GE6757- TOTAL QUALITY MANAGEMENT

UNIT-1 INTRODUCTION

INTRODUCTION – NEED FOR QUALITY

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

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

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

However, in 21 st century, high growth of economy- the new millennium brought about increased emphasis on worldwide quality and the Internet. Japanese and other world's business organization started not only for quality product and services for External customer satisfaction but started satisfying them by trying to achieve the highest business excellence model – Deming Award, Malcolm Baldrige National Quality Award, CII – EXIM Award and TPM Award and others. Thanks – QUALITY

EVOLUTION OF QUALITY

1920s

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

1930s

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

1950s

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

1968

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

Today

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

DEFINITION OF QUALITY

Quality can be quantified as

Q = P/E

Where Q=Quality

P=Performance

E=Expectations

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

DIMENSIONS OF MANUFACTURING AND SERVICE QUALITY

- **Performance**
- **Features**
- **Conformance**

- **----------**
- **Reliability**
- **Durability**
- **Service**
- **----------**
- **Response- of Dealer/ Mfgr. to Customer**
- **Aesthetics – of product**
- **Reputation- of Mfgr./Dealer**

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

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

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

BASIC CONCEPTS OF TQM

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

DEFINITION OF TQM

Total Quality Management

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

Meaning

Total-Made up of the whole

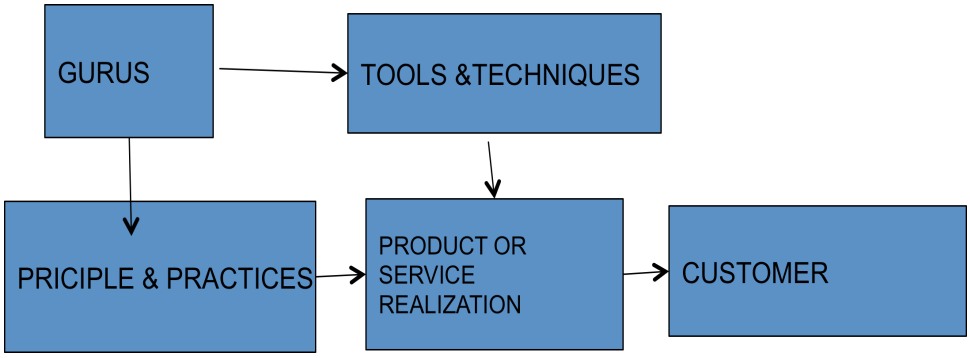
Quality- Degree of excellence a product or service provides.

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

TQM FRAMEWORK

- TQM framework gives the overall structure of the organization.

It consist of



Gurus

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

Tools and Techniques

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

People and Relationships

- Leadership

Customer Satisfaction

- Employee Involvement
- Supplier Partnership

Approach

- ❖ Continuous Process Improvement

Measure

- ❖ Performance measures

CONTRIBUTION OF DEMING

Deming has given 14 points

Create and Publish the Aims and Purposes of the Organization

• Management must create and publish the aims and purposes of the organization to investors, customers, suppliers, employees, the community and a quality philosophy.

• Organization should develop a long term view of business and set goals according to that.

• In order to achieve these goals resources must be allocated to research, training and continuing education.

• Innovation must be promoted to ensure that the product or service does not become obsolete.

Learn the New Philosophy:

• Top management and everyone in the organization must learn the new philosophy.

• Organization must concentrate on defect prevention rather than defect detection.

• Organizations must give importance to never ending improvement and refuse to accept nonconformance.

• Customer satisfaction is the number one priority because dissatisfied customers will not continue to purchase nonconforming products or services.

• Everyone in the organization including the union must be involved in the quality journey and change his or her attitude about quality.

Understand the Purpose of Inspection:

• Management must understand that the purpose of inspection is to improve the process and reduce its cost.

• For the most part of the organization, mass inspection is costly and unreliable.

• Where ever the inspection is required it should be applied and replaced by never ending improvement process.

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

Stop Awarding Business Based on Price Alone:

• The organization must stop awarding business based on the low bid because price has no
meaning without quality.

• The goal is to have single suppliers for each item and to develop a long term relationship
of trust and loyalty, thereby providing improved products and services.

• They must follow the materials throughout the life cycle in order to examine how customer expectations are affected and provide feedback to the supplier regarding the

quality.

Improve Constantly and Forever the System:

• Management must take more responsibility in actively finding and correcting problems, so that quality and productivity are continually and permanently improved and costs are reduced.

• The focus is on preventing problems before they happen.

• Responsibilities are assigned to the teams to remove the causes of the problems and continually improve the process.

Institute Training:

• Each employee must be oriented to the organizations philosophy of never ending improvements.

• Management must allocate resources to train their employees to perform their jobs in the better manner.

Teach and Institute Leadership:

• Improving Supervision in the organization is the management's responsibility.

• Management must appoint supervisors with training, so that the new philosophy can be implemented.

• Supervisors should create a positive and supportive work environment instead of focusing on negative and fault finding atmosphere.

• All communication must be clear from top management to supervisors to operators.

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

• Management must encourage open, effective communication and team work.

• Fear is caused because of lack of job security, possible physical harm, performance appraisals, and ignorance of organization goals, poor supervision and not knowing the job.

• Driving out fear will lead to success, for this management must concentrate on workers with adequate training, good supervision, and proper tools to do the job as well removing physical dangers. When people are treated with dignity fear can be eliminated and they will work for the general well being of the organization.

Optimize the efforts of teams, groups and staff areas:

• Management must optimize the efforts of teams, groups and staff areas to achieve the aims and purposes of the organization.

• Internally the barriers exist among levels of management, among departments, within departments and among shifts.

• Externally it exists between the organization and its customers and suppliers.

• The barriers exist because of poor communication, ignorance of organization mission and it can be overcome by multifunctional team.

Eliminate Exhortations for the Workforce:

• Exhortations that ask for increased productivity without providing specific improvement methods can handicap an organization.

• They do not produce better product or service because the workers are limited by the system.

• Improvements in the process cannot be made unless the tools and methods are available.

a. Eliminate Numerical Quotas for the Workforce:

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

b. Eliminate Management by Objective:

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

Remove Barriers that Rob People of Pride of Workmanship:

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

Encourage Education and Self Improvement for Everyone:

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

Take Action to Accomplish the Transformation:

Management has to accept the primary responsibility for the never ending improvement of the process.

• A cultural change is required from the previous "business as usual" attitude.
• Management must be committed, involved and accessible if the organization is to succeed in implementing the new philosophy.

CROSBY'S CONTRIBUTIONS

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

His "Absolutes" are:

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

14 Principles

1. Management commitment, that is, top level management must be convinced and committed and communicated to the entire company.
2. Quality improvement team composed of department heads to oversee improvements.
3. Quality measurement is established for every activity.
4. Cost of quality is estimated to identify areas of improvement.

5. Quality awareness is raised among all employees.
6. Corrective action is taken.
7. Zero defects are planned for.
8. Supervisor training in quality implementation.
9. Zero defects day is scheduled.
10. Goal setting for individuals.
11. Error causes are removed by having employees informed management of problems.
12. Recognition is given, but it is non-financial, to those who meet quality goals.
13. Quality councils meet regularly.
14. Do it all over again (i.e., repeat steps one through thirteen).

CONTRIBUTION OF JURAN

Juran's Triology

Quality Planning

- ❖ Quality Control
- ❖ Quality Improvement

Quality Planning:

• The planning component begins with external customers.

• Once the quality goals are established, marketing determines the external customers and all organizational personnel (managers, members of multifunctional teams or work groups) determine the internal customer.

• Once the customers are determined, their needs are discovered.

• Customer needs has to be stated in their own words, however real needs may differ from stated needs.

• Internal customers may not wish to voice real needs out of fear of the consequences.

• The customer needs which are stated in their view point should be translated to requirements that are understandable to the organization and its suppliers.

• The next step is to develop the product/service features that respond to customer needs, meet the needs of organization and its suppliers.

• The fourth step is to develop the processes able to produce the product or service features.

• Transferring plans to operations is the final step of the planning process.

Quality Control:

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

Steps:

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

Quality Improvement:

• Aim is to attain the levels of performance that are significantly higher than current levels.

• Process improvements begin with the establishment of quality council.

• Two duties of quality council

✓ Identify the improvement projects

✓ Establish the project teams with a project owner.

• Quality council needs to provide the teams with resources to determine the causes, create solutions and establish controls to hold the gains.

• In the figure juran provides a distinction between sporadic waste and chronic waste

✓ Sporadic waste can be identified and corrected through quality control.

Chronic waste requires an improvement process.

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

Improvement Strategies:

➢ Repair

➢ Refinement

➢ Renovation

➢ Reinvention

Repair:

• This strategy is simple; if anything is broken it must be fixed so that it functions as designed.

• If a customer receives a damaged product, a quick fix is required.

• The second level is to identify and eliminate the root causes of the problem and effects a permanent solution.

• Repair strategy does not make the process better than the original design.

Refinement:

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

Renovation:

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

Reinvention:

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

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

Types of Problems:

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

BARRIERS TO TQM

❖ **Lack of Management Commitment**

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

❖ **Inability to change organizational Culture**

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

❖ **Improper Planning**

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

❖ **Lack of continuous training and education**

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

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

- Differences between departments and individuals can create implementation problems.
- The use of multifunctional team will help to break down long-standing barriers. Restructuring the organization to meet organization needs is important.
- Individuals who do not embrace the new philosophy can be required to leave the organization.

❖ **Ineffective Measurement Techniques and Lack of Access to Data and Results.**

- Key characteristics of the organization should be measured so that the effective decisions can be made.
- Access to data and quick retrieval is necessary for effective processes.

❖ **Paying Inadequate Attention to Internal and External Customers**

- Organizations need to understand the changing needs and expectations of their customers.
- Effective feedback mechanisms that provide data for decision making are necessary for this understanding.
- When an organization fails to empower individuals and teams, it cannot hold them responsible for producing results.

❖ **Inadequate Use of Empowerment and Teamwork**

- Teams need to have the proper training and at least in the beginning a facilitator.
- Individuals should be empowered to make decisions that affect the efficiency of their process or the satisfaction of their customers.

❖ **Failure to Continually Improve**

- A lack of continuous improvement of the processes, product or service will even leave the leader of the pack in the dust.

QUALITY STATEMENTS

The quality statements include the

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

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

Vision Statement

- The vision is a short declaration of what an organization aspires to be tomorrow.
- It is the ideal state that might never be reached but which we continually strive to achieve.
- Successful visions are timeless, inspirational and become deeply shared within the organization.

- Successful vision provides a guide line for decision making.
- It is important that the leader articulate and act upon the vision and those employees understand the vision and can connect their work with the well-being of the organization.

❖ **Mission Statement**

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

❖ **Quality Policy Statement**

- The quality policy is a guide for everyone in the organization as to how they should provide products and services to the customers.
- It should be written by the CEO with feedback from the workforce and be approved by the quality council.
- Common Characteristics are

- Quality is first among equals
- Meet the needs of the internal and external customers
- Equal or exceed the competition
- Continually improve the quality

1. ▪ Include business and production practices
   Utilize the entire workforce

CUSTOMER SATISFACTION

Customers are important asset to the organization, satisfied customers will buy more, and buy more frequently, and pay their bill promptly.

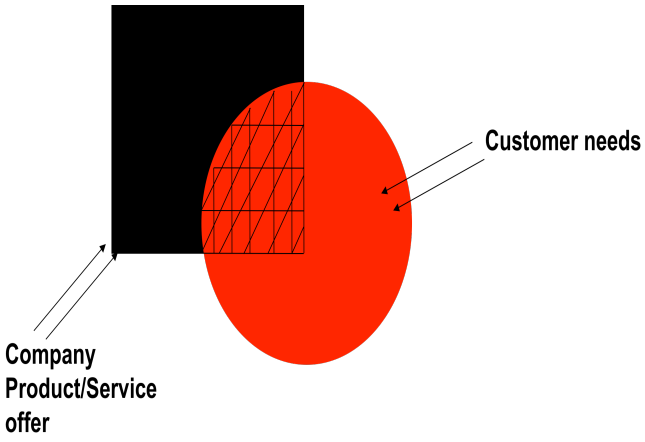
❖ In a manufacturing and service organization, customer satisfaction is considered as a measure of quality.TQM implies an organizational drive with meeting or exceeding customer needs.

❖ Understanding the customer's needs and expectations is essential to winning new business.

❖ To attain this level, the organization should examine their quality system to respond to their ever changing customer's needs.

A simple definition of customer satisfaction is illustrated below

Teboul model



Characteristics of customer satisfaction.

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

Types of customers.

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

CUSTOMER PERCEPTION OF QUALITY.

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

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

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

CUSTOMER COMPLAINTS

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

Ways to get customer feedback or complaint

1. Comment Card

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

2. Customer Questionnaire

- A customer questionnaire is a popular tool for obtaining opinion and perceptions about an organization and its products and services
- However they can be costly and time consuming.
- Surveys may be administered by mail or telephone**.**

❖ In the questionnaire the customer is asked to furnish answers relating to the quality of product and services.

3. Focus Groups

❖ Customer focus groups are a popular way to get feedback, but they too can be very expensive**.**

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

❖ A group of customers is assembled in a meeting room to answer a series of questions.

❖ These carefully structured questions are asked by a skilled moderator.

4. Toll-Free Telephone Numbers

❖ Toll-free telephone numbers are an effective technique for receiving complaint feedback.

❖ Organizations can respond faster and more cheaply to the complaint.

5. Customer Visits

❖ **Visit**

6.Report card-quarterly basis

7.Internet and computer

8. Employee feedback

Handling the customer complaints

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

CUSTOMER RETENTION

❖ Customer retention represents the activities that produce the necessary customer satisfaction which in turn creates the customer loyalty.

❖ Customer retention moves customer satisfaction to the next level by determining what is truly important to the customers and making sure that the customer satisfaction system focuses valuable resources on things that are important to the customer.

❖ Customer retention is the connection between customer satisfaction and the bottom line.

❖ World-class companies know that continuous improvement and customer satisfaction should go handin- hand.

❖ Improved service to the customer is a costlier affair, so an organization must determine its return on the service investment. For this the important service elements that significantly improve revenues and market share should be determined.

❖ One survey indicates, it requires five times of effort to win a new customer than retaining a present customer. In this context customer retention is important for organizational success.

COST OF QUALITY

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

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

CATEGORIES & ELEMENTS OF QUALITY COST

I. Preventive Cost Category

1. Marketing/Consumer/User:

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

2. Product/Service/Design Development:

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

3. Purchasing:

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

4. Operations (Manufacturing or service):

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

5. Quality Administration:

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

II. Appraisal Cost Category

1. Purchasing Appraisal Costs:

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

2. Operations (Manufacturing or service) Appraisal Costs:

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

3. External Appraisal Costs:

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

4. Review of Test & Inspection:

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

5. Miscellaneous Quality Evaluations:

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

III. Internal Failure Cost Category

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

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

2. Purchasing Failure Costs:

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

3. Operations (Product or Service) Failure Costs:

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

IV. External Failure Cost Category

1. Complaint Investigations of Customer or User Service:

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

2. Returned Goods:

Costs incurred in evaluating, repairing and replacing goods.

3. Retrofit and Recall costs

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

4. Warranty Claims

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

5. Liability Costs

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

6. Penalties

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

7. Customer or user good will

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

8. Lost Sales

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