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# Department of Electronics and Communication Engineering

## Regulation 2021

## IV Year VII Semester

## GE3752/Total Quality Management

# TOTAL QUALITY MANAGEMENT

## UNIT NOTES

## Unit I Introduction

### Basic concepts of Quality and TQM

Quality, though familiar to everyone, is one of the most important issues that all sectors have focused on in the last 20 - 30 years. As markets have become much more competitive, quality has become a key ingredient for success in today's business. Qualityhas become a prime focus of business attention because of the impact it has on sustained performance and customer satisfaction. The quality movement has been growing throughout the world for many years now. Thus, Quality is the need of the hour; crux of the time; and the present Dharma of all.

### Meaning of Quality

Quality is a relative term. It is generally used with reference to the end use of theproduct. For example, one could argue that a gear used in wrist watch is of betterquality than a gear used in automobile gear boxes. But both the gears areconsidered of good quality if they perform satisfactorily the intended functions. Thus the quality is defined as the fitness for use or purpose at the most economical level.

Quality is a judgment by customers or users of a product or service. That is, qualityis a customer determination, not an engineer's determination or a manager's determination.

### Quality Definition

The dictionary lists many definitions of quality. A short definition that hasreceived wide acceptance is: Quality is customer satisfaction: An alternative shortdefinition is: 'Quality is fitness for use.

Broadly defined, the term 'quality' refers to the ability of a product or service to consistently meet or exceed customer expectations. In simple terms, quality meansgetting what you pay for.

However, quality has been defined in various ways by many authors and some ofthe important definitions of quality are given below:

| | |
|---|---|
| 1. Quality is fitness for use. | – Juran |
| 2. Quality is conformance to requirments. | - Crosby |

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| 3. Quality is a predictable degree of uniformity and dependability, at, low cost and suited to the market. – Deming |
| 4. Quality is the (minimum) loss imported by a product to society from the time the product is shipped. – Taguchi |
| 5. Quality is in its essence, a way of managing the organisation. - Feigenbaum |
| 6. Quality is correcting and preventing loss, not living with loss - Hoshin |
| 7. The universally accepted definition of quality which is provided by International organization for standardization (ISO), is a follows; "Quality is the totality of features and characteristics of a product or service, that bear onits ability to satisfy stated and implied needs of the customer." - ISO |

Quality can be quantified as follows: Q=P/E, Performance /Expectations

Q is greater than 1.0, then the customer has a good feeling about the product or service. The determination of P and E will most likely be based on perception with the organization determining performance and the customer determining expectations.

**TQM Definition**

TQM has been defined in various ways. Some of the important definitions of TQM are given below:

1. TQM is the management approach of an organisation, 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 organisation and to society. -ISO
2. TQM is an integrated organisational approach in delighting customers (both internal and external) by meeting their expectations on a continuous basis through everyone involved with the organisation working on continuous improvement in all products, services, and processes along with proper problem-solving methodology. - Indian Statistical Institute (IST)
3. TQM is a people-focussed management system that aims at continual increase in customer satisfaction at continually lower cost. TQM is a total system approach (not a separate area or programme), and an integral part of high- level strategy. Itworks horizontally across functions and departments, involving all employees, top to bottom, and exceeds backwards and forwards to include the supply chain and the customer chain.

**Characteristics of TQM**

The above definitions revealed the following characteristics of TQM:

- ✓ TQM is a management philosophy to guide a process of change.
- ✓ TQM is a customer-oriented management system.
- ✓ TQM starts at the top; it requires the leadership of top management and continuousinvolvement.
- ✓ TQM is a teamwork it requires organisation-wide involvement.
- ✓ TQM calls for planning.
- ✓ TQM is a strategy for continuously improving performance at all levels and in all areas of responsibility.

- ✓ TQM is about achieving results by produces based approach.
- ✓ TQM recognises internal customer-supple relationship tons
- ✓ TQM considers suppliers as part of the organisation's processes.
- ✓ TQM aims to instill a 'prevention not an inspection' ethic.
- ✓ TQM emphasizes the importance of measurement.
- ✓ TQM inter-links and integrates the various sub-systems of the organisation.
- ✓ TQM aims at meeting the dynamic needs of the customer and creates a loyal and diversified customer base.

**Contribution of Quality Gurus: An Overview**

**Introduction**

There are a number of writers whose work dominates the quality movement. Theirideas and approaches have stood the test of time and have come to form a body of accepted knowledge, to lead and advise their own movement in quality. They havebecome known as 'gurus'.

Many of the 'gurus' appear to present different theories of quality management. Inreality they are all thinking the same 'language' but they use different dialects.

There have been three groups of gurus since the 1940's:The various roadblocks in implementing TQM are:

- Early 1950's Americans who took the message of quality to Japan
- Late 1950's Japanese who developed new concepts in response to the Americans 1970's-1980's Western gurus who followed the Japanese industrial success
- The most American and Japanese quality gurus and the main years of their workare given below.

**American Quality Gurus**

1. Walter Shewhart (1920s 1940s)
2. W. Edwards Deming (Post World War II through 1980s)
3. Joseph M. Juran (Past World War II through 1980s) War II through 1980) S
4. Philip Crosby (1980s)
5. Armand Feigenbaum (1970s-1980s)

**Japanese Quality Gurus**

1. Kaoru Ishikawa (Post World War II through 1980s)
2. Genichi Taguchi (1960s-1980s)
3. Shigeo Shingo (Post World War II through 1980s)
4. Masaaki Imai (1980s)

**W. Edwards Deming**

**About Deming**

Deming, an American, was the senior quality guru.

- 1928 - awarded doctorate in mathematical physics.
- 1946 after sharing his expertise in statistical quality control to help the US war effort during World War II, the war department sent Deming to Japan to help nation recover from its wartime losses.
- 1951 after having impressed by his contributions, the Japanese established the Deming Prize. Deming prize is awarded annually to firms that distinguish themselves with quality management programs.
- 1956 awarded the Shewhart medal by the American Society for Quality Control.
- 1960 awarded by the Japanese Emperor with the Second Order of the Sacred Treasure for his teachings.

Deming was a prominent consultant, teacher, and author on the subject of quality. He has published more than 200 works, including well-known books Quality', Productivity and Competitive Position', and 'Out of the Crisis

**Deming's Contribution**

Deming's contributions can be grouped under the following four topics:

1. Deming's 14 points on route to quality:
2. Deming cycle (or PDCA cycle):
3. Seven deadly diseases of Management; and,
4. System of profound knowledge.

**1. Deming's 14 Points**

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| 1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs. |
| 2. Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities and take on leadership for change. |
| 3. Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place. |
| 4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust. |
| 5. Improve constantly and forever the system of production and service, to improve quality and productivity and thus constantly decrease costs. |

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| 6. Institute training on the job |
| 7. Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job, supervision of management is in need of overhaul, as well as supervision of production workeers. |
| 8. Drive out fear, so that everyone may work effectively for the company. |
| 9. Break down barriers between departments, People in research, design, sales and production must work as a team, foresee problems of production and in use that may be encountered with the product or service |
| 10. Eliminate slogans, exhortations, and targets for the work force which ask for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, ,since the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the workforce |
| 11. Eliminate work standards (quotes) on the factory floor, substitute leadership, eliminate management by objectives, Eliminate management by numbers, numerical goals, substitute leadership. |
| 12. Remove barriers to pride of workmanships. The responsibility of supervisors must be changed from sheer numbers to quality remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, for example, abolishment of annual or merit rating and of management by objectives |
| 13. Institute a vigorous program of education and self- improvement. |
| 14. Put everybody in the company to work to accomplish the transformation. The transformation is everyon's job |

**Joseph M. Juran**

**About Juran**

Juran born in Romania (1904) and emigrated to America in 1912.

- 1951 - published "Quality Control Handbook".
- Mid 1950's-like Deming, travelled to Japan to conduct top and middle level executive seminars on planning, organisational issues, management responsibilities for quality and the need to set and monitor improvement target goals.

Juran has authored hundreds of papers and 12 books, including "Juran's Quality Control Handbook", "Quality Planning and Analysis", and "Juran on Leadership for Quality".

Juran has been awarded over 30 medals and fellowships worldwide, including Japan's highest honour for a non-Japaneses citizen, the Second Order of the SacredTreasure presented by the Emperor.

**Juran's Contributions**

Juran's contributions can be studied under the following six topics:

1. Internal customer:
2. Cost of quality:
3. Quality trilogy:
4. Juran's 10 steps for quality improvement; and
5. The breakthrough concept.

**1. Internal Customer**

Juran realised that the customer was not just the end customer and that each personalong the chain has an internal customer. Each person along the chain, from product designer to final user, is a supplier and a customer.

In addition, the person will be a process, carrying out some transformation or activity. Therefore Juran maintained that at each stage was a "three role model" supplier,process, and customer.


**2. Cost of Quality**

Juran classified the cost of quality into three classes as:

**(i) Failure costs:** Scrap, rework, corrective actions, warranty claims, customer complaints, and loss of customer.

**(ii) Appraisal costs:** Inspection, compliance auditing and investigations. implementation. Juran demonstrated the potential for increased profits thatwould result if the costs of poor quality could be reduced.

**(iii) Prevention costs:** Training, preventive auditing, and process improvement

**3. Juran's Quality Trilogy**

Juran views quality as fitness-for-use. He also believes that roughly 80% of quality defects are management controllable. Thus management has the responsibility tocorrect this deficiency. Juran divides quality management into three parts. They are given below:

1. **Quality planning**: Objectives are to determine quality goals; to form implementation planning: to do resource planning: to express goals in qualityterms; and to create the quality plan.
2. **Quality control:** Objectives are to monitor performance; to compare objectives with achievements; and to act to reduce the gap.

3. **Quality improvement:** Objectives are to reduce waste; to enhance logistics: to improve employee morale: to improve profitability; and to satisfy customers,

**4. Juran’s 10 steps for Quality Improvement**

1. Build awareness of the need and opportunity for improvement.
2. Set goals for improvement.
3. Organise to reach the goals.
4. Provide training..
5. Carry out projects to solve problems,
6. Report progress.
7. Give recognition.
8. Keep score.
9. Maintain momentum by making annual improvement part of the regular systems and processes of the company.
10. Choose units of measurement

**5. The Breakthrough Concept**

Like the Deming cycle, Juran's breakthrough concerns itself with the product/service life cycle. In essence, this splits it up into two areas: the "journey from symptom to cause" and the journey from cause to remedy".

**Philip Crosby**

**About Crosby**

Crosby is another of the American quality gurus who rose to international fame mainly thanks to his teachings on quality management.

He is best known for the concepts of Zero Defects' and 'Do it right first time!
He has authored many books, including "Quality is Free", "Quality without Tears", and "Let's talk Quality and Leading: The art of becoming an Executive".

He was the founder and chairman of the board of Career IV, an executive management consulting firm. He also founded Philip Crosby Associates Inc. andthe Quality college.

**Crosby's Contributions**

Crosby is known for his following contributions:

1. Four absolutes of quality:
2. Fourteen steps to quality management; and
3. Crosby's quality vaccine.

**1. Crosby's Absolutes for Quality Management**

Crosby proposed four absolutes of quality for his quality improvement process.

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| **First Absolute:** | The definition of quality is conformance to requirements, not goodness. |
| **Second Absolute:** | The system for causing quality is preventive, not appraisal. |
| **Third Absolute:** | The performance standard must be zero defect, not “that’s close enough”. |
| **Fourth Absolute:** | The measurement of quality is the price of non-conformance, not indexes. |

**2. Crosby's Fourteen Steps for Quality Improvement**

Crosby has laid down 14 steps for implementing the quality improvement process in an organisation.

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|---|---|
| **Step 1:** | Establish and ensure management commitment |
| **Step 2:** | Form quality improvement teams (QITs) for quality improvement process planning and administration. |
| **Step 3:** | Establish quality measurements. |
| **Step 4:** | Evaluate the cost of quality and explain its use as a management tool to measure waste. |
| **Step 5:** | Raise quality awareness among all employees. |
| **Step 6:** | Take actions to correct problems identified through previous steps. |
| **Step 7:** | Establish a zero defects committee and programme. |
| **Step 8:** | Train supervisors and managers on their role and responsibilities in the quality improvement process. |
| **Step 9:** | Hold a zero defects day to reaffirm management commitment. |
| **Step 10:** | Encourage individuals and groups to set improvement goals. |
| **Step 11:** | Obstacle reporting (i.e., encourage employees to communicate to management any obstacles they take in attaining their improvement goals). |
| **Step 12:** | Recognise and appreciate all participants. |
| **Step 13:** | Do it all over again to demonstrate that the improvement process never ends. |

**3. Crosby's Quality Vaccine**

In the Crosby style, the "vaccine" is explained as medicine for management to prevent poor quality. The five sections of vaccine that cover the requirements of total quality management are:

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| **Section 1 – Integrity:** Treat quality seriously throughout the whole business organisation from top to bottom. That the companies future will be judged on its performance on quality. |
| **Section 2 – Systems :** Appropriate measures and systems should be put in place for quality costs, education, quality, performance, review, improvement and customer satisfaction. |
| **Section 3 – Communication :** The communication systems are of paramount importance to communicate requirement's and specifications and improvement opportunities around the organisation. Customers and operators know that needs to be put in place to improve and listening to them will give you're the edge. |
| **Section 4 – Operations :** Work with and develop suppliers. Processes should be capable and improvement culture should be the norm. |
| **Section 5 – Policies :** Must be clear and consistent throughout the business. |

**Principles of TQM**

The important underlying principles of TQM are as follows:

1. Customers' requirements must be met the first time, every time.
2. Everybody must be involved, from all levels and across all functions.
3. Top management's participation and commitment is must.
4. A culture of continuous improvement must be established.
5. Emphasis should be placed on purchasing and supplier management.
6. Every job must add value.
7. Quality improvement must eliminate wastes and reduce total cost.
8. There must be a focus on the prevention of problems.
9. A culture of promoting creativity must be established.
10. There should be focus on team work.

**EVOLUTION OF QUALITY**

The history of quality management is as old as industry itself. Abrief outline of how the quality concepts have evolved starting from 19th century.

| Time | Events |
|---|---|
| **Until the 1960s** | |

| | |
|---|---|
| Prior to the 20th century | Quality is an art.<br>Demands over come potential production<br>An era of workmanship |
| F. Taylor 1900s | The scientific approach to management resulting in renationalization of work and its break down leads to greater need for standardization, inspection and supervision. |
| Shewart 1930s | Statistical beginnings and study of quality control. In parallel, studies by R.A. Fisher on experimental design; the beginning of control charts at western Electric in U.S.A. |
| Late 1930s | Quality standards and approaches are introduced in France (Darmois) and Japan, Beginning of SQC, reliability and maintenance engineering. |
| 1942 | Seminal work by Deming at the ministry of war in U.S.A on quality control and sampling<br>Working group setup by Juran and Dodge on SQC in U.S. Army.<br>Concepts of acceptance sampling devised |
| 1944 | Dodge and deming carried out seminal research on acceptance sampling. |
| 1945 | Founding of the Japan standard association. |
| 1946 | Founding of the ASQC (American society for quality control) |
| 1950 | Visit of deming in Japan at the invitation of K.Ishikawa |
| 1951 | Quality assurance increasingly accepted. |
| 1954 | TQC in Japan (Feigenboun and Juran); book published 1956. |
| 1957 | Founding of European organisation for the control of quality<br>(France – AFCIQ, Germany, Italy, Holland, England) |
| **After the 1960s** | |
| 1961 | The Marting (Matietta) Co. in U.S.A introduces the zero – defects 'approach' while developing and producing Missiles (Crosby). Quality motivation is starting in the U.S. andintegrated programmes begun. |
| 1962 | Quality circles are started in Japan |
| 1964 | Ishikawa publishes book on Quality Management. |
| 1970 | Inshikawa publishes the book on the basics of quality circles and the concept of Total Quality is affirmed and devised in Japanese Industries. |
| 1970 to 1980 | Just-In-Time and Quality become crucial for competitiveness. A large number of U.S. and European Corporations are beginning to appreciate the advance of Japan's industries. Taguch popularises the use of environmental design robust systems and products. |

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| 1980+ | Facing the rising sun challenge in quality management.<br>Development and introduction of FMSs and greater dependenceon supplier contracts.<br>Growth of economic based on quality control, information software packages. |
| 1990+ | The management of quality has become a necessity that is recongnized at all levels of management. Increasing importance is given to off-line quality management for the design Robust manufacturing processes and products. The growth of process optimization. |

**Dimensions of Quality**

| .No | Dimension | Meaning | Explanation (taking a cell phone as an example) |
|---|---|---|---|
| 1. | Performance | ✓ It is the primary operating characteristics of the product.<br>✓ How well the product performs the customer's intended use. | ✓ The signal Coverage and audio quality of the mobile phone. |
| 2. | Features | ✓ Features are nothing but the secondary / special characteristics of the product that appeal to the customers.<br>✓ The features supplement the product's basic functioning | ✓ Face book facility, camera and music system features. |
| 3. | Conformance | ✓ Conformance is meatting specifications or applicable standards, wherever applicable, such as national standards, international standards and industry standards<br>✓ It is the degree to which physical and performance characteristics of a product match preestablished standards. | ✓ Same blackberry mobile models are banned in India as they fail to conform the Government's regulations. |

| | | | |
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| 4. | Reliability | ✓ Reliability is the probability of a product's surviving over a specified period of time under stated conditions of use.<br>✓ It is the consistency of performance of the product over time<br>✓ It is measured by mean time between failure (MTBF) | ✓ The MTBF of a mobile phone can be specified in number of months. |
| 5. | Durability | ✓ Durability is the measure of product life or the useful lift of the product.<br>✓ It is the length of time or amount of use before needing to be required or replaced. | ✓ The durability of a low – priced mobile phone can be considered as 2 to 3 years. |
| 6. | Serviceability | ✓ Serviceability is the ability to repair a product quickly and easily.<br>✓ It is the resolution of problems and complaints on the product. | ✓ Customers prefer the mobile service providers who offer easy, faster and economical service to their mobiles. |
| | | ✓ It is the speed, cost and convenience of repairs and maintenance. | |
| 7. | Responsiveness | ✓ Response, also known as customer responsiveness, is a measure of how well the manufacturer of the product is able to adapt to the changing of the customer<br>✓ It is about being flexible, dynamic and agile. | ✓ The development of multi-cim mobile phones is an example of responsiveness of the manufacturers to satisfy the customer need. |

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| 8. | Aesthetics | ✓ Aesthetics is the effect on human senses such as look, feel, smell or sound.<br>✓ Aesthetics may include, but not limited to the appearance of the product, the finish, colour etc., | ✓ The mobile models with slim in size, the flip-flop design, touch screen, coloured finish attract more customers. |
| 9. | Reputation | ✓ Reputation is nothing but the perceived quality.<br>✓ It is the subjective assessment resulting from image, advertising or brand names. | ✓ For instance, Nokia sony Ericson and Samsung, etc., are considered as branded mobile manufacturers in India.<br>✓ Airtel, Vodafone, and BSNL are branded as top mobile service providers in India. |

**Dimensions of Service Quality**

| S.No | Dimension | Meaning | Examples of questions that customers might ask |
|---|---|---|---|
| 1. | Tangibles | ✓ Appearance of physical facilities, equipment, personnel and communication materials | ✓ Are the hotel's facilities attractive?<br>✓ Is my bank statement easy to understand?<br>✓ Does the equipment modern? |
| | | | ✓ How clean is the waitress's apron? |
| 2. | Reliability | ✓ Ability to perform the promised service dependably and accurately. | ✓ Is feedback regarding student progress always given?<br>✓ Is my college bus on time always?<br>✓ Is the problem fixed? |

| | | | |
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| 3. | Responsiveness | ✓ Willingness to help customers and provide prompt service. | ✓ Are letters/e-mails replised with a day or two?<br>✓ Is feedback on assignments given within a week in time for students?<br>✓ Are customer service personnel willing to answer my questions? |
| 4. | Assurance | ✓ Knowledge and courtesy of employees and their ability to convey trust and confidence. | ✓ Are the ticket counter attendants, train driver and guards knowledgeable about their jobs?<br>✓ Do the customer service personnel seen knowledgeable about the repair? |
| 5. | Empathy | ✓ Caring, individualized attention provided to customers | ✓ Are customer service personnel and the cashier friendly and courteous?<br>✓ Are the telephone operator consistently polite when answering my calls? |

**Barriers to TQM Implementation**

1. Lack of management commitment.
2. Lack of faith in and support to TQM activities among management personnel.
3. Misunderstanding about the concept of TQM.
4. Improper planning.
5. Lack of employees commitment.
6. Lack of effective communication.
7. Lack of continuous training and education.
8. Lack of interest or incompetence of leaders.
9. Ineffective measurement techniques and lack of access to data and results.
10. Non-application of proper tools and techniques.
11. Inadequate use of empowerment and team work.
12. Inadequate attention to internal and external customers.

**Quality Statements**

Quality statements are established by the quality council to provide overall direction for achieving the total quality culture.

Three elements of quality statements are:

1. Vision statement,
2. Mission statement, and
3. Quality policy statement.

**Vision Statement**

The vision statement is a short declaration of what on organisation aspires to be in the very long term future. It is the ideal state that might never be reached; but on which one will work hard continuously to achieve. Successful visions provide a brief guideline for decision- making. Vision statements describes where leadership sees the organisation in the a vision describes aspirations for the future, without specifying the means that will be usedin desired ends.

**Examples of vision statements:**
"Sustain ITC's position as one of India's most valuable corporations through worldclass performance, creating growing value for the Indian economy and theCompany's stakeholders."

-Infosys International Inc ."Preparing young minds to contribute to the betterment of the global society."

**Mission Statement**

The mission statement, is usually one paragraph, describes the function of the organisation. It provides a clear statement of purpose for employees, customers, and suppliers. The mission statement answers the following questions: who we are?: who are thecustomers?: what we do?; and how we do it?.

**Examples of mission statements:**
"To enhance the wealth generating capability of an enterprise in a globalizing environment, delivering superior and sustainable stakeholder value."- ITC Limited

**Quality Policy statement**

The quality policy is a guide for everyone in the organization as to how theyprovide products and service to the customers. It is used as a guide to managerial action. It should be written by the CEO with feedback from the workforce and be approved by the quality council.

# Unit 2 – TQM Principles

## Customer Satisfaction

As emphasised so far, in today's buyers market the customer is the king. Even the definition of quality, 'quality is what customer wants, emphasises on the customer requirements. In other words, quality is a measure of customer satisfaction. It is obvious that business cannot survive without satisfied customers. Therefore TQM's purpose is meeting or exceeding customer expectations, so that the customers are delighted.

## Customer Perception of Quality

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

### 1. Performance

Performance involves "fitness for use". It indicates that the product and serviceis ready for the customers' use at the time of sale.

Other considerations include:

1. **Availability:** It is the probability that a product will operate wher needed.
2. **Reliability:** It is freedom from failure over time.
3. **Maintainability:** It is the ease of keeping the product + operable.

### 2. Features

Features are secondary characteristics of the product or service.

For example, the primary function of a cell phone is for communication, whereas other facilities such as calculator and alarm are features of the cell phone.

### 3. Service

Customer service is an intangible in nature. Intangible characteristics are those traits that are not quantifiable, but it contributes greatly to customer satisfaction.

Organizations objective is to provide good quality of the product to the customerat the right time, even though the customers are not complaining about their service.

### 4. Warranty

The product warranty represents an organization's public promise of a quality product. In other words, it represents a public commitment to guarantee a levelof service sufficient to satisfy the customer.

A warranty forces the organization to focus on the customers' definition of product and service quality. It also forces the organization to develop a corrective action system.

**5.Price**

In our highly competitive environment, each customer's concept of value is continually changing. In order to overcome this challenge, the organisations should identify, verify and update each customer's perception of value in relation to each product and service regularly.

**6. Reputation**

It is obvious that customers are willing to buy products or service from a known,trusted and reputed organisation. The total customer satisfaction is based on, not only with the product, the entire experience with the organization.

Thus reputation of a firm brings the market to them. So organisation should strive for customers for life.

**Customer Complaints**

A customer complaint in any communication a customer has with a company in which 'displeasure' is expressed. A customer complaint may be defined as an expression of dissatisfaction with a product/service, either orally or in writing, from an internal or external customer. Customer complaints are mainly either related to product itself or related to after-sales-service.

Why is Customer Feedback/Customer Complaint Necessary?

(i) To discover customer dissatisfaction,

(ii) To identify customer's needs,

(iii) To discover relative priorities of quality,

(iv) To compare performance with the competition, and

(v) To determine opportunities, for improvement.

**1. Customer Complaints Related to Product Itself**

- ✓ Product is defective/non-functioning
- ✓ Product is unreliable
- ✓ Product did not meet the basic requirements
- ✓ Customer expectation was higher than what the product could deliver
- ✓ Frequent breakdown of product
- ✓ Product has defective parts
- ✓ Product provided with defective accessories

**2. Customer Complaints Related to After-Sales-Service**

- ✓ Service department responding to the problem
- ✓ Speed of response to a complaint call
- ✓ Basic behaviour and courteousness of the service personnel
- ✓ Competence of the service personnel
- ✓ Product complaint not resolved even after repairs

**Common Customer Feedback Collection Tools**

Various tools used for collecting customer feedback/customer complaint include:

1. Comment cards
2. Customer questionnaire (online, phone and mail surveys)
3. Post-transaction surveys
4. Report (or feedback) cards ng.n
5. Focus groups
6. Customer feedback or customer complaint is required:
7. Social media
8. Toll-free telephone numbers
9. Customer visits
10. Employee feedback

**1. Comment Cards**

Comment cards are physical, paper cards or forms with one or more survey questions designed to gather customer feedback at the point of an in-person service interaction. These are typically filled out by customers immediately after an interaction and left with someone in the organization

**2. Customer questionnaire**,

It also known as a survey, is a more effective and also a popular tool for obtaining opinions and perceptions about an organisation and itsproducts and services.

**3. Post-Transaction Surveys**

Post-transaction surveys are conducted immediately after a customer service interaction, and usually provide feedback directly on that interaction. They are particularly useful for establishing customer service performance goals or benchmarks, and setting standards around service delivery.

**4. Report (or Feedback) Cards**

Report cards are nothing but feedback cards. Report cards, like comment cards, are physical, paper cards or forms with one or more survey questions designed tocollect customer feedback.

**5. Focus Groups**

Focus groups are moderated, small-group discussions where a pre-selected group of individual (often customers, or potential customers) provide insightinto their preferences, attitudes, and opinions about products or services.

**6. Social Media**

Social media, such as social networks, online communities, blogs, forums or discussions boards, can be used to collect customer feedback.

**7. Toll-Free Telephone Numbers**

Toll-free telephone numbers are an effective tool for receiving customer feedback/complaint. Toll-free telephone numbers provide the opportunity to the organisations torespond quickly and more cheaply to the customers' complaints.

**8. Customer Visits**

Visits to customer's place of business is an another technique for gathering information and feedback of the product. Customer visits by senior executives along with operating personnel will greatly help in monitoring their product's performance when it is used and in identifyingany specific or reoccurring problems.

**9. Employee Feedback**

In addition to the customers' feedback, the employee feedback is also a potential source of information. Since employees can offer insight into conditions that inhibit service quality in the organisation, their feedback are also crucial for customer complaint redressal.

## SERVICE QUALITY OR CUSTOMER SERVICE

Customer service is the set of activities an organisation uses to satisfy thecustomers and their needs. Though the terms 'service quality' and 'customer service' are used invariably, the term 'service quality may be misleading sometimes. Because many authors use the term 'service quality' to represent the quality efforts in service sectors/industries. However, our text focuses more on customer service.

**Elements of Customer Service**

**I. Organization**

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

| |
|---|
| **II. Customer care**<br>6. Meet the customer's expectations.<br>7. Get the customer's point of view.<br>8. Deliver what is promised.<br>9. Make the customer feel valued<br>10. Respond to all complaints<br>11. Over-respond to the customer<br>12. Provide a clean and comfortable customer reception area. |
| **III. Communication**<br>13. Optimize the trode-off between time and personal attention.<br>14. Minimuze the number of contact points |
| 15. Provide pleasant, knowledgeable and enthusiastic employees.<br>16. Write documents in customer friendly language. |
| **IV. Front-line people**<br>17. Hire people who like people<br>18. Challenge them to develop better methods<br>19. Given them the authority to solve problems<br>20. Serve them as internal customers<br>21. Be sure they are adequately trained<br>22. Recognize and reward performance |
| **V. Leadership**<br>23. Lead by example<br>24. Listen to the front-line people<br>25. Strive for continuous process improvement. |

**CUSTOMER RETENTION**

Customer retention is the process of retaining the existing customers. It is obvious that customer retention is more powerful and effective than customer satisfaction. Customer care can be defined as every activity which occurs within an organisation that ensures that a customer is not only satisfied but also retained.

The following research findings will enable us to understand the realsignificance of customer retention. The important research findings are:

- Over 60% of an organisation's future revenue will come from existingcustomers.
- A 2% increase in customer retention has an equivalent impact upon profitability as a 10% reduction in operating costs.

- Upto 96% of unhappy customers do not infact complain. But they are three times more likely to communicate a bad experience to other customers thana good one.
- 91% of the unhappy customers will never purchase goods and services from you again.
- If you make an effort to remedy customers' complaints, 82 to 95% of them will stay on with you.
- It costs 5 times as much to attract a new customer as it costs to keep an old one. Thus the customer retention is more essential than attracting new customers.

Customer retention represents the activities that produce the necessary customer satisfaction that creates customer loyalty. Customer retention can be improved by obtaining customer feedback and by measuring customer satisfaction.

Customer feedback is obtained from customer satisfaction surveys, focus groups, interviews, and observations. Customer satisfaction should be measured by using the hard measures of cash register receipts, market share, the level of customer retention, and the number of referrals from customers.

Customer retention really moves the customer satisfaction to the next levelcalled customer delight.

**Employee Involvement**

Some of the important aspects of employee involvement are:

1. Employee motivation,
2. Employee empowerment,
3. Team and teamwork,
4. Recognition and reward schemes, and
5. Performance appraisal.

We shall discuss the above said aspects of employee involvement, in detail, in the following sections.

**Employee Motivation**

According to Scott, motivation means a process of stimulating people to accomplish desired goals.

Edwin B. Flippo defines motivation as the process of attempting to influence others to do your will through the possibility of reward.

**Theories of Motivation**

**I. Maslow's Hierarchy of Needs**

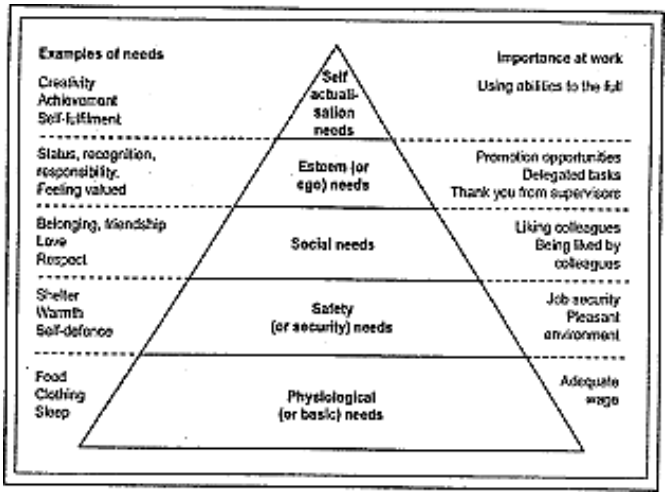
(i) Physiological needs,

(ii) Safety needs,

(iii) Social needs,

(iv) Esteem needs, and

(v) Self-actualisation needs.




**II.** Herzberg's Two factor Theory

- ✓ Herzberg's two factor theory is also called motivation-hygiene theory.
- ✓ This theory is based on two factors.
  1. Motivation factors or satisfiers and
  2. Hygiene factors dissatisfiers
- ✓ According to Herzberg, maintenance or hygiene factors are necessary to maintain a reasonable level of satisfaction among employees . These factors do not provide satisfaction to the employees but their absence will dissatisfy them. Therefore these factors are called dissatisfy them. Therefore these factors are called dissatisfiers.
- ✓ On the other hand, motivational factors creates satisfaction to the workers at the time of presence but their absence does not cause dissatisfaction.
- ✓ It can be noted that Herzberg's dissatisfiers are roughly equivalent to Maslow's lower levels and the motivators are similar to the Maslow's upper levels.

**Employee Empowerment**

According to Webster's Dictionary, the verb empowers means to give the means, ability or authority. Therefore empowerment in work setting involves giving people the means, ability and authority to do something they have not done before.

**General Principles for Empowering Employees**

The following general principles may be used to empower the employees.

1. Tell people what their responsibilities are.
2. Give them authority equal to the responsibility assigned to them.
3. Set standards of excellence.
4. Provide them with training that will enable them to maintain standards.
5. Give them knowledge and information.

6. Provide them with feedback on their performance.
7. Trust them and create trust worthiness in the organisation.
8. Allow them to fail but guide them and counsel them when needed.
9. Treat them with dignity and respect.

**Conditions to Create the Empowered Environment**

The three conditions required to create the empowered environment are:

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

**Characteristics of Empowered Employees**

Some important characteristics of empowered employees, identified by HubertRampersad, are that:

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

**Teams and Team Work**

A team can be defined as a group of people working together to achieve common objectives or goals.

TQM is based on the involvement of everyone in making improvements. So working in teams is an inseparable part of the TQM environment. Nowadays teamwork is adopted universally as the organisational mechanism for involving people in quality improvements.

**Benefits of Teamwork**

(i) Improved solutions to quality problems.

(ii) Improved ownership of solutions.

(iii) Improved communications.

(iv) Improved integration.

**Types of Teams**

**1. Process Improvement Team**

Process improvement team focuses its attention on improvements of a process which is already operating to a satisfactory level with agreed to tolerances.

**2. Cross-functional Team**

At the top management level, the cross-functional teams are formed by certain organisations which are very successful in solving complex problems involving functions of various departments. Six to ten members are selected from various functional areas of management to constitute cross-functional teams.

**3. Natural Work Teams**

Team comprise of all the members of the work unit and the team members are not volunteer; they are selected by management. Manager is also a part of the team and he is selecting the projects to be improved.

**4. Self-directed/Self-managed Work Teams**

A self-managing team is a group of individuals who work together continuously. These teams plan, execute and control their work to achieve a defined output. The team consist of members from the work unit except supervisor.

**Characteristics of Successful Teams**

**1. Sponsor**: In order to have effective liaison with the quality council, there should be a sponsor. The sponsor is a person from the quality council to provide support to the organisation.

**2. Team Charter**: A team charter is a document that defines the team's mission, boundaries, the background of the problem, the team's authority and duties, and resources. It also identifies the members and their assigned roles-leader, recorder, time keeper and facilitator.

**3. Team Composition**: The size of the team should not exceed ten members except in the case of natural work teams or self-directed teams. Teams should be diversed by having members with different skills, perspectives and potential. Wherever needed, the internal and external customers and suppliers should be included as a team member.

**4. Training**: The team members should be trained in the problem-solving techniques, team dynamics and communication skills.

**5. Ground Rules:** The team should have separate rules of operation and conduct. Ground rules should be discussed with the members, whenever needed it should be reviewed and revised.

**6. Clear Objectives:** The objective of the team should be stated clearly. Without the clear objective, the team functions are not to be effective.

**7. Accountability**: The team performance is accountable. Periodic status report of the team should be given to the quality council. The team should review its performance to determine possible team process weaknesses and make improvements.

**8. Well-defined Decision Procedures**: The decision should be made clearly at the right time by the team.

**9. Resources**: The adequate information should be given to the team wherever needed. The team cannot be expected to perform successfully without the necessary tools.

**10. Trust**: Management must trust the team to perform the task effectively. There must also be trust among the members and a belief in each other.

**11. Effective Problem-Solving**: Problem-solving methods are used to make the effective decision.

**12. Open Communication**: Open communication should be encouraged ie, everyone feels free to speak in the team whatever they are thinking, without any interruptions.

**13. Appropriate Leadership:** Leadership is important in all the team. Leader is a person who leads the team, motivates the team and guides the team in a proper direction.

**14. Balanced Participation**: Everyone in a team should be involved in the team's activities by voicing their opinions, lending their knowledge and encouraging other members to take part.

**15. Cohesiveness**: Members should be comfortable working with each other and act asa single unit, not as individuals or subgroups.

**Role of Team Members**

- ✓ Devote themselves to the common team goals based on a common mission andvision.
- ✓ Feel themselves responsible and equal.
- ✓ Be interested and motivated.
- ✓ Accept, appreciate, and respect each other.
- ✓ Give high priority to continuous improvement.
- ✓ Participate actively with the activities of the team. ✓ Offer views, opinions andideas freely and voluntarily.
- ✓ Trust, support, understand and have genuine concern for other team members.
- ✓ Attend training seriously with a receptive attitude.
- ✓ Abide by the decisions taken by the team.
- ✓ Be responsible for their own contribution as well as for the results of the team.
- ✓ Encourage feedback on own behaviour.
- ✓ Be aware of and recognize their responsibility for improvement

**Stages of Team Development**

**1. Forming stage:** When a team is created, it consists of group of individuals and team work does not exist at this stage. Team's purpose, members' roles, acceptance of roles, authority and process of functioning are learnt in the formation process.

**2. Storming stage:** Initial agreements and role allocations are challenged and re- established at this stage of team development. At this stage, hostilities and personal needs often emerge which may be resolved.

**3. Norming stage**: During norming stage of team development, formal and informal relationships get established among team members. Openness and cooperation havebeen observed as signs of team's behaviour.

**4. Performing stage**: At this stage, the team starts operating in successful manner. Trust, openness, healthy conflict and decisiveness of a group's performance can be reached at this stage.

**5. Maintenance stage**: Functioning of team does not deteriorate overtime. At this stage,the performance of teamwork at the earlier stage will be maintained for some period of time.

**6. Evaluating stage**: At this stage, team's performance is to be evaluated in view of the set targets. Both self-evaluation and management-based evaluation form this stage of team development.

**Recognition and Reward**

Recognition is a process whereby management shows acknowledgement of an employee's outstanding performance. Recognition is a form of employee positive motivation. Recognition ofemployees is highly essential as people find themselves in a accepted and winning role.

1. Employment security
2. Celebrations to acknowledge achievement of quality improvement goals,
3. Compensation time

Reward is a tangible one, such as increased salaries, commissions, cash bonus, gain sharing, etc., to promote desirable behaviour.

**Types of Rewards**

Broadly, one can classify the rewarding systems into two groups. They are:

**1. Intrinsic rewards:** These are related to feelings of accomplishment or self-worth.

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

**Performance Appraisal**

Performance appraisal is a systematic and objective assessment or evaluation of performance and contribution of an individual. It is a systematic and objective way of judging the relative worth of an employee in performing his task. It is the systematic, periodic and an impartial rating of an employee's excellencein matters pertaining to his present job and his potential for a better job.

**Need for Performance Appraisal**

1. To identify employees for salary revision, promotion, transfer, demotion, andlay-off.
2. To take an organisational of inventory people, skills and potential for comparingit with its needs.
3. To determine training and development needs of the employees.
4. To motivate employees by providing feedback on their performance levels.
5. To know personal strengths and weaknesses of different individuals.
6. To establish a basis for research and reference for personnel decisions inEmployee Involvement future.
7. To guide the individual to plan job and personal objectives and to help him incareer planning.
8. To validate the selection procedures.
9. To improve communication in an organisation.

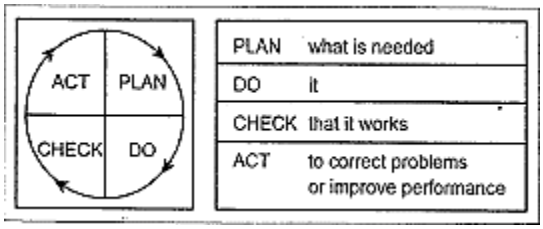
**Process of Performance Appraisal**

1. Establish performance standards
2. Communicate performance expectations to employees
3. Measure actual performance
4. Compare actual performance with standards
5. Discuss the appraisal with the employee
6. If necessary, initiate correction action

**Continuous Process Improvement**

**PDSA Cycle**

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




**Phase of PDSA Cycle**

| Phase | Description |
|---|---|
| 1. Plan | ✓ Define the problem<br>✓ Analyse the cause and draft an action plan for solving the problem.<br>✓ Determine the quality objectives and the critical factors.<br>✓ Define the performance indicators.<br>✓ Collect and analyze the necessary process data.<br>✓ Generate possible solutions.<br>✓ Select the most feasible solution; and work it out |
| 2. Do | ✓ First implement the plan on a limited scale or conduct an experiment to test the proposed improvement. Collection of date is hereby essential.<br>✓ Train all involved employees in the use of quality improvement methods and techniques.<br>✓ Describe the process which is considered for improvement and form project teams to load the process. |

| | |
|---|---|
| 3. Check | ✓ Evaluate the trial project with the performance indicators<br>✓ Verify whether the improvement has been successful or not. |
| 4. Act | ✓ Act to implement proven improvements. The choice are:introduce the plan, adjust or reject it.<br>✓ The improvements are documented in standard procedures so all employees are well-informed on how to handle in future. |
| | ✓ Usually, the cycle will be repeated under the different circumstance and conditions to test how consistent the resultsare. |

**5S HOUSE KEEPING**

- The 55 practice is a house keeping technique used to establish and maintain a productive and quality environment in an organisation.
- A well-organized work place results in a safer, more efficient and more productive operation. It boosts the morale of the workers, promoting a sense of pride in their work and ownership of their responsibilities.
- 55 was invented in Japan. It stands for five Japanese words that start with the letter 'S': SEIRI, SEITON, SEISO, SEIKETSU, and SHITSUKE.

**Objectives of '5S'**

1. To create a neat and clean work place.
2. To systemise day-to – day working.
3. To improve work efficiency
4. To standardize work practices.
5. To improve work discipline
6. To improve the quality of work and products.

**1. SEIRI: SORTING**

SEIRI denots action to identify and sort out all items into necessary andunnecessary items and discard all unnecessary items.

**2. SEITON: SYSTEMATIZE**

SEITON means to arrange everything in proper order so that it can be easilypicked up for use. A place for everything and everything in its place.

**3. SEISO: SHINE**

SEISO means to clean the workplace thoroughly so that there is nodust/dirt/scrap anywhere.

**4. SEIKETSU: STANDARDISE**

SEIKETSU means maintaining a high standard of workplace organisation andhouse keeping at all times.

**5. SHITSUKE: SELF-DISCIPLINE**

SHITSUKE denotes self-discipline, especially with regard to safety rules andpunctuality.

**Kaizen**

Kaizen is a Japanese word which means continuous improvement or improvement over improvement. Improvements in It is the process of continuous improvements in smallincrements that make the process more efficient, effective, controllable, and adequate.

**Features of Kaizen**

According to Glem Gee et al, the Kaizen improvement focuses on the use of:

1. Value-added and non-value-added wrok activities.
2. Mud, which refers to the seven classes of wastes. Wastes are over production, deky, transportation, processing, inventory, wasted motion and defective parts.
3. Principles of motion study and the use of cell technology.
4. Principles of materials handling and use of one-piece flow. 5. Documentation of standard operating procedures.
5. The 55 for workplace organisation, which are five Japanese words that mean Proper arrangement (SEIRI), Orderliness (SEITON), Personal cleanliness (SEISO), Standardisation (SEIKETSU) and Discipline (SHITSUKE).
6. Visual management by means of visual displays that everyone in the plant can use for better communication.
7. Just-in-time principles to produce only the units in the right quantities, at theright time, and with the right resources.
8. Poka-Yoke to prevent or detect errors.
9. Team dynamics, which include problem solving, communication skills andconflict resolution.

**Supplier Partnership**

Partnering is defined as a continuing relationship, between a buying firm and supplying firm, involving a commitment over an extended time period, an exchange of information, and acknowledgement of the risks and rewards of the relationship.

**Key Elements to Partnering**

**1. Long-term commitment:** Long-term commitment provides both customer and supplier the much needed environment to achieve the planned objectives. Because to set up and solve the problem of continuous improvement, both parties may require the sufficient time.

**2. Trust:** Mutual trust between two parties forms the basis for a strong working - relationship. Trust enables the partners to effectively combine their resources and knowledge. It results in a win-win' situation for both partners.

**3. Shared vision:** Both the customers and suppliers have the common goal ie, to satisfy the end user. In order to ensure this goal, both parties should share and understand their goals and objectives. This concept is also known as mutual strategic planning

## Supplier Sourcing

Three types of supplier sourcing are:

1. Sole sourcing:
2. Multiple sourcing; and
3. Single sourcing.

### Supplier Selection

Usually suppliers are selected based on their performance in terms of cost, quality, and delivery reliability. In addition, supplier criteria includes factors such as management compatibility, goal congruence, and strategic direction of the supplier firm.

### Stages in Supplier Selection and Evaluation

There are four stages in supplier selection and evaluation and they are briefed below.

1. Survey Stage: In survey stage, based on the information available through catalogues, advertisements, brochures, etc., a list is drawn up for further investigation.
2. Enquiry Stage: In enquiry stage, a detailed analysis is made after obtaining required information.
    - Standard enquiry forms are sent to the vendors, requesting them to furnish information. This may be followed by plant visit if necessary to have first hand details.
    - The vendor's present customers may be enquired regarding his performance, promptness in delivery, etc.
3. Negotiation and Selection Stage: During the enquiry stage itself, many of the vendors might have been dropped from the original list as unsatisfactory.

    The remaining vendors may be called for direct negotiations to discuss various terms and conditions like payment terms, discounts, supply procedures, quality control procedures, etc.

    As a result of this a final list of approved vendors is drawn up.
4. Experience Stage: In this stage, the performance of the supplier is evaluated mainly on basis of quality and promptness in delivery.

## Supplier Rating

A supplier rating system, also referred as a scorecard system, is used to obtain an overall rating of supplier performance. It is analogous to students progress report. Usually supplier rating is based on quality, price, performance and production capability.

**Objective of Supplier Rating**

- Obtain an overall rating of supplier performance
- Ensure complete communication with suppliers
- Provide each supplier about the details of problems for corrective action; and
- Maintain and improve the partnering relationship between the customer and the supplier.

**Supplier Rating Format**

| **Item** | **Rated by:** | | | | **Date:** | |
|---|---|---|---|---|---|---|
| **Period Location** | **Maximum Points** | **Supplier A** | **Supplier B** | **Supplier C** | **Supplier D** | **Supplier E** |
| Quality Performance | | Actual Points | Actual Points | Actual Points | Actual Points | Actual Points |
| I. Quality | | | | | | |
| (i) Quality personnel | | | | | | |
| (ii) Quality Procedure | | | | | | |
| (iii) Concern for quality | | | | | | |
| (iv) Concern history | | | | | | |
| II. PRICE | | | | | | |
| (i) Price-quality | | | | | | |
| (ii) Price-negotiation | | | | | | |
| (iii) Financial ability | | | | | | |
| III. PERFORMANCE | | | | | | |
| (i) Technical | | | | | | |
| (ii) Delivery history | | | | | | |
| (iii) Technical assistance | | | | | | |
| IV. PRODUCTION CAPABILITY | | | | | | |
| (i) Production capacity | | | | | | |
| (ii) Manufacturing equipment | | | | | | |

Rating Scale: 5.0 = Very good 2.0 = Poor

4.0 = Good 1.0 = Very poor

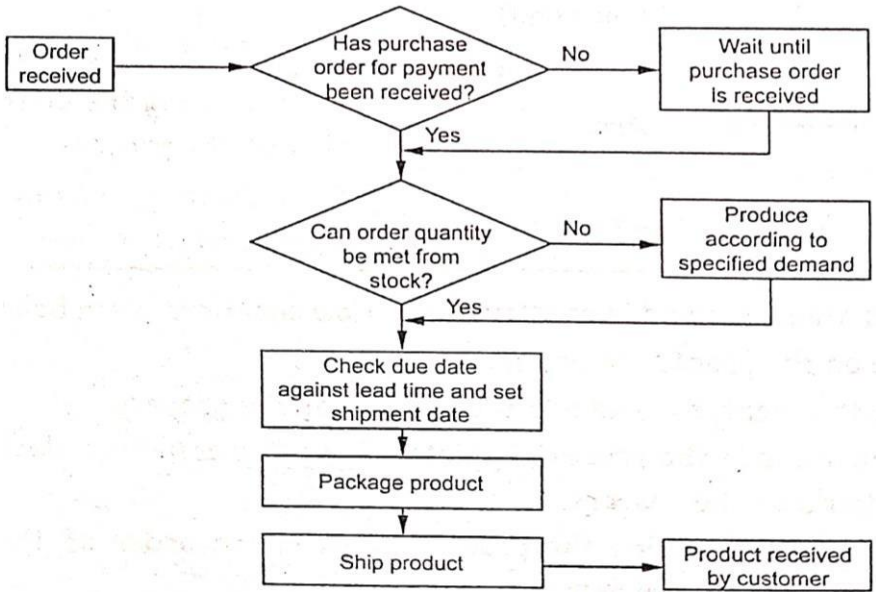
3.0 = Average 0 = Negative

## UNIT – III - TQM TOOLS

### Seven Statistical Tools of Quality

### Flow chart

Flow chart, also known as process chart, flow diagram, and process deployment flow, a diagrammatic view of the various steps in sequential order that an overall process in an organization. Flow charts are used in the quality management for depicting the steps of a process in an easily understandable form, by using standard symbols.

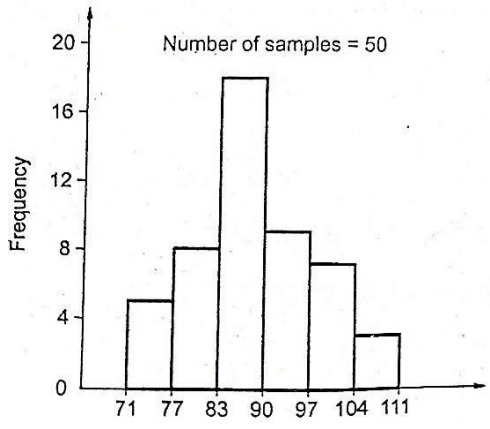



### Check sheet

Check sheet also known as tally sheet, is a form for systematic data gathering andregistering to get a clear view of the facts. It is used to keep track of how often somethingoccurs. The form of the check sheet is tailored for each situation/application.

### Histogram

Histogram is a bar chart/diagram showing a distribution of variable quantities orcharacteristics. It is a graphical display of the frequency distribution of the numerical data. Thedata are displayed as a series of rectangles of equal width and varying heig



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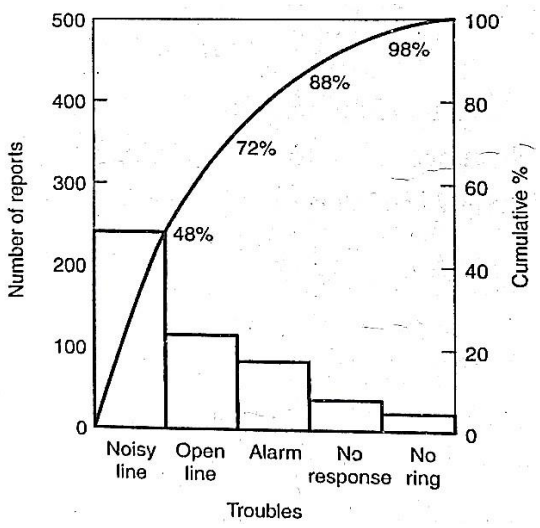
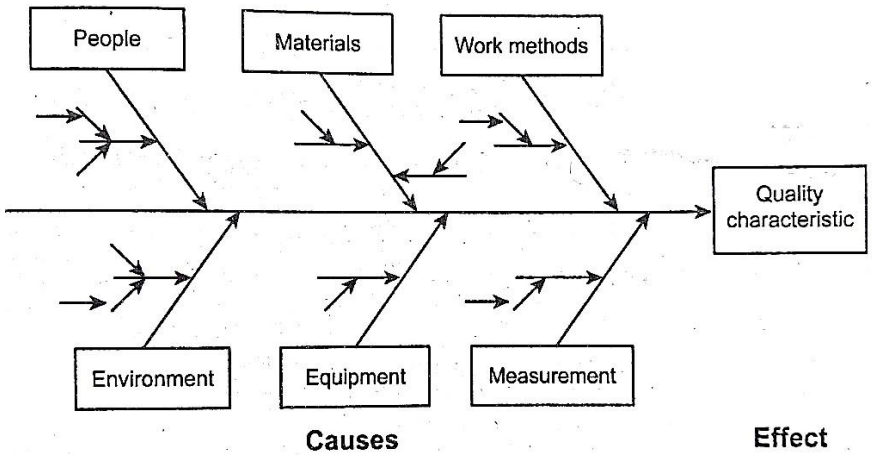
**Pareto diagram**

Pareto diagram is a diagnostic tool commonly used for separating the vital few causes that account for a dominant share of quality loss. This tool is named after Wilfredo Pareto, the Italian economist who devised this tool first. This tool is used to single out the 'vital few' from the 'trivial many'. The Pareto diagram is based on the Pareto principles, which states that a few of the defects accounts for most of the effects.



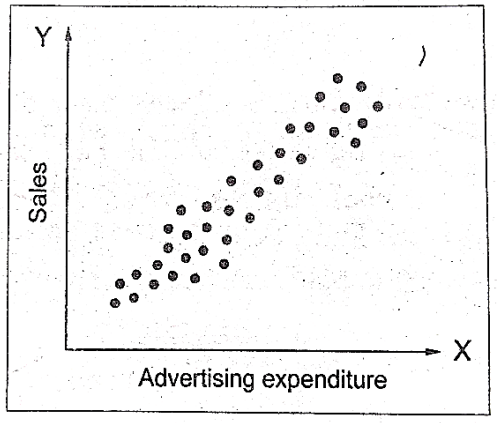

**Cause and Effect diagram**

Cause and Effect diagram is a graphical tabular chart to list and analyze the potential causes of a given problem. The cause and effect diagram is also called the fishbone diagram because of its appearance and the Ishikawa diagram after the man who developed it in 1943. The basic structure of a cause and effect diagram is as follows



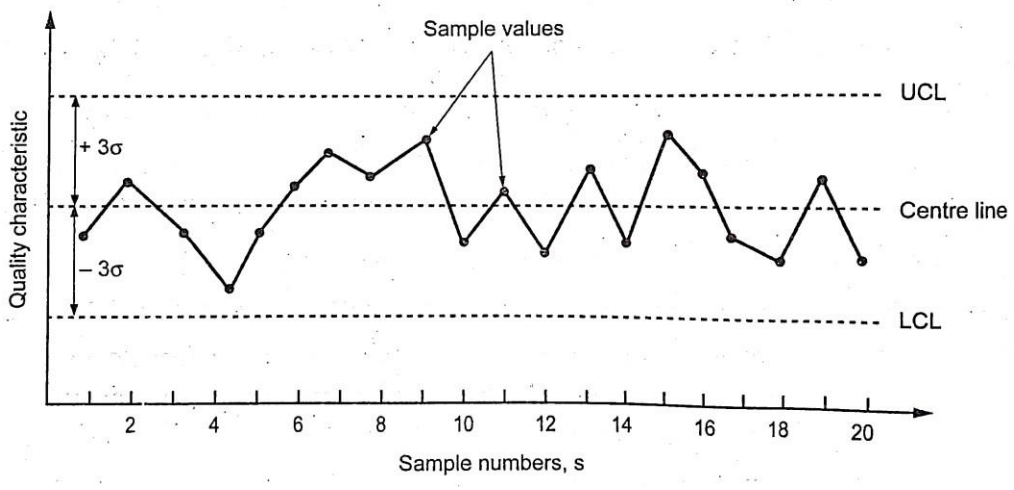

**Scatter diagram**

Scatter diagram is a simple graphical device to depict the relationship between two variables. It is the graphical component of regression analysis. A scatter diagram is composed of a horizontal axis containing the measured valuesof one variable (independent i.e. cause) and a vertical axis, representing the measurementsof the variable (dependent i.e. effect).



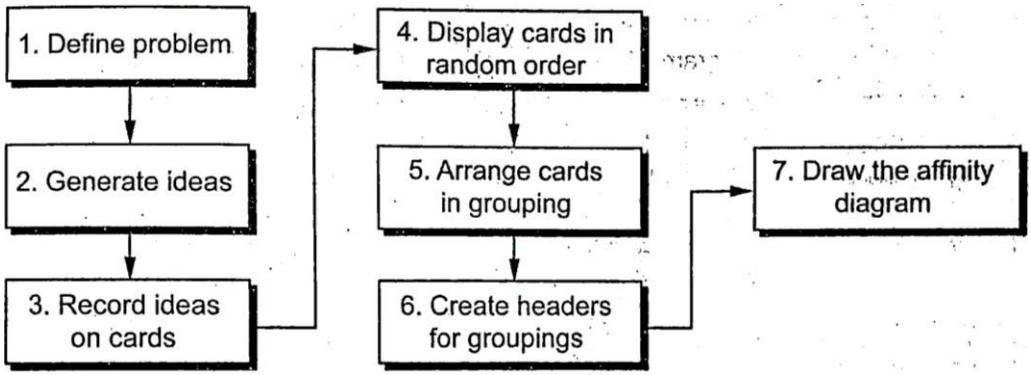

**Control chart**

Control chart, invented by Walter A. Shewart is the most widely used tool instatistical process control (SPC). The control chart is a graph that displace data taken over time and the variations of this data. The control chart can be used to check whether the process is being controlledstatistically.



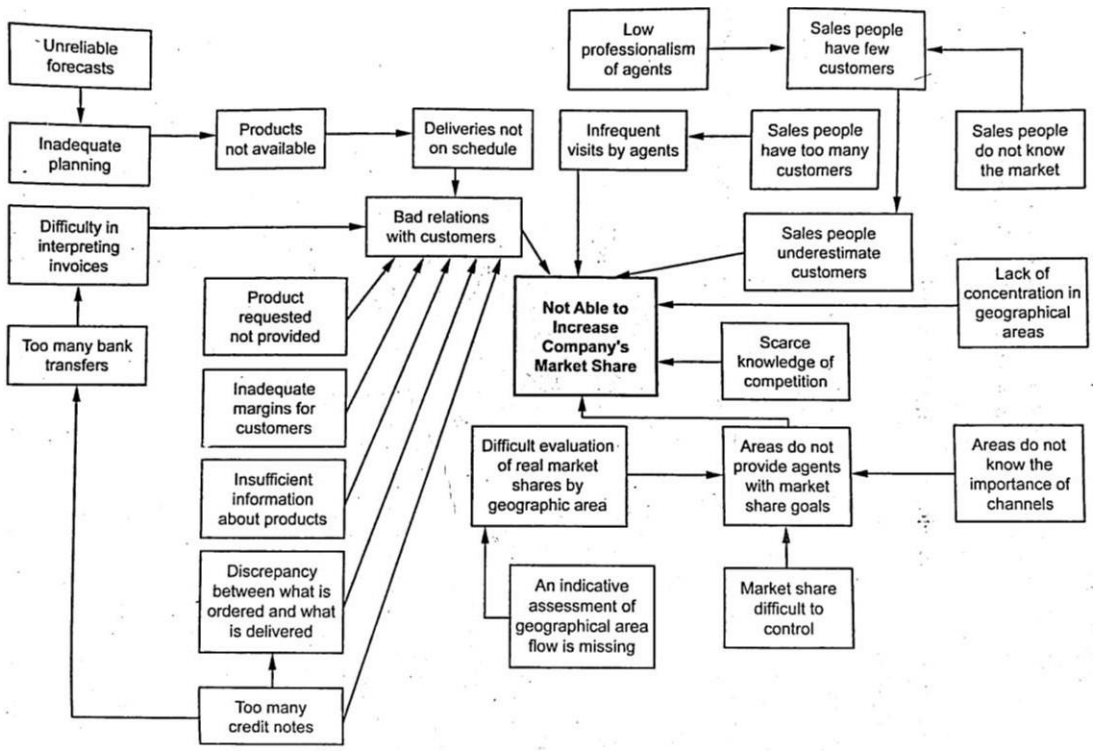

**New Seven Management Tools**
**Affinity diagram**

Affinity diagram is a tool to collect a large amount of verbal expressions (ideas, opinions, observations etc.) and organize them in groups according to natural relationships between individual items. Affinity diagram is also referred to as a KJ diagram, after its inventor Jiro Kawakita. Affinity diagram is a special kind of brainstorming tool.



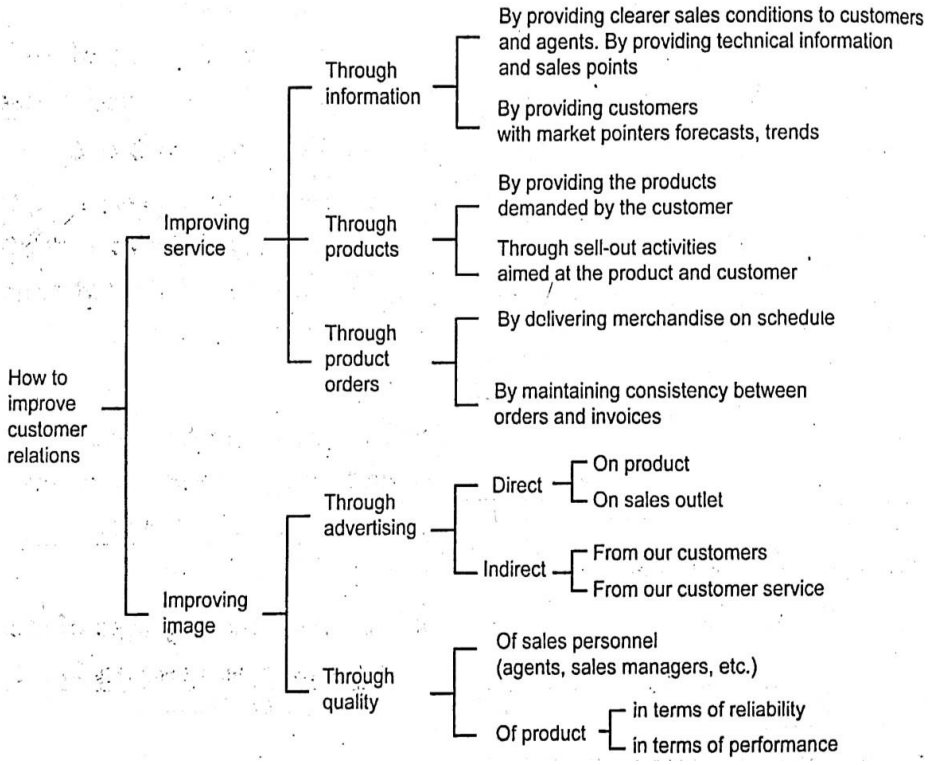

**Relationship diagram or Inter-relationship diagram**

Relationship diagram or Inter-relationship diagram is a tool for finding causes to a problem. The basic logic behind the tool is the same as those of the cause and effect diagram. The relationship diagram not only clarifies the relationship between cause and effect but also between the various causes. It is a graphical representation of all factors in a complicated problem, system or situation.



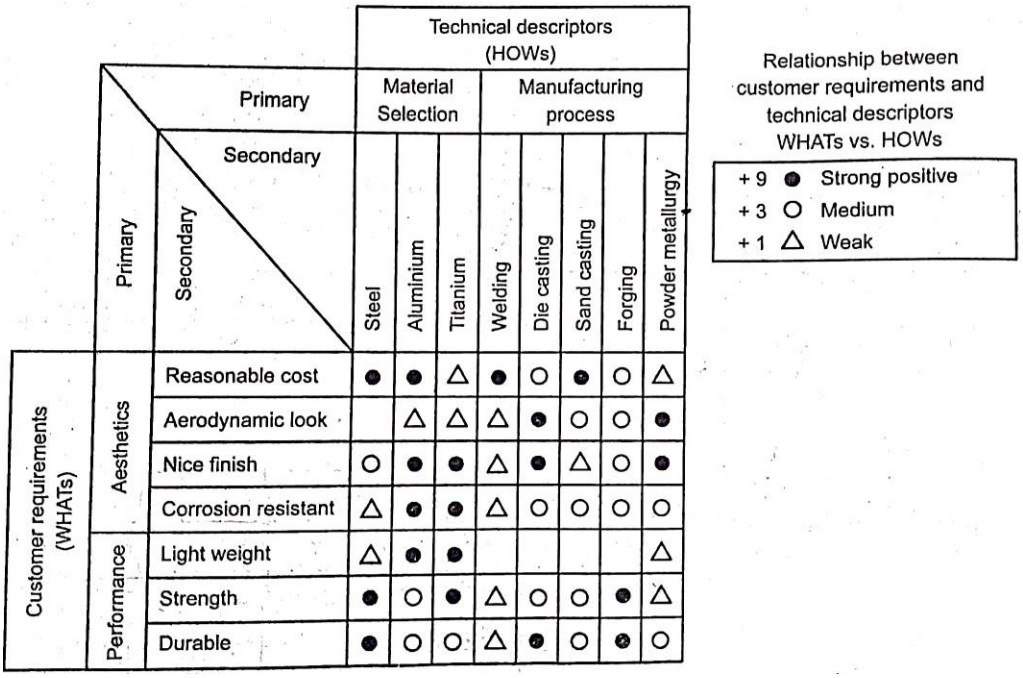

**Tree diagram**

Tree diagram systematically breaks down a topic into its component, elements and shows the logical and sequential links between these elements. The tree diagram systematically outlines the complete spectrum of paths and taskthat must be carried out to achieve a goal.



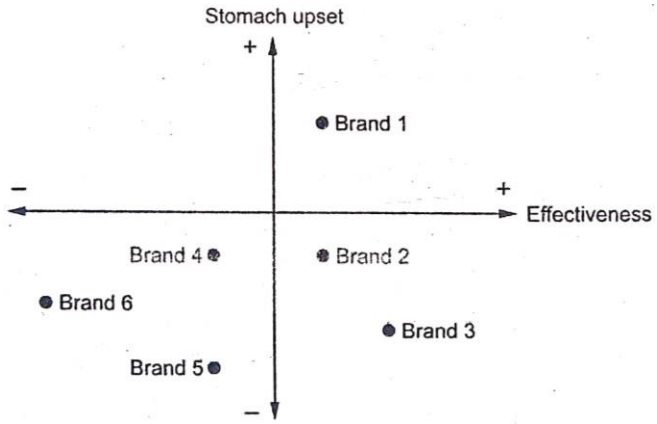
## Matrix diagram

Matrix diagram is a tool that is used to systematically organize information that must be compared on a variety of characteristics in order to make a comparison selection or choice. It is a told which depicts the relations between two, three or four sets of factors in the form of a table or a matrix. Matrix diagram, sometimes referred as a 'quality table' is the starting point in building a 'house of quality'.




## Matrix data analysis diagram

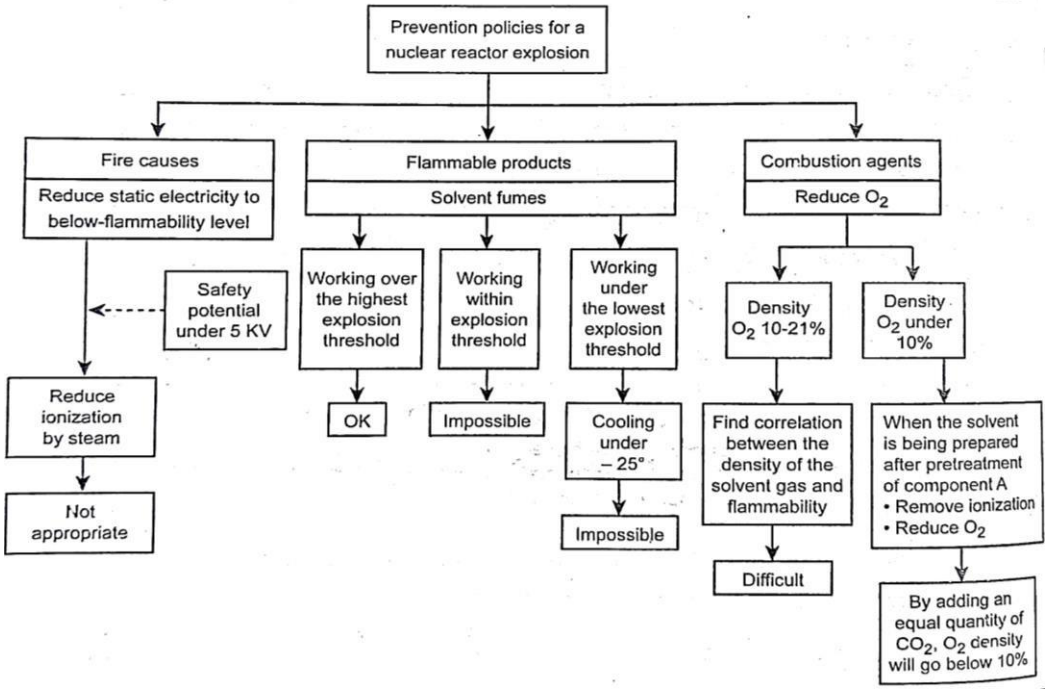
Matrix data analysis diagram is very much similar to a matrix diagram with a difference that numerical data is used instead of symbols indicating the existence and strength of relationship. It is the only tool among the new seven management tools which uses numerical data and produces numerical results.




## Process Decision Programme Chart or Decision Tree

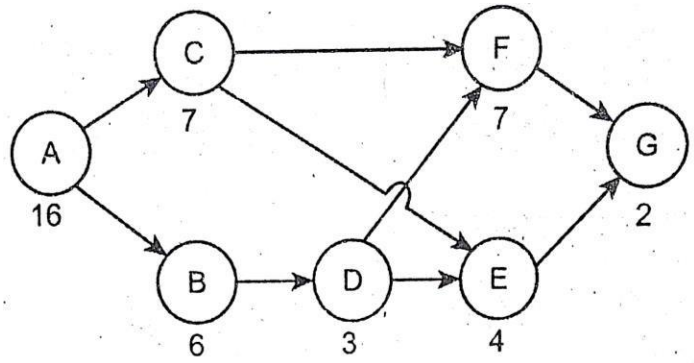
Process Decision Programme Chart or Decision Tree also known as decision tree,is a planning to outline every

conceivable and likely occurrence in any planning. The PDPC forces proactive thinking on what can go wrong with one's plan andwhat would one do to overcome the effect of such adverse occurrences. In other words, this tool helps to anticipate undesirable occurrences and enables one to prepare with plans to neutralize their effect.




**Arrow diagram**

Arrow diagram also known as the activity network is a graphic description of thesequential steps that must be completed before a project can be completed. The PERT (Program Evaluation and Review Technique) and CPM (Critical PathMethod) charts are the best known arrow diagrams. It is a planning tool that determines the critical path of a process or a project.

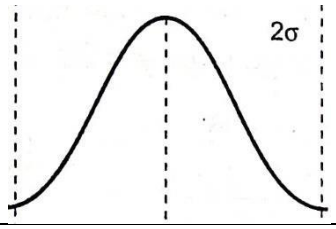
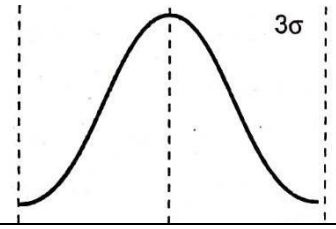
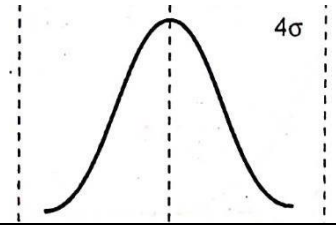
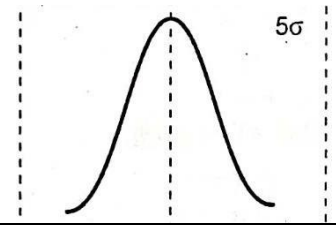


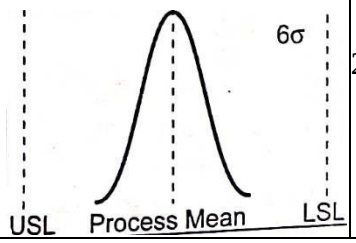
**Six Sigma**

The Concept Six Sigma has evolved over the last two decades and so has its definition. Six Sigma has literal, conceptual, and practical definitions. Six Sigma (6σ) stands for six standard deviation (σ) from mean (sigma (σ) is the Greek letter used to represent standard deviation in statistics). Six sigma is similar to Zero Defects (ZD), is a philosophical benchmark or standard of excellence proposed by Philip Crosby.

Six sigma methodology provides the techniques and tools to improve the capability and reduce the defects in any process. Six sigma was started by Motorola in 1987 in its manufacturing division then General Electric (GE) embraced it in 1995 for its products (ppm). Six sigma strives for perfection. It allows for only 3.4 defects per million opportunities or 99.999666 percent accuracy. Here a defect can be anything from a faulty party to an incorrect customer bill.

**The concept of Six Sigma**

| Process variability | CP | Total amount outside limits | Typical actions to be taken |
|---|---|---|---|
|  | 0.67 | 45500 ppm | Heave process control sorting rework, etc. |
|  | 1.0 | 2700 ppm | Heave process control, inspection |
|  | 1.33 | 63 ppm | Reduced inspection selected use of control charts |
|  | 1.67 | 0.57 ppm | Spot checking selected use of control charts |

| | | | |
|---|---|---|---|
|   | 2 | 0.002 ppm | Reduced need for control, uniformity in process inputs |

USL = Upper Specification Limit ; LSL = Lower specification Limit

**Six Sigma process**

The six Sigma methodology is described by the acronym DMAIC.DMAIC modelsimilar to PDCA (plan do check act) tool used in six sigma process improvements.

**DMAIC -** The basic methodology consists of the following five steps:

- **D**efine process improvement goals that are consistent with customer demands and the enterprise strategy.
- **M**easure key aspects of the current process and collect relevant data.
- **A**nalyze the data to verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered.
- **I**mprove or optimize the process based upon data analysis using techniques like Design of Experiments.
- **C**ontrol to ensure that any deviations from target are corrected before they result in defects. Set up pilot runs to establish process capability, move on to production, set up control mechanisms and continuously monitor the process.

**DMADV**

The basic methodology consists of the following five steps:

- **D**efine design goals that are consistent with customer demands and the enterprisestrategy.
- **M**easure and identify CTQs (characteristics that are **C**ritical **T**o **Q**uality), product capabilities, production process capability, and risks.
- **A**nalyze to develop and design alternatives, create a high-level design andevaluatedesign capability to select the best design.
- **D**esign details, optimize the design, and plan for design verification. This phase may require simulations.
- **V**erify the design, set up pilot runs, implement the production process and hand it over to the process owners.

**Advantages of Six Sigma:**

- Improved customer satisfaction
  - ➢ Ensures products/services meeting customer requirements

- Improved quality, efficiency and cost of products sold
  - Reduction of waste and defects
  - Variation reduction
  - Financial saving through cost reduction and cost avoidance
- Creation of self-sustaining infrastructure
  - Well defined rolls and responsibilities
  - Empowering all the employees (including champions, black belts etc) for better performance improvement
  - Improved communication
- Standardization
  - Common language training materials, tools and software
  - Standardized methodology
  - Creating commonality in expectations, solutions and financial tracking of theprocess

**Scope of Six Sigma**

Though the six Sigma concept is originated from manufacturing field now it isapplied to non-manufacturing processes also.

Today one can apply six sigma to many fields such as

- Services,
- Medical and insurance procedures,
- Call centres etc.

**Quality Costs or Cost Of Quality**

Quality costs are the costs associated with preventing, detecting, and remediating product issues related to quality. Quality costs do not involve simply upgrading the perceived value of a product to a higher standard. Cost of quality (COQ) is a financial measure of the quality measure of an organization. It is essentially a measure of lack of quality and can also be termed as costof poor quality.

**Elements of Quality Costs**

The American Society for Quality Control (ASQC) divides quality costs into four categories as shown in below table.

| Types | Meaning |
|---|---|
| **I. Cost of good Quality (or Cost of Conformance)** | |
| 1. Prevention costs | Costs incurred to prevent the occurrence of non-conformances in the future |
| 2. Appraisal costs | Costs incurred in measuring and controlling current production to assure conformance to requirements |

| II. Cost of Poor Quality (or Cost of Non-Conformance) | |
|---|---|
| 3. Internal failure costs | Costs generated before a product is shipped as a result of non-conformance to requirements. |
| 4. External failure costs | Cost generated after product is shipped as a result of non-conformance to requirements |

**1. Costs of Prevention**

Prevention costs are the costs that occur when a company is performing activities designed to prevent quality problems from arising in product or services. Prevention costs relate to efforts to prevent failures.

**Costs of prevention include:**

i. Cost documenting: It includes cost preparation of required documents such as manuals, procedures, policies, etc.

ii. Process control cost: It is the cost associated with implementing the quality plans and procedures to achieve the stated purpose.

iii. Cost of training: It includes the costs of conducting training programmes.

iv. Cost of quality awareness programme.

**2. Costs of Appraisal**

Appraisal costs are associated with measuring, evaluating or auditing products or services to ensure that they conform to specifications or requirements. Appraisal costs relate to testing, execution and examination to assess whetherspecified quality is being maintained.

**Costs of appraisal include:**

i. Cost of receiving test and inspection

ii. Cost of laboratory acceptance testing

iii. Cost of installation testing

iv. Cost of installation and commissioning

**3. Costs of Internal Failure**

Internal failure costs arise due to internal failures. These costs are linked to correcting mistakes before delivery of the product such as scrap, rework, remaking, reinspection, retesting and sales discounts for inferiorproducts.

**Cost of internal failure include:**

i. Cost associated with scrap and rejects

ii. Cost of repair and rework

iii. Cost of design changes

iv. Cost of reinspection and resting

**4. Costs of External Failure**

External failure costs arise from the rejection of the products/services by the customers due to poor

quality. In other words, the external failure costs are tests that occur when non-conforming product or service reaches the customer.

**Cost of external failure include:**

i. Cost of processing complaints from customers

ii. Cost of commissioning failures

iii. Cost of guarantee and warranty claims

iv. Cost of lost goodwill of customer

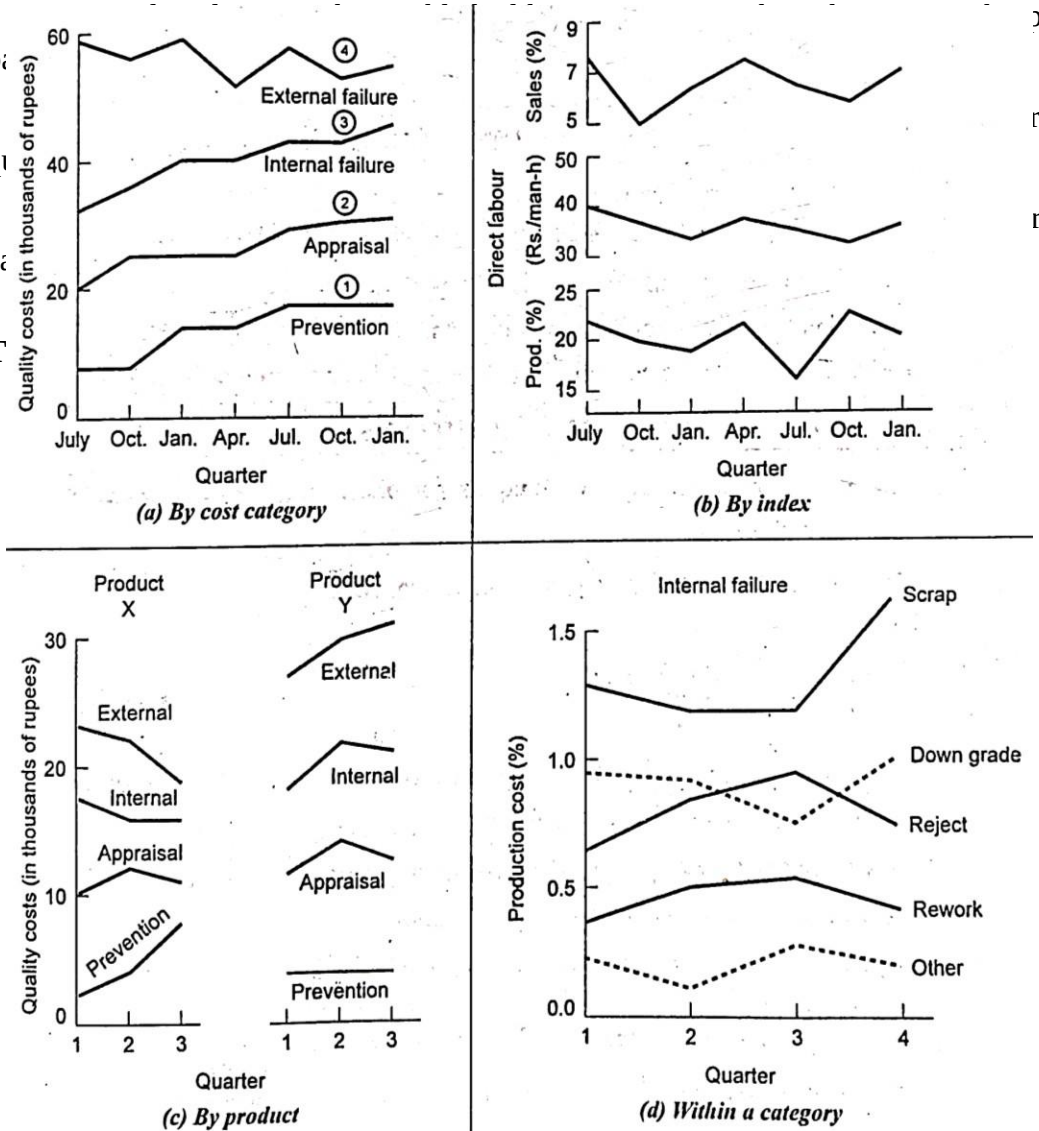
**Analysis Techniques for Quality Costs**

The most commonly used techniques for analyzing the quality costs are Trend and Pareto analysis. The objective of these techniques is to determine opportunities for qualityimprovement.

**1. Trend Analysis**

A trend analysis or a trend graph is a planning tool that provides information for long range planning. It also provides information for the investigation and assessment of quality improvement programmes.

**Characteristics of Trend Analysis**




product, by measurement

raphs may be by month,

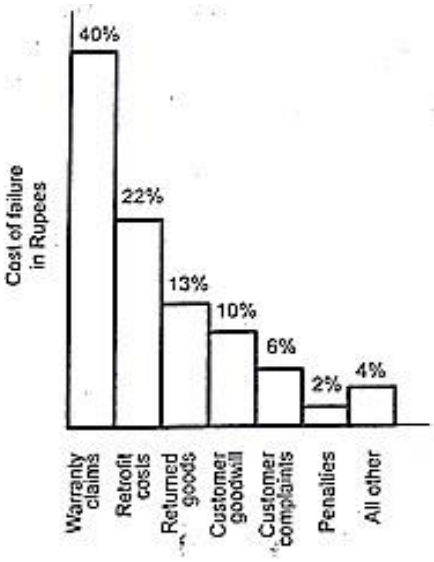
ransaction reports of the

## 2. Pareto Analysis

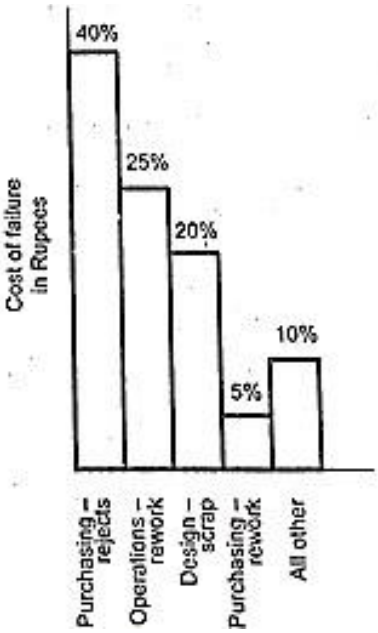
A Pareto analysis is a method of classify items events or activities according totheir relative important. A Pareto analysis is a diagnostic tool commonly used for separating the vital few causes that account for a dominant share of quality loss. The Pareto diagram is based on the Pareto principle which states that a few of thedefects accounts for most of the effects.

The Pareto diagrams can be established for quality costs by operator, by machine,by product line, by non-conformity, by category, by element and so forth.

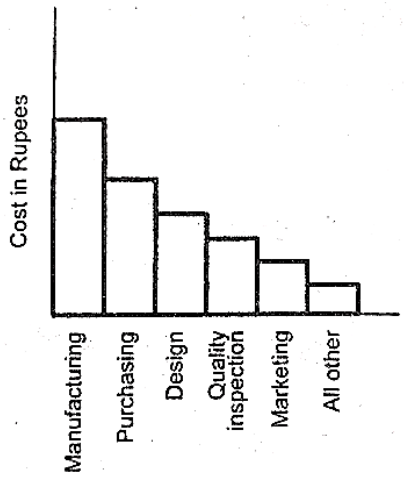
**(a) The below diagram represents Pareto diagram for the analysis of the externalfailure costs for cell phone manufacturer.**



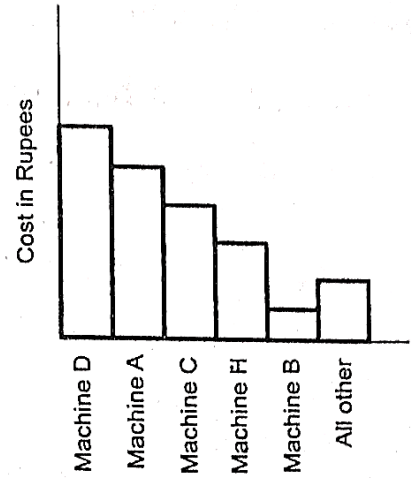

**(b) Pareto diagram for Internal Failures is depicted**



**(c) Pareto diagram for quality cost by department are shown**




**(d) Pareto diagram for quality cost by machine are shown**




**Reengineering Process**

Reengineering sometimes called Business Process Reengineering (BPR), involves a complete rethinking and transformation of key business processes, leading to strong horizontal coordination and greater flexibility in responding to changes in environment. Because work is originated around processes rather than function, reengineering often involves a shift to horizontal structure based on teams.

Reengineering basically means starting over–throwing out all the notions of how work was done and deciding how it can best be done now. It requires identifying customerneeds and them designing how it can best be done now. It requires identifying customer needs then designing processes and aligning people to meet those needs.

Banks and insurance companies, manufacturing and mining companies, andservice companies throughout the world, all have achieved breakthroughs in speed, flexibility, innovation and quality through reengineering.

Business Process Reengineering is the radical redesign of business processes to achieve dramatic improvements in productivity, cycle times, quality, and employee and customer satisfaction. Companies

start by assessing what work needs to be done to delivercustomer value.

**The Six key Steps of Business Process Reengineering**

1. **Define Business Processes**. Map the current state (work activities, workflows, roles and reporting relationships, supporting technology, business rules, etc.).
2. **Analyze Business Processes**. Identify gaps, root causes, strategic disconnects, etc. in the context of improving organizational effectiveness, operational efficiency and in achieving organizational strategic objectives.
3. **Identify and Analyze Improvement Opportunities**. Identify, analyze and validate opportunities to address the gaps and root causes identified duringanalysis. This step also includes identifying and validating improvement opportunities that are forward facing – often strategic transformational opportunities that are not tethered to current state process.
4. **Design Future State Processes**. Select the improvement opportunities identifiedabove that have the most impact on organizational effectiveness, operational efficiency, and that will achieve organizational strategic objectives. Make sure toselect opportunities for which the organization has the budget, time, talent, etc. toimplement in the project timeframe. Create a forward-facing future-state map thatcomprehends the selected opportunities.
5. **Develop Future State Changes**. Frequently overlooked (and a key root cause in failed BPR initiatives), this is where the above opportunities are operationalized before implementation. New workflows and procedures need to be designed and communicated, new/enhanced functionality is developed and tested, etc. Changes and opportunities cannot be implemented until they are operationalized.
6. **Implement Future State Changes**. Classic implementation based on dependencies among changes/opportunities, change management, project management, performance monitoring, etc.

**Major Types of changes made in Business Process Reengineering are**

**1. Work change:**

Work change is any alternation that occurs in the work environment. Its effect areas follows:

(a) The whole organization tends to be affected by change in any part of it.

(b) Change is a human as well as technical problem.

(c) Organization tend to achieve an equilibrium in their social structure. The equilibrium is established when people develop a relatively stable set of relationswith their environment.

The manager's role is to introduce continual organizational changes so as to bringabout a better fit between the firm and its environment. The manager should be proactive- anticipating events, initiating change, and taking control of the organization's destiny. Also the manager is reactive-responding to events adapting to change and tempering theconsequence of change.

**2. Planned versus Reactive change:**

Some changes are planned well in advance, while some other changes come aboutas a reaction to unexpected events. Planned change is a change that is designed and implemented in an orderly and timely fashion in anticipation of future events. Reactive change is a piecemeal response to events as they occur.

**3. Technological change:**

High technology is one of the most important cause of organizational change today. As a result of technological advances, more than half of the existing jobs will be changed within the next decade and about 30 per cent of the jobs will be eliminated. In the manufacturing or production technology field, revolutionary changes have taken place. Robots and computer-controlled machines manufacture items while technicians stand by computer controls, monitoring activities.

**Mentioned below are some Advantages of Business Process Reengineering (BPR):**

- It gives an appropriate focus to business as it revolves around customer needs.
- BPR helps in building a strategic view of operational procedures by making radical inquiries about how processes are improved and how things could be done.
- It eliminates unnecessary activities and thereby helps in reducing organizational complexity.
- It coordinates and integrates several functions immediately.
- Provides improved viability and adequacy to an organization by eliminating the delay and unessential phases of operations and management.
- Reduced the number of checks/controls and reconciliation processes.
- It helps overcome short-sighted approaches that usually emerge from excessive concentration on functional boundaries.

**BPR comes with various Limitations as well**

Business Process reengineering isn't always easy. There have been some challenges revolving around the usage of BPR since its inception, like objections, issues, and problems. Business process reengineering disadvantages include:

- It doesn't suit every business need as it depends on factors like size and availability of resources. It usually benefits large organizations.
- In some cases, the efficiency of one department was improved at the expense of the overall process.
- This BPR approach does not provide an immediate resolution. It concentrates significantly upon long haul income collaborations of a business which not only takes some effort to take shape but are hard to gauge as well
- It might require a substantial investment in IT along with proper planning,fantastic teamwork, and exceptional implementation.
- It can replace humans when it comes to getting the job done error-free hence posing as a real threat to jobs.
-

**Improvement Strategies (Four R's of Total Improvement)**

**1. Repair Strategy:**

As its name implies, the repair strategy aims at fixing things right so that to perform its designed functions.

**There are two levels of repair:**

In the first level, an individual or team identifies the problem and eliminates the root cause(s) of the problem and hence it results in a permanent solution.

In the second level, if a customer receives a faulty product, the product is either replaced or repaired, which is a temporary or short-term measure.

**2. Refinement Strategy:**

Refinement strategy involves activities that continually improve a process that isnot broken.

In this strategy, improvements to processes, products and services are accomplished on an incremental basis (Kaizen concept).

Since refinement improves efficiency and effectiveness, it should become an integral part of every employee's job.

**3. Renovation Strategy:**

Renovation strategy results in major or breakthrough improvements. Innovation and technological advancements are two key factors in this strategy.

Compared to repair and refinement strategies, renovation is more costly and usually it is undertake by teams rather than individuals.

**4. Reinvention Strategy:**

Reinvention or re-engineering strategy involves developing product, service, process or activity using teams based on a complete understanding of the customer's requirement and expectations.

Reinvention strategy is the most demanding improvement strategy to maintain competitive advantage in the market.

**Taguchi Methods**

Taguchi methods are statistical methods developed largely by Genichi Taguchi to improve the quality of manufactured goods.

Taguchi's principle contributions to statistics are:

- Taguchi loss function;
- The philosophy of off-line quality control; and
- Innovations in the design of experiments

However our scope is limited to only Taguchi loss function which will be discussedin the following sections.

**Concepts of Taguchi Loss Function**

Taguchi defines quality as "the loss imparted by product to society from the time the product is shipped".

This loss includes costs to operate, failure to function, maintenance and repair costs, customer dissatisfaction, injuries caused by poor design and similar costs.

Defective products/parts that are detected, repaired, reworked or scrapped beforeshipment are not considered part of this loss.

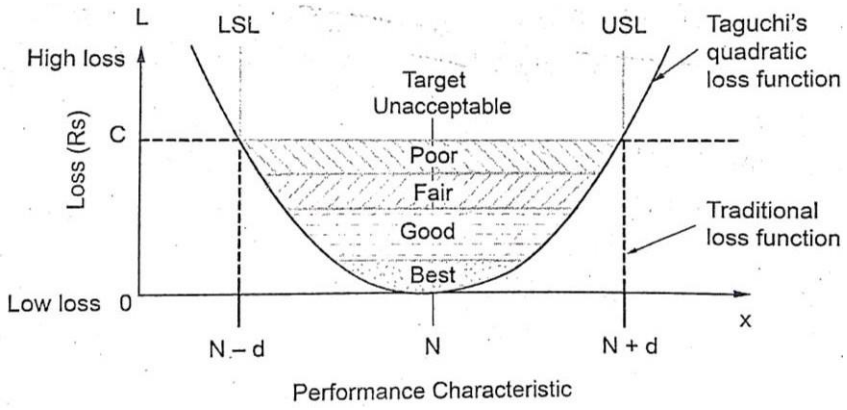
The essence of the loss function concept is that whenever a product deviates from its target performance, it generates a loss to society. This loss is minimum whenperformance is right on target, but it grows gradually as one deviates from the target.

Therefore the loss function philosophy says that for a manufacturer, the best strategy is to produce products as close to the target as possible, rather than aiming at 'being within specifications'.

**Taguchi's Quadratic Quality Loss Function**

Quality loss occurs when product's specifications deviates from target value tonominal value. No matter how small the deviation. There is some loss in quality.

If the deviation grows, then the loss increases. The Taguchi's U-shaped loss function curve is shown below.




**Role of IT in TQM.**

In the TQM application with information systems, the technologies play a vital role.
These are classified as current and emerging technologies.

The objective of the Total Quality Management (TQM) in the information system design is to assure the quality of information. This is done by ensuring, verifying, and maintaining software integrity through an appropriate methodology choice amongst the technology, design and architecture. It institutes appropriate procedures with checks and control in all the processes of information systems development. It ensures that the scopeand the objective of the system, choice of the design architecture and development methodology and further quality ensuring the processes and planned implementation methodologies are correctly chosen.

The quality of information is governed by the quality of the information processing system design. The perception of good quality is that of a customer or a user of the information system and not that of the conceiver, the planner or the designer of the information system.

The quality of the information and the systems which generate that information will be rated high provided it assures:

- A precise and an accurate information
- A high level response in an interactive processing
- User friendly operations
- Reliability of information
- An ease of maintenance

A single most important measure of quality assurance is the level of user satisfaction it attains. The user satisfaction is highest if it meets his information needs on a continuing basis in a dynamic business environment.

In the process of achieving user satisfaction, the information system must be conceived with business focus and orientation. It must address the total scope of the business with specific attention in the areas of core competence and mission critical applications. The choice of the Information Technology strategy should be such that it supports the businessstrategy implementation to achieve business goals and mission.

TQM addresses all these requirements of the information systems development. It ensures that the information system design is flexible, bug free and easy to maintain with thechanging needs.

In the TQM application to information systems, the technologies play a vital role. We can make two parts of these technologies. First, as a current and the second one as the emerging technologies. The current technologies are database management, distributed data processing, object orientation, parallel processing, data warehousing andreplication, networks and communication.

The emerging technologies are Internet/Intranet, EDI and E-mail, Groupware for team based application, client/server for application processing, multi-media for voice, video, image processing, imaging systems for image creation, storage mixing knowledgebase (KBS) for expert, artificial intelligence system and Computer Aided Software Engineering (CASE) for a systematic application development.

James W Cortada measures the quality of information by seven parameters.

They are

- Flexibility,
- Maintainability,
- Reusability,
- Integration,
- Consistency,
- Usability And

## UNIT – IV - TQM TECHNIQUES

### Introduction to Benchmarking

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

In more conventional terms, benchmarking can be defined as measuring anorganisation's performance against that of best-in-class companies, determining how thebest-in-class achieve those performance levels.

The essence of benchmarking is the process of barrowing ideas and adapting them to gain competitive advantage. Therefore it is a tool for continuous improvement.

### Reasons to Benchmark (Objectives of Benchmarking)

The important objectives of benchmarking are as follows:

1. Benchmarking aims at a goal setting process to facilitate comparison with the best.
2. It aims at motivating and stimulating company employees towards the goal of continuous quality improvement.
3. It aims at external orientation of the company.
4. It aims at identifying a technological break-through.
5. It aims at searching for industry best practices.

| **Objectives** | **Without benchmarking** | **With benchmarking** |
|---|---|---|
| Becoming competitive | • Internally focused<br>• Evolutionary change | • Understanding of competitiveness<br>• Ideas from proven practices |
| Industry best practices | • Few solutions<br>• Frantic catch-up activity | • Many options<br>• Superior performance |
| Defining customer requirements | • Based on history or gut feeling<br>• Perception | • Market reality<br>• Superior performance |
| Establishing effective goals and objectives | • Lacking external focus<br>• Reactive | • Credible, unarguable<br>• Proactive |

| | | |
|---|---|---|
| Developing true measures of productivity | • Pursuing pet projects<br>• Strength and weaknesses not understood<br>• Route of least resistance | • Solving real problems<br>• Understanding outputs<br>• Based on industry best practices |

**Types of Benchmarking**

The benchmarking can be classified into two categories:

(i) Based on the object to be benchmarked, and

(ii) Based on the organisations against whom one is benchmarking.

**I. Classification Based on the Object to be Benchmarked**

**1. Product Benchmarking**

This refers to comparison of different features and attributes of competingproducts and services.

It is done through either engineering analysis or through analyses of perception ofcustomers.

It is also called as 'customer satisfaction benchmarking' or 'customer valueprofiling".

It can help in identifying activities where improvement is possible

**2. Performance Benchmarking**

This refers to comparison of performance indicators related to a business as awhole or to the group of critical activities or processes.

It measures all the different kinds of system performance variables such asefficiency, effectiveness, productivity, quality, flexibility, profitability, etc.

**3. Process Benchmarking**

This refers to comparison of processes.

It identifies a more effective and efficient process to be implemented.

**4. Strategic Benchmarking**

This refers to examining competitive position in the market place.

It helps the company to study the business strategy of another successful businessand use the strategy for becoming more competitive.

**5. Generic Benchmarking**

This refers to comparison of general best practices which are common acrossindustry sectors markets.

In this, comparison is not restricted to any one market or industry.

**II. Classification Based on the Organisations against Whom One is Benchmarking**

1. **Internal Benchmarking**: It refers to comparison of performance between departments, plants, subsidiaries, etc., within the same organisation.
2. **External Benchmarking**: It refers to comparison of performance with external organisations producing same class of products and services.
3. **Industry Benchmarking**: It refers to comparisons with a group larger than the direct competitor (i.e., other organisational players such as suppliers, distributors,customers, etc.).
4. **Competitive Benchmarking**: It refers to comparison of performance against direct competitors in order to catch up or surpass competitor performance.
5. **Best-in-class Benchmarking**: It refers to comparison of performance with best practices prevalent in an organisation irrespective of products and services.
6. **Relationship Benchmarking**: It refers to comparison of performance with the benchmarking company which already has a relationship like customer-supplier relations, joint venture arrangement, etc.

**Benchmarking Process**

| Phase | | Steps |
|---|---|---|
| I. Planning | 1. | Earmark what is to be benchmarked? |
| | 2. | Identify the best competitor. |
| | 3. | Determine the data collection method and start collecting data. |
| II. Analysis | 4. | Determine the current performance gap |
| | 5. | Project future performance levels. |
| III. Integration | 6. | Communicate benchmark findings and gain acceptance |
| | 7 | Establish functional goals<br>Communication data for analysis<br>Gain acceptance for analysis |
| IV. Action | 8 | Develop action plans |
| | 9 | Implement specific actions and monitor progress |
| | 10 | Recalibrate benchmarks |
| V. Maturity | 11 | Attain the leadership position |
| | 12 | Integrate practices into the process |

**Failure Mode And Effect Analysis (FMEA)**

Failure Mode and Effect Analysis (FMEA), also known as risk analysis, is a preventive measure to systematically display the causes, effects, and possible actions regarding observed failures. The objective of FMEA is to anticipate failures and prevent them from occurring.

**Types of FMEA**

The several types of FMEA include:

1. System FMEA - Analyses components, subsystem and main system in early stageof design.
2. Design FMEA - Analyses the products/parts before they are released tomanufacturing.
3. Process FMEA-Focuses on manufacturing and assembly processes.
4. Service FMEA - Analyses service industry processes before they are released to impact the customer.
5. Equipment FMEA
6. Maintenance FMEA
7. Concept FMEA
8. Environmental FMEA

**Stages of FMEA (FMEA Methodology)**

The FMEA methodology has four stages. They are:

**Stage 1. Specifying Possibilities**

(i) Functions (ii) Possible failure modes (iii) Root causes

(iv) Effects (v) Detection/prevention

**Stage 2. Quantifying Risk**

(i) Probability of cause (ii) Severity of effect

(iii) Effectiveness of control to prevent cause (iv) Risk Priority Number (RPN)

**Stage 3. Correcting High Risk Causes**

(1) Prioritizing work (ii) Assigning action responsibility

(iii) Detailing action (iv) Check points on completion

**Stage 4. Re-evaluation of Risk**

(i)Recalculation of risk priority number

## FAILURE MODE AND EFFECT ANALYSIS
## (Design/Process FMEA)

FMEA Number .....

Page ..... of .....

Item ..... Design/Process Responsibility ..... Prepared By .....

Model Number/Year ..... Key Date ..... FMEA Date (Orig) ..... (Rev) .....

Core Team .....

| Product/ Process Function Requirements | Potential Failure Mode | Potential Effect(s) of Failure | S | C L A S S | Potential cause(s)/Mechanism(s) of Failure | O | Current Design/ Process Controls | D | R P N | Recommended Actions | Responsibility and Target Completion Dates | Action Results | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Actions Taken | S E V | O C C | D E T | R P N |
| | | | | | | | | | | | | | | | | |

**FMEA Procedure (Details of a FMEA Form)**

The basic steps for implementation of a FMEA are outlined below.

1. **Describe the product/process and its function.**
2. **Create a block diagram of the product/process**: The block diagram shows the logical relationships of components and establishes a structure around which the FMEA can be developed.
3. **Complete the header of the FMEA form worksheet**: Item, Design/Process responsibility (i.e., team leader), Prepared by, Model number/Year, Key date, Core team (i.e., team members name), and Revision date (Refer Fig.4.2). Modifythese headings as needed.
4. **List product/process functions.**
5. **Identify failure modes.**

   A failure mode is defined as the manner in which a component, subsystem,system, process, etc., could potentially fail to meet the design purpose.

   Examples of potential failure modes include: Corrosion, torque, fatigue,deformation, cracking, electrical short or open, and hydrogen embrittlement.
6. **Describe the potential failure effects.**

   For each failure mode identified the engineer should determine what theultimate effect will be. A failure effect is defined as the result of a failure mode on the function ofthe product/process as perceived by the customer.

   Examples of failure effects include: Injury to the user, impaired operation,poor appearance, odours, noise, and degraded performance.
7. **Establish a numerical ranking for the severity (S) of the effect.**

   Severity (S) is the assessment of the seriousness of the failure effect. A common industry standard scale uses 1 to represent no effect and 10 sindicate very serious effect.

   This numerical ranking enables the engineer to prioritize the failures addressthe real big issues first
8. **The CLASS column** is used to classify any special product characteristics for components, sub-systems, or systems that may require additional process and controls.
9. **Identify the potential causes/mechanisms of failure**

   A failure cause is defined as a design weakness that may result in a failure. The potential causes for each failure mode should be identified and documented. The causes should be listed in technical terms and not in terms of symptoms.

   Examples of potential causes include: Improper torque applied, improper operating conditions, contamination, erroneous algorithms, improper alignment, excessive loading, and excessive voltage.

**10. Enter the probability factor**

Occurrence (O) is the chance that one of the specific causes/mechanisms willoccur.

A numerical weight should be assigned to each cause that indicates how likelythat cause is (i.e., probability of the cause causing). A common industry standard scale uses 1 to represent not likely and 10 toindicate inevitable.

**11. Identify current controls (design or process)**

Current controls (design or process) are the mechanisms that prevent the cause of the failure mode from occurring or which detect the failure before itreaches the customer.

These controls may be supported through tests, mathematical studies, feasibility reviews, and prototype testing.

**12. Determine the likelihood of detection (D)**

Detection (D) is an assessment of the likelihood that the current controls willdetect the cause of the failure mode or the failure mode itself.

The likelihood of detection is also based on a 1 to 10 scale, with 1 being the certain of detection and 10 being the absolute uncertainty of detection.

**13. Review Risk Priority Number (RPN)**

The Risk Priority Number (RPN) is defined as the product of the severity (S), occurrence (O), and detection (D) rankings.

That is,

RPN = Severity x Occurrence x Detection Or RPN =

(S)x(O)x(D)

The RPN is used to prioritize items that require additional quality planning oraction.

**14. Determine recommended action(s)**

Determine recommended action(s) to address potential failures that have a high RPN.

These actions may include specific inspection, testing, de-rating, selection of parts and materials, redesign of the items, monitoring mechanisms and performing preventive maintenance.

**15. Assign responsibility and a target completion date** for these actions. This makes responsibility clear-cut and facilitates tracking.

**16. Indicate actions taken**

After these actions have been taken, re-assess the severity, occurrence and detection and review the revised RPN's.

**17. Update the FMEA** as the design or process changes, the assessment changes ornew information becomes known.

## Concept, Definition of QFD

Quality Function Deployment (QFD) is the latest approach to product design. Thetrue meaning of the phrase QFD is customer driven product (or process or services) development. QFD is a systematic and organised approach of taking customer needs and demands into consideration while designing new products and services (or while improving the existing products and services). QFD focuses on the voice of the customer' i.e., customer expectations or requirements. That's why QFD is sometimes called as 'customer driven engineering'. The QFD translates this voice of the customer into technical and functional requirements at every stage of design and manufacture.

## Objectives of QFD

The objectives of QFD are:

(i) To identify the true voice of the customer and to use this knowledge to developproducts which satisfy customers.

(ii) To help in the organisation and analysis of all the pertinent information associated with the project.

## House of Quality

The primary planning tool used in QFD is the House of Quality (HOQ). The house of quality converts the voice of the customer into product design characteristics. QFD uses a series of matrix diagrams, also called, quality tables', that resemble connected houses.

## Basic Structure of House of Quality

### Section I: Customer Requirements

- The exterior walls of the house are the customer requirements.
- On the left hand side, the voice of the customer ie., what the customer expect fromthe product is listed.

### Section II: Prioritized Customer Requirements

- On the right hand side, the prioritized customer requirements matrix are listed. orplanning Matrix are listed.
- Some of the listed items include customer benchmarking, customer importance rating, target value, scale-up factor, and sales point.

### Section III: Technical Descriptors

- The second floor, or ceiling, of the house contains the technical descriptors. Product design characteristics, expressed in engineering terms, are located in thisceiling.
- The interior walls of the house are the relationships between customer requirements and technical descriptors.
- This relationship matrix correlates customer requirements with productcharacteristics.

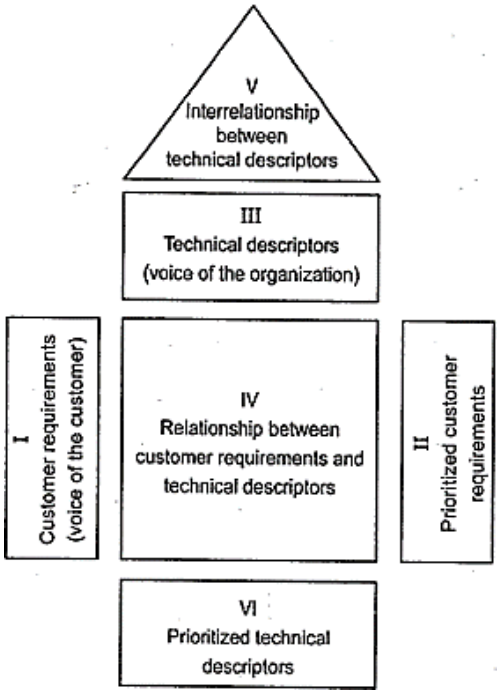
### Section V: Trade-off Matrix

- The roof of the house is the interrelationship between technical descriptors.

- Trade-offs between similar and/or conflicting technical descriptors are identified.

**Section VI: Prioritized Technical Descriptors**

- The foundation of the house is the prioritized technical descriptors.
- Some of the items included are the technical benchmarking, degree of technical difficulty, and target value.




**QFD Methodology (Constructing the House of Quality)**

The steps required for building the house of quality are listed below:

**Step 1. List Customer Requirements (WHATS)**

- Define the customer and establish full identification of customer wants anddislikes.
- Measure the priority of these wants and dislikes using weighing scores.
- Summarise these customer wants into a small number of major (primary) wants, supported by a number of secondary and tertiary wants.

**Step 2. List Technical Descriptors (HOWS)**

- Translate the identified customer wants into corresponding 'hows' or design characteristics. Express them in terms of quantifiable technical parameters or product specifications.

**Step 3. Develop a Relationship Matrix between WHATS and HOWS**

- Investigate the relationships between the customers' expectations (WHATS) and the technical descriptors (HOWS).
- If a relationship exists, categorise it as strong, medium or weak (or by assigning scores).

**Step 4. Develop an Interrelationship Matrix between HOWs**

- Identify any interrelationships between each of the technical descriptors.
- These relationships are marked in the correlation matrix by either positive or negative. Here a positive correlation represents a strong relationship and a negative correlation represents a weak relationship.

**Step 5. Competitive Assessments**

- Compare the performance of the product with that of competitive products.
- Evaluate the product and note the strong and weak points of the product against its competitors' product according to the customer.
- This competitive assessment tables include two categories: customer assessment and technical assessment.

**Step 6. Develop Prioritized Customer Requirements**

- Develop the prioritized customer requirements corresponding to each customer requirement in the house of quality on the right side of the customer competitive assessment.
- These prioritized customer requirements contain columns for importance tocustomer, target value, scale-up factor, sales point, and an absolute weight.

**Step 7. Develop Prioritized Technical Descriptors**

- Develop the prioritized technical descriptors corresponding to each technical descriptor in the house of quality below the technical competitive assessment.
- These prioritized technical descriptors include degree of technical difficulty. target value, and absolute and relative weights.

At the end of house of quality analysis, the completed matrix contains much information about which customer requirements are most important, how they relate to proposed new product features, and how competitive products compare with respect to these input and output requirements.

**QFD Process**

There are four phases of product development:

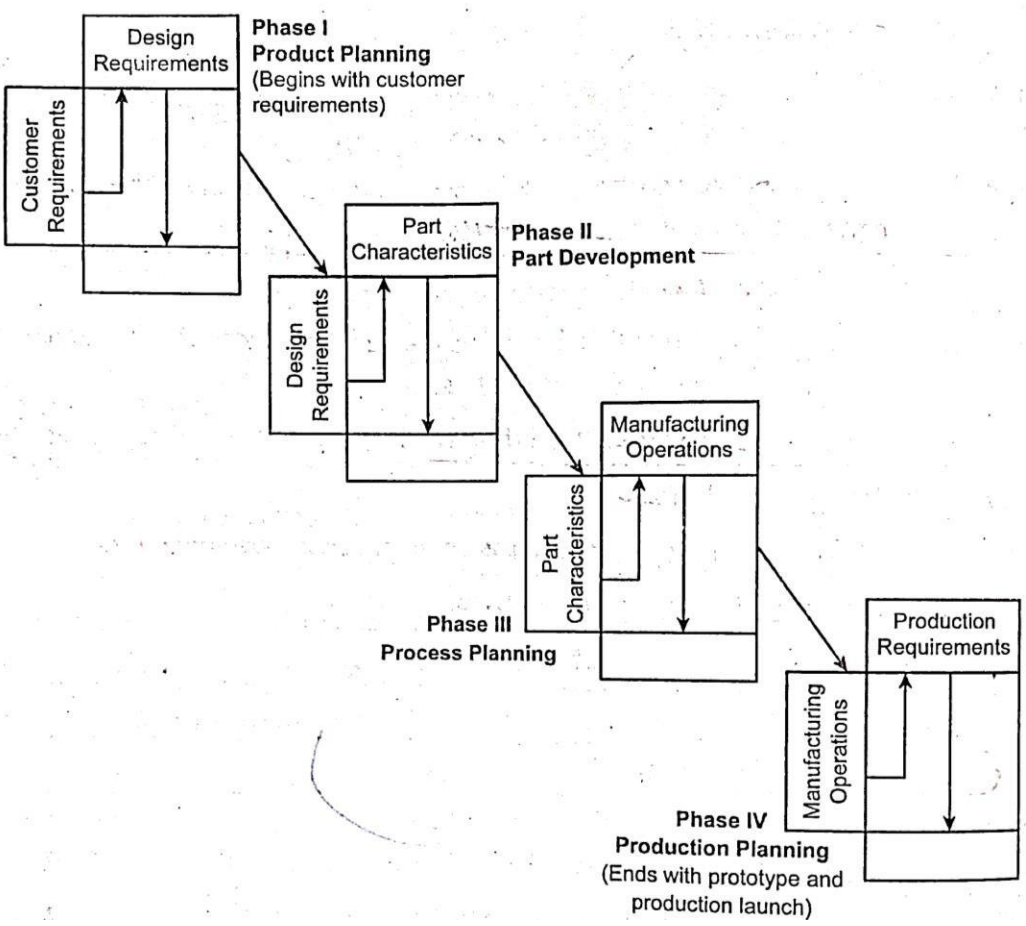
(i) Product planning.

(ii) Part development,

(iii) Process planning, and

(iv) Production planning.

The house of quality matrix focuses on product definition. So it guides all steps of product development. Therefore the overall success of the product depends on a good product definition (using house of quality) leading to a better design.




**Total Productive Maintenance (TPM)**

Total Productive Maintenance (TPM) is a holistic approach to equipment maintenance that strives to achieve perfect production (i.e., production without any breakdowns, small stops or slow running, defects and accidents). TPM emphasizes proactive and preventive maintenance to maximize the operational efficiency of equipment.

Analysing the three letters of TPM, we have

Total - All-encompassing 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 theoriginal condition at all times.

Thus TPM is keeping the current plant and equipment at its highest productive level through cooperation of all areas of organization.

TPM emphasizes on empowering operators to help maintain their equipment andthereby creates a shared responsibility for equipment that encourages involvement by plant floor workers.

**Features of TPM**

- The concept of 'true' TPM is that everyone from the operator to top management is responsible for maintenance activities.
- TPM embraces various disciplines to create a manufacturing environment wherein everyone feels that it is his/her responsibility to keep the equipment running and productive.
- Under TPM, operators no longer limit themselves to simply using the machine and calling the technician when a breakdown occurs. Operators can inspect, clean, lubricate, adjust, and even perform simple calibrations on their respective equipment.
- In TPM, a management should also show interest in data concerning equipment uptime, utilization, and efficiency.
- In short, everyone understands that zero breakdowns, zero defects, and maximum productivity are goals to be shared by everyone under TPM.
- TPM cannot be implemented overnight. Normally it takes an organisation at least two years to set an effective TPM system in place.
- TPM activities are carried out in small teams with specific tasks. Every level in the overall organisation must be represented by a team or more.

**The Eight Pillars of TPM**

The eight pillars of TPM are mostly focused on proactive and preventative techniques for improving equipment reliability.

| S.No | Pillar | What is it? | How does it help? |
|---|---|---|---|
| 1 | Autonomous maintenance | Place responsibility for routine maintenance, such as cleaning, lubricating and inspection, in the hands of operators. | • Gives operators great ownership of their equipment.<br>• Increases operators knowledge of their equipment.<br>• Ensures equipment is well cleaned and lubricated. |
| 2 | Planned Maintenance | Schedules maintenance tasks based on predicted and /or measured failure rates. | • Significantly reduces instances of unplanned down time.<br>• Enables most maintenance to be planned for times when equipment is not scheduled for production. |

| | | | |
|---|---|---|---|
| 3 | Quality maintenance | Design error detection and prevention process, Apply root cause analysis to eliminate recurring sources of quality defects. | • Specifically targets quality issues with improvement projects focused on removing root sources of defects.<br>• Reduces number of defects. |
| 4 | Focused improvement | Have small groups of employee work together proactively to achieve regular, incremental improvement in equipment operation. | • Recurring problems are identified and resolved by cross functional teams.<br>• Combines the collective talents of a company to create an engine for continuous improvement. |
| 5 | Early equipment management | Directs practical knowledge and understanding of manufacturing equipment gained through, TPM towards improving the design of new equipment. | • Maintenance is simpler and more robust due to practical review and employee involvement prior to installation. |
| 6 | Training and Education | Fill in knowledge gaps necessary to achieve TPM goals. Applies to operators | • Operators develop skills to routinely maintain equipment and identify emerging problems. |
| | | , maintenance personnel and managers. | • Maintenance personnel learn techniques for protective maintenance. |
| 7 | Safety, Health, Environment | Maintain a safe and healthy working environment. | • Eliminates potential health and safety risks, resulting in a safer workplace.<br>• Specifically target the goal of an accident – free workplace. |

| | | | |
|---|---|---|---|
| 8 | TPM in Administration | Apply TPM techniques to administrative functions. | • Extends TPM benefits beyond the plant floor by addressing waste in administrative functions.<br>• Supports production through improved administrative operations(e.g. order processing procurement and scheduling |

**Twelve Steps for TPM Development**

| Stage | Step | Details |
|---|---|---|
| I. Preparation Stage | 1. Announce top management about the decision to introduce TPM. | Use statement at TPM lecture in company, articles in company, newspaper. |
| | 2. Launch education and campaign to introduce TPM. | Use seminars, slide presentations, retreats etc. |
| | 3. Create organization to promote teams. | Create special committees at top, medium and low levels and assign staffs. |
| | 4. Establish basic TPM policies and goals. | Analyse existing conditions, set goals and predict results. |
| | 5. Formulate basic TPM policies and goals | Prepare detailed implementation plans. |
| II. Preliminary Implementation Stage | 6. Hold TPM kick-off | Invite clients, affiliated and subcontracting companies. |
| | 7. Improve effectiveness of each piece of equipment. | Select model equipment and form project teams. |
| | 8. Develop an autonomous maintenance program. | Build diagnosis skills and established worker certification procedure. |

| | | |
|---|---|---|
| III. TPM Implementation Stage | 9. Develop a scheduled maintenance program for the maintenance department.\ | Include periodic and preventive maintenance and management of spare parts, tools, blue prints and schedule. |
| | 10. Conduct training to improve operation and maintenance skills. | Train leaders together. Leaders share information with group members. |
| | 11. Develop early equipment management program. | Design, commission and control the maintenance prevention program |
| IV. Stabilization Stage | 12. Perfect TPM implementation and raise TPM levels. | Evaluate TPM and set higher goals. |

**Benefits of TPM (TPM Achievements)**

The properly implemented TPM has made excellent progress in a number of areas. These include:

(i) Increased equipment productivity

(ii) Improved equipment reliability

(iii) Reduced equipment downtime

(iv) Increased plant capacity

(v) Extended machine line

(vi) Lower maintenance and production costs

(vii) Approaching zero equipment-caused defects

(viii) Improved team work between operators and maintenance people

## UNIT-V - Quality Management System

**Definition:** International Organisation for Standardization (ISO) defined theterm quality system as follows:

"The quality system is the organisational structure, responsibilities, procedures, processes and resources for implementing quality management."

In short, a QMS involves:

(i) How-methods and process description;

(ii) Who- responsibilities and authorities;

(iii) When-records and evidence; and

(iv) Where-identification and traceability.

The QMS typically applies to and interacts with all activities, pertinent to the quality of product/service. It involves all phases from initial identification to final satisfaction of requirements and customer expectations.

### Need for ISO 9000 and Other Quality Systems

Every organisation is concerned with the quality of its product or service. To assure the quality one has to ensure the quality. To ensure the quality it is necessary to make quality assurance system. Sound quality assurance system requires well defined quality system standards.

Quality and standardisation are the two essential pre-requisites for an organisation to market its products and services in the competitive business environment. Thus quality begins with standards. Also the ever-increasing pressure to provide better quality of products/services led to the development of quality standards.

### Objectives of ISO 9000 Quality System

The five objectives of ISO 9000* quality system are given below.

1. To achieve, maintain and seek to continuously improve product/service qualityin relationship to requirements.
2. To improve the quality of operations to continually meet customers' andstakeholders' stated and implied needs.
3. To provide confidence to internal management and other employees that qualityrequirements are being fulfilled and that improvement is taking place.
4. To provide confidence to customers and other stakeholders that qualityrequirements are being achieved in the desired product.
5. To provide confidence that quality system requirements are fulfilled.

### Benefits of ISO 9000 Certification

Organizations go for ISO 9000 certification because of the benefits listed below.

(i) It forms a solid foundation for improvement, consistency, and profitability.

(ii) It provides good platform for continuous quality improvement.

(iii) It provides a status symbol for the organization and acts as powerfulmarketing tool.

(iv) It increases the potential market share.

(v) It improves employees' morale and ensures their total involvement.

(vi) It establishes a firm base for management of growth, change and continuingimprovement.

(vii) It increases awareness of employees in company requirements and activities.

(viii) It ensures customer satisfaction.

(ix) It generates customer confidence through world-class products/services.

(x) It ensures confidence with all stakeholders in the organization including suppliers, investors, shareholders, etc.

(xi) It fulfills the mandatory requirements of entry as a supplier to export market and many domestic organizations.

(xii) It improves documentation, operating standards, and housekeeping.

(xiii) It improves the perception of product quality.

(xiv) It helps in reducing the wastage and reduction in the cost of production.

**ISO 9000 Family of Standards**

| **Standard** | **Title** | **Scope** |
|---|---|---|
| **1. ISO 9000:2015** | Quality Management Systems: Fundamentals and Vocabulary (definitions) | • Provides information about the concepts and vocabulary used in the other two standards.<br>• This standard serves as a reference to support the interpretation of requirements. |
| **2. ISO 9001:2015** | Quality Management Systems: Requirements | • Provides the requirements that organisation must meet in order to achieve certification.<br>• ISO 9001 is the only standard within the ISO 9000 family that may be used for registration or certification. |

| | | |
|---|---|---|
| **3. ISO 9001:2018** | Quality Management - Quality of an Organization-Guidance to Achieve Sustained. Success (continuous improvement) | • Provides guidelines for enhancing an organization's ability to achieve sustained success.<br>• Establishes a quality management that not only meets customer requirements but also focuses on improving performance.<br>• ISO 9004 is not a requirement and does not lead to certification. |

**ISO 9000:2015 Requirements**

| |
|---|
| **Section 0: Introduction** |
| **Section 1: Scope** |
| **Section 2: Normative reference** |
| **Section 3 Terms and definitions** |
| **Section 4: Context of the organisation**<br>4.1. Understanding organizational context Total Quality Management<br>4.2. Understanding the needs and expectations of relevant stakeholders<br>4.3. Determining the scope of the management system<br>4.4. The quality management system and its processes |
| **Section 5: Leadership**<br>5.1. Demonstrating leadership and commitment, and customer focus<br>5.2. Establishing and communicating the quality policy<br>5.3. Establishing roles of authority and responsibility in the workplace |
| **Section 6: Planning**<br>6.1. Actions to address risks and opportunities<br>6.2. Management system objectives and plans to achieve them<br>6.3. Planning for change/change management |

| **Section 7: Support** |
|---|
| 7.1. Resources |
| 7.2. Competence |
| 7.3. Awareness |
| 7.4. Communication |
| 7.5. Documented information |

| **Section 8: Operation** |
|---|
| 8.1. Operational planning and control |
| 8.2. Determining requirements for products |
| 8.3. Design and development of products and services |
| 8.4. Control of external processes, such as suppliers and contractors |
| 8.5. Production and service provision |
| 8.6. Release of products and services |
| 8.7. Nonconforming products or services |
| **Section 9: Performance evaluation** |
| 9.1. Monitoring, measurement, analysis and evaluation |
| 9.2. Internal auditing |
| 9.3. Management review |
| **Section 10: Improvement** |
| 10.1. Improvement |
| 10.2. Nonconformity and corrective action |
| 10.3. Continual improvement |

**Implementation of Quality System (Steps to Registration)**

**Step 1: Top Management Commitment**

- The most important step in implementing a quality stem is to get the full support of upper management.
- The top management must be willing to commit the resources necessary to achieve certification.

**Step 2: Appoint the Management Representative**

- The next step is the appointment of a management representative. The representative can be a member of the top management group.
- The management representative is responsible for coordinating the implementation and maintenance of the quality system. Also he is the contact person for all parties involved in the process, both internal and external.

**Step 3: Awareness**

- The next step is to create awareness about the ISO 9000 QMS.
- Since the implementation of the quality system requires involvement of all members in the organisation, the members should understand the process and implications of ISO program.

**Step 4: Appoint an Implementation Team**

- Now the implementation team should be formed.
- This team should be drawn from all levels and areas of the organisation.
- The team should identify the QMS processes and their sequence and interaction.

**Step 5: Training**

- The implementation team, supervisors, and internal audit team should be trained.
- This activity can be accomplished through in-house training programs, seminars,workshops, etc.

**Step 6: Time Schedule**

- This activity develops a time schedule for the implementation and registration ofthe system.
- This time frame will vary, depending on the size and type of organisation.

**Step 7: Select Element Owners**

- The implementation team selects owners for each of the system elements.
- Many of these owners will be members of the implementation team.
- Each owner has the option of selecting a team to assist in the process.

**Step 8: Review the Present System**

- A review of the present quality system should be performed.
- Copies of all the quality manuals, procedures, work instructions, and formspresently in use are obtained.
- This activity is a gap analysis and can be performed by the element owners andtheir teams or by an external consultant.

**Step 9: Write the Documents**

- Written quality policy and procedure manuals should be prepared.
- This documentation of work instructions should be done by the employee whoperforms the job.

**Step 10: Install the New System**

- The policies, procedures, and work instructions should be integrated into the day-to-day workings of the organisation.
- Now the new system is installed.

**Step 11: Internal Audit**

- An internal audit of the quality system should be conducted.
- This step ensures that the system is working effectively and to provide management with information for the comprehensive management review.
- This activity can be accomplished through in-house training programs, seminars,workshops, etc.

**Step 12: Management Review**

- The management review should be conducted in order to determine the effectiveness of the system in achieving the stated quality goals.

**Step 13: Preassessment**

- The preassessment is an optional step. If a good job has been done on the previous steps, then preassessment is not necessary.

**Step 14: Registration**

- The registration activity includes: choosing a registrar, submitting an application, and conducting the registrar's system audit.
- While choosing a registrar, one should consider so many factors such as cost, lead time, customer's acceptance of the registrar, the registrar's accreditation, and familiarity with the industry.
- The application for registration should also include supplying the registrar with the policy and procedure manuals for their review.
- The time involved in the registrar's system audit will vary depending on the size and complexity of the organisation and the number of auditors involved.

**Step 15: Award of ISO 9000 Certificate**

- After accepting the application and setting a time frame for registration, the registrar will review the quality system documentation.
- Based on the satisfactory report of the assessment team, licence i.e., ISO certificate will be granted to the organisation by ISO/BIS to use the certification mark in letter heads, quality certificates, etc.
- The certificate awarded is normally valid for 3 years.- During the period of validity, surveillance audits are conducted to ensure that the document quality system is being effectively maintained.
- The surveillance audits will not be full audits but random checks of some elements to ensure that

the system continues to function.

**Sector Specific Standards**

**AS9100-Aerospace Quality Management Systems**

- AS9100 is the single common quality management standard for the aero space industry.
- AS9100 is the International Quality Management System standards for the Aviation, Space and Defense (AS&D) organizations, created by the InternationalAerospace Quality Group (IAQG).
- The standard provides suppliers with requirements for creating and maintaininga comprehensive quality system for providing safe and reliable products to the ASD industry, as well as civil & military aviation requirements.
- The International Aerospace Quality Group (IAQG) has created AS9100standards by adding in specific aerospace Quality Management System requirements in the ISO 9001:2015 requirements without removing any existing requirements.
- It is used and supported by the world's leading aerospace companies and throughout their supply chains.
- AS9100 can be used by organizations across the aerospace sector, including design, manufacturing, maintenance and distributing companies.

**ISO/TS 16949-Automotive Quality ManagementSystems**

- TS 16949 is an internationally recognized Quality Management System specification for the automotive industry. It specifies the quality system requirements for the design/development, production, installation and servicing of automotive-related products.
- TS 16949 Vs. IATF 16949: IATF 16949 is the latest version of ISO/TS16949. Major difference is that ISO /TS 16949:2009 linked with ISO9001:2008 but IATF 16949:2016 linked with ISO 9001:2015.
- It was developed by the International Automotive Task Force (IATF).
- TS 16949 is an ISO Technical Specification which aligns existing American(QS 9000), German (VDA 6.1), French (EAQF) and Italian (AVSQ) automotive quality system standards within the global automotive industry, with the aim of eliminating the need for multiple certifications to satisfy multiple customerrequirements.
- The introduction of TS 16949 has resulted in substantial improvements in all aspects of quality, delivery and overall efficiency throughout the supply chain .Ithas also reduced the requirement for multiple audits of manufacturers.
- The International Automotive Task Force (IATF), which members include nine major OEMs (Original Equipment Manufacturers) like Ford, BMW, GM), is committed to ensure that TS 16949 remains the automotive quality systems standard for the future.

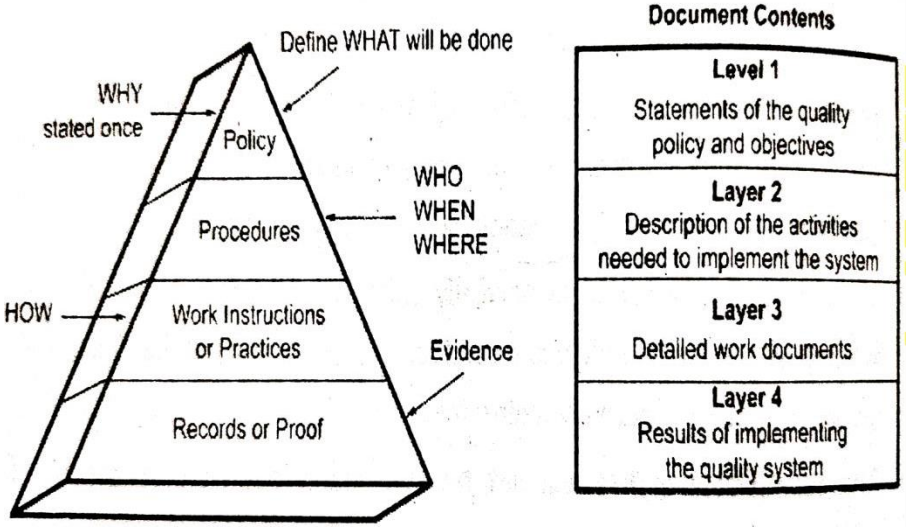
**TL 9000-Quality Management System for theTelecommunications Industry**

- TL 9000 is an internationally recognized Quality Management System for the telecommunications industry, also known as Information and Communication Technologies (ICT) industry.
- Globalization of the ICT industry is driving the need to apply a common set of quality system requirements throughout the supply chain of ICT industry. TL9000 addresses this need.
- TL 9000 is an international standard that establishes the requirements for a quality management system (QMS) for the design, development, manufacture, supply, installation and maintenance of telecommunications products and services.
- In 1998, the TIA Business Performance Community (formerly QUEST Forum) developed the TL 9000 Quality Management System to meet the supply chain quality requirements of the worldwide telecommunications industry.
- This TL 9000 standard is based on ISO 9001 and it includes specific requirements to meet the needs of the Information and Communications Technology (ICT) industry.
- TL 9000 is a customer-oriented standard with requirements on customer satisfaction, quality improvement, and customer-supplier communication. It provides a measurement system that allows an organization to track performance and improve results. It also mandates the use of a product life-cycle model and the use of predefined measurements.
- The expected benefits include improved organizational performance, overall cost reduction, increased competitiveness, enhanced customer-organization-supplier relationships, and continual improvement of products and services.

**Documentation of Quality System -**

The documents requires by most organisations are:

| | |
|---|---|
| 1. Quality Policy Manual | 3. Work Instructions (WIs) |
| 2. Quality System Procedures (QSPs) | 4. Records/Formats/Forms |



**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."

**Features of Quality Audits**

Some salient features about quality audits are:

- The quality audit typically applies to quality systems or elements such as processes, products or services. Such audits are often called 'quality system audits', 'process quality audits', 'product quality audits' and 'service quality audit' respectively.
- Quality audits are carried by staff who are not directly responsible in the areas being audited. But preferably auditors should work in cooperation with relevant personnel.
- Quality audit is an information gathering activity. It is not a 'police' kind of activity.
- Quality audits may be conducted for internal or external purposes. They need not cover whole quality system, at once, but may cover elements of it.

**Types of Audits**

The general classification of audits is given below:

(i) 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 organisation, working on itself.

(ii) Second party audit: This refers to audit by one organisation on another organisation (auditee). This type of audit is normally done on a supplier by a customer.

(iii) Third party audit: This refers to audit by an independent organisation on a supplier, for accreditation assessment purposes.

**Stages of an Audit**

The four stages of the auditing are:

1. Audit planning,
2. Audit performance,
3. Audit reporting, and
4. Audit follow-up.

**Stage 1: Audit Planning**

The key elements in the audit planning stage are given below:

(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 duringaudit.

**Stage 2: Audit Performance**

The key elements in the audit performance stage are given below:

(i) Opening/entry meetings: Opening meeting is organised to initially brief theauditee about the scope of audit.

(ii) Audit process: Audit is run to schedule and should cover entire scope, asplanned. 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**

- Audit reporting deals with the recording of any non-conformity and summarising the audit findings.
- The audit report may contain:

(ii) Identification of the reference documents against which audit is conducted (ie., quality system standard), company's quality manual, etc.

(iii)Observations of non-conformities. (iv)Corrective

action requests.

**Stage 4: Audit Follow-up**

- The auditor is responsible only for identifying the non-conformity. But theauditee is responsible for determining and initiating corrective action needed to correct a non-conformity.
- Corrective action and subsequent follow-up should be completed within a time period agreed to by the client and the auditee in consultation with the auditing organisation.

These four stages complete the ISO 9000 quality system audit.

**ISO 14000: Environmental Management System Standards.**

- An EMS, or environmental management system, is a set of policies and procedures designed to help organizations:

(i) to reduce negative environmental impact; and

(ii) to improve efficiency and operational effectiveness

- Just like a quality management system (QMS), an EMS is a set of guidelines for continuous improvement, based on proven methods of business process management and optimization.

- Definition of EMS: The International Organization for Standardization (ISO) defines an environmental management system as "part of the management system used to manage environmental aspects, fulfill compliance obligations, and address risks and opportunities. "

**What is ISO 14000?**

- After the success of the ISO 9000 series of quality standards, the International Organization for Standards (ISO) has developed a compressive set of standards for environmental management (which is known as ISO 14000 series) in 1992.
- The ISO 14000 standards are a set of norms for Environmental Management System (EMS) either at organisation and process level or product level.
- ISO 14000 refers to a family of standards for the design, implementation, and optimization of an environmental management system (EMS) for businesses andorganizations.
- The series of ISO 14000 standards are designed to cover:

  (i) Environmental management systems,

  (ii) Environmental auditing,

  (iii) Environmental performance evaluation, Life-cycle assessment, and

  Environmental aspects in product standards.
- The overall objective of 150 14000 Environmental Management Standard is to encourage environmental protection and pollution prevention while taking into account the economic needs of society.
- The ISO 14000 series of standards enables a company to improve environmental management voluntarily.
- ISO 14000 standards and practices can be applied to any organization, regardless of size or industry.

**ISO 14000 Family Of Standards**

**Organizational evaluation standards**

(i) Environmental Management System (EMS),

(ii) Environmental Auditing (EA), and

(iii) Environmental Performance Evaluation (EPE).

| Designation | Title | Description |
|---|---|---|
| ISO 14001 | Environmental Management Systems— Requirements with Guidance for Use | Gives the elements that organisations are required to conform to get registration certificate. |

| | | |
|---|---|---|
| ISO 14004 | Environmental Management Systems— General Guidelines on Implementation | Provides supplementary material. It is only for information and not used for registration. |
| ISO 14010 | Guidelines for Environmental Auditing— General Principles on Environmental Auditing | Provides information for internal or external auditing. |
| ISO 14011 | Guidelines for Environmental Auditing-—Au4jt Procedures—Auditing of Environmental Management Systems | Provides information on how to plan and conduct an audit. |
| ISO 14012 | Guidelines for Environmental Auditing---Qualification Criteria for Environmental Auditors. | Covers information on auditor qualification, training, and personal attributes and skills. |
| ISO 14031 | Guidelines on Environmental Performance Evaluation | Helps the organisation to meet the requirements of ISO 14001, monitoring, and measuring. |

**Product Evaluation Standards**

(i) Environmental Aspects in Product Standards (EAPS),

(ii) Environmental Labels and Declarations (ELD), and

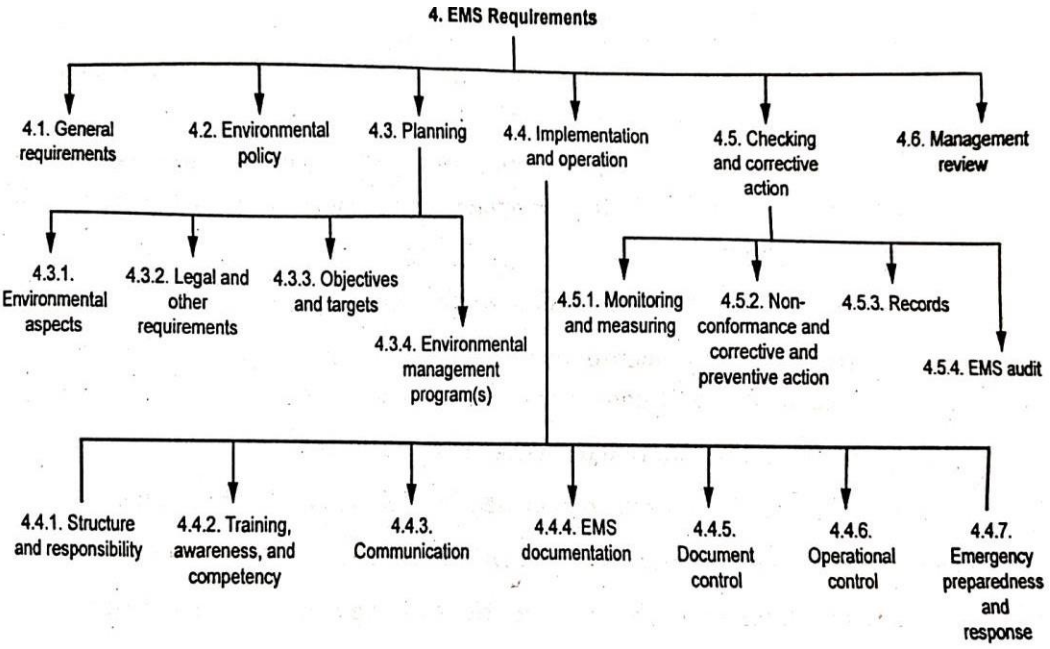
(iii) Life Cycle Assessment (LCA).

| Designation | Title | Description |
|---|---|---|
| ISO Guide 64 | Environmental Aspects in Product Standards. | Designed to help writers to develop product standards. |
| ISO 14020 | Environmental Labeling-Basic Principles for All Environmental Labeling | Provides guidance on the goals and principles that should be used in all labeling programs. |
| ISO 14021 | Environmental Labeling— Self-Declaration of Environmental | Ensures that this type of labeling is accurate, verifiable, and not deceptive. |
| | Claims: Terms and Conditions | |
| ISO 14022 | Environmental Labeling— Symbols | Provides a standard set of symbols for use by organisations. |

| | | |
|---|---|---|
| ISO 14023 | Environmental Labelingg—Testing and Verification Methodologies | Provides information on the appropriate methods to use toconfirm the guidelines of the product. |
| ISO 14024 | Environmental Labelingg—Practitioner Programs:<br>Principles, Practices, Certification Procedures Multiple Criteria Programs Guiding and for | Establishes criteria for third-party labeling or seal programs. |
| ISO 14040 | Life Cycle Assessmentent—Principles and Framework | Provides an overview of the practice, applications and limitations of life cycle assessment. |
| ISO14041 | Life Cycle Assessment—goalsand Definition/Scope Inventory Analysis and | Provides guidelines for the preparation, conduct, and critical review of the life cycle inventory analysis. |
| ISO 14042 | Life Cycle Assessment—impact Assessment | Intended to use the results of the inventory analysis to evaluate the significance of potential environmental impacts. |
| ISO 14043 | Life Cycle Assessment—Improvement Assessment | Provides information to improve the total environmental performance ofa product system. |

**Requirements of ISO 14001**

ISO 14001 standard consists of four sections and an information annexure. Thefour sections of ISO 14001 are:



## QUALITY AWARDS

A Quality Award is a formal recognition of outstanding performance that demonstrates a commitment to continuous improvement, innovation and customer satisfaction. These awards recognize organizations that consistently exceed expectationsregarding quality, service delivery and responsiveness.

Various Quality Award programs are available to all types of organizations, including governments, not-for-profits, private companies and public sector entities.

### Most Famous Performance Excellence Models

These are some of the most popular quality awards or performance excellence models.

1. European Excellence Award (EFQM)
2. Excellence Canada
3. ASQ International Team Excellence Award (ITEA)
4. Malcolm Baldrige National Quality Award (MBNQA)
5. Deming Prize

Each of these models uses a different set of criteria to evaluate organizations. However, each one shares common elements such as:

- Demonstrated leadership skills
- An emphasis on process approach and continuous improvement
- A focus on customer orientation
- Commitment to employee involvement
- Value creation through innovation
- Focus on strategic planning and fact-based decision making
- Consistent results (financial and non-financial)

All these models also share similar characteristics. For example:

- Their assessments are made independently
- They require organizations to submit objective evidence of their performance
- They are not restricted to any particular industry
- They are open to all types of organizations
- They measure performance against clearly defined standards

### 1. European Excellence Award (EFQM)

Founded in 1991, EFQM was developed to help European businesses improve their performance. It has been widely adopted throughout Europe and beyond. EFQM

assesses the performance of organizations in two broad categories: Enablers and Result. Both of these categories have equal weight age in the final assessment.

Enabler category contains Leadership, People, Policy Strategy, Partnership and Resources, and Processes.

Result category contains People Results, Customer Results, Society Results and Key Performance Results.

**2. Excellence Canada**

Founded in 1992 as the National Quality Institute (NQI), it was renamed Excellence Canada in 2011. It's now known for its expertise in helping organizations improve their customer experience.

Canada Awards for Excellence aims to recognize outstanding achievements by organizations across Canada.

For an organization to be eligible for the award, they need to show exceptional performance in the respective category*:* Excellence, Innovation and Wellness, Healthy Workplace, Mental Health at Work *and* Financial Wellness.

**3. ASQ International Team Excellence Award (ITEA)**

The ASQ ITEA is the global performance recognition program in the field of quality and organizational excellence best practices. This is a team award. Teams from across the world present their quality improvement projects to compete for this award.

**4. Malcolm Baldrige National Quality Award (MBNQA)**

The Malcolm Baldrige National Quality Program was founded in 1987. The program was named after Malcolm Baldridge, who served as U.S. Secretary of Commerce under President Ronald Reagan.

This award is given out by the United States Department of Commerce every year.

Three MBNQA awards can be given annually in these six categories:

1. Manufacturing
2. Service Company
3. Small Business
4. Education
5. Healthcare
6. Non-profit

Recipient selection is based on achievement and improvement across seven key areas called the Baldrige Criterion for Performance Excellence.

1. Leadership
2. Strategy
3. Customers
4. Measurement, analysis, and knowledge management
5. Workforce

## 5 Deming Prize

In 1951, Deming Prize was founded to recognize Dr. Deming's contributions to Japan's post–World War II economic recovery efforts. It's an award for companies that achieve outstanding results in the field of Total Quality Management (TQM).

It recognizes both individuals who contribute to the field of Total Quality Management (TQM) and companies that have successfully implemented TQM.

Unlike other awards, there is no limit to the total number of people/organizationswho may win the Prize. Organizations scoring above the minimum threshold for each category (passing) will receive the Deming Award.

There are four categories in Deming Prize:

- The Deming Prize for Individuals
- The Deming Distinguished Service Award for Dissemination and Promotion(Overseas)
- The Deming Prize
- The Deming Grand Prize (former Japan Quality Medal).

The Union of Japanese Scientists and Engineers (JUSE) administers this program.