critical success factors”

### Broad and shallow:

- ✓ What is done?
- ✓ Broad and shallow studies are useful in developing strategies, setting goals and reorganizing functions to be more effective.

### Narrow and Deep:

- ✓ How it is done?

- ✓ It is useful in changing how people perform their jobs.

## **Step 2: Understanding Current Performance**

- ✓ To compare outside practices, it is necessary to thoroughly understand and document the current process.
- ✓ Attention must be paid to inputs and outputs.
- ✓ The benchmarking team should be comprised of those who won or work in the process to ensure suggested changes are actually implemented.
- ✓ When documenting the process it is important to quantify it.
- ✓ Units of measure must be determined.
- ✓ These are the key metrics that will be compared during the benchmarking investigation.
- ✓ Common examples are unit costs, hourly rates, asset measures and quality measures.

## **Step 3: Planning**

- ✓ Once internal processes are understood and documented it is possible to make decisions about how to conduct the study.
- ✓ Benchmark planning is a learning process.
- ✓ The first is to use the information that are available in the public domain to focus the inquiry and to find appropriate benchmark partners.
- ✓ 3 types of benchmarking
  - Internal
  - Competitive
  - Process
- ✓ **Internal**-internal comparisons have several advantages, data are easy to obtain because problems of confidentiality does not exist.
- ✓ **Competitive**-product competitors are an obvious choice to benchmark. An organizations survival depends on its performance relative to the competition.
- ✓ **Process**-process benchmarking is sometimes known as functional or generic benchmarking.

## **Step 4: Studying others**

- ✓ Benchmarking studies look for two types of information: descriptions of how best in class processes are practiced and the measurable results of these practices.
- ✓ In seeking this information bench markers can use internal sources , data in the public domain, original research or most likely a combination of sources.
- ✓ When most people of benchmarking they generally think of conducting original research through site visits and interviews.
- ✓ This is not always necessary and some organizations find industrial tourism a waste of time.
- ✓ Three techniques for conducting original research are questionnaires, site visits and focus groups.

## **Step 5: Learning from the data**

- ✓ Is there a gap between the organizations 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 the best in class practices were adopted what would be the resulting improvement?
- ✓ Benchmarking studies can reveal three different outcomes

- External processes may be significantly better than internal processes( a negative gap)
  - Process performance may be approximately equal(parity)
  - The internal process may be better than that found in external organizations(positive gap)
- ✓ Negative gap calls for a major improvement effort
  - ✓ Parity requires further investigation to determine if improvement opportunities exist.
  - ✓ Positive gap should result in recognition for the internal process.
  - ✓ When best in class processes have been described and quantified, additional analysis is necessary to determine the root causes of the gaps.

#### **Step 6: Use the findings**

- ✓ When a benchmark study reveals a negative gap in performance, the objective is to change the process to close the gap.
- ✓ Benchmarking is a waste of time if change does not occur as a result.

#### **FAILURE MODE AND EFFECT ANALYSIS (FMEA)**

- 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.
- FMEA is a “before the event” action requiring a team effort to easily and inexpensively alleviate changes in design and production.

#### **Types:**

- ❖ Design FMEA
- ❖ Process FMEA

#### **Reliability:**

- Reliability is one of the most important characteristics of any product, no matter what its application.
- It is also an important aspect when dealing with customer satisfaction, whether the customer is internal or external.
- Customers want a product that will have a relatively long service life, with long times between failures.
- Reliability may be defined as the probability of the product to perform as expected for a certain period of time, under the given operating conditions and at a given set of product performance characteristics.

#### **Types of failures:**

- i. Debug
- ii. Chance
- iii. Wear out

**Debug-** includes a high failure rate at the initial stages because of inappropriate use or flaws in the design or manufacturing.

**Chance-**is the failure of the product due to accidents, poor maintenance or limitations on the design.

**Wear out-**covers failure after the product or process has performed as expected for at-least the time given by the manufacturer as the product or process life. A successful design or product should ideally fail only in this last method.

#### **Intent of FMEA:**

- When acquiring new machines, creating a new product or even modifying an existing product, it is always necessary to determine the product or process.
- One of the most powerful methods available for measuring the reliability of the process or product is FMEA.

- FMEA can be implemented both in design and process areas as it basically involves the identification of the potential failure modes and the effect of those on both the internal and external customers.
- FMEA attempts to detect the potential product related failure modes.
- The technique is used to anticipate the causes of failure and prevent them from happening.
- In order to make FMEA as successful, it is extremely important to treat the FMEA as a living document, continually changing as new problems are found and being updated to ensure that the most critical problems are identified and addressed quickly.
- One purpose of FMEA is to compare the design characteristics relative to the planned manufacturing or assembly methods to make certain that the product meets the customer requirements.
- Corrective action should begin as soon as failure mode is identified.
- Consumers today are far more particular than they have been in the past, demanding products of the highest quality for the lowest possible cost.
- FMEA also allows the engineer to keep a record of all thoughts and actions taken to ensure a safe and reliable product.

#### **FMEA Team:**

- The FMEA methodology is a team effort where the possible engineer involves assembly, manufacturing, materials, quality, service, supplier and the customer.
- The team leader has certain responsibilities, which include determining the meeting time and place, communicating with the rest of the team, coordinating with the rest of the team, coordinating corrective action assignment and follow-up, keeping files and records of FMEA forms, leading the team through completion of the forms, keeping the process moving and finally drawing everyone in to participation.
- There also should be a recorder who records the results on the form and distributes to participants in a timely manner.

#### **Stages of FMEA:**

There are four stages of FMEA

##### **Specifying Possibilities**

- ❖ Functions
- ❖ Possible Failure Modes
- ❖ Root Causes
- ❖ Effects
- ❖ Detection/Prevention

##### **Quantifying Risk:**

- ❖ Probability of Cause
- ❖ Severity of Effect
- ❖ Effectiveness of Control to Prevent cause
- ❖ Risk Priority Number

##### **Correcting High Risk causes**

- ❖ Prioritizing Work
- ❖ Detailing Action
- ❖ Assigning Action Responsibility
- ❖ Check Points on completion

## Re-evaluation of Risk:

- ❖ Recalculation of Risk Priority Number

### FMEA DOCUMENTATION

The Design FMEA document

The top section in the form is used mainly for document tracking and organization.

- 1. FMEA Number:** On the top left corner of the document is the FMEA number, which is only needed for tracking
- 2. Item:** The item space is used only to clarify which exact component or process is being analyzed.
- 3. Design Responsibility:** The team in charge of the design or process should be included. The name and company of the person or group responsible for preparing the document should be included.
- 4. Prepared By:** The name, telephone number and address should be included.
- 5. Model number/Year:** Both the name and identification number of the system, sub-system or component should be included to avoid confusion between similar components.
- 6. Key Date:** The date the initial FMEA is due should be placed.
- 7. FMEA date:** The date the original FMEA was compiled and the latest revision date should be placed in the FMEA date space.
- 8. Core Team:** The names of the responsible individuals and departments that have authority to perform tasks should be listed.
- 9. Item/Function:** The name and number of the item being analyzed is recorded here. This information should be as precise as possible to avoid confusion involving similar items. Next the function of the item is to be entered here.
- 10. Potential failure Mode:** It may be the method in which the item being analyzed may fail to meet the design criteria.
- 11. Potential Effects of Failure:** It is the effect of failure as perceived by the customer. The effects of failure must be described in terms of what the customer will notice or experience in the product.
- 12. Severity:** Severity is the assessment of the seriousness of the effect of the potential failure mode to the next component, subsystem, system or customer if it occurs.
- 13. Classification:** This column is used to classify any special product characteristics for components, subsystems or systems that may require additional process controls.
- 14. Potential Causes/ Mechanisms of Failure:** The failure modes may have more than one cause or mechanism of failure, each of these must be examined and listed separately. Then each of these causes must be reviewed with equal weight.
- 15. Occurrence:** Occurrence is the chance that one of the specific cause/mechanism will occur.
- 16. Current Design Controls:** It consist of prevention measures, design validation and design verification.
- 17. Detection:** It is a relative measure of the assessment of the ability of the design control to detect either a potential cause/mechanism before the component, subsystem or system is completed for production.
- 18. Risk Priority Number (RPN):**  $RPN = (S) * (O) * (D)$
- 19. Recommended Actions:** After every concern has been examined and given a risk priority number, the team should begin to examine the corrective actions that may be employed, beginning with the greatest RPN and moving to descending RPN number
- 20. Responsibility and Target Completion dates:** Here the individual or group responsible for the recommended actions and the target completion date should be entered.

**21. Actions Taken:** After an action has been implemented, a brief description of the actual action and its effective date should be entered.

## UNIT-IV

### TQM TOOLS AND TECHNIQUES II

#### **Introduction:**

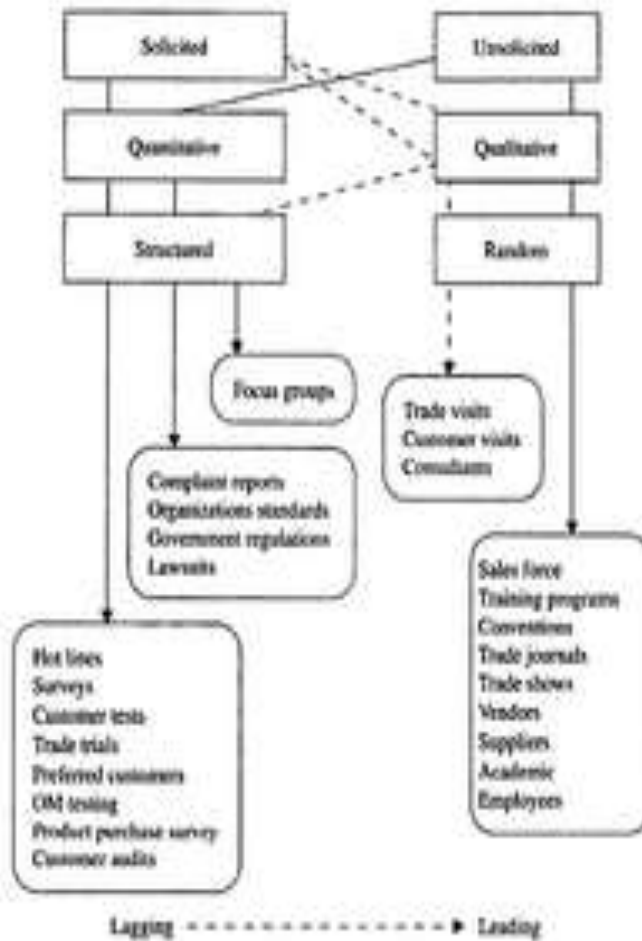
- Quality Function Deployment (QFD) is a planning tool used to fulfill customer expectations.
- It is a disciplined approach to product design, engineering and production and provides in-depth evaluation of a product.
- QFD focuses on customer expectations or requirements often referred to as the voice of the customer.
- It is employed to translate customer expectations in terms of specific requirements, in two directions and actions, in terms of engineering or technical characteristics that can be deployed through
  - Product planning
  - Part development
  - Process Planning
  - Production Planning
  - Service Industries

#### **QFD Team:**

- When an organization decides to implement QFD, the project manager and team members need to be able to commit a significant amount of time to it, especially in the early stages.
- Teams compose of members from marketing, design, quality, finance and production.
- One of the most important tools in the QFD process is communication.
- Team meetings are very important in the QFD process.
- The team leader needs to ensure that the meetings run in the most efficient manner and that the members are kept informed.
- The meeting format should have some way of measuring how well the QFD process is working at each meeting and should be flexible depending on certain situations.

#### **Voice of the Customer:**

- Words used by the customer to describe their expectations are often referred to as the voice of the customer.
- Customer satisfaction like quality is defined as meeting or exceeding customer expectations.
- QFD begins with marketing to determine what exactly the customer desires from a product.
- During the collection of information, the QFD team must continually ask and answer numerous questions such as
  - a) What does the customer really want?
  - b) What are the customers' expectations?
  - c) Are the customers' expectations used to drive the design process?
  - d) What can the design team do to achieve customer satisfaction?

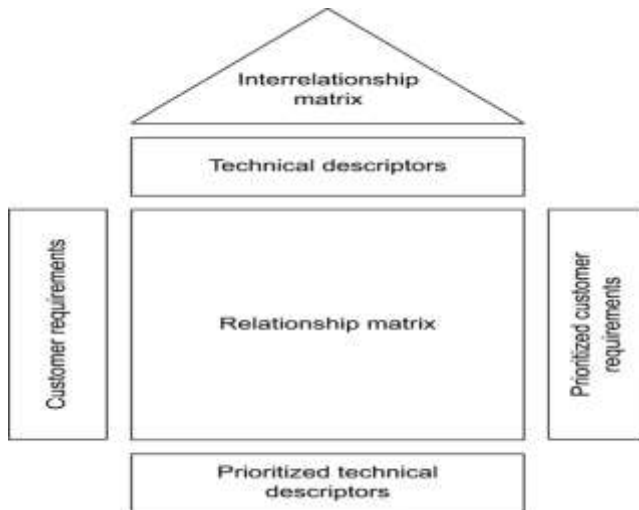


**Organization of Information**

**House of Quality:**

The primary planning tool used in QFD is the house of quality. The house of quality translates the voice of the customer in to design requirements that meet specific target values and matches those against how an organization will meet those requirements.

Many managers and engineers consider the house of quality to be primary chart in quality planning.



## Building a House of Quality:

### Step1: List Customer Requirements (WHATs)

QFD starts with a list of goals and objectives.

- This list is often referred as the WHATs that a customer needs or expects in a particular product.
- This list of primary customer requirements is usually vague and very general in nature.
- Further a most detailed list of secondary customer requirements is needed to support the primary customer requirements.

Customer requirements (WHATs)	Primary	Secondary	Tertiary
	Aesthetics	Reasonable cost	
Aerodynamic look			
Nice finish			
Performance	Corrosion resistant		
	Lightweight		
	Strength		
	Durable		

### Step 2: List Technical Descriptors (HOWs)

- The goal of the house of quality is to design or change the design of a product in away that meets or exceeds the customer expectations.
- Here the customer needs and expectations are expressed in terms of customer requirements; it is the duty of the QFD team to convert these requirements in to engineering characteristics or technical descriptors.
- Implementation of the customer requirements is difficult until they are translated in to counterpart characteristics.
- Counterpart characteristics are an expression of the voice of the customer in technical language.
- The list of technical descriptors is divided in two primary, secondary and tertiary technical descriptors.

- Determine their respective relationships.
- One way to reduce the confusion associated with determining the relationships between customer requirements and technical descriptors is to use an L-Shaped matrix.
- The L-Shaped matrix makes interpreting the complex relations very easy and does not require a significant amount of experience.

	Primary	Secondary	Tertiary
Technical descriptors (HOWs)	Material selection	Steel	
		Aluminum	
		Titanium	
	Manufacturing process	Welding	
		Die casting	
		Sand casting	
		Forging	
		Powder metallurgy	

### Step 3: Relationship Matrix

- The inside of the house of quality is called as the relationship matrix and it is usually filled by the QFD team.
- It is common to use symbols to represent the relationship between the customer requirements and descriptors.

Example:

- A solid circle represents a strong relationship
- A single circle represents a medium relationship
- A triangle represents a weak relationship.



An empty column indicates that a particular technical descriptor does not affect any of the customer requirements and after careful scrutiny may be removed from the house of quality.

### Step 4: Develop an interrelationship Matrix between HOWs

- The roof of the house of the quality called the correlation matrix is used to identify any interrelationships between each of the technical descriptors.

Symbols:

- ✓ A solid circle represents a strong positive relationship
- ✓ A circle represents a positive relationship

- ✓ An X represents a negative relationship
- ✓ An asterisk represents a strong negative relationship.

#### **Step 5: Competitive Assessments**

- The competitive assessments are a pair of weighted tables that depict item for item how competitive products are compared with current organization products.
- The competitive assessment tables are separated in to two categories customer assessment and technical assessment.
- The numbers 1 through 5 are listed in the competitive evaluation column to indicate a rating of 1 for worst and 5 for best.
- The customer competitive assessment is a good way to determine is the customer requirements has been met and identifies areas to concentrate in on the next design.

#### **Technical Competitive Assessment:**

- Customer requirements and technical descriptors that are strongly related should also exhibit a strong relationship in their competitive assessments.
- If an organization technical assessment shows its products to be superior to the competition, then the customer assessment should show a superior assessment.
- If the customer disagrees, then a mistake in engineering judgement has occurred and should be corrected.

#### **Step 6: Develop Prioritized customer requirements**

- Importance to customer
- Target value
- Scale-up factor
- Sales point
- An absolute weight

#### **Step 7: Develop Prioritized technical descriptors**

- Degree of technical difficulty
- Target value
- Absolute weights
- Relative weights

### **TOTAL PRODUCTIVE MAINTENANCE**

#### **Definition:**

TPM (Total Productive Maintenance) is a maintenance philosophy designed to integrate equipment maintenance into the manufacturing process. The goal of any TPM program is to eliminate losses tied to equipment maintenance or, in other words, keep equipment producing only good product, as fast as possible with no unplanned downtime.

## Meaning:

**Total-** All encompassing by maintenance and production individuals working together.

**Productive-** Production of goods and services that meet or exceed customers expectations

**Maintenance-** Keeping equipment and plant in as good as or better than the original condition at all times.

## Steps:

- ❖ Management learns the new philosophy
- ❖ Management promotes the new philosophy
- ❖ Training is funded and developed for everyone in the organization
- ❖ Areas of needed improvement are identified
- ❖ Performance goals are formulated
- ❖ An implementation plan is developed
- ❖ Autonomous work groups are established.

### 1. Learning the new philosophy:

- ✓ TPM is merely trying to tap in to an unused resource, the brain power and problem solving ability of all the organizations employees.
- ✓ Thus it is necessary to allow people to make decisions.
- ✓ Many organizations have had the flavor-of-the-mouth approach to changing management techniques.
- ✓ This approach has led to credibility problems with employees.
- ✓ Management is changed and the new manger does not build on past accomplishments but develops a new system that will presumably solve all of the organizations problems.
- ✓ Lack of ownership seems to cause low cause morale and dissatisfaction with management.
- ✓ Ownership should be based on what is good for the customer and for the employees that serve the customer.

### 2. Promoting the new philosophy:

- ✓ Senior management must spend more time in promoting the system.
- ✓ They must sell the idea and let the employees know that they are totally committed to its success.
- ✓ If the belief in the new philosophy and commitment are not there, then positive results will not happen.
- ✓ Too often lip service is given to a “new idea”.
- ✓ This can be solved by a belief that the new system will solve some immediate problems and lead to an immediate return on investment.
- ✓ A long term commitment to the new philosophy is required.
- ✓ One of the best ways to implement the new philosophy is just to start doing it.
- ✓ In other words start giving the maintenance and production personnel more autonomy.
- ✓ Once the employees realize that management is serious about taking the organization in a new, more positive direction, employees will usually respond.

### 3. Training:

- ✓ Teach the new philosophy to mangers at all levels.
- ✓ Begin with senior management and work down to first line supervisors.
- ✓ Don't teach the **HOW** also teach the **WHY**

- ✓ Senior management must spend time learning about and understanding the ramifications of this philosophy to their organization.
- ✓ Some managers are needed to be replaced because they don't accept change and also identify managers who readily respond to new philosophy.
- ✓ First line supervisors need to learn their role in what most likely will be a new environment.
- ✓ There needs to be some instruction in the areas of jobs that maintenance people do and jobs that production people do.
- ✓ A great benefit of TPM is the cross-pollination of ideas between maintenance technicians and production operators.

#### **4. Improvement Needs:**

- ✓ There are usually some machines that seem to be on the verge of breaking down or require an excessive amount of maintenance.
- ✓ Employees who work with the equipment on a daily basis are better able to identify those conditions than anyone else in the organization.
- ✓ A good first step is to let the operators and maintenance technicians tell management which machines and systems need the most attention.
- ✓ An implementation team of operators and technicians to coordinate this process is essential.

#### **Six Losses:**

Downtime Losses:

- ❖ **Planned**
  - ✓ Start ups
  - ✓ Shift Changes
  - ✓ Coffee and lunch breaks
- ❖ **Unplanned:**
  - ✓ Equipment breakdown
  - ✓ Change over's
  - ✓ Lack of material
- ❖ Idling and minor stoppages
- ❖ Slow downs and poor quality losses
- ❖ Process nonconformities
- ❖ Scrap

#### **5. Goal:**

- ✓ Goal should be set after the improvement needs are identified.
- ✓ The first goal is to establish the time frame for fixing the prioritized problem.
- ✓ Technicians and operators will probably want it done faster than management because it causes them more problems on a daily basis.
- ✓ Identifying needs and setting goals begins the process of getting the organization to work as a team.

#### **6. Developing Plans:**

- ✓ First, develop and implement an overall plan of action for training all employees.
- ✓ Plans for developing the autonomous work groups should take place during the training phase.

- ✓ Plan to use, team of maintenance technicians and operators to work on particularly troublesome problems.
- ✓ Priorities can be set and management can make a commitment with resources to correct some of the basic problems.

## **7. Autonomous Work Groups:**

- ✓ Autonomous work groups are established based on the natural flow of activity.
- ✓ First make the operator responsible for the equipment and the level of maintenance that he is capable of performing.
- ✓ Next, identify the maintenance personnel who work in certain areas or have certain skill levels.
- ✓ Operators and maintenance personnel are brought together resulting in an autonomous work group.
- ✓ These groups must have the authority to make decisions about keeping the equipment in first class running order.

## **COST OF QUALITY**

Quality costs are defined as those costs associated with the non-achievement of product or service quality as defined by the requirements established by the organization and its contracts with customers and society.

*Simply stated, quality cost is the cost of poor products or services.*

## **CATEGORIES & ELEMENTS OF QUALITY COST**

### **I. Preventive Cost Category**

#### **1. Marketing/Consumer/User:**

Costs are incurred in the accumulation and continued evaluation of customer and user quality needs and perceptions affecting user satisfaction with the organizations product or service.

#### **2. Product/Service/Design Development:**

Costs are incurred to translate customer and user needs in to reliable quality standards and requirements and to manage the quality of new product or service.

#### **3. Purchasing:**

Costs are incurred to assure conformance requirements of supplier parts, materials or processes and to minimize the impact of supplier non conformance on the quality of delivered products or services.

#### **4. Operations (Manufacturing or service):**

Costs are incurred in assuring the capability and readiness of operations to meet quality standards and requirements and to impart quality education to operating personnel.

#### **5. Quality Administration:**

Costs are incurred in the overall administration of the quality management function.

## **II. Appraisal Cost Category**

### **1. Purchasing Appraisal Costs:**

Purchasing appraisal costs can generally be considered the costs incurred for the inspection and test of purchased supplies or service to determine acceptability to use.

### **2. Operations (Manufacturing or service) Appraisal Costs:**

Operations appraisal costs can generally be considered the costs incurred for the test or audit required to determine and assure the acceptability of product or service.

### **3. External Appraisal Costs:**

External appraisal costs are incurred for field set up or installation and check out for the acceptance of customers.

### **4. Review of Test & Inspection:**

Costs are incurred for regular reviewing inspection and test data, prior to release of the product for shipment.

### **5. Miscellaneous Quality Evaluations:**

Costs involved in quality audits to assure continued ability to provide acceptable support to the production process.

## **III. Internal Failure Cost Category**

### **1. Product or Service Design Failure Costs (Internal):**

Design failure costs are the unplanned costs that are incurred because of inherent design inadequacies.

### **2. Purchasing Failure Costs:**

Costs which are incurred due to the rejects of purchased items.

### **3. Operations (Product or Service) Failure Costs:**

The costs associated with nonconforming product or service discovered during the operations process. It is categorized in to three distinct areas: material review and corrective action, rework or repair costs and scrap costs.

## **IV. External Failure Cost Category**

### **1. Complaint Investigations of Customer or User Service:**

It includes the total cost of investigating, resolving and responding to individual customer and user complaints.

### **2. Returned Goods:**

Costs incurred in evaluating, repairing and replacing goods.

### **3. Retrofit and Recall costs**

Retrofit and recall costs are those costs required to modify or update products or field service facilities to a new design change level, based on major redesign due to design deficiencies.

#### **4. Warranty Claims**

Warranty costs include the total costs of claims paid to the customer or user after acceptance to cover expenses, including repair costs, such as removing defective hardware from a system, or cleaning costs, due to food or chemical service accident.

#### **5. Liability Costs**

Liability costs are organization-paid costs due to liability claims, including the cost of product or service liability insurance.

#### **6. Penalties**

Penalty costs are those costs incurred because less than full product or service performance is achieved as required by contracts with customers or by government rules and regulations.

#### **7. Customer or user good will**

This category involves costs incurred that customers are not satisfied with quality of delivered product or service because the customer's quality expectations were greater than the quality they received.

#### **8. Lost Sales**

Lost sales comprise the value of the contribution to profit that is lost due to sales reduction because of quality problems.

## UNIT-V QUALITY MANAGEMENT SYSTEMS

*ISO stands for International Organization for Standardization*

### ISO 9001 REQUIREMENTS

1. Scope

2. Normative References

3. Definitions

#### **4. Quality Management Systems**

- ✓ Documentation
  - Quality Manual
  - Control of documents
  - Control of records

#### **5. Management Responsibility**

- ✓ Management Commitment
- ✓ Customer Focus
- ✓ Quality policy
- ✓ Planning
- ✓ Responsibility, authority and communication
- ✓ Management review

#### **6. Resource Management**

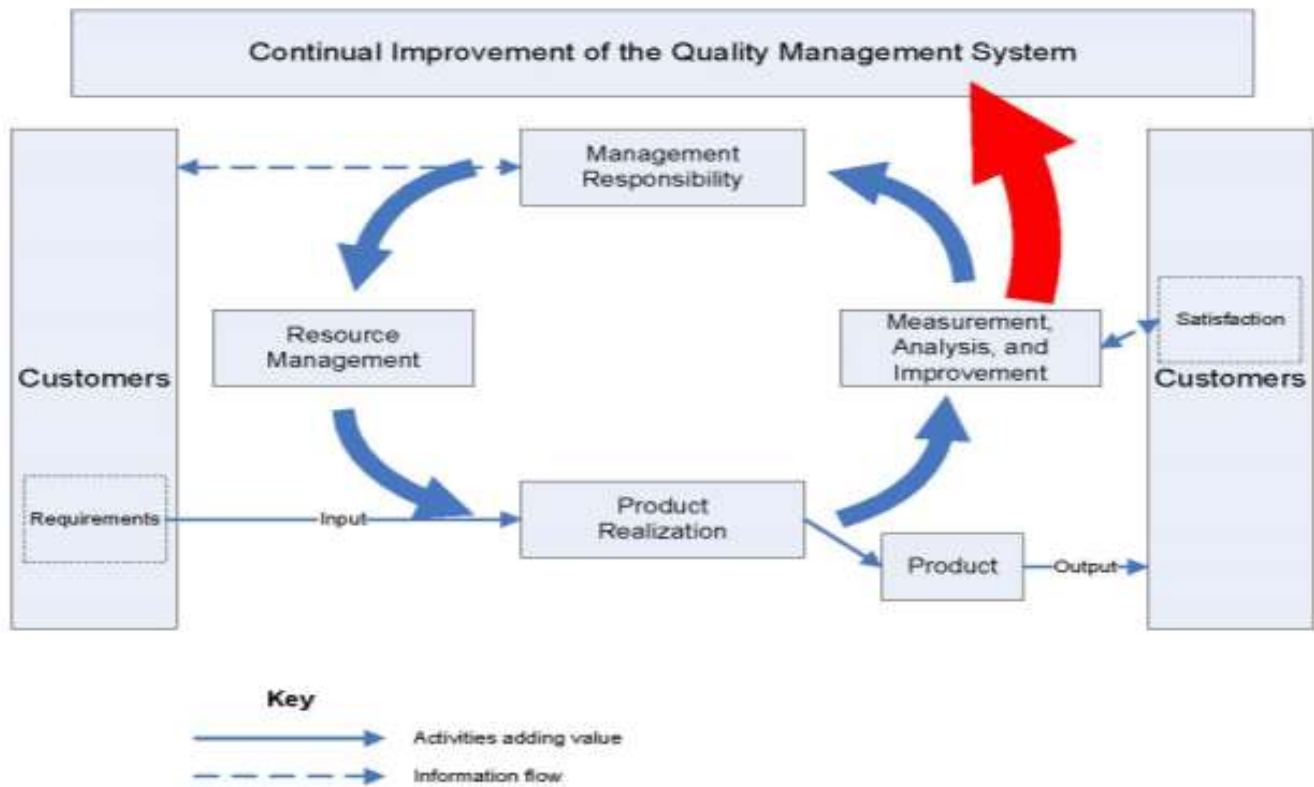
- ✓ Human resources
- ✓ Infrastructure
- ✓ Work Environment

#### **7. Product or service realization**

- ✓ Planning of product realization
- ✓ Customer related processes
- ✓ Design and development

#### **8. Measurement, Analysis and improvement**

- ✓ Monitoring and measuring
- ✓ Analysis of data
- ✓ Improvement



## ISO 9001 IMPLEMENTATION

### **Top Management Commitment:**

- ❖ The chief executive officer (CEO) must be willing to commit the resources necessary to achieve the certification.
- ❖ Without the CEO's support the process may continuously run in to unnecessary road blocks or even be doomed to failure.

### **Appoint the Management Representative:**

- ❖ The next step is to appoint the management representative.
- ❖ This person is responsible for coordinating the implementation and maintenance of quality system and he is the contact person for all parties involved in the process both internal and external.
- ❖ The representative can be a member of the top management group who is able to ensure that the quality system is effectively implemented, documented and maintained.

### **Awareness:**

- ❖ An awareness program is required because the process is going to affect every member of the organization as well require their input, it stands to reason that everyone should understand the quality system.
- ❖ The employees should know how it will affect their day-to-day operations and the potential benefits.
- ❖ This information can be relayed through short, one hour awareness training sessions.

### **Appoint an implementation team:**

- ❖ After every one has been informed of the organizations intentions to develop the quality system, an implementation team should be assembled.

- ❖ This team should be drawn from all levels and areas of the organization so that it is representative.
- ❖ It is important to keep the project visible for all employees.

#### **Training:**

- ❖ The implementation team, supervisor and internal audit team should be trained.
- ❖ This activity can be accomplished by sending team leaders for training and make them to train the rest of the members by one or two day seminar.

#### **Time Schedule:**

- ❖ A time schedule has to be framed for the implementation and registration of the system.
- ❖ This time frame will vary depending on the size and type of organization and the extent of its existing quality system.
- ❖ Most organizations can complete this entire process in less than 1.5 years.

#### **Select Element Owners:**

- ❖ The implementation team should select owners for each of the system elements.
- ❖ Many of these owners will be the members of the implementation team.
- ❖ Owners may be assigned more than one element.
- ❖ The more people involved, the more effective the system.

#### **Review the present system:**

- ❖ The present system has to be reviewed.
- ❖ Copies of all the quality manuals, procedures, work instructions and forms which are used presently are obtained.
- ❖ These documents are sorted in to system elements to determine what is available and what is needed to complete the system.
- ❖ This is called as gap analysis.

#### **Write the document:**

- ❖ Prepare written quality policy and procedure manuals, they can be combined in to one document.
- ❖ Write appropriate work instructions to maintain the quality of specific function.
- ❖ This process should involve every employee, because the best person to work with instruction is the one who performs the job on a regular basis.

#### **Install the new system:**

- ❖ Integrate the policies, procedures and work instructions in to the day today workings of the organization and document what is being done.
- ❖ Be sure all people are trained.

#### **Internal Audit:**

- ❖ Conduct an internal audit of the quality system.
- ❖ This step is necessary to ensure that the system is working effectively.
- ❖ Minor corrections to the system are made as they occur.
- ❖ A cross section of the trained people should be used for the audit team.

#### **Management Review:**

- ❖ A management review is conducted.
- ❖ The management review is used to determine the effectiveness in achieving the stated quality

## Pre assessment:

- ❖ This step is optional.
- ❖ If a good job has been done on the previous steps pre assessment is not necessary.

## Registration:

- ❖ It has three parts
  - ❖ Choosing a registrar
  - ❖ Submitting an application
  - ❖ Conducting the registrar's system audit.
- A registrar's audit usually lasts one to three days and will consist of an opening meeting, the process the auditors will follow, the audit itself and closing meeting to discuss the findings of the audit.

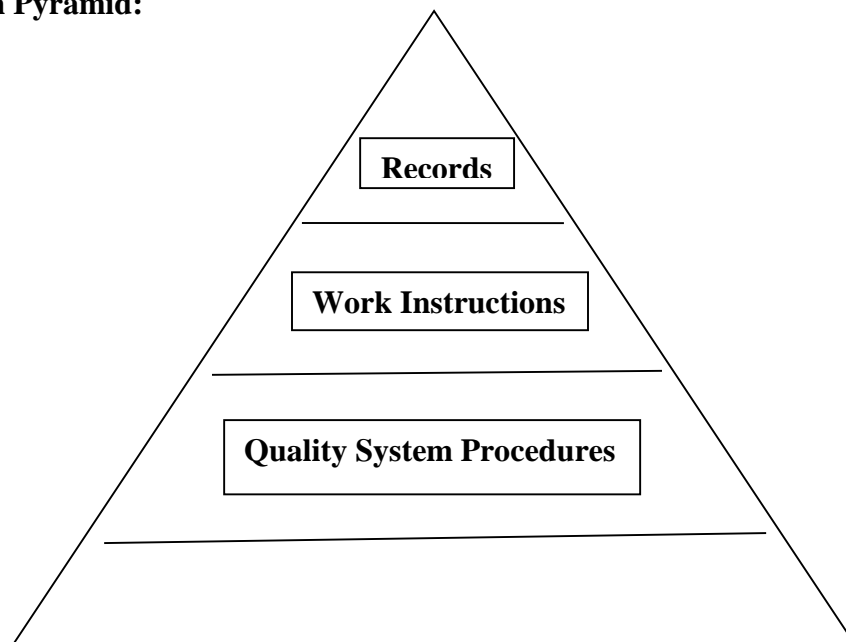
## DOCUMENTATION OF QUALITY SYSTEM

- ❖ Proper documentation is the pre-requisite for implementing quality system.
- ❖ The documentation serves as a reference for the management, the staff and other agencies whose involvement is essential for implementation of the quality system.
- ❖ Advantages of having a documented quality system:
  - ✓ Serves as a reference
  - ✓ Brings about clarity of objectives and targets
  - ✓ Provides standardization in work procedures
  - ✓ Brings about consistency in operations
  - ✓ Develops confidence amongst employees
  - ✓ Generates customer confidence
  - ✓ Provides a basis for continuous improvement

## Documents to be prepared:

- ❖ Quality Policy Manual
- ❖ Quality System Procedures
- ❖ Work Instructions
- ❖ Records/formats/forms

## The documentation Pyramid:



## Quality Policy Manual

### 1. Quality Policy Manual:

- ✓ Quality policy manual is the first level of documentation. This is the document that defines ‘what will be done ‘and ‘why’.
- ✓ It should be short and simple definition of the organizations quality intentions.
- ✓ The remainder of the policy manual addresses what will be done to comply with the standard being used.
- ✓ The policy manual communicates the quality policy and objectives of an organization.
- ✓ This manual is a living document. Because it reflects the current system being followed in the organization.

### 2. Quality System Procedures:

- ✓ The second level of documentation is the quality procedures. These procedures describe the methods that will be used to implement and perform the stated policies.
- ✓ These procedures define who should perform specific tasks, when the task should be done and where the documentation will be made.
- ✓ These documents collectively define the organizations operations from receiving an enquiry to delivering a completed product or service.
- ✓ These procedures are confidential documents of the organization and therefore need not to be revealed to others.

### 3. Work Instructions:

- ✓ The third level of documentation is generally company specific. It gives details of how individual work processes (e.g.: welding, casting) are carried out with in a company.
- ✓ Work instructions should also specify how the work should be done, who should undertake the work and what records are to be maintained.
- ✓ The work instructions may be in the form of a detailed drawing, recipe, routing sheet, specific job function, photograph, video or simply a sample for comparison of conformity.
- ✓ The work instructions should be written by the employee who performs the task.

### 4. Records:

- ✓ These provide evidence of activity having been performed in compliance with quality system procedure.
- ✓ Records may be forms that are filled out, a stamp of approval on a product or a signature and date on some type of document.

## QUALITY AUDITING

- ❖ Quality auditing should be carried out in order to verify whether a quality system is effective and suitable.

## Definition:

A quality system audit is defined as “a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements, whether these arrangements are implemented effectively and whether these are suitable to achieve objectives”

## Objectives of Quality Audits:

- ✓ To determine the conformity or non-conformity of the quality system elements with regard to specified requirements.
- ✓ To determine the effectiveness of the implemented quality system in meeting specified quality objectives.
- ✓ To meet regulatory requirements, if applicable.
- ✓ To permit the listing of the audited organizations quality system in a register for third party certification.
- ✓ To evaluate an organizations own quality system against a quality system standard.

## Types of Audits:

### ❖ **First party audit (or internal audit):**

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

### ❖ **Second party audit:**

This refers to audit by one organization on another organization (auditee). This type of audit is normally done on a supplier by a customer.

### ❖ **Third party audit:**

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

## Stages of an Audit:

There are four stages

1. Audit Planning
2. Audit Performance
3. Audit reporting
4. Audit follow-up

### **Stage 1: Audit Planning (It has 4 key elements)**

- i. **Audit schedules:** It is a matrix of the timings, which details when each audit element is to be checked throughout the year.
- ii. **Audit personnel:** It refers to the appointment of an auditor.
- iii. **Notification to the auditee:** This is the formal and timely request by audit to auditee for making available all quality system documents relevant to the audit.
- iv. **Preparation of checklist:** This lists all specific questions to be asked during audit.

## **Stage 2: Audit Performance**

- i. **Opening/entry meetings:** Opening meeting is organized to initially brief the auditee about the scope of audit.
- ii. **Audit process:** Audit is done according to the schedule and should cover entire scope, as planned. Regular liaison meetings should be held.
- iii. **Audit deficiencies:** During auditing, clear and precise discrepancy reports are raised. All discrepancies should be based on sound and objective evidence.

## **Stage 3: Audit Reporting**

- i. Audit reporting deals with the recording of any non conformity and summarizing the audit findings.
- ii. The audit report may contain:
  - Identification of the reference documents against which audit is conducted (ie quality system standard), company's quality manual.
  - Observation of non conformities
  - Corrective action requests

## **Stage 4: Audit Follow-up**

- i. The auditor is only responsible for identifying the non conformity. But the auditee is responsible for determining and initiating corrective action needed to correct a non conformity.
- ii. Corrective action and subsequent follow up should be completed within a time period.

**These 4 stages complete the ISO 9000 quality system audit**

## **ISO 14001**

### **What is ISO 14001?**

- It is an Environmental Management System (EMS) that uses a continual improvement approach in achieving and demonstrating sound environmental performance.
- The goal is for organizations to control the impacts that their activities, products and services have on the environment.
- ISO 14000 is the standard, and ISO 14001 is the document containing the requirements.

### **Overview of the Requirements of the ISO 14001 Standard**

- The organization must develop an effective system that meets the requirements of the Standard.
- Document, implement and maintain the system.
- The EMS documents need to be controlled.

### **Follow a Plan-Do-Check-Act approach.**

- Plan - Establish the objectives and processes needed to deliver the results (in line with the EMS).
- Do - Implement the needed processes of the EMS.

- Check - Check the processes against the policy, objectives, targets, regulations, and report on the results. (Auditing)
- Act - Take actions that will continually improve the EMS.

### **Requirements (Plan): Management**

- Top Management must be committed to and involved in the design and implementation of the EMS.
- They will write the Environmental Policy and be responsible for making sure it is communicated and implemented.
- Many specific responsibilities are assigned to Top Management to ensure their input and participation.
- After implementation Management will conduct management review to ensure continued effectiveness of the system.
- Requirements (Plan): Resources
- The EMS must clarify what resources, human and physical are required to create safe products and operations.
- During development of the system you will determine how to ensure competent personnel, identify training that is required, and identify the infrastructure and work environment required
- Requirements (Plan): Form EMS
- Your organization will need to plan all of the processes that go into making your product to ensure safe conditions.
- You will need to state of scope of the EMS and clearly identify the products and define the locations or sites that are part of the EMS.

### **Requirements (Do): Environmental Review**

- An initial environmental review will be needed.
- An assessment of environmental aspects and their Impacts will have to be performed.
- Regulatory, legal and other requirements will need to be identified.
- Environmental programs with targets and objectives will need to be established, implemented and evaluated on an ongoing basis.
- Emergency preparedness procedures will be required to address potential accidents and emergencies.
- Measuring and monitoring of product and process characteristics that can have an impact on the environment will be required.
  - Measuring and monitoring equipment will need to be controlled and calibrated.
  - A process will be needed for the Environmental Safety Team to evaluate compliance to legal and other requirements.

## **Requirements (Check):Control Nonconformities**

- Establish and document a system for controlling nonconformities.
  - When specified product and process limits are exceeded potentially unsafe conditions must be identified, assessed, controlled and dispositioned appropriately.
  - Identify corrections and corrective actions to mitigate environmental impacts and to eliminate the nonconformity and its cause.
- Establish the internal audit process.
  - Train auditors, and plan internal audits to establish an audit program that will determine if the EMS is effective and up to date.
- Control the records associated with the EMS.
- Conduct regular management reviews to ensure effectiveness of the EMS.

## **Requirements (Act): Improve your EMS**

- Continually improve the EMS through the use of:
  - Management reviews
  - Internal audits
  - Corrective actions
  - Analysis of data / results
  - Update the EMS

## **ISO 14001 IMPLEMENTATION STEPS**

Implementation: Conduct the Environmental Gap Analysis

**You must determine your position with regards to the environment:**

- Are there GAPS that need to be bridged?
- What are they and where are they located?
- How can they be improved?
- Who will be taking corrective / preventive actions?

**Your environmental position needs to be analyzed so that the GAPS can be bridged / closed.**

Conduct the Environmental Gap Analysis

**Conduct a Gap Analysis – Complete a series of assessments in the following order:**

- Perform Initial Environmental Review
- Perform Environmental Assessment – Aspects/Impacts

- Identify Legal and Other Requirements
- Identify Environmental programs with objectives and targets

**Based on the results of the assessments, implement Improvement actions.**

- Implementation: Form a Team
- Appoint a Management Representative
  - This individual will be the ISO project manager.
- Assign a Environmental Safety Team
  - This team will be active in the design and development of the EMS and participate in the on going operation of the system.
- Assign a Management Team
  - This team will be providing the direction and guidance for the development and implementation of the EMS.
- The Management Team will act as a steering team for the project, assigning responsibilities, providing resources and coordinating the project.
  - The Management Team can assign task teams to work on specific processes that must be designed and documented for the EMS.
- Each task team will evaluate the current process that they are assigned to and the requirements of the standard.
  - A new or modified process will be developed, documented and submitted to the Management Team for review and approval.
- After the task teams have designed and documented a new or modified process, it must be implemented.
- Train all employees that are involved in the process
- When the required processes have been implemented, start your internal audit program and management review meetings.
- Use information / results from internal audits and management review to make improvements to the EMS.
- Run your system long enough to generate records for the Registrar to audit.
- Make sure all employees are trained on ISO 14001
- Have a Registrar conduct your Registration Audit.

# GE8077-TOTAL QUALITY MANAGEMENT

## UNIT I INTRODUCTION

### 1. Define 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(Juran).
- 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).

### 2. Define Quality?

Quality = Performance x Expectations

### 3. Define Total Quality?

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

### 4. Give the Basic Concepts of TQM?

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

### 5. List the dimensions of quality. The dimensions of quality are

1. Performance
2. Futures
3. Conformance
4. Reliability
5. Durability
6. Service
7. Response
8. Aesthetics and
9. Repetition.

### 6. What are the three components of the Juran Trilogy?

The three components of the Juran Trilogy are

- Planning
- Control
- Improvement

## 7. What are the six basic concepts that a successful TQM programme requires?

The six basic concepts that a successful TQM programme requires

1. Top management commitment
2. Focus on the customer
3. Effective employee involvement
4. Continuous improvement
5. Treating suppliers as partners and
6. Establishing performance measures.

## 8. What are the pillars of TQM?

The four pillars of TQM are:

1. Problem solving discipline
2. Interpersonal skills
3. Teamwork and
4. Quality improvement process

## 9. Give the Objectives of TQM?

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

## 10. Give the Quality Hierarchy?

- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Inspection               | Inspect products. Detection |
| 2. Quality Control (QC)     | Finding &                   |
| 3. Quality Assurance (QA)   | Fixing Mistakes.            |
| 4. Total Quality Management |                             |

## 11. Tabulate the tangible and intangible benefits of TQM. tangible Benefits

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| • Improved product quality       | • Improved teamwork                 |
| • Improved productivity          | • Improved working relationships    |
| • Reduced quality costs          | • Improved customer satisfaction    |
| • Increased market and customers | • Improved communication            |
| • Increased profitability        | • Enhancement of job interest       |
| • Reduced employee grievances    | • Enhanced problem-solving capacity |
| Intangible Benefits              |                                     |
| Improved employee participation  |                                     |

## 12. What does a typical meeting agenda contain after establishing the TQM?

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

## **UNIT-2 TOM PRINCIPLES**

### **1. Who are internal and external customers?**

The customers inside the company are called internal customers, whereas the customers outside the company are called external customers.

### **2. What are the customer's perceptions on quality?**

The six important customer's perceptions are:

- Performance
- Features
- Service
- Warranty
- Price and
- Reputation.

### **3. List the various tools used for collecting customer complaints.**

The various tools used are:

1. Comment card.
1. 2. Customer questionnaire
2. Focus groups
3. Toll-free telephone numbers
4. Report cards
5. The Internet and computer etc.

### **4. What is meant by customer retention?**

Customer retention is the process of retaining the existing customers.

### **5. What is motivation?**

Motivation means a process of stimulation people to accomplish desired goals.

### **6. What are the Maslow's basic needs?**

Maslow's basic needs are:

1. 1. Physiological
2. 2. Safety
3. 3. Society
4. 4. Esteem and
5. 5. Self-actualization needs.

### **7. What are physiological needs?**

Physiological needs are the biological needs required to preserve human life. These needs include needs for food, clothing and shelter

## **8. List the Herzberg's motivators and dissatisfies.**

Motivator factors or hygiene factors

- Achievement
- Recognition
- The work itself
- Responsibility
- Advancement and growth.
- Supervisors
- Working conditions
- Interpersonal relationships
- Pay and security
- Company policy and Administration

## **9. Define empowerment. (Au Nov 05)**

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

## **10. What are the conditions necessary for empowerment?**

The conditions required are:

1. Everyone must understand the need for change.
2. The system needs to change to the new paradigm.
3. The organization must provide information, education and skill to its employees.

## **11. Define team and teamwork.**

- A team can be defined as a group of people working together to achieve common objectives or goals.
- Teamwork is the cumulative actions of the team during which each member of the team subordinates his individual interests and opinions to fulfill the objectives or goals of the group.

## **12. List the different types of teams.**

The different types of teams are

1. Process improvement team
2. Cross-functional team
3. Natural work team and
4. Self-directed work team.

## **13. Name different members in a team.**

The different members in a team are

1. Team leader
2. Facilitator
3. Recorder
4. Timekeeper and 5. Member

#### **14. What is needed for a leader to be effective?**

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

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

#### **15. What is the important role of senior management?**

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

#### **16.. Give the basic steps to strategic quality planning?**

- Customer needs
- Customer positioning iii. Predict the future
- Gap analysis
- Closing the gap vi. Alignment
- vii. Implementation

#### **17. What is meant by recognition in an organization?**

Recognition is a process whereby management shows acknowledgement of a employee's outstanding performance.

#### **18. Classify rewards.**

**1. Intrinsic rewards:** These are related to feelings of accomplishment or selfworth.

**2. Extrinsic rewards:** These are related to pay or compensation issues.

#### **19. What is performance appraisal? ( Au June 06)**

Performance appraisal is a systematic and objective assessment or evaluation of performance and contribution of an individual.

#### **20. List four common barriers to team progress.**

The four common barriers to team progress

- i. 1. Insufficient training
- ii. 2. Incompatible rewards and compensation
- iii. 3. Lack of management support

#### **21. Give the steps involved in training process?**

The steps involved in training process are

1. Make everyone aware of what the training is all about.
2. Get acceptance.
3. Adapt the program.
4. Adapt to what has been agreed upon.

## **22. Define Recognition and Reward?**

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

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

## **23. What are the types of appraisal formats? The types of appraisal formats are**

- Ranking
- Narrative iii. Graphic
- Forced choice

## **24. What are the benefits of employee involvement?**

The benefits of employee involvement are

Employee Involvement improves quality and increases productivity because

- Employees make better decisions using their expert knowledge of the Process.
- Employees are more likely to implement and support decisions they had a part in making.
- Employees are better able to spot and pinpoint areas for improvement.

## **25. What are the basic ways for a continuous process improvement?**

The basic ways for a continuous process improvement are

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

## **26. What are the three components of the Juran Theory?**

The three components of the Juran Theory are

- i. Planning
- ii. Control
- iii. Improvement

## **27. What are the steps in the PDSA cycle?**

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

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

## **28. What are the phases of a Continuous Process Improvement Cycle?**

The phases of a Continuous Process Improvement Cycle are

- a) Identify the opportunity
- b) Analyze the process
- c) Develop the optimal solutions
- d) Implement
- e) Study the results

- f) Standardize the solution
- g) Plan for the future

### **29. What are the three key elements to a partnering relationship?**

The three key elements to a partnering relationship are

- i. Long-term commitment
- ii. Trust
- iii. Shared vision

### **30. What are the objectives of Performance measures?**

The objectives of Performance measures are

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

### **31 What are the characteristics used to measure the performance of a Particular process?**

The characteristics used to measure the performance of a particular Process are

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

### **32. Define 5S?**

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

- 1 Sort – (Seiri) the first S focuses on eliminating unnecessary items from the workplace.
- 2 Set In Order (Seiton) is the second of the 5Ss and focuses on efficient and effective storage methods.
- 3 Shine: (Seiso) Once you have eliminated the clutter and junk that has been clogging Your work areas and identified and located the necessary items, the next step is to thoroughly clean the work area.
- 4 Standardize: (Seiketsu) Once the first three 5S's have been implemented, you should concentrate on standardizing best practice in your work area.
- 5 Sustain: (Shitsuke) This is by far the most difficult S to implement and achieve. Once fully implemented, the 5S process can increase morale, create positive impressions on customers, and increase efficiency and organization.

### **33. What is a Kaizen?**

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

## UNIT III TOM TOOLS & TECHNIQUES I

### **1. Give the seven tools of quality?**

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

### **2. Define Statistics?**

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

### **3. What is a measure of central tendency?**

A measure of central tendency of a distribution is a numerical value that describes the central position of the data or how the data tend to build up in the center. There are three measures in common in use in quality viz, the average, the median and the mode.

### **4. What is Measures of dispersion?**

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

### **5. What is a normal curve?**

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

### **6. What is the use of the control chart?**

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

### **7. Give the objectives of the attribute charts?**

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

### **8. Define Six Sigma Problem Solving Method?**

*Define* - improvement opportunity with an emphasis on increasing customer satisfaction.

*Measure* - determine process capability (Cp/ Cpk) & dpmo (defects per million opportunities).

*Analyze* - identify the vital few process input variables that affect key product output variables ("Finding the knobs").

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

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

### **9. What are the new seven management tools?**

- Affinity Diagram
- Interrelationship Digraph iii. Tree Diagram
- Matrix Diagram
- Prioritization Matrices
- Process Decision Program Chart vii. Activity Network diagram

### **10. Define Benchmarking?**

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

### **11. Enumerate the steps to benchmark?**

- a) Decide what to benchmark
- b) Understand current performance
- c) Plan
- d) Study others
- e) Learn from the data f) Use the findings

### **12. What are the types of benchmarking?**

- i. Internal
- ii. Competitive iii. Process

### **13. What are the four basic steps included in SPC?**

The four basic steps included in SPC are

- Measuring the process
- Eliminating variances in the process to make it consistent.
- Monitoring the process.
- Improving the process to its best target value.

### **14. Mention the seven basic tools involved in statistic quality control.**

The seven tools involved in statistical quality control. They are,

- Pareto diagram b. Check sheet
- Cause and effect diagrams d. Scatter diagram
- e. Histogram
- f. Control charts g. Graphs

### **15. What is Pareto chart?**

A Pareto chart is a special form of a bar graph and is used to display the relative importance of problems or conditions.

## **16. Give some applications of Pareto chart.**

The applications of Pareto chart are,

- Focusing on critical issues by ranking them in terms of importance and frequency (Example: which course causes the most difficulty for students?; which problem with product X is most significant to out customers?)
- Prioritizing problems or causes to efficiently initiate problem solving (Example: which discipline problems should be tackled first? or what is the most frequent complaint by parents, regarding the school? solution of what production problem will improve quality most?)

## **17. What is the use of SPC?**

SPC is used to monitor the consistency of processes used to manufacture a product as designed.

## **18. Define check sheet. Mention its uses.**

The check sheet is a data gathering and interpretation tool. A check sheet is used for,

- Distinguishing between fact and opinion (Example: How does the community perceive the effectiveness of the school in preparing students for the world of work?)
- Gathering data about how often a problem is occurring? (Example: How often are students missing classes?)
- Gathering data about the type of problem occurring. (Example: What is the most common type of word processing error created by the students-grammar, punctuation, transposing letter etc.?)

## **19. What are the uses of cause and effect diagram?**

A cause and effect diagram is used for,

- Identifying potential causes of a problem or issue in an orderly way. (Example: why has membership in the band decreased? Why isn't the phone being answered on time? Why is the production process suddenly producing so many defects?)
- Summarizing major causes under four categories. (Example: People, machines, methods and materials or policies, procedures, people and plant.)

## **20. What is scatter diagram?**

A scatter diagram is used to interpret data by graphically displaying the relationship between two variables.

## **21. List some applications of scatter diagram.**

The applications of scatter diagram

- Validating 'hunches' about a cause-and-effect relationship between types of variables (examples: I wonder if students who spend more time watching TV having higher or lower average GPA's? IS there a relationship between the production speed of an operator and the number of defective parts made? Is there relationship between typing speed in WPM and errors made?)
- Displaying the direction of the relationship (positive negative, etc). (Examples: will test scores increase or decrease if the students spend more time in study hall? Will increasing assembly line speed, increase or decrease the number of defective parts made? Do faster typists make more or fewer typing errors?)
- Defective parts produced? How strong is the relationship between typing faster and the number of typing errors made?).

## **22. Define histogram.**

A histogram is used to display in bar graph format measurement data distributed by categories.

### **23. What are the problems that can be interpreted by the histogram?**

The problems that can be interpreted by the histogram are,

- Skew problems
- Clustering problems.

### **24. Define control chart.**

Control chart is defined as a display of data in the order that they occur with statistically determined upper and lower limits of expected common cause variations. It is used to indicate special causes of process variations to monitor a process for maintenance and to determine if process changes have had the desired effect.

### **25. What is line graph?**

A line graph is a way to summarize how two pieces of information are related and how they vary depending on one another. The numbers along a side of the line graph are called the scale.

### **26. What is an arrow diagram?**

An arrow diagram is another term for a PERT or CPM chart. It is a graphic description of the sequential steps that must be completed before a project can be completed.

### **27. Give some applications of arrow diagram.**

The applications of arrow diagram are,

- i. Understanding and managing complex project or task.
- ii. Understanding and managing a project that is of major importance to the organization, and the consequences of late completion are severe.
- iii. Understanding and managing a project in which multiple activities must take place and be managed simultaneously.
- iv. Explaining the project status to others.

### **28. How is an arrow diagram constructed? Steps in constructing an arrow diagram are,**

- Select a team that is knowledgeable about the project, its task and subtasks.
- Record all of the tasks and subtasks necessary to the completion of the project.
- Sequence the tasks.
- Assign a time duration to each task.
- Calculate the shortest possible implementation time schedule using the critical path method.
- Calculate the earliest starting and finishing times for each task.
- Locate tasks with slack (extra) time and calculate total slack.
- Update the schedule as the project is being completed.

### **29. What is nominal group technique?**

The nominal group technique is a structured process, which identifies and ranks the major problems or issues that need addressing.

## UNIT IV TQM TOOLS & TECHNIQUES II

### 1. What is a QFD?

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

### 2. What are the benefits of QFD?

- i. Customer driven
- ii. Reduces implementation time
- iii. Promotes teamwork
- iv. Provides documentation

### 3. What are the steps required to construct an affinity diagram?

- Phrase the objective
- Record all responses
- Group the responses
- Organize groups in an affinity diagram

### 4. What are the goals of TPM?

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

- i. Maintaining and improving equipment capacity
- ii. Maintaining equipment for life
- iii. Using support from all areas of the operation
- iv. Encouraging input from all employees
- iv. Using teams for continuous improvement

### 5. Give the seven basic steps to get an organization started toward TPM?

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

### 6. What are the major loss areas?

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

### 7. Define TPM?

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

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

M: Maintenance = Keeping equipment & plant in as good or better than original condition at all times.

### 8. Define quality cost.

Quality cost is defined as the cost associated with the non-achievement of product/service quality as defined by the requirements established by the organisation and its contracts with customers and society.

### **9. List the categories of quality costs.**

The categories of quality cost are

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

### **10. What is meant by cost of prevention?**

Prevention costs are the costs that are incurred on preventing a quality problem from arising.

### **11. List the elements of cost of prevention.**

The elements of cost of prevention are

1. Cost of quality planning
2. Cost of documenting
3. Process control cost
4. Cost of training
5. Costs associated with preventing recurring defects.

### **12. What is cost appraisal?**

Appraisal costs are the cost that are incurred in assessing that the products/services conform to the requirements

### **13. What are the costs of appraisals?**

The costs of appraisal are

1. Cost of receiving test and equipment
2. Cost of Laboratory acceptance testing
3. Cost of installation testing
4. Cost of installation and commissioning
5. Cost of maintenance and calibration of testing and inspecting equipments.

### **14. What is meant by cost of internal failures?**

The costs associated with defective products, components and materials that fail to meet quality requirements and result in manufacturing losses are called as costs of internal failures. These costs are linked to correcting mistakes before delivery of the product

### **15. List the components cost of internal failures.**

The costs of internal failures are

1. Cost associate with scrap and rejects.
2. Cost of repair and rework.
3. Cost of design changes.
4. Cost of trouble shooting
5. Cost of reinspection and retesting., etc;

### **16. What is meant by cost of external failures?**

It consist of the cost which are generated because of defective products being shipped to customers. These cost are associated with the adjustments of malfunctions after delivery of the product.

**17. Give the sub-elements of Preventive cost category?**

- Marketing/Customer/User
- Product/Service/Design development
- Purchasing
- Operations/
- Quality Administration vi. Other Prevention Costs

**18. Give the sub-elements of Appraisal cost category?**

- Purchasing appraisal cost
- Operations appraisal cost
- External appraisal cost
- Review of test and application data
- Miscellaneous quality evaluations

**19. Give the sub-elements of internal failure cost category?**

- i. Product or Service Design costs (Internal)
- ii. Purchasing failure costs iii. Operations failure costs

**20. Give the sub-elements of External failure cost category?**

- i. Complaint investigations of customer or user service
- ii. Returned goods
- iii. Retrofit and recall costs
- iv. Warranty claims
- v. Liability costs vi. Penalties
- vi. Customer or user goodwill viii. Lost sales
- vii. Other external failure costs

**21. Give the typical cost bases?**

- Labor
- Production
- Unit iv. Sales

**22. How will you determine the optimum cost?**

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

## UNIT V QUALITY SYSTEMS

### 1. Give the ISO 9000 Series of Standards?

- ISO 9000, “Quality Management and Quality Assurance Standards Guidelines for Selection and Use”.
- ISO 9001, “Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation & Servicing”.
- ISO 9002, “Quality Systems – “Model for Quality Assurance in Production, Installation & Servicing”.
- ISO 9003, “Quality Systems – “Model for Quality Assurance in Final Inspection and Test”.
- ISO 9004-1, “Quality Management and Quality System Elements – Guidelines”.

### 2. What is the need for ISO 9000?

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

### 3. Give some other quality systems?

The quality systems are

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

### 4. Enumerate the steps necessary to implement the Quality Management System?

The steps necessary to implement the Quality Management System are

- i. Senior management commitment
- ii. Appoint the management representative
- iii. Awareness
- iii. Appoint an implementation team
- v. Training
- v. Time schedule
- vi. Select element owners
- vii. Review the present system
- viii. Write the documents
- x. Install the new system
- xi. Internal audit
- a) xii. Management review
- xiii. Pre assessment
- b) xiv. Registration.

### 5. What are the three sections of QS-9000?

The three sections of QS-9000 are

- Common requirements, which include the exact text of ISO 9001 and the addition of automotive/heavy trucking requirements.
- Additional requirements covering production part approval process, continuous improvement and manufacturing capabilities.
- Customer-specific requirements.

### 6. Give the objectives of the internal audit?

The objectives of the internal audit

- Determine the actual performance conforms to the documented quality systems.

- Initiate corrective action activities in response to deficiencies.
- Follow up on noncompliance items of previous audits.
- Provide continued improvement in the system through feedback to management.
- Cause the auditee to think about the process, thereby creating possible improvements.

7. What are the requirements of ISO 14001? The requirements of ISO 14001 are

- General requirements
- Environmental policy
- Planning
- Implementation and operation
- Checking and corrective action
- vi. Management review

8. What are the benefits of ISO 14000? The benefits of ISO 14000 are

a. Global

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

b. Organizational

**9. What are the four elements for the checking & corrective action of ISO 14001?**

- Monitoring and measuring
- Nonconformance and corrective and preventative action c) Records
- EMS audit

**10. What are the seven elements for the implementation & operations of ISO 14001?**

- Structure and responsibility
- Training, awareness and competency
- Communication
- EMS documentation
- Documentation control f) Operational control
- Emergency preparedness and response

**11. What are the four elements for the planning of ISO 14001?**

- Environmental aspects
- Legal and other requirements
- Objectives and targets
- Environmental Management Programs

**12. Give the types of Organizational Evaluation Standards?**

- Environmental Management System ii. Environmental Auditing
- Environmental Performance Evaluation

**13. Give the types of Product Evaluation Standards?**

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

#### **14. Define Quality Audits?**

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

#### **15. Give the usage of an effective recognition and reward system?**

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

#### **16. What are the typical measurements frequently asked by managers and teams?**

- i. Human Resource
- ii. Customers
- iii. Production
- iv. Research & Development
- v. Suppliers
- vi. Marketing/Sales
- vii. Administration

#### **17. Explain the ISO/QS 9000 elements?**

- i. Management responsibility
- ii. The Quality system
- iii. Contract review
- iv. Design control
- v. Document and data control
- vi. Purchasing
- vii. Control of customer-supplied product
- viii. Product identification and traceability
- ix. Process control
- x. Inspection and testing
- xi. Control of inspection, measuring and test equipment
- xii. Inspection and test status

#### **18. What are the benefits of ISO?**

- i. Fewer on-site audit by customers.
- ii. Increased market share.
- iii. Improved quality, both internally and externally.
- iv. Improve product and service quality levels from suppliers.
- v. Greater awareness of quality by employees.
- vi. A documented formal systems.
- vii. Reduced operating costs.

#### **19. Give the ISO 9001 requirements?**

- i. Scope
- ii. Normative Reference
- iii. Terms and Definitions

- iv. Quality Management System
- v. Management Responsibility
- vi. Resource Management
- vii. Product Realization

**20. What are the methods of actual audit?**

- i. Examination of documents
- ii. Observation of activities
- iii. Interviews

# GE8077 TQM online test 1

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\_\_\_\_\_ is not a process tools for TQM systems

1 point

- process flow analysis
- histograms
- plier
- control charts

Processes that operate with "six sigma quality" over the short term are assumed to produce long-term defect levels below \_\_\_\_\_ defects per million opportunities (DPMO).

1 point

- 2
- 2.4
- 3
- 3.4

Inspection, scrap, and repair are examples of \_\_\_\_\_

1 point

- internal costs
- external costs
- costs of dissatisfaction
- societal costs

\_\_\_\_\_ are used in six sigma

1 point

- black belt
- green belt
- both black belt and green belt
- none of the Above

Customers are primarily concerned with \_\_\_\_\_

1 point

- Communication, courtesy, and credibility of the sales person
- Competence, courtesy, and security of the sales person
- Competence, responsiveness, and reliability of the sales person
- Communication, responsiveness, and cleverness of the sales person

Assured quality is necessary for building customer confidence.

1 point

- correct
- correct to some extent
- correct to great extent
- incorrect

\_\_\_\_\_ are the areas that will be covered by the organization's processes

1 point

- process areas
- product Areas
- private areas
- preset areas

All of the following costs are likely to decrease as a result of better quality except

1 point

\_\_\_\_\_

- customer dissatisfaction costs
- inspection costs
- maintenance costs
- warranty and service costs

"Quality is defined by the customer" is

1 point

- An unrealistic definition of quality
- A user-based definition of quality
- A manufacturing-based definition of quality
- A product-based definition of quality

TQM stands for \_\_\_\_\_

1 point

- Total Quality Management
- Total Quantity Management
- Total Qualitative Management
- To question management

After E.deming, who is considered to have the greatest impact in quality management?

1 point

- Kauro Ishikawa
- Joseph M. Juran
- W.E. Deming
- Genichi Tagucchi

In Six Sigma, a \_\_\_\_\_ is defined as any process output that does not meet customer specifications

1 point

- error
- cost
- quality
- defect

Plan-do-study-act cycle is a procedure to \_\_\_\_\_

1 point

- Overall improvement
- Continuous improvement
- Permanent improvement
- Immediate improvement

Quality practices must be carried out \_\_\_\_\_

1 point

- at the start of the project
- throuout the life of the project
- at the end of the project
- no need to carry out quality practices

----- are the charts that identify potential causes for particular quality problems. 1 point

- Control Chart
- Flow chart
- Cause and Effect Diagram
- Pareto chart

Quality circles work best if employees are initially trained in \_\_\_\_\_ 1 point

- Group dynamics
- Motivation principles
- Communications
- All of the three. (Not sure)

Quality Trilogy includes 1 point

- Quality planning
- quality improvement
- quality control
- All the three

production issues should be addressed early

1 point

- correct (not sure)
- correct to some extent
- correct to great extent
- incorrect

inspection is part of the \_\_\_\_\_

1 point

- quality control (not sure)
- Quality Planning
- Quality improvement
- Quality circle

QFD stands for \_\_\_\_\_

1 point

- Quantity for deployment
- Quality for deployment
- Quality function deployment
- Quality for decision

reliability is the degree to which a unit of equipment performs its intended function under \_\_\_\_\_ for \_\_\_\_\_ of time.

1 point

- specified conditions; specified period
- any condition; specified period
- specified conditions; all periods
- any condition; any period

Kaizen is a \_\_\_\_\_ process, the purpose of which goes beyond simple productivity improvement.

1 point

- weekly
- daily
- monthly
- annual

elements of quality management system are \_\_\_\_\_

1 point

- organizational structure
- responsibilities
- procedures
- all the three (not sure)

At the time of making a purchase agreement with a vendor, what is important to mention about inspection? 1 point

- the characteristics of the product that are to be inspected
- the tolerances that would be allowed
- the reputation of the vendor
- a & b both (not sure)

"Poka-yoke" is the Japanese term for \_\_\_\_\_

1 point

- Card
- Fool proof
- Continuous improvement
- Fishbone diagram

Based on his 14 Points, Deming is a strong proponent of \_\_\_\_\_

1 point

- inspection at the end of the production process
- an increase in numerical quotas to boost productivity
- looking for the cheapest supplier
- training and knowledge

A fishbone diagram is also known as a \_\_\_\_\_

1 point

- cause-and-effect diagram
- poka-yoke diagram
- Kaizen diagram
- Taguchi diagram

According to Deming most of the problems are related to systems and it is the responsibility of the management to improve the systems

1 point

- correct
- correct to some extent
- correct to great extent
- Taguchi

A maturity model can be used as a benchmark for comparison and as an aid to understanding

1 point

- TRUE
- FALSE
- depends
- can't say

fourteen points framework for quality and productivity improvement was suggested by \_\_\_\_\_ 1 point

- Crosby
- Ishikawa
- Deming
- Juran

Juran's Quality trilogy emphasizes the roles of quality planning, quality control and \_\_\_\_\_ 1 point

- Quality Definition
- Quality enhancement
- Quality improvement
- quality maintenance

Quality Circles members are \_\_\_\_\_ 1 point

- Paid according to their contribution to quality
- External consultants designed to provide training in the use of Quality tools
- Always machine operators
- None of the three.

Identify the cost not likely to reduce as a result of better quality.

1 point

- Maintenance costs
- Inspection costs
- Scrap costs
- Warranty and service costs

Costs of dissatisfaction, repair costs, and warranty costs are elements of cost in the \_\_\_\_\_

1 point

- Taguchi Loss Function
- Pareto Chart
- ISO 9000 Quality Cost Calculator
- Process Chart

Deming's 4 step cycle for improvement is \_\_\_\_\_

1 point

- plan, do, check, act
- schedule, do, act, check
- do, act, check, monitor
- plan, control, act, sustain

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A maturity model can be used as a benchmark for comparison and as an aid to understanding

1 point

- TRUE
- FALSE
- depends
- can't say

fourteen points framework for quality and productivity improvement was suggested by

---

1 point

- Crosby
- Ishikawa
- Deming
- Juran

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Costs of dissatisfaction, repair costs, and warranty costs are elements of cost in the \_\_\_\_\_

1 point

- Taguchi Loss Function
- Pareto Chart
- ISO 9000 Quality Cost Calculator
- Process Chart

DMAIC is \_\_\_\_\_

1 point

- develop, multiply, analyze, improve, check
- define, multiply, analyze, improve, control
- define, measure, analyze, improve, control
- define, manufacture, analyze, improve, control

Quality fulfills a need or expectation that is:

1 point

- Explicitly stated
- Implied
- Legally required
- All of the above

Check Sheet is used during \_\_\_\_\_ stage of DMAIC.

1 point

- Define
- Measure
- Analyze
- Improve

\_\_\_\_\_ is the set of activities that ensures the quality levels of products and services are properly maintained and that supplier and customer quality issues are properly resolved.

1 point

- Quality Assurance
- Quality Planning
- Quality Control
- Quality Management

Which of the following is not a target of Total Quality Management:

1 point

- Customer Satisfaction
- Reducing manpower
- Continuous Cost Reduction
- Continuous Operational Improvement

The \_\_\_\_\_ is used to identify what might go wrong in a plan under development. 1 point

- Pareto Chart
- PDPC
- Arrow Diagram
- Matrix Diagram

The taste of the burger can be categorized as good or bad This is an example of which type of data: 1 point

- Variable
- Attribute
- Cannot be determined
- None of the above

Juran's quality management philosophy is based on three pillars namely planning, control and \_\_\_\_\_. 1 point

- Implementation
- Improvement
- Monitor
- Design

For a point in the control chart to be out of control, it must lie

1 point

- Above UCL or Below LCL
- Between Central Line and LCL
- Between Central Line and UCL
- None of the above

A major assumption for p chart is that all units produced are \_\_\_\_\_.

1 point

- Independent
- Dependent
- None of the above
- Cannot be determined

While the first generation of Six sigma focused on \_\_\_\_\_, the third generation of six sigma focused on \_\_\_\_\_.

1 point

- Variability reduction, creating value
- Variability reduction, improved business performance
- Creating value, Improved business performance
- None of the above

A \_\_\_\_\_ chart can be used to identify the most frequently occurring defect. 1 point

- Pareto
- Ishikawa
- Histogram
- Scatter

The main aim of QFD is to 1 point

- Listen to the voice of customer
- Lower cost
- Reduce errors
- Reduce supplier defect

The x bar chart monitors: 1 point

- Between sample variability
- Within sample variability
- Instantaneous variability
- Natural variability

When the number of defects is low, which of the following is true:

1 point

- We should use c or u chart
- Most samples will have non-zero defects
- Create a time between occurrence control chart
- None of the above

The focal point of all quality control should be:

1 point

- Price focus
- Cost Focus
- Customer Focus
- Manufacturing Focus

Kaizen is a Japanese term meaning \_\_\_\_\_

1 point

- continuous improvement
- Just-in-time (JIT)
- a fishbone diagram
- setting standards

establishing measurements based on customer needs for optimizing product design is known as \_\_\_\_\_ 1 point

- Quality planning
- quality improvement
- quality control
- Quality planning (Actual answer is Quality planning roadmap)

Quality management includes forming and directing a team of people to achieve a qualitative goal within an effective cost and time frame that results in \_\_\_\_\_ 1 point

- a project completed in shortest possible time.
- a product or service that conforms to the required specifications.
- an award-winning product that brings public recognition to the project
- an innovative project that establishes qualification of the project team

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Juran's quality management philosophy is based on three pillars namely planning, control 1 point  
and \_\_\_\_\_.

- Implementation
- Improvement
- Monitor
- Design

The dimension of reliability is concerned with:

1 point

- How easy it is to repair the product
- How long does the product last
- Will the product do the intended job
- How often does the product fail

From a consumer perspective quality is determined by \_\_\_\_\_ while from a producers perspective quality is determined by \_\_\_\_\_.

1 point

- Variability, Cost
- Cost, Price
- Price, Cost
- Cost, Variability

The probability distribution function corresponding to tossing of a coin will be a:

1 point

- Probability Density function
- Probability Mass function
- Probability Measurement function
- Probability Cumulative Function

While the first generation of Six sigma focused on \_\_\_\_\_, the third generation of six sigma focused on \_\_\_\_\_.

1 point

- Variability reduction, creating value
- Variability reduction, improved business performance
- Creating value, Improved business performance
- None of the above

A \_\_\_\_\_ chart can be used to identify the most frequently occurring defect. 1 point

- Pareto
- Ishikawa
- Histogram
- Scatter

Average Total Inspection is defined as: 1 point

- Average of rejected lots and accepted lots
- Average number of units inspected per lot
- Average of rejected Lots
- Average of accepted Lots

When the number of defects is low, which of the following is true: 1 point

- We should use c or u chart
- Most samples will have non-zero defects
- Create a time between occurrence control chart
- None of the above

If variability of a product decreases, its quality \_\_\_\_\_

1 point

- remains unchanged
- decreases
- increases
- may increase or decrease

The key process input variables (KPIV) and key process output variables are developed during the \_\_\_\_\_ phase.

1 point

- Define
- Analyze
- Measure
- Improve

Which of the following statement is false:

1 point

- Important step of strategic quality management is identification of those dimensions in which the organization will compete
- Selection of suppliers should be based on quality, schedule, and cost, rather than on cost alone
- All of the individuals in the organization must have an understanding of the basic tools of quality improvement
- Manufacturing Unit should be the unit focusing on Quality Improvement among all units in an organization

Cause and Effect Diagram can be used in the \_\_\_\_\_ and \_\_\_\_\_ step of DMAIC. 1 point

- Define, Measure
- Analyze, Control
- Analyze, Improve
- Define, Improve

Which of the following is false regarding when acceptance sampling is useful: 1 point

- When testing is destructive
- When 100% inspection cost is very low
- When there are potentially serious product liability risk
- When 100% inspection is not technically feasible

A company wants to measure the length of a fan as a part of its quality control exercise. 1 point  
The type of data collected will be:

- Variable
- Attribute
- Cannot be determined
- None of the above

Attribute charts may be used when:

1 point

- Several characteristics can be jointly measured
- When one particular quality characteristic is of importance
- Specific information like process mean is required
- None of the above

Inspection of incoming/outgoing items is an example of \_\_\_\_\_.

1 point

- Prevention Cost
- Appraisal Cost
- Internal Failure Cost
- External Failure Cost

Four basic characteristics of an optimal process are:

1 point

- Economy, efficiency, control, quality
- Quality, Improvement, efficiency, productivity
- Economy, efficiency, productivity, cost
- Economy, efficiency, productivity, quality

\_\_\_\_\_ diagram is used for identifying potential relationship between two variables.

1 point

- Pareto
- Ishikawa
- Histogram
- Scatter

Lots for acceptance sampling should be \_\_\_\_\_ and \_\_\_\_\_.

1 point

- Homogeneous, Large
- Heterogeneous, Small
- Homogeneous, Small
- Heterogeneous, Large

The roof of house of quality shows the interrelationship between:

1 point

- Functional Requirements
- Design Attributes
- Service Process
- Manufacturing Process

In phase 1 of control chart usage, if a point is outside the control limits and some assignable cause is found for the point, then we should:

1 point

- Discard the point but do not recalculate control limits
- Discard the point and recalculate the control limit
- Do not discard the point
- Cannot be determined

Identification of customers and listening to the Voice of Customer (VoC) are a part of:

1 point

- Quality Assurance
- Quality Planning
- Quality Control and Improvement
- Quality Execution

Ease of repair is associated with \_\_\_\_\_ dimension of quality.

1 point

- Serviceability
- Performance
- Durability
- Perceived Quality

Two major components of fitness of use are Quality of Design and \_\_\_\_\_.

1 point

- Quality of Conformance
- Quality of Service
- Quality of Specification
- Quality of Manufacturing

The concept of rational sub group means that subgroups or samples be selected such that if assignable causes are present the chances for differences between subgroups will be \_\_\_\_\_.

1 point

- minimized
- maximized
- neutralized
- optimized

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Some organizations today are using "six sigma", to set the upper and lower limits on control charts rather than the traditional sigmas.

1 point

- two
- three
- four
- five
- twelve

Quality is one part of the three major parameters of a project. When the quality in a project exceeds the specifications, that is called \_\_\_\_\_.

1 point

- excellence
- superior quality
- deviation plus quality
- gold plating
- silver plating

During which century, the manufacturers began to include quality processes in quality practices?

1 point

- 17th century
- 18th century
- 19th century
- 20th century

Which of the following was developed by Motorola to improve its processes by minimizing defects?

1 point

- ISO 9000
- Six sigma
- QS 9000
- TQM

Total quality costs include:

1 point

- Prevention costs
- Appraisal costs
- Failure costs
- All of the given options

Example of prevention costs is:

1 point

- Quality improvement projects
- Downgrading
- To link outcomes to uses
- Warranty claims

The concept of zero inventory is called:

1 point

- Six sigma
- Continuous improvement
- Just in Time
- Zero defects

Quality is

1 point

- zero defects
- a problem
- a specification
- a cost
- A, C, and D

On a project, quality should generally be of

1 point

- equal priority with cost and schedule
- lower priority than cost and schedule
- equal priority with cost, but higher priority than schedule
- equal priority with schedule, but higher priority than cost
- higher priority than cost and schedule

The process of monitoring specific project results to determine if they comply with relevant quality standards is called:

1 point

- Quality Assurance
- Quality Control
- Quality Planning
- Quality Review

What percentage of sales is estimated to be the cost of non-quality?

1 point

- 3-5%
- 12-20%
- 30-40%
- 6-8%

The zero defects concept

1 point

- is a performance standard for management
- is a motivational technique that promotes "doing it right the first time"
- is used by management to communicate to all employees that everyone should do things right the first time
- A and C
- B and C

If the acceptance sampling attribute for a lot is 30%, this means that

1 point

- 30% of all lots must be tested
- 30% of all lots must pass the test
- any given lot must have 30% or fewer defects
- a sample of a given lot must have 30% or fewer defects to pass the entire lot
- C and D

Which of the following statements regarding quality is false?

1 point

- Quality improvements depends upon better definition and increased awareness of the requirements specifications
- Future gains in quality will often rely on advanced technology
- Recognition of key actions required of each team member is necessary to meet quality objectives
- Computer-aided design systems can improve quality, but only a the expense of an increase in the cost of design
- A and C

Quality is often influenced by all of the following except:

1 point

- fabrication processes and methods
- supervision
- inspection
- cost of materials
- design

The cost of quality has been argued as being primarily driven by the workers. When items were produced that did not meet the customers' expectations, the workers were "found" to be at fault. Current thinking is that management has at least \_\_\_\_\_ percent of the responsibility for the cost of quality.

1 point

- 85
- 75
- 65
- 55
- 50

Unless evidence indicates otherwise, a process is assured to be:

1 point

- in control
- out of control
- working at full capacity
- working at less than full capacity
- operating within required engineering tolerances

Statistical Process Control uses diagrams called "Control Charts." These charts depict horizontal, parallel lines to represent \_\_\_\_\_ standard deviations.

1 point

- six
- five
- four
- three
- two

The 14-step process to quality improvement is a progressive to total involvement of everyone in a company toward the production of quality products and services. The 14-steps do not include \_\_\_\_\_.

1 point

- management commitment
- quality improvement team
- quality measurement
- goal achievement measures
- supervisor training

Which of the following is not a benefit of long-term supplier relationships?

1 point

- supplier involvement in design
- information system linkages to customer facilities
- capacity and facility plans favorable to their customers
- all of the above are benefits

Which of the following models has the viewpoint that change and learning are valued in themselves? 1 point

- Organism mode
- Mechanistic model
- Cultural model
- Total Quality model

Which of the following document(s) is (are)'included in the quality system?

1 point

- A quality policy
- Customer focus
- Commitment
- All of the given options

The overall intentions and direction of an organization with regard to quality as formally expressed by top management is a: 1 point

- Quality Plan
- Quality Statement
- Quality Policy
- TQM

The same quality control manager decides to increase his daily sample size from three to six. The size of the control band will: 1 point

- Increase
- Decrease
- Remain unchanged
- Not determinable from given data
- None of the above

Cost of quality is a concept that includes: 1 point

- the cost necessary for ensuring conformance to requirements
- the life cycle cost of the project
- all research and development costs related to the project
- only the cost of the quality control function
- A and B

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Which of the following is not a type of attribute chart?

1 point

- P chart
- C chart
- U char
- X bar chart

Failure Mode and Effects Analysis, which prioritizes different sources of error, is used in \_\_\_\_\_ stage.

1 point

- Define
- Measure
- Improve
- Analyze

In a six sigma improvement project the least experienced individuals are:

1 point

- Green Belt
- Black belts
- Red Belts
- Master Black Belts

The \_\_\_\_\_ diagram starts with one item which then branches of into two or more items. This diagram is used to breakdown broad categories into finer levels of detail.

1 point

- Affinity
- Tree
- Relations
- Matrix

Lot tolerance percent defective (LTPD) is a level of lot quality specified by the \_\_\_\_\_.

1 point

- Consumer
- Producer
- Supplier
- Sampling Plan

Machine wear and tear is \_\_\_\_\_ source of variation.

1 point

- Random
- Natural
- Assignable
- Cannot be determined

Pattern in control charts which show the tendency to cluster around central line is termed as:

1 point

- stratification
- Mixture
- Cyclic pattern
- Shift in process level

When output product of several sources is fed into a common stream, the pattern of the control chart expected is:

1 point

- Stratification
- Trend
- Mixture
- Cyclic Pattern

A fan blade is specified by length and thickness. While sampling, it was found that for one particular blade, the length was non-conforming while the thickness was as per specifications. Should the blade be considered non-conforming for construction of a p chart?

1 point

- Yes
- No

Identify the charts which might give an indication of process going out of control (before the process has actually changed)

1 point

- X bar and c
- P and c
- R and u
- X bar and R

For a process which is six sigma complaint, the percentage of products within specifications is:

1 point

- 95.20%
- 99.73%
- 99.10%
- 96.78%

A serious problem can occur in multiple regression analysis if an important variable is omitted from the list of independent variables. This can lead to

1 point

- unbiased least squares estimators.
- biased least squares estimators.
- a biased estimator of the variance.
- All of these

\_\_\_\_\_ is the set of activities that ensures the quality levels of products and services are properly maintained and that supplier and customer quality issues are properly resolved.

1 point

- Quality Assurance
- Quality Planning
- Quality Control
- Quality Management

The \_\_\_\_\_ sum of squares measures the variability of the observed values around their respective treatment means.

1 point

- treatment
- error
- interaction
- total

What are residuals?

1 point

- Residuals are the differences between the observed and expected dependent variable scores
- Serendipitous findings
- Extreme scores
- Uncontrolled variables

Which of the following statement is true?

1 point

- Only factor A is significant; factor B and the two-factor interaction are not significant.
- Only factor B is significant; factor A and the two-factor interaction are not significant.
- Only the two-factor interaction is significant; factor A and factor B are not significant.
- Factor A and factor B is significant; the two-factor interaction is not significant.

Attribute charts may be used when:

1 point

- Several characteristics can be jointly measured
- When one particular quality characteristic is of importance
- Specific information like process mean is required
- None of these

In hypothesis testing, a Type 2 error occurs when

1 point

- The null hypothesis is not rejected when the null hypothesis is true.
- The null hypothesis is rejected when the null hypothesis is true.
- The null hypothesis is not rejected when the alternative hypothesis is true.
- The null hypothesis is rejected when the alternative hypothesis is true.

A \_\_\_\_\_ effect(s) analysis examines mean differences at each level of the independent variable.

1 point

- main
- simple main
- interaction
- simple interaction

A researcher conducted a 2 x 2 completely repeated measures factorial design and planned 15 participants in each condition. How many participants would be required to conduct this experiment?

2 points

- 15
- 30
- 45
- 60

What is the purpose of a multiple regression?

1 point

- To predict scores on a dependent variable from scores on a single independent variable
- To predict scores on an independent variable from scores on a single dependent variable
- To predict scores on an independent variable from scores on multiple dependent variables
- To predict scores on a dependent variable from scores on multiple independent variables

A \_\_\_\_\_ chart can be used to identify the most frequently occurring defect.

1 point

- Pareto
- Ishikawa
- Histogram
- Scatter

A null hypothesis is rejected if the value of a test statistic lies in the:

1 point

- Rejection region
- Acceptance region
- Both (a) and (b)
- Neither (a) nor (b)

Analysis of variance is a statistical method of comparing the \_\_\_\_\_ of several populations.

- standard deviations
- variances
- means
- proportions

You conduct a hypothesis test and you observe values for the sample mean and sample standard deviation when  $n = 25$  that do not lead to the rejection of  $H_0$  (null hypothesis). You calculate a p-value of 0.0667. What will happen to the p-value if you observe the same sample mean and standard deviation for a sample  $n > 25$ ? 1 point

- Increase
- Decrease
- Stay the same
- May either increase or decrease

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# SSM INSTITUTE OF ENGINEERING AND TECHNOLOGY

Dindigul - 624002.

Department of Electrical and Electronics Engineering

GE8077 – Total Quality Management

Test No.	Online Test link	Maximum Marks
	<a href="https://www.mbamcq.com/total-quality-management/3.php">https://www.mbamcq.com/total-quality-management/3.php</a>	
1	<a href="https://docs.google.com/forms/d/e/1FAIpQLSfQUo9th-6K5QhuxOe1QYttISdW0NKEE77s_4HqiQZWkUSaKg/viewform?usp=sf_link">https://docs.google.com/forms/d/e/1FAIpQLSfQUo9th-6K5QhuxOe1QYttISdW0NKEE77s_4HqiQZWkUSaKg/viewform?usp=sf_link</a>	35
2	<a href="https://docs.google.com/forms/d/e/1FAIpQLSfG8w64gs2gmJ6CPSANyHndIqGmQ1mnZnxq3XEywC1qUzIfpA/viewform?usp=sf_link">https://docs.google.com/forms/d/e/1FAIpQLSfG8w64gs2gmJ6CPSANyHndIqGmQ1mnZnxq3XEywC1qUzIfpA/viewform?usp=sf_link</a>	25
3	<a href="https://docs.google.com/forms/d/e/1FAIpQLScwtojqN5CCCoGY1xI3P5A181i-JQoeTEqSf-khICq_Zbp6lw/viewform?usp=sf_link">https://docs.google.com/forms/d/e/1FAIpQLScwtojqN5CCCoGY1xI3P5A181i-JQoeTEqSf-khICq_Zbp6lw/viewform?usp=sf_link</a>	25
4	<a href="https://docs.google.com/forms/d/e/1FAIpQLSfaQ1tjyQpnPII6Q0vYHm9vkHAO4X4HP4Sj0zTjyOwF1QZHvQ/viewform?usp=sf_link">https://docs.google.com/forms/d/e/1FAIpQLSfaQ1tjyQpnPII6Q0vYHm9vkHAO4X4HP4Sj0zTjyOwF1QZHvQ/viewform?usp=sf_link</a>	25
5	<a href="https://docs.google.com/forms/d/e/1FAIpQLSdQYfjmR3aEuWONfjAKR8JDs0_tdj9TL0RgQigOBWGacKoO8Q/viewform?usp=sf_link">https://docs.google.com/forms/d/e/1FAIpQLSdQYfjmR3aEuWONfjAKR8JDs0_tdj9TL0RgQigOBWGacKoO8Q/viewform?usp=sf_link</a>	25

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