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ISO 9000 “Quality System”

A 1.1 INTRODUCTION

- The ISO 9000, a well-known and widely accepted **Quality Management System**, is a series of *standards* developed by the **International Organization for Standardization (ISO)** in Geneva, Switzerland.
- There are *five standards* in the ISO 9000 series, ISO 9000-9004.
ISO 9001, 9002 and 9003 are applicable to contractual situations.
ISO 9004 is for non-contractual cases and used for internal management purposes.
- **ISO 9000**
It is the contour map furnishing the guidelines for selection and use of ISO series standards.
- **ISO 9001**
Model for quality assurance in design/development, production, installation and servicing.
- **ISO 9002**
Model for quality assurance in production and installation.
- **ISO 9003**
Model for quality assurance in final inspection and test.
- **ISO 9004**
Quality management and quality system elements — Guidelines.

As part of ISO 9000's commitment to continuous improvement, the standards are reviewed every five years.

A 1.2 NEED FOR ISO 9000 CERTIFICATION

- Customers, all over the world, like to have confidence in manufacturer's capability to design, develop, produce and service. *Competition* is forcing industries to get *ISO 9000 certification*.
- Today, more than 40 countries worldwide have already adopted ISO 9000.
- Already European markets are insisting on ISO 9000 certification. Very soon it will be a pre-qualification for bidding in the markets.
- ISO 9000 is the only credibility passport which certifies that a company meets international standards in designing, developing, producing, installing and servicing the products it supplies.
- The time has already come, when an industry will not be able to export to World markets without ISO 9000 certification.

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- Few Indian industries have already got ISO 9000 accreditation of their quality system and many more are at various stages of implementation.
- ISO 9000 is based on the philosophy that an integrated, systematic and planned approach only can ensure quality.

ISO 9000 has originated from Western Countries and is a documentation oriented quality system requiring participation by *all*.

Since cultural, economic, political and social differences between Western Countries and India are great, so certain *obstacles* are clearly in the way to implement ISO 9000 in India.

- The Indian Industry will have to overcome the following *obstacles/weaknesses* in order to improve quality and not only to get ISO 9000 accreditation but to sustain it also :
 - (1) Lack of faith. The management lacks faith in workers (unions) and vice-versa.
 - (2) Lack of clarity/seriousness for achieving targets.
 - (3) Lack of precise observation of rules and norms.
 - (4) Low quality of items bought from vendors.
 - (5) Management view of short term benefits.
 - (6) Politicalisation of Labour Unions.
 - (7) Lack of accountability for actions.
 - (8) Lack of top management commitment.
 - (9) Lack of national quality policy.
 - (10) Inadequate infrastructure.
 - (11) Quantity before Quality.
 - (12) Lack of planning.
 - (13) Lack of manufacturing and test facilities.
 - (14) Lack of education and training of workers.
 - (15) Passive attitude of Industry towards Quality.
 - (16) Lack of professional attitude.
 - (17) Indian cultural factors.
 - (18) Resistance to change etc.

A 1.3 BENEFITS OF ISO 9000 CERTIFICATION

There are manifold benefits, direct as well as indirect, resulting from ISO 9000 Quality Systems Standards. Some of them are given below.

- (1) ISO 9000 provides a competitive edge in the domestic and global markets.
- (2) It provides a climate for consistent improvement in quality.
- (3) It reduces wastes and repairs — enhancing profits in turn.
- (4) It maintains streamlined records.
- (5) It maintains streamlined material handling and storage.
- (6) It changes the attitude of workforce, the result is — improved house keeping, work atmosphere and quality awareness.
- (7) Process of quality improvement is maintained.
- (8) Products right in the first instance, no rework and nothing for rectification.
- (9) ISO 9000 gives international recognition of ability, credibility and expertise, thereby increasing the number of customers.

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- (10) Supplier without ISO certification can face higher insurance rates, or, be denied insurance in some markets.

A 1.4 LIMITATIONS OF ISO 9000

- (1) Implementation of this system is very demanding of resources.
- (2) Assessment and registration are expensive.
- (3) Work-culture need to be changed/improved.
- (4) Upgrading of manufacturing and test facilities is essential.
- (5) Unless carefully planned, the system can become non cost effective.
- (6) Dedication, will to improve and constant improvement are must for success.

A 1.5 THE QUALITY NOTION

- Quality is the conformance to requirement or specification.
- Quality is the fitness for the purpose. In other words if a product serves your purpose well, it can be called of good quality.
- Quality is what the customer wants.
- According to ISO 8402 (1986) :
Quality is defined as the totality of features and characteristics of product or service, in conformance with the customer's stated or implied *needs*. Needs may include safety, reliability, maintainability, economics etc.
- The term quality is not used to express a degree of excellence in a comparative sense nor it is used in a quantitative sense for technical evaluations. In these cases, a qualifying objective shall be used.
- The *quality* should not be confined to *product* quality alone, rather quality should mean — to be the quality of the *system*. Quality cannot be inspected into a product, it has to be manufactured along it. The concept of quality as an inspection function is obsolete now, it is perceived to be a process control function.

Quality Control

- The operational techniques and activities that are used to fulfil requirements for quality is **Quality Control**.
- *Quality control* involves operational techniques and activities aimed both at monitoring a process and at eliminating causes of unsatisfactory performance at relevant stages of the quality loop (quality spiral) in order to result in economic effectiveness, (Fig. A.1).
- There are two main aspects of Quality control.
 - (i) *Make things right first time*. In other words, production should be defect free.
 - (ii) Work for continual improvement in quality.

Quality Policy

- The overall quality intentions and direction of an organization as regards quality, as formally expressed by top management.
- Quality policy shall be consistent with Company's policy and the top-management must ensure that its corporate quality-policy is clearly understood, implemented and maintained. This will ensure the degree of commitment of top-management to quality.

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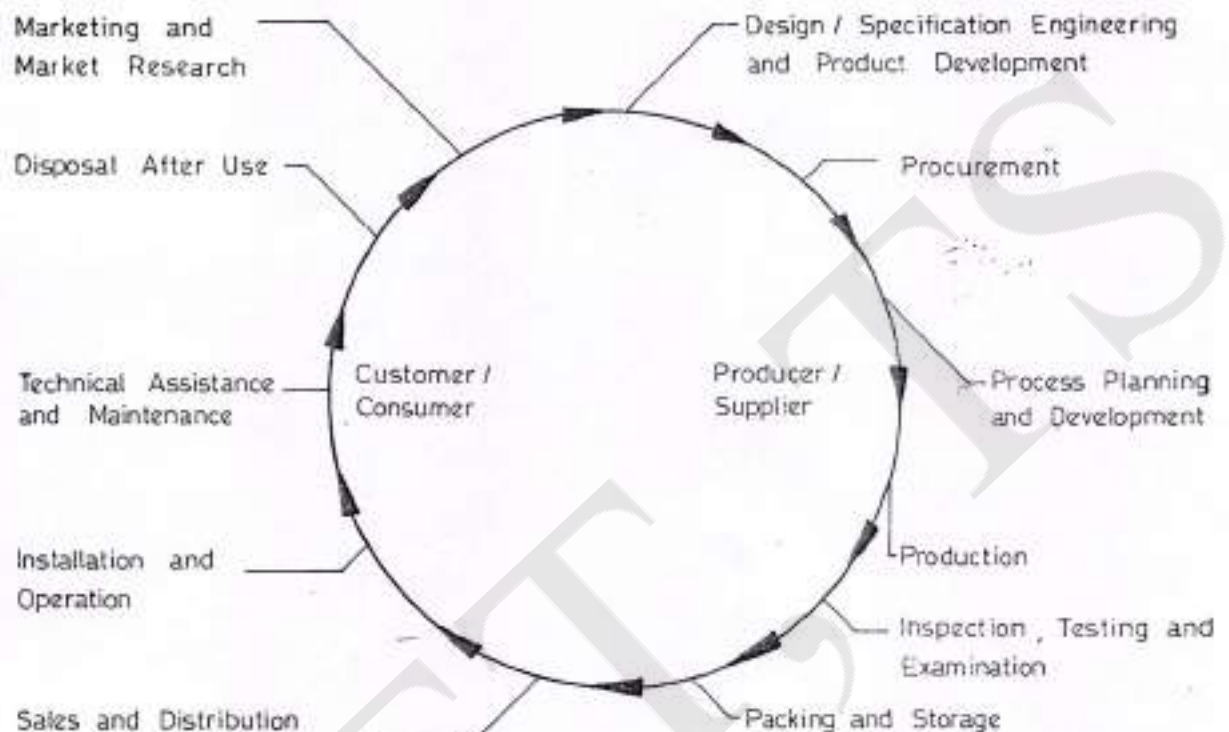


Fig. A. 1. Quality loop

- Quality policy shall cover the areas in terms of quality improvement and strategic planning: the design, conformance to design, field service and marketing.
- Quality policy must clearly state key-elements of quality such as fitness for use, performance, safety, reliability etc. Product design shall meet the customer's quality requirements including functional, safety etc. Every attempt shall be made to adhere to specifications during manufacture.

Quality Management

- That aspect of the overall management function that determines and implements the quality policy.
- Quality management includes strategic planning, allocation of resources and other systematic activities for quality, such as quality planning, operations and evaluations.
- The attainment of desired quality requires the commitment and participation of all members of the organization whereas the responsibility for quality management belongs to top management.

Quality System

- The organizational structure, responsibilities, procedures, processes and resources for implementing quality management.

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- The quality system should only be as comprehensive as needed to meet the quality objectives.

Benefits of Quality Systems :

- (1) Quality performance is institutionalized.
- (2) Efficient tool to achieve and ensure consistent quality improvement.
- (3) Reduces wastes and time consuming reworks and repairs — increasing profits in turn.
- (4) Saves money as quality system ensures efficient and sound procedures.
- (5) Provides a competitive edge in domestic as well as global market.
- (6) Brings confidence to the consumer.

Quality Assurance

- All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.
- For effectiveness, quality assurance usually requires a continuing evaluation of factors that affect the adequacy of the design or specification for intended applications as well as verifications and audits of production, installation and inspection operations. Providing confidence may involve producing evidence.
- *Within* an organization, quality assurance serves as a management tool. In *contractual situations* quality assurance also serves to provide confidence in the supplier.

Quality Objective

- (1) The organization should achieve and sustain the quality of the product so as to meet continually the purchaser's stated or implied needs.
- (2) The organization should provide confidence to its own management that the intended quality is being achieved and sustained.
- (3) The organization should provide confidence to the purchaser that the intended quality is being, or will be, achieved in the delivered product or service provided. When contractually required, this provision of confidence may involve agreed demonstration requirements.

A 1.6 TOTAL QUALITY ELEMENTS/INGREDIENTS

There are four basic elements of total quality operation :

- (a) Quality awareness.
- (b) Management Attitude.
- (c) Tools and Techniques of Process Management.
- (d) Quality System Standards.

(a) Quality Awareness

- Company-wide awareness as regards *quality* is must from top to bottom if manufactured goods and services have to meet the customer's specifications and requirements.
- The company must communicate its *quality objectives* to the workforce, through *quality awareness programmes*, stressing on the following *points* :
 - (i) To make quality as the foremost policy.
 - (ii) Customer's requirements first.
 - (iii) Products/services right first time (prevention tha cure).

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13. **Control of Non-Conformity Product** : Non-Conformity of product be prevented from inadvertent use or installation. The non-conformity product be identified and arrangements be made for its disposition and notification to the functions concerned.
14. **Corrective Action** : Whenever a discrepancy is observed during an audit, the cause of non-conformity be investigated and corrective action taken to prevent recurrence.
15. **Handling, Storage, Packing and Delivery** : The procedures for handling, storage packaging and delivery of the product be well established, documented and maintained.
16. **Quality Records** : Identify the features essential to a record document to qualify it as objective evidence on quality. Records shall be legible and identifiable to the product involved.
17. **Internal Quality Audits** : The management shall plan and execute quality audits to verify whether the quality activities comply with planned arrangements and to determine the effectiveness of the quality system.
18. **Training** : Identify the training needs and provide for training of all personnel performing activities affecting quality.
19. **Servicing** : If servicing is specified in the contract the management shall establish and maintain procedures for performing and verifying that servicing meets the specified requirements.
20. **Statistical Techniques** : Where appropriate, the management shall establish procedures for identifying adequate statistical techniques required for verifying the acceptability of process capability and product characteristics.

A 1.8 ISO 9000 QUALITY SYSTEM SERIES

Introduction

- *ISO is the international organisation for standardisation, set up with the objective to promote the development of standards and related activities, for facilitating international exchange of goods and services.*
- *ISO 9000 series of standards developed in 1987, relate to quality systems. It has evolved from the standardization of quality assurance system standards of several nations all over the world.*
- *The standards allow a wide flexibility, but, at the same time, are rigid too. They permit a supplier to formulate his own quality policy and write the quality manual, procedures and instructions in his own way, within the frame work of the system elements, but does not allow rendering of nonconforming products or services.*
- *For an organization having several good quality systems, ISO 9000 certification is just a step ahead, for others it means a quantum jump, presenting real challenge.*

Characteristics of ISO 9000

- (i) ISO 9000 can be implemented in any type and size of organization.
- (ii) It is independent of the product, size and country.
- (iii) It has international acceptance and recognition.
- (iv) It ensures consistent improvement in quality.

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ISO 9000 series

- There are five standards in the ISO 9000 series, ISO 9000-9004.
- ISO 9001, 9002 and 9003 are applicable to *contractual situations*.
- ISO 9004 is for *non-contractual* cases and is used for internal management purpose.

In the *contractual cases*, the purchaser contractually requires that certain quality system elements be part of the supplier's quality system so that he gets quality products at consistent level. The purchaser wants to make sure that the supplier has the capability to meet contractual requirements.

The same supplier may sell some products in *Contractual situations* and others in *non-contractual situations* where he is not bound by any specific written quality contract; but some standard of quality is even then to be maintained.

<i>International Standard</i>	<i>Corresponding Indian Standard</i>
(1) ISO 8402 : 1986 Quality—Vocabulary	IS 13999 : 1988 Quality systems—Vocabulary (identical)
(2) ISO 9000 : 1987 Quality management and quality assurance standards—Guidelines for selection and use	IS 14000 : 1988 Quality systems—Guidelines for selection and use of standards on quality systems (identical)
(3) ISO 9001: 1987 Quality systems—Model for quality assurance in design/development, production, installation and servicing	IS 14001 : 1988 Quality systems—Model for quality assurance in design/development, production, installation and servicing (identical)
(4) ISO 9002 : 1987 Quality systems—Model for quality assurance in production and installation	IS 14002 : 1988 Quality systems—Model for quality assurance in production and installation (identical)
(5) ISO 9003 : 1987 Quality systems—Model for quality assurance in final inspection and test	IS 14003 : 1988 Quality systems—Model for quality assurance in final inspection and test (identical)
(6) ISO 9004 : 1987 Quality management and quality system elements—Guidelines	IS 14004 : 1989 Quality systems—Guidelines on elements of quality management system (second revision) (Technically equivalent)

ISO 9000 series of standards deal with generic quality principles, the need for an international minimum standard to establish quality control methods not just to control product quality, but also to maintain it. People, today in the world market, want assurance that whether they will get reliable quality for their money.

ISO 9000 is a big success from day one and probably a first of its kind to go beyond nuts and bolts and attempt to address management practices.

ISO 9000

- It is the contour map furnishing the guidelines for selection and use of ISO series standards.
- It gives guidelines for selection and use of quality standards to have quality assurance.

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- It provides the basis for the implementation of quality systems and their assessment and verification. In establishing a quality system it is essential that the organisation clearly defines the personnel who are responsible for functions affecting quality.
- The quality system will generally be codified in a series of documents which are commonly known as the **Quality Manual**. All aspects relating to quality should be identified in these documented procedures which should include all references to work instructions and records. The manual should also contain procedures for specific actions which need to be taken as part of the quality control procedure.

ISO 9001 Quality System

It is for *use* when conformance to specified requirements is to be assured by the supplier during several stages which may include design/development, production, installation and servicing.

ISO 9002 Quality System

It is for *use* when conformance to specified requirements is to be assured by the supplier during production and installation.

ISO 9003 Quality System

It is for use when conformance to specified requirements is to be assured by the supplier *solely* at final inspection and test.

- ISO 9001, 9002 and 9003 provide guidelines for external quality-assurance purposes in contractual situations. Therefore purchaser and supplier should refer to these standards to determine which of these standards is most relevant to the contract.

ISO 9004 Quality System

- ISO 9004 provides guidelines on the technical, administrative and human factors affecting the quality of products or services, at all stages of the *quality loop system* (Fig. A-1). In this standard, emphasis is laid on the satisfaction of the customer's need, the establishment of functional responsibilities and the importance of assessing the potential risks and benefits.

ISO 9004 can be used for internal quality assurance.

ISO 9004 may deal with quality related cost, quality in marketing, quality in specification and design, quality in procurement, quality in production, quality in documentation and records, corrective action etc.

It is intended that these international standards will normally be adopted in their present form, but on occasions they may need to be tailored for specific contractual situations. ISO 9000 provides guidance on such tailoring as well as selection of the appropriate quality assurance models.

A 1.9 PREREQUISITES FOR IMPLEMENTING ISO 9000 QUALITY SYSTEM

For effectively implementing ISO 9000 Quality systems, any organization must meet the following requirements:

- (1) Development of Quality Awareness.
- (2) Imparting Education and Training to Employees.

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- (3) Introduction of Motivation and Incentive Programs.
- (4) Development of Measuring Equipments Laboratory.
- (5) Development of Planning Scheme for implementation.
- (6) Above all, to have firm commitment of top management to fully support the Quality system with a strong will and faith to make it success.

(1) Development of Quality Awareness

Every body in the organization from top to bottom should extend his wilful support to the quality program and make quality as the first policy.

(for details refer page A-5)

(2) Imparting Education and Training to Employees

- The first and most important component of managing quality project is education and training of employees.
- Purposeful education and training to the workforce at different levels is a must in order to make sure that the desired skill is available within the organization to meet International Quality Standards.
- Education and training should be job-oriented and must be an integral part of quality policy, because education and training are the basic requirements on the road leading to quality excellence, quality maintenance and quality improvement.
- Properly planned education and training makes each employee to understand the work to be performed by him. Training puts the education into practice.
- The education and training program should be structured for three levels on the lines of ISO 9004, as explained below:

(a) Training for executives and managerial personnel

- Understanding of quality system together with the tools and techniques needed for participation in the operation of the system.
- Understand the criteria to evaluate the effectiveness of the system.
- To make use of employees to achieve the quality targets.

(b) Training for technical personnel

Training should be imparted to technical persons in the following fields:

- Process engineering and Product engineering.
- On-line and Off-line quality control techniques.
- Statistical quality control techniques.
- Process capability studies.
- Quality improvement methods.
- Problem identification, problem analysis and corrective action.
- Material and equipment procurement, etc.

(c) Training to work-force (shop floor) and production supervisors.

This training should include

- Operation of machines, tools and instruments.

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- Reading and understanding the documents provided.
- Relationship of their duties to quality and work place safety etc.

(3) Motivation and Incentive Programs

- Quality systems have clearly recognized the importance of *people* in achieving product quality on a consistent basis. Until and unless the workforce is motivated, the chances of success are not bright.
- The two main programs viz. *Zero Defect program* and *Quality Circles* (refer page 8–45) which enlist the cooperation, assistance and participation of employees to improve product have built-up motivational and incentive programs in them. (For motivation and incentive programs refer pages 19–20 and 30–31 respectively).

(4) Laboratory for Measuring Equipments

- In order to prove that yours is a quality product, you have to measure and control its *quality characteristics*.
- *Quality Characteristics* refer to product parameters (i.e. dimensions, shape etc.) that can be quantitatively assessed/measured by some equipment such as scale, vernier calliper, micrometer, gauges and comparators etc. The measured quality characteristics of a component are then compared with some *standards* and these standards are the foundation for quality. Standards establish the quality of products. Therefore, test methods and measuring equipments are extremely important components of quality system.
- A *Metrology and Material Testing Laboratory* is a very important prerequisite to make the Quality System a success.
- According to ISO 9001 : 1987
 - (a) Identify the product measurements to be made in terms of accuracy required and select the measuring equipment and the appropriate inspection accordingly.
 - (b) Accordingly, identify, calibrate and adjust all inspection, measuring and testing equipments those can affect product quality.
 - (c) Establish document and maintain calibration procedures including details of equipments, frequency of checks, check method, acceptance criteria and the action to be taken when the results are not satisfactory.
 - (d) Ensure the capability of accuracy and precision of the inspection, measuring and test equipments.
 - (e) Ensure that environmental conditions are suitable for calibration, inspection, measurement and test being carried out.
 - (f) Ensure the handling and storage of inspection, measuring and test equipments so that their accuracy is maintained.

(5) Planning Scheme for Implementation

- **Quality Planning** (ISO 9003 and 9004) is a written document which must be read and understood by every body from top to bottom in the organization before implementing quality systems.

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- For projects relating to new products, services or processes, (ISO 9004), management should prepare, as appropriate, written **quality plans** consistent with all other requirements of a company's quality management system.

Quality Plan should Define

- (a) the quality objectives to be attained;
- (b) the specific allocation of responsibilities and authority during the different phases of the project;
- (c) the specific procedures, methods and work instructions to be applied;
- (d) suitable testing, inspection, examination and audit programmes at appropriate stages (for example, design, development);
- (e) a method for changes and modification in a quality plan as projects proceed;
- (f) other measures necessary to meet objectives.
- **Development Planning** should include the following because without these the *quality plans* cannot be developed:
 - (a) Clear cut definition of project and its objectives.
 - (b) Organization of project, team structure, contractors, subcontractors etc.
 - (c) Project schedule—the tasks to be performed and their time phases.
 - (d) How the project is to be managed.
 - (e) Development planning needs updating on the basis of feedback.
- **Verification** of each phase of development is a must. The supplier should get verified the output at the end of each phase.
The verified development output should be submitted to *Configuration Management* and then accepted for subsequent use.
- *Configuration Management* should provide a mechanism for identifying, controlling and tracking the versions of each item being used, and then the status of products in development or delivered and installed.
- **Audit Inspection** provides management with an early view of the product quality. It allows immediate *corrective action*, if any, on the part of supplier, before the product goes into the market and the customer complaints about it.
During the course of audit, reporting and follow up of audit-findings are essential to make it success.

Corrective Action

(As per ISO 9000 and ISO 9004)

- The implementation of *corrective action* begins with the detection of a quality problem (e.g. materials, components or products non-confirming to quality standards) and involves taking measures to eliminate or minimize the recurrence of such a problem.
- The supplier shall establish, document and maintain procedures for
 - (a) investigating the cause of nonconforming product and the corrective action needed to prevent recurrence;
 - (b) analysing all processes, work operations, quality records, service reports and customer complaints to detect and eliminate potential causes of non-conforming product;

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- (c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered;
- (d) applying controls to ensure that corrective actions are taken and they are effective.
- (e) implementing and recording changes in procedures resulting from corrective action.

Procedure for Corrective Action

- (1) The responsibility and authority for instituting corrective action should be defined as part of the quality system.
- (2) The significance of a problem affecting quality should be evaluated in terms of its potential impact on production costs, quality costs, safety, reliability etc.
- (3) Investigation of possible causes (cause and effect relationship) resulting in non-conforming products should be carried out.
- (4) Analysis of problem to determine root cause should be done before planning preventive measures.
- (5) In order to prevent a future recurrence of a nonconformity, it may be necessary to change a manufacturing process, packing, storage process, product specification etc.
- (6) When the preventive measures are implemented, their effect should be monitored in order to ensure that desired goals are met.
- (7) For work-in-process, remedial action should be instituted as soon as practicable in order to limit the cost of repair, reworking or scrapping. Recall finished goods not conforming to quality standards.
- (8) Permanent changes resulting from corrective action should be recorded in work instructions, product specifications or the quality system.

A 1.10 INSTALLATION PROCEDURE OF ISO 9000 QUALITY SYSTEM

- Every organization is interested in improving the quality of its completed work, as it has to compete with the best in the World market. Thus it has become quite essential for a company to have a structured and well defined quality system that identifies, documents, coordinates and maintains the necessary quality to meet the customer demands.
- ISO 9000 Quality System is just a model that stipulates certain time honoured quality management practices as guidelines and minimum requirements.
- Therefore every organization, today, is bent upon installing ISO 9000 Quality System. This system can be installed in several stages, that have to be sequentially undertaken. The time involved in installation depends upon the size and complexity of the organization.

The basic steps to be followed for ISO 9000 certification are given below:

- (1) Quality Awareness training.
- (2) Form task force.
- (3) Analyse existing practices and corrective action.
- (4) Design and develop standard procedures.
- (5) Prepare Documentation.
 - Quality manual

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- Quality procedures
 - Work instructions
 - (6) Implement the Quality System.
 - (7) Quality Auditing.
 - (8) Preliminary Audit by Third party.
 - (9) Apply for Accreditation.
 - (10) Maintain the system.
- (1) **Quality Awareness Training**
(Refer page A-5)
- (2) **Form Task Force**
- (a) *Strategic* : Management — Quality Policy/Quality Manual.
 - (b) *Tactic* : Dept. Heads — Quality Procedures.
 - (c) *Operational* : Supervisors — Work Instructions/Drawings.
- (3) **Analyse Existing Practices and Corrective action**
(As per ISO 9001 : 1987)
- The supplier shall establish, document and maintain procedures for
 - (a) investigating the cause of nonconforming product and the corrective action needed to prevent recurrence;
 - (b) analysing (*existing practices* i.e.,) all processes, work operations, concessions, quality records, service reports and customer complaints to detect and eliminate potential causes of nonconforming product;
 - (c) initiating preventive actions to deal with problems to a level corresponding to the risks encountered;
 - (d) applying controls to ensure that corrective actions are taken and that they are effective;
 - (e) implementing and recording changes in procedures resulting from corrective action.
- Corrective action also presupposes the repair, reworking, recall or scrapping of unsatisfactory material or items (components/products).
- (4) **Design and Develop Standard Procedures**
- Standard procedures of manufacturing will have to be developed to fully meet the customer's quality requirements including functional, safety, aesthetic etc., with adequate attention to economy of manufacture.
- (5) **Prepare Documentation**
(As per ISO 9004 : 1987 and IS 14004 : 1989)
- All the elements, requirements and provisions adopted by a company for its quality management system should be documented in a systematic and orderly manner in the form of written policies and procedures.
 - Such documentation should ensure a common understanding of quality policies and procedures that is, quality programmes/plans/manuals/records.

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- The quality management system should include adequate provision for the proper identification, distribution, collection and maintenance of all quality documents and records.
- The following are *examples* of the types of quality documents requiring control:

(a) Drawing	(b) Specifications
(c) Blue prints	(d) Inspection instructions
(e) Test procedures	(f) <i>Work instructions</i>
(g) Operation sheets	(h) <i>Quality manual</i>
(i) Operational procedures	(j) <i>Quality (assurance) procedures.</i>

Quality Manual (As per ISO 9004 : 1987)

- The typical form of the main document used in drawing up and implementing a quality system is a *Quality Manual*.
- The primary *purpose* of a quality manual is to provide an adequate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system.
- Procedures should be laid down for making changes, modifications, revisions or additions to the contents of a quality manual.
- In large companies, the documentation relating to the quality management system may take various forms, such as:
 - (i) corporate quality manual;
 - (ii) divisional quality manuals; and
 - (iii) specialized quality manuals (for example, design, procurement, project, work instructions).

In brief, a quality manual includes the quality policy of the company, organisational structure of the quality assurance department, job description of the quality assurance personnels, relationship of the quality control department with other departments, quality control/inspection procedures and documentation (with a copy of every form in use).

Quality Policies and Procedures (As per ISO 9004 : 1987)

- All the elements, requirements and provisions adopted by a company for its quality management system should be documented in a systematic and orderly manner in the form of written *policies* and *procedures*. Such documentation should ensure a common understanding of quality policies and procedures, that is, quality programmes/plans/manuals/records.
- **Quality procedures** instruct the workforce how the quality objectives mentioned in the quality manual can be obtained. Procedures document inter-documental activities, detailing the working and interaction of different sections of the company, for fulfilling the requirements of quality.

The *procedures specify* what has to be done, by whom, when, where and how will it be done. A common format and a suitable numbering system has to be devised for all procedures. This enables easy identification of individual sections and individual procedures in each section.

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Work Instructions

Work instructions deal with a lower level of activities than the *quality procedures*. While procedures describe who does what, work instructions give specific information about the standards of quality to be achieved. The instructions include what has to be done, the proper sequence of work stages, the materials and equipments to be used, the environmental conditions to be maintained, reference/standards to be adhered to and instructions for special processes, if any, like welding, annealing, soldering etc. The instructions also include the recordings, product/process affected, issue and control and authorization of the concerned signatories.

(6) Implementing the Quality System

- Before implementing the quality system, certain pre-requisites are to be met. Such requirements have been discussed on page A-10.
- Implementing the quality system means putting the system into practice in the organization.
- It will be always better to start the implementation, when the *documentation* is ready for use and success is expected. *Education* and *Training* are essential for a successful quality system. The *follow-up action* on the effectiveness of quality system is done by performing *audits*. The audit reports should be followed up, correcting the procedure/process and providing training at all levels. Whenever changes are made in the procedures, the documents also should be amended and have to be controlled, as a part of implementation.

(7) Quality Auditing (ISO 9004 : 1987)

- *Quality Auditing* is independent and objective evaluation of the outgoing product level, as it would be measured and judged from the viewpoint of the customer, whether that customer be the ultimate user, a dealer, the next department or another plant.
- *Quality Audits may be of the following types*
 - (a) Internal audits.
 - (b) Customer audits.
 - (c) Independent third party audits.
- All elements and aspects pertaining to a quality system should be **internally audited** and evaluated on a regular basis. Audits should be carried out in order to determine whether these are effective in achieving stated quality objectives. For this purpose, an appropriate audit plan should be formulated and established.
- **Audit Plan** format should cover the following:
 - (a) Specific activities and areas to be audited;
 - (b) Suitability of personnel carrying out audits;
 - (c) The basis for carrying out audits (for example, organizational changes, reported deficiencies, routine checks and surveys); and
 - (d) Procedures for reporting audit findings, conclusions and recommendations.
- **When Carrying out the Audit**, objective evaluation of quality system elements by competent personnel may include the following activities or areas:
 - (a) Organizational structures;

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- (b) Administrative and operational procedures;
- (c) Personnel, equipment and material resources;
- (d) Work areas, operations and processes;
- (e) Items being produced (to establish degree of conformance to standards and specifications); and
- (f) Documentation, reports and record keeping.
- **Personnel Carrying out Audits** of quality system elements should be independent of the specific activities or areas being audited.
- Audit findings, conclusions and recommendations should be submitted in documentary form for consideration by appropriate members of the management.

The following points should be covered in the **reporting and follow-up of Audit findings**:

- (a) Specific examples of noncompliance or deficiencies should be documented in the audit report, possible reasons for such deficiencies, where evident, may be included;
- (b) Appropriate corrective action may be suggested; and
- (c) Implementation and effectiveness of corrective actions suggested in previous audits should be assessed.

(8) Third Party Audit

A third/external party assessment is carried out by an independent body to establish the extent to which an organization meets the requirements of an applicable standards or set of regulations.

- Third party can assess an organization against any quality standard but the concentration here is given on ISO 9000 : 1987 against which assessment can be made. It is an independent audit body which would normally issue a *certificate of registration*, indicating acceptance of the organization as *A Company of Assessed Capability* i.e., witness to the world that this assessed organization complies with all the requirements of ISO quality standards.

(9) Accreditation

The next step for the organisation is to apply for Accreditation.

- The National Accreditation Council for Certification Bodies (NACCB) funded by Department of Trade and Industry (DTI) is responsible for the accreditation and supervision of *Certification Bodies* in U.K. An accredited certification body issues the *Crown and Tick logo* only after certification within its accredited scope. Some bodies have accreditation in a wide range of activities and they assess organizations to ISO standards.
- After, an assessment by an independent audit body is successfully concluded, the *certification body* will issue a certificate, attached to which is a definition of the scope of activities which have been assessed.
- A few *Accredited Certification Bodies* are
 - (a) ASTA Certification Services, Prudential Chambers, 23/24 Market Place, Rugby CV 21 3 DT.
 - (b) Lloyd's Register Quality Assurance Limited, Norfolk house, Wellesley Road, Croydon CR 9 2 DT.

(c) Bureau Veritas Quality International Limited, 3rd floor, 70 Borough High Street, London SE1 1XF.

- Certification bodies carry out assessments in accordance with documented procedures. Most of the certification bodies are always prepared to issue copies carrying informations regarding registration.

(10) Maintain the System

- The Quality system is to be reviewed periodically by the *management*, by performing *internal audits* and taking corrective actions where necessary based on audit reports, thus streamlining the system.
- The *Certification body* also maintains some system of monitoring to ensure continued compliance with the standard.
Monitoring the quality system needs to have a system of regular, unannounced audits, reassessment at regular intervals, etc.

A 1.11 INDIAN STANDARD ON QUALITY SYSTEMS

The Bureau of Indian Standards recognized the importance of preparation of Indian Standards on quality systems. Therefore, an Indian Standard manual on quality assurance system, IS 10201 was published in 1982 which describes a basic set of quality elements by which quality management systems could be developed and implemented within an organization. After the publication of International Standards on Quality Systems, BIS adopted these as IS 14000 series of Standards.

(1) IS 13999 : 1988

This standard defines basic and fundamental terms relating to quality concepts, as they apply to products and services, for the preparation and use of quality standards and to facilitate mutual understanding in international communication. The terms defined in this standard have a direct application to all Indian Standards in the series on quality systems (IS 14000).

(2) IS 14000 : 1988

This standard provides the guidelines for the selection and use of series of Indian Standards on quality systems that can be used for internal quality management (IS 14004) as well as external quality assurance purposes (IS 14001), (IS 14002) and (IS 14003). It clarifies the relationship among various quality concepts and specifies the rules for using the three models given in IS 14001, IS 14002 and IS 14003. IS 14000 introduces the notion of degree of demonstration concerning the adequacy of the quality systems and the conformity of the product with the specified requirements. A cross reference list of quality system elements has also been included as an annexure to the Standard.

(3) IS 14001 : 1988

This standard is applicable when conformance to specified need is to be assured by the supplier throughout the whole cycle — from design through to servicing. It is used when the contract specifically requires design effort and the product requirements are stated (or need to be.

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stated) principally in performance terms. This standard represents the fullest requirements, involving all the quality system elements detailed in IS 14000 at their most stringent.

(4) IS 14002 : 1988

This standard is for use when the specified requirements for products are stated in terms of an already established design or specification. Only the supplier's capabilities in production and installation are to be demonstrated. All the quality system elements listed in IS 14000 : 1990 except 'design' and 'after sales service' are present but some are treated less stringently.

(5) IS 14003 : 1988

This standard applies to situations where only the supplier's capabilities for inspection and tests (conducted on the product as supplied) can be satisfactorily demonstrated. In this standard, only half of the quality system elements of IS 14000 : 1990 are required, and at a lower level of stringency than for IS 14002 : 1990.

(6) IS 14004 : 1991

This standard, together with IS 14000, provides guidance to all organizations on quality management. Each of the quality system elements listed in IS 14000 : 1990 has been explained in 14004.

The standard helps in developing and implementing a quality system as also determining the extent to which each quality element is applicable. It also provides guidance on the technical, demonstrative and human factors affecting the quality of products or services at all stages—from detection of customer's needs to their satisfaction. Throughout this standard, emphasis is placed on the satisfaction of the customer's needs and establishment of functional responsibilities. The object is to minimize the cost of the quality project while maximizing the benefits.

(7) IS 14004 (Part 2) : 1992

Quality and customer satisfaction are important subjects receiving increasing attention worldwide. The creation and maintenance of quality in an organization is dependent upon a systematic approach to quality management aimed at ensuring that customer needs are understood and met. The achievement of quality necessitates a commitment to quality principles at all levels in the organization and continual review and improvement of the established system of quality management based on feedback of the customer's perception of the service provided.

The successful application of quality management to a service provides significant opportunities for

- improved service performance and customer satisfaction,
- improved productivity, efficiency and cost reduction, and
- improved market share.

To achieve these benefits, a quality system for services should also respond to the human aspects involved in the provision of a service by

- managing the social processes involved in a service,
- regarding human interactions as a crucial part of service quality,
- recognizing the importance of a customer's perception of the organization's image, culture and performance,

- developing the skills and capabilities of personnel, and
- motivating personnel to improve quality and to meet customer expectations.

This standard gives guidance for establishing and implementing a quality system within an organization. It is based on the generic principles of internal quality management described in IS 14004 : 1991 and provides a comprehensive overview of a quality system specifically for services.

This standard can be applied in the context of developing a quality system for a newly offered or modified service. It can also be applied directly when implementing a quality system for an existing service. The quality embraces all the processes needed to provide an effective service, from marketing to delivery, and includes the analysis of service provided to customers.

The concepts, principles and quality system elements described are applicable to all forms of service, whether solely of a service character or in combination with the manufacture and supply of a product.

A-2 FACTORS AFFECTING PLANT LAYOUT

- *Plant layout* shows the physical relationships between the plant and its equipment, workers, machines, workbenches etc.

The factors affecting plant layout are

- (1) The components/products to be manufactured.
- (2) The volume of production and hence the volume of raw material and inprocess inventory to be handled.
- (3) The operations needed to be done on each component, sub assemblies and assemblies.
- (4) The assembly relationship between the components and subassemblies of each product.
- (5) The type, size and capacity of machines required for each operation and to be installed (layout) in the plant.
- (6) Location of manufacturing areas for individual components, subassemblies and assemblies.
- (7) Movement of material handling equipments.
- (8) Characteristics and requirements of auxiliary services (e.g. compressed air, steam, standby electricity etc.) necessary for production to proceed.

A-3 ROLE OF MANAGEMENT

Given below are the roles of management which a manager has to fill :

A. *Interpersonal-roles*

1. The figure head role (performing ceremonial and social duties)
2. The leader role
3. The liaison role (particularly with outsiders)

B. *Informational roles*

1. Receiving information about the operation of an enterprise.
2. The disseminator role (passing information to subordinates).
3. The spokesman role (transmitting information outside the organization).

C. *Decision roles*

1. The entrepreneurial role

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Total Quality Management

1.1. INTRODUCTION

In order to capture increased market share, quality had been the main concern of every manufacturer since old days. Started with the inspection, concept moved to the quality control concept, when it was realised that making the inspection department only responsible for quality of the product would be counter productive. Concept of quality control emphasises self inspection and appropriate systems to ensure quality by identifying defectives and eliminating them. Help of statistical quality control, sample analysis, were also undertaken.

Then arose the concept of quality assurance. But the quality movement did not stop with this and the attempt is to continuously improve the quality and assure higher and higher standards of quality, offer better products to the consumer, ensure better and longer service and improve the utility of the product. It was felt that quality is not the job of quality control department only, but other departments like sales, accounting, procurement, material handling, industrial relations, design, production, forecasting, marketing, stores, after-sales service have also to contribute substantially. Thus, quality is the responsibilities of all the employees. The workers should run the system, managers should design and improve the system, while top management should provide leadership and team spirit.

In a Total Quality Management concept, the word quality has a wider meaning, it means quality of output of every department and by every employee, cleanliness, orderliness, punctuality, customer service, standardization of works and continuous efforts for their improvement are also part of T.Q.M. In this, needs of the customer are constantly monitored to improve the products and processes to meet their requirement.

In Total Quality Management programme, voluntary participation of workpeople is sought for the quality of the task.

Total Quality Management involves effective Decision making, Problem-solving and Integration of Quality Planning, Quality Implementation and Quality Improvement strategies of all the departments of an Organisation (such as Marketing, Production, Finance, Personnel) and other satisfied suppliers, highly committed and involved employees, lower costs, higher

revenues and high profits for the Organisation.

Customer satisfaction is the most important aspect of TQM. Here Customers are all those who are affected by our work. They could be external to the organisation or may be inside the organisation. Meeting the needs of the outside customers depends on meeting the needs of the inside customers. Any individual (or department) receives inputs, processes them and passes it to next person (or department). Every individual (or department) plays these roles : Customer-Processor-Supplier.

It has been emphasized that Quality be managed by a structured process of Planning, Implementation (or Control) and Improvement. Quality Planning identified the quality features to be provided and plans for delivering them without deficiencies. Quality Implementation (or Control) compares the actual performance with the planned performance to take proper actions to bring these two to an agreement, Quality Improvement works for reducing or eliminating deficiencies in the present products, processes or services.

Total Quality Control

Total quality control (TQC) may be defined as, "an effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow for full customer satisfaction". TQC requires participation of all divisions.

Characteristics of Total Quality Control Concept

1. Quality Control is the responsibility of all the workers and all the divisions.
2. Total Quality Control is a group activity and can not be done by individuals.
3. It calls for team work.
4. Quality Control Circle activities are part of the T.Q.C.
5. It adopts the philosophy of refusing to allow any defect.
6. It relies on Sampling (S.Q.C.) rather than cent-percent inspection.
7. Continuous process for improving quality of products and services.
8. All employees are provided with proper tools and proper training to do the quality job.
9. It clearly defines top management's permanent commitment to quality.

Integrated Quality Control

In affecting integrated quality control, control of quality is central, but at the same time cost control (profit control and price control), quantity control (amount of production, of sales, of stock), and control of delivery date are to be promoted. This method is based on the fundamental assumption of QC that a manufacturer must develop, produce and sell commodities that satisfy the needs of consumers. This extends the term quality to the quality of work in the offices, in the service related industries and in the banks etc.

Elements of TQM

- | | |
|---|----------------------------|
| 1. Customers satisfaction | 2. Employees involvement |
| 3. Total Organisation involvement | 4. Morale of employees |
| 5. Quality control Circles and suggestion system. | |
| 6. Higher revenue. | 7. Lower cost |
| 8. Quality control | 9. Control of production. |
| 10. Quality planning | 11. Quality implementation |

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- | | |
|--|---------------------------------------|
| 12. Quality improvement | 13. Quality Assurance system |
| 14. Vendor control & quality in procurement. | 15. Customer relationship management. |
| 16. Measurement information analysis | 17. Strategic quality management. |
| 18. Leadership | 19. Quality education and training. |

Ways for T.Q.M.

1. Adopt new philosophy of 'not to allow defects to occur'.
2. Create consistency of purpose for improvement.
3. Improving production and service quality, should a continuous process.
4. Cease dependence on mass inspection. Adopt statistical quality control.
5. Insist quantifiable evidence from the suppliers about the quality of their product.
6. All employees should be trained, retrained and refresher courses be arranged.
7. Provide proper tools to all the employees.
8. Adopt proper communication system.
9. Encourage productivity.
10. Encourage coordination between departments
11. Permanent commitment of top management to quality.
12. Respect towards 'work' and 'humanity'.
13. Adopt consumer orientation and not the product orientation.
14. Objective should be, 'Quality first, and not the short term profits'.
15. Use facts and data

46.2. EFFECTIVE TOTAL QUALITY IMPLEMENTATION

1. Quality Implementation ensures that a process continuously produce the quality that was planned into it. Effective Implementation includes:

- (i) A clearly stated policy.
- (ii) Development of resources of men, machine and others to specific tasks involved, identifying the departments/ individuals to do the specific tasks.
- (iii) Proper selection of control factors, with details of when, where, who, what, how and why they are to be done.
- (iv) Establishing self control for all those who run the process.
- (v) Personnel leadership from the Manager in motivating, training and recognising the work of his people. Creation of a healthy culture.
- (vi) Existence of an established Quality Assurance System.
- (vii) Total Organisational Involvement, both formal and informal, such as Quality Circles.
- (viii) Informations needed about deficiencies in the goods and processes, and cost of poor quality, with analysis of their causes.
- (ix) Measurable standards are to be established for having a benchmark for Quality Implementation purposes.

2. A feedback loop measures on output from a process, compares them with the established standards and takes the necessary action. Control standards are established based on the actual performance of the process. CONTROL CHARTS are the tools for establishing control standards and testing the actuals against standards.

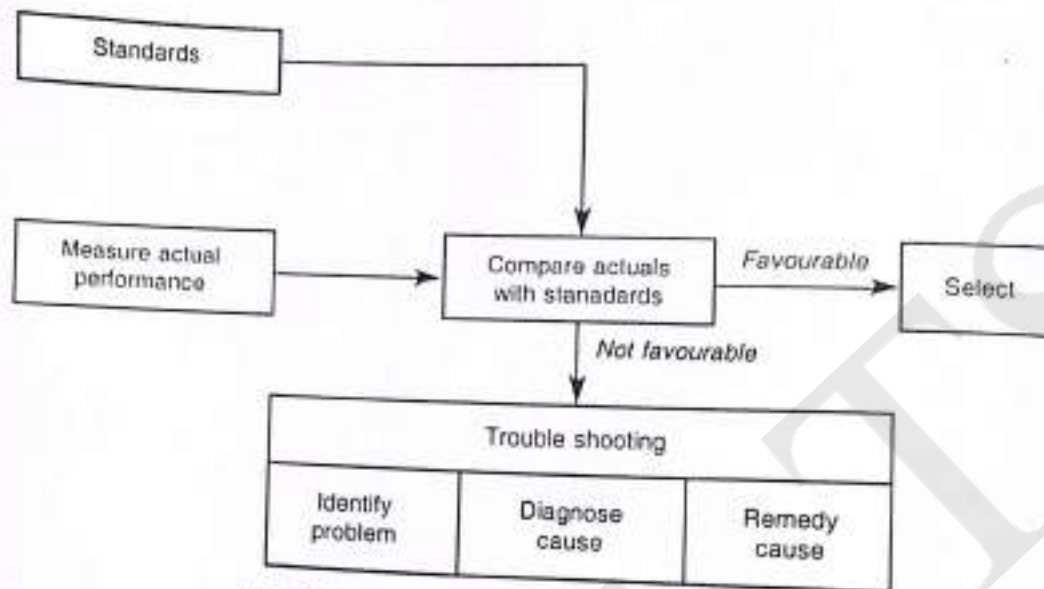


Fig. 46.1. Quality control feed-back loop.

46.3. TOTAL QUALITY IMPROVEMENT

1. Total Quality Improvement is a structured process for reducing the deficiencies that are present in products, processes and services and/or improving performance whenever there is an opportunity to improve.

2. Improvements take place in following steps :

(i) A clear understanding of the SYMPTOMS

(ii) A diagnosis to find the CAUSES

(iii) To find REMEDY/REMEDIES for the causes :

(a) For achieving Quality Improvement specific problems are to be identified and well defined such as : reducing energy consumption, improving capacity, reducing lead time and reducing failure rates.

(b) Diagnosing the root cause is a structured process. The team must analyze the symptoms to identify and clearly define the problem or problems. Then they must formulate assumptions, hypothesis and theories which might be causing the symptoms. Lastly, they test the theories systematically until the data and the analysis establish the causes. Brain storming, Pareto Analysis, Flow diagrams, Data Analysis, Data Collection, Ishikawa Diagrams, Histograms are all helpful in this exercise.

(c) Once the root cause/causes is/are known, the team should deliberate in great detail by considering all aspects such as managerial, technical, personnel, financial and other aspects before formulating any remedies. Control charts, Motivational Techniques, Training Methods are very helpful in this connection.

3. To overcome resistance to change, some of the things that a manager must do are :

(i) providing enough participation

(ii) giving time to adjust and accommodate

(iii) being flexible instead of being rigid

(iv) being capable of practicing what he says, recognizing, respecting and positively responding to employees.

4. The Quality Improvement suggestion should be capable of giving "GAINS" which are stable, long term and should become a part of the employees usual work. Quality Improvement Process should be continuous.

5. Quality Planning, Quality Implementation and Control and Quality Improvement Process are all "Inter-Related".

46.4. THREE T.Q.M. AXIOMS (SELF-EVIDENT TRUTHS)

For achieving sustainable, long term competitive advantage, continuous efforts should be made for improvement. The essence of the strategy should be the establishment of a TQM culture, which should be based on its three principles : Commitment, involvement, and scientific knowledge. These three principles are interdependent. Considering these principles TQM can be defined as follows :

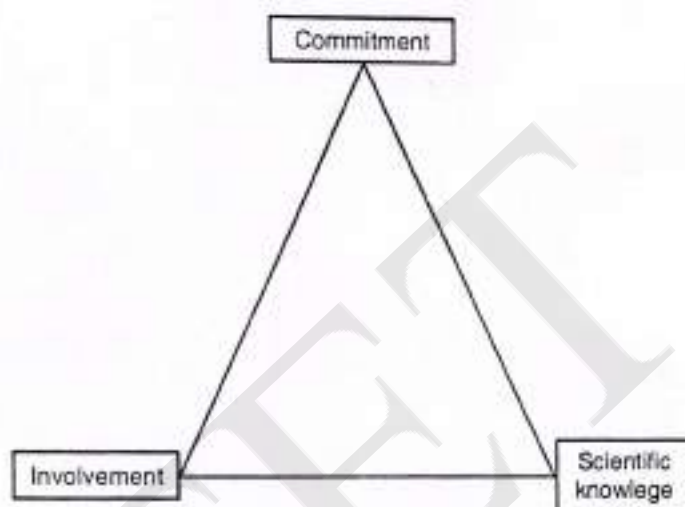


Fig. 46.2. The T.Q.M. Triangle.

Total quality management is a culture, inherent in this culture is a total commitment to quality and an attitude expressed by everybody's involvement in the process of continuous improvement of products and services, through the use of innovative scientific methods.

The three TQM axioms are discussed hereunder :

1. Commitment.

A management commitment to continually improving the quality of products and services is most essential, but it needs a total cultural transformation in the company. Management participation and demonstration by example are the best ways of convincing the workforce that the managers are serious about quality and that the same should be expected of everybody. Commitment should be demonstrated by actions and not just words and declarations.

Change in attitudes and culture can be achieved by :

- Proper working conditions.
- Good communication and cooperation.
- Good incoming materials.
- Appropriate tools of good quality.
- Adequate education and training.
- Modern leadership.
- Good equipment.
- Job satisfaction etc.

From this, it can be seen that such a change is not possible by quality department alone. In this, top management is responsible to plant the seed of quality tree (through quality policy and demonstration of commitment) and to provide appropriate soil and environmental conditions,

middle management is responsible to ensure that the quality tree is continuously nourished and strengthened (by spreading TQM principles to maintain TQM culture so as to bring results).

2. Scientific Knowledge.

The role of a TQM quality department should be that of coordination, education and support of scientific quality tools throughout the organisation, and continuous research on and development of innovative methods. In order to avoid fire fighting and wastage, 'preventive' methods like predictability, statistical techniques, process capability etc. can be adopted.

3. Involvement.

Principles 1 and 2 i.e. commitment and scientific management are concerned with structural and technological aspects, while this principle is concerned with social aspects. TQM culture can only be brought through social factors, as it concerns every body in the organisation and requires a new social attitude and new network of relationships. Unless work-force is motivated enough, commitment and scientific knowledge will not help much.

It has been experienced that higher salaries and monetary rewards can motivate only for a short duration, real motivators for the long term are : pride in one's work and being involved in the achievement of excellence are the real motivators.

46.5. FOCUS ON CUSTOMER

Total quality management focuses on the requirements of the customers. Following facts should be recognised about the customers :

- (i) Customers are the most important people in any business.
- (ii) They are not dependent on us, rather we are dependent on them.
- (iii) They are doing a favour when they are coming to us.
- (iv) They are part of our business.
- (v) They are human beings with feelings and emotions.
- (vi) People come to us with their needs and wants, and it is our job to fulfill them.
- (vii) They deserve most courteous and attentive treatment.
- (viii) Without them we would have to close our business.

Consumers are now-a-days becoming stronger and well organised. Consumer forums are becoming popular. In some countries consumer reports are published by them in respect of large number of products. Most manufacturing concerns concentrate on 'getting' the new customers rather than 'retaining' them. Marketing relationship must therefore be given more importance.

In TQM, quality involves 5 dimensions for the customer to be satisfied. Quality measurements of these should be decided through questionnaire asked from the customers. These elements are :

1. **Specifications.** Customers must be asked as to what he expects from the product or service, during the survey to ascertain the customer requirements.
2. **Conformance.** Whether the product fulfills his expectations ?
3. **Reliability.** Does it continue to do, what was expected ?
4. **Cost (Value).** How much customer expects to pay ?
5. **Delivery.** When customer expects to have it ?

Considering above factors, quality can be defined as : fully satisfying agreed customer requirements at the lowest internal cost.

To meet the customers' requirements means to listen to the customer and to respond to what he wants and to what is agreed. Customers may be;

- (a) external to the company i.e. the people outside who are the end users of firm's products, and
- (b) internal customers i.e. the person within the company who receives the work of another and then adds his contribution to the product before passing it on to someone else. In manufacturing, the internal customer is the next person down the line who builds the product. If the internal customers' requirements are agreed and met, a chain of quality is made.

Some of the routine duties of every individual or division within the organisation, for the achievement of customer satisfaction could be as follows :

1. To monitor performance and customer satisfaction levels.
2. To identify improvement necessary in the customer interface.
3. To deliver improved customer products at the lower cost.
4. To assess and agree the customer's requirements.
5. Output should be as per customer's demand.

46.6. MAIN CONCEPTS OF TQM

1. Quality for Profit. Quality improvement in product and services, business processes and people is profitable. Quality is the single largest factor in achieving market success for any company. Actual quality improvement also increases sales by generating customer demand.

Fig. 46.3 indicates that, to gain increase in profit P through increased sales would require a significant increase A in operating costs (sales, personnel, promotion, inventories etc.), while the same profit P can be increased through quality improvement by increasing operating costs B , which also diminishes through time.

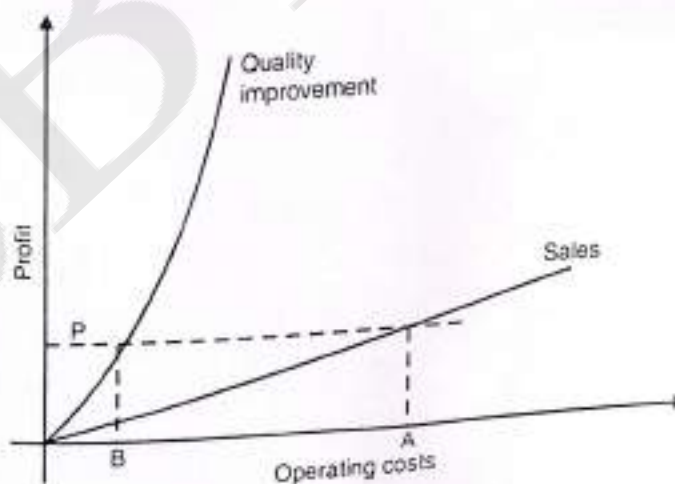


Fig. 46.3. Quality improvement reduces cost.

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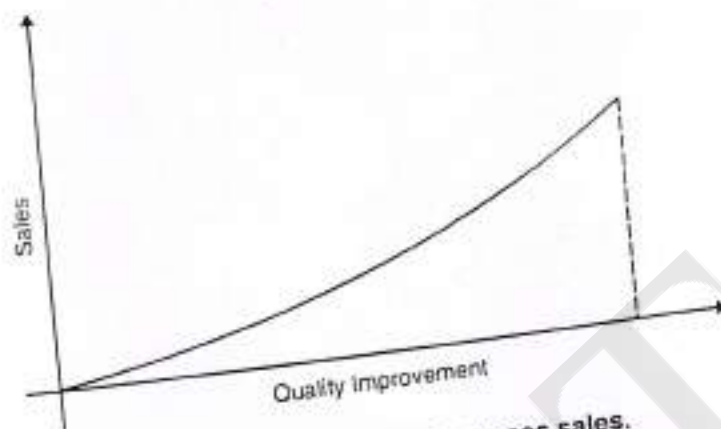


Fig. 46.4. Quality itself increases sales.

Fig. 46.4 indicates, more quality improves, faster will be increase in sales because customer satisfaction carries its own acceleration. 'Quality reputation' when grows it acts as a major element in advertising and reduce the money required on advertisement.

2. Right First Time or Zero Defect. Main aim of TQM is the conviction that it is possible to achieve defect-free work most of time. This can be phrased as : right first time or zero defects. The idea is to strive for perfection in the work. Right first time is the result of an emphasis on prevention, and the use of measurement, process control and the data-driven elimination of waste and error, continuous improvement. Planned and systematic action such as documentation, work processes, quality audits, quality assurance etc. prevents quality problems.

Importance of zero defect can be visualised from the fact that, if one sets an acceptable quality level of 99 percent, the results will be : 10000 wrong prescriptions in a hospital treating 1 million patients in a year, no electricity, telephone and television transmission for about 15 minutes each day, no newspaper for 4 days in a year, one misspelled word on every page of a book. It means 1 percent goods were waste or scrap.

Fig. 46.5 indicates defects/cost as per traditional culture. In this culture, achieving quality is expensive—defects are reduced over time only by increasing cost through extensive inspection.

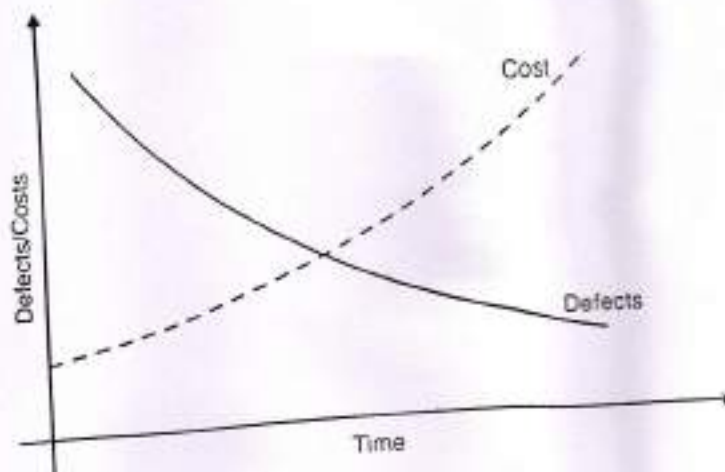


Fig. 46.5. 'Traditional' quality

tion, checking and progress chasing. In this, most effort is concentrated on correcting failure. Fig. 46.6 indicates that by adopting TQM management, after certain time defects and costs both will be minimal.

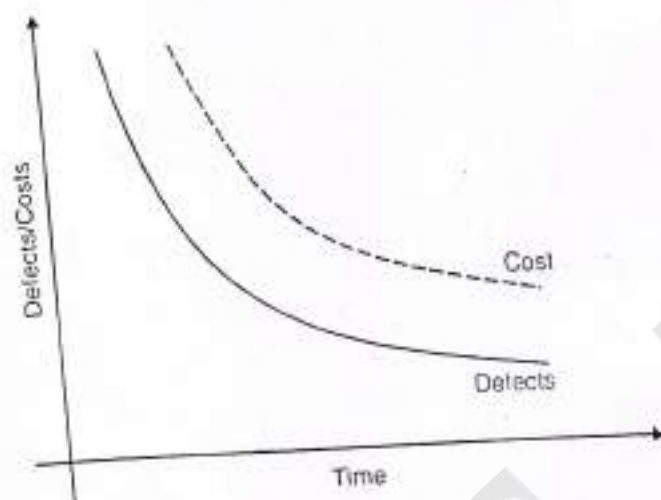


Fig. 46.6. 'Total Quality' concept.

3. Cost of Quality. As discussed in earlier chapters, cost of quality include prevention costs, appraisal costs, internal failure costs, external failure costs, the cost of exceeding customer requirements, and the cost of lost opportunities. Taken together these costs amounts to 20-30 percent of its revenue.

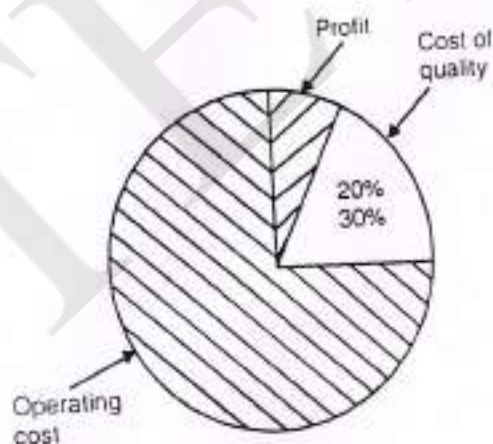


Fig. 46.7. Cost of quality as a proportion of revenue.

4. Competitive benchmarking. Competitive benchmarking is a continuous process that helps firms assess their competition. In this case, to strive to be better than the best competitor is the target. The means to achieve this aim are :

- benchmarking the products and services delivered to external and internal customers,
- benchmarking the business processes in all departments and functions, and
- benchmarking the organisation, business culture and calibre of people.

Benchmarking process has the following steps :

- (i) Decide what is going to be benchmarked.
- (ii) Select the competitors who are the best in terms of products and services, business processes, and people and aspects that one's firm wants to measure.
- (iii) Decide the most appropriate measurements.
- (iv) Determine competitor's strengths against own company.
- (v) Develop an action plan.

5. Involving everybody. This aspect has already been discussed in this chapter.

6. Synergy in Team Work. Synergy means harmony in working, and is the result of team work in which output is greater than each of the inputs taken separately and also greater than the sum total of the inputs. As theoretical knowledge of engineers as well as practical knowledge of workers are essential for progress, both of them acts as partners for effective management.

Main points for the success of team work are :

- (i) Team members be valued as individual.
- (ii) Individuals feel integrated within a team.
- (iii) Team in-charges be fair to all team members.
- (iv) Team must be confident.
- (v) Individuals must enjoy themselves.

7. Self-management. This aspect has already been discussed in the book.

8. Managers as Role Models. Managers need to be conscious that they are role models for total quality. It is very important that what they say and do about total quality. The best TQM programme has a system of management feedback so that managers get some idea on how they are doing as role models for quality. Performance feedback is most important to enable managers at all levels to improve their contribution.

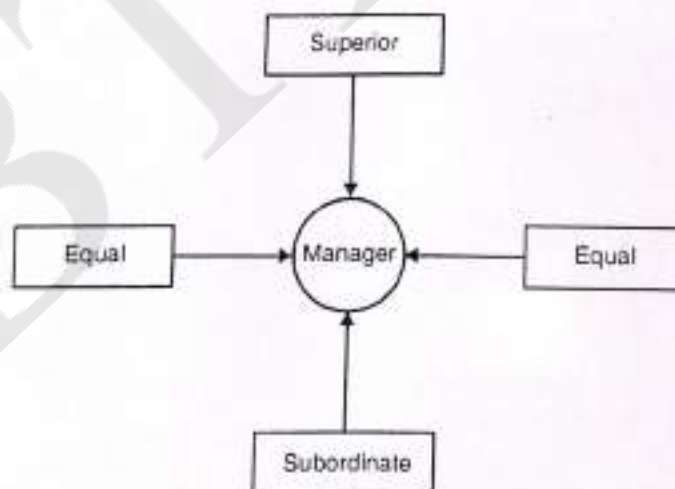


Fig. 46.8. Directions of managerial feedback.

Feedback should be on general management areas : leadership , team work, motivating, people development, and commitment to the total quality process.

9. Recognition and Rewards. This concept have already been discussed in the preceding chapters.

10. Quality Delivery Process. It is the name given to the implementation of new systems. This is necessary for quality improvement which is a continuous process.

Following steps are taken for quality delivery process.

- (i) Create mission statement.
- (ii) Determine the outputs of the workgroup.
- (iii) Identify both internal and external customers.
- (iv) Define agreed customer requirements for each output.
- (v) Develop specifications for each output of work group.
- (vi) Determine the group's work processes.
- (vii) Identify the measurements of each output.
- (viii) Identify any problem/opportunity for achieving target.
- (ix) Establish a project team to solve the identified problem.
- (x) Measure customer satisfaction against the agreed customer requirements.

The ways in which the quality of outputs can be measured are :

- | | |
|-------------------------|--------------------|
| 1. Defects | 2. Rework |
| 3. Scrap | 4. Lost items |
| 5. Work behind schedule | 6. Late deliveries |
| 7. Surplus items. | |

Key measurements for each output are :

1. *Target* : budget or level of performance.
2. *Forecast* : level of performance.
3. *Actuals* : level of performance.
4. *Problem* : difference between the actual and target level of performance where actual is less than target.
5. *Opportunity* : Opportunity for improving quality at no extra cost.

11. Six Sigma Theory. Six sigma (6σ) is a statistical term used to describe the state of zero defect or as close as the experts estimate it is possible to come to perfection. Six sigma is a rigorous and disciplined methodology that uses data and statistical analysis to measure and improve a company's operational performance by identifying and eliminating defects in manufacturing and service related processes - six sigma translates to 3.4 defects per million or 99.99976% perfection. Six sigma quality is not just product quality, it also means getting every thing right throughout the organisation. Thus six sigma is a culture, according to which improvement will occur because the elimination of defects at the source of the defects within the design stage rather than adjusting the machinery after detecting the defects. To succeed at a six sigma level, the suppliers also must be encouraged to follow along the same quality lines.

46.7. PIONEERS OF TOTAL QUALITY CONCEPT

By adopting the learnings from the quality gurus, the Japan which was a largely illiterate, semi-industrialized country in fifties manufacturing cheap and unreliable copies of Western products, has now become a nation with world's highest per capita income and a producer of best quality goods.

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Views of some of the renowned quality *gurus* are given here :

1. W. Edwards Deming

Dr. Deming was the first American quality expert to reach Japan in 1947 to teach Japanese managers methodically about quality.

According to Deming, interpreting quality in terms of reliability, dependability, predictability and consistency of product and service, it is clear that quality improvement is analogous to reduction of variation, i.e.

"Quality and productivity increases as variability decreases".

Deming's points on promoting product or service quality are :

- (1) Be constant and purposeful in improving products and services. Aim is to be competitive, to stay in business, long-term needs.
- (2) Adopt new philosophy. Commonly accepted delays, mistakes, defective workmanship can no longer be tolerated.
- (3) Stop depending on mass inspection, demand statistical evidence of quality being built into manufacturing and purchasing functions.
- (4) Work to minimise total cost not just initial cost. Move towards a single supplier for any one item on a long-term relationship of loyalty and trust.
- (5) Improve the system continually. Make better every process for planning, production and service to improve quality, increase productivity and decrease costs.
- (6) Institute modern methods of on-the-job training. New skills are required to keep up with changes in material, methods, product design, machinery, techniques and service.
- (7) Set up new ways of supervising production workers. Improvement of quality will automatically improve productivity. Management should initiate action in response to reports of inherited defects, maintenance needs, bad tools, confused operational definitions and other things that lead to poor quality.
- (8) Drive out fear, so that everyone may work effectively for the company.
- (9) People in research, design, sales and production should work as a team to deal effectively with problems of products and service.
- (10) Eliminate numerical goals, slogans, exhortations (like zero defects).
- (11) Use statistical methods for continuous improvement of quality and productivity.
- (12) Abolish performance appraisal and management by objectives.
- (13) Institute a vigorous programme of education and retraining. Competitive advantage is always rooted in knowledge.
- (14) Push every day to progress the thirteen preceding points and take action to make the total transformation happen.

According to Deming, following are the major obstacles to implementing his philosophy.

- | | |
|---|---------------------------|
| 1. Preoccupation with short-term profits. | 2. Lack of consistency. |
| 3. Reliance on only visible figures. | 4. Performance appraisal. |
| 5. Managerial job mobility. | |

2. Dr. Joseph M. Juran

Juran developed his TQM message around the following ten steps :

1. Create awareness of the need and opportunity for quality improvement.
2. Set goals for continuous improvement.
3. Build an organisation to achieve goals for establishing a quality council, identifying problems, selecting a project, appointing teams and choosing facilitators.
4. Give training to everyone
5. Carry out projects to solve problems
6. Report progress
7. Show recognition
8. Communicate results
9. Keep a record of successes
10. Incorporate annual improvements into the company's regular systems and processes and thereby maintain momentum.

Juran expresses his essential message to managers through the three basic quality related processes : quality planning, quality control and quality improvement which has become known as the Juran trilogy.

3. Kaoru Ishikawa

He is known as 'Father of Quality Circles' and is known for his role in launching Japan's quality movement in the 1960s.

According to him, seven basic tools were 'indispensable for quality control'. These tools are:

- | | |
|-----------------------|-------------------------|
| (i) Pareto analysis. | (ii) Fishbone diagrams. |
| (iii) Stratification. | (iv) Tally charts. |
| (v) Histograms. | (vi) Scatter diagrams. |
| (vii) Control charts. | |

With these tools, Ishikawa argued, managers and staff could tackle and solve the quality problems facing them.

4. Philip B. Crosby

Crosby prefers to target his training on managers rather than on quality control people. He cited his zero defects goal as something practical, reasonable and achievable. He listed following four essentials of quality management. He calls them 'The absolutes' :

1. Quality is defined as conformance to requirements, not as goodness.
2. Quality is achieved by prevention not appraisal.
3. The quality performance standard is zero defects.
4. Quality is measured by the price of non-conformance not by indexes.

5. William E. Conway

Conway defines quality as a result of quality management which is 'the development, manufacture, administration and distribution of consistent low-cost products and services that customers want and need'. He targets three categories of waste in a company : time, capital and material, with time being his priority, excessive inventory comes second which requires space with all the associated costs.

Conway recommended following six tools for continuous improvement :

1. *Human relations skills* : Motivate and train all employees at all levels of the company.
2. *Statistical surveys* : Collection of data about internal and external customers, employ-

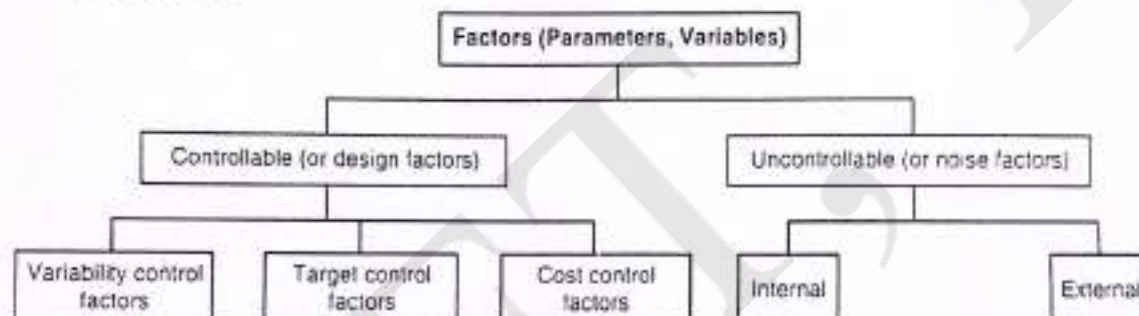
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- ees, technology and equipment.
3. *Simple statistical techniques* : Charts and diagrams should be used to identify problems.
 4. *Statistical Process Control* : These are used to reduce variation
 5. *Imagining for problem Solving* : Technique encourages creativity when linked to 'vision statements' and brainstorming.
 6. *Industrial Engineering* : To use workstudy including pacing, work simplification, method analysis, plant layout and material handling to make improvement.

6. Genichi Taguchi

Taguchi devised a quality improvement technique that uses experimental design methods for efficient characterisation of a product or process, combined with a statistical analysis of its variability. He divided the behaviour of a product or process in terms of factors (parameters or variables) as follows :



Principal idea in the Taguchi philosophy is that statistical testing of a product should be carried out at the design stage in order to make the product and the process robust to variations in the manufacturing and use environment.

Taguchi suggested that following steps should be taken in carrying out statistical studies :

- | | |
|-------------------------------------|-----------------------------------|
| 1. Define the problem. | 2. Determine the objectives. |
| 3. Conduct a brainstorming session. | 4. Design the experiment. |
| 5. Conduct the experiment. | 6. Analyse the data. |
| 7. Interpret the results. | 8. Run a confirmatory experiment. |

Taguchi defines quality in a negative way as, "the loss imparted to society from the time the product is shipped." This loss include (a) the cost of customer dissatisfaction which may lead to a loss of reputation and goodwill for the company, (b) direct loss to the company arising from warranty and service costs, (c) indirect loss due to market share loss, and (c) increased marketing efforts needed to overcome lack of competitiveness.

46.8. COMPANY-WIDE QUALITY ASSESMENT

As we have already discussed, for total quality mangement, company-wide participation from top management to all levels of employees of all the departments is essential. Participation by not only departments of technology, design, research and manufacturing but also by sales, materials, marketing, electrical and other management departments like planning, finance, personnel, business development etc. Similarly in the total quality management, quality control concept is used not only for incoming materials, production process, new product design but also for checking whether quality policies of the management are being implemented C.

Company-wide assessment of quality comprises of following major elements.

1. Cost of poor quality.
2. Standing in the market place.
3. Quality culture in the organisation.
4. Operation of the company quality system.

(1) Cost of Poor Quality.

This aspect have already been discussed in detail in the chapter on "Quality Concept". This assessment of cost of poor quality is essential for quantifying the size of the quality problem in the language of money, as this can be easily understood by the upper management and middle management.

This assessment or analysis identifies major opportunities for cost reduction. The vital few segments so identified, accounts for the bulk of the costs, are tackled through "the Pareto Principle" as discussed later in the book. This also identifies the opportunities for reducing the customer dissatisfaction and associated threats to product salability.

(2) Stranding in the market place.

Although it is essential to estimate the cost of poor quality, but it is also necessary to understand where the company stands in the marketplace as regards to quality relative to the competition. This component of assesment is very important in increasing sales income by identifying opportunities and threads.

Such market studies should be conducted by a team involving members from marketing, product development, quality, manufacturing, and other areas as needed. The questionair should include the questions which enable to understand customer needs. The market study report based on the answers to such questions is prepared considering as inputs from customers. This study helps in understanding the company's standing in the market.

(3) Quality Culture in the Organisation.

Quality Culture in the organisation is judged by the employees' opinions, beliefs, traditions and practices regarding the quality. For this, if required a detailed survey can be got conducted, which may also include the aspects related to the attitudes of employees and management in this regard.

(4) Operation of Company Quality System.

The assesment of this aspect is carried out by evaluating the current quality related activities in the company.

46.9. TEN MANTRAS FOR TQM

1. Quality is always the will to produce a quality product and is the result of continuous and intellegent efforts.
2. Quality never comes out without hardwork and devotion.
3. Quality is every body's business.
4. Quality begins with the cleanliness of the workplace.
5. Take care of quality, quantity (productivity) will take care of itself.
6. Make it right for first time and all times.
7. Quality is achieved through team work.
8. Document is dependable and not the memory.

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9. Quality begins and ends with education (includes knowledge)
10. Quality is the attribute that a customer uses to evaluate products or services.

46.10. TOOLS AND TECHNIQUES FOR TQM

Commonly used tools and techniques for analysing quality process and then utilising for quality improvement are :

- | | |
|--|---------------------------------------|
| 1. Histograms | 2. Block diagrams |
| 3. Bar charts | 4. Line graphs |
| 5. Control Charts | 6. Pareto analysis |
| 7. Brainstorming | 8. Scatter diagram |
| 9. Break-even analysis | 10. Quality circles |
| 11. Statistical tools | 12. OC curves |
| 13. Risk analysis | 14. Quality function deployment (QFD) |
| 15. Kaizen | 16. Poka Yoke |
| 17. Kanban system | |
| 18. 5-S campaign (Principle of House-keeping). | |
| 19. Just-In-Time (JIT) philosophy | |
| 20. Cause and effect diagram (Fishbone diagram) or Ishikawa diagram. | |

Tools and techniques mentioned at serial numbers from 1 to 8 are also known as basic analytical tools.

1. Histograms

Histograms are graphical representations of the spread or distribution of data. They are also called "frequency distribution". These are used to monitor a process to see if it consistently meets customer requirements. The information presented in histograms is represented by a series of rectangles which are proportional to groups of data. Histograms also illustrate the various measures of central tendency, the mean, mode and median. This information can be helpful in understanding the extent to which a process is operating in control. Deviations from normal can help teams to locate root cause(s).

2. Block Diagram

In block diagram, every activity which is part of process is represented by a block (box) and all blocks are connected by lines representing the interfaces between activities, a macrolevel view of the process is obtained. The diagram traces the paths that any information, necessary actions or materials can take between the original input and the final output of the process.

3. Bar Charts

A bar chart is a graphical representation of discrete groups or categories of data, shown in such a way that clear comparisons can easily be made. The bar chart is normally used to emphasize the variation and unevenness in data. Using this information, further investigation can be made to determine the reasons for occurring the variations. When the data are spread across a continuous range of values, a bar chart is equivalent to a histogram.

4. Line Graphs

A line graph is a simple way of graphical representation data. Direct relationship between the two qualities can be shown easily without looking at the actual data. These can be used to summarize the complex information, to point out trends, fluctuations and relationships, and generally to effectively organize the data and communicate important results. These are drawn to display the relationship between two variables, and are useful in monitoring trends of a variable interest.

5. Control Charts

A control chart is a line chart to which statistically determined limits have been added. A detailed description of the control chart—the main tool of statistical process control—can be seen in the section on “Statistical Control Charts”.

6. Pareto Analysis

Pareto analysis is a technique for arranging the causes or problems from the most to the least significant. Thus, the most significant problems are identified (Juran has called them as “the vital few”) and efforts can be concentrated on those, so as to get maximum benefits with least efforts in minimum time.

Pareto analysis can also be referred in the chapter on “Reliability Engineering”. The pareto analysis takes the help of Pareto diagram, which is in the form of bar chart and displays in decreasing order, the relative contribution of each cause (or problem) to the total. This relative contribution may be based on the number of occurrences, the quality damage or the cost associated with each cause. The Pareto diagram is based on the Pareto principle which states that a few causes are responsible for most of the effect. This principle when applied to quality improvement i.e., solving a few key quality problems, can lead to major improvements.

7. Brain-storming

Brain-storming is an activity which promotes group participation and team-work, encourages creative thinking and stimulates the generation of as many ideas as possible within a short period of time. The participants in a brain-storming meeting are invited on the basis of their particular knowledge and experience, and are expected to contribute to the topic under discussion.

8. Scatter Diagram

A scatter diagram is used to determine if a relationship exists between two variables.

9. Break-even Analysis

Break-even analysis helps in “cost-volume-profit analysis” or simply known as cost-benefit analysis. For studying the relationship between sales volume, costs (fixed and variable), prices and profits, cost-volume-profit analysis is carried out. It helps in determining the minimum sales volume to avoid losses. Thus it helps the management to seek the most profitable combinations of costs and volume.

The break-even analysis not only highlights the areas of economic strength and weaknesses in the firm but also helps in finding out the ways which can enhance its profitability. With the help of this analysis management of a production firm can take decisions related to the following:

- (a) Volume needed to attain target profit.
- (b) Change in price and its effect.

- (c) Whether to expand production capacity or not.
- (d) How much cost can be incurred for improving the quality.
- (e) Whether to add a new product or drop production of any product.
- (f) Whether to make or buy.
- (g) Selection of production machinery so as to get maximum profit for a particular volume of the product.
- (h) Improving profit performance, by
 - (i) increasing the volume of sales, and/or
 - (ii) improving the quality, and/or
 - (iii) increasing the selling prices,
- (i) When to discard a machine?
- (j) How much sale should increase, to offset a wage increase or increase in expenses on quality improvement?

As mentioned above, break-even analysis technique helps in cost-benefit analysis which is used for assessing the viability of an action in monetary terms. In this analysis, the cost of taking a particular action are compared to the benefits achievable from the future outcome. It can also be used to compare, in money terms, a number of problem solutions or plans of action.

10. Quality Circles

Quality circles have been discussed in detailed in the chapter on "Participative Management".

11. Statistical Tools

Various statistical tools have been described in detail in the sections on "Statistical Concept" and also on "Statistical Control Charts".

12.. O.C. Curve

Operating characteristic curve (O.C. Curve) qualifies manufacturer's (producer's) risk and consumer's (purchaser's) risk. This is a graph of the percentage defective in a lot versus the probability that the sampling plan will accept a lot. O.C. curve have been discussed in the section on "Acceptance Sampling and O.C. Curves", in the Chapter on "Quality Assurance".

13. Risk Analysis

The purpose of risk analysis is to identify and qualify all risks which could hamper the quality improvement effort. Appropriate risk management can control and possibly eliminate each risk. Risk analysis alongwith risk management can reduce costs and effort, can assess potentially damaging circumstances and control any slippage in the project plan. Main element of risk analysis are as follows :

1. Identify and list potential areas of risk.
2. Quantify the risks.
3. Develop contingency plans
4. Monitor and review the risks

14. Quality Function Deployment (Q.F.D.)

Quality function deployment is defined as, a system for translating consumer requirements into appropriate company requirements at every stage, from research, through product design

and development, to manufacture, distribution, installation and marketing, sales and services.

Thus, quality function deployment (QFD) is a process which brings together the essential elements and crucial characteristics of the various phases in the lifecycle of a product, from its conception through design, development, manufacture, distribution and use. It encourages teamwork between marketing people, design engineers and manufacturing staff.

By recognising the interrelationship between the engineering properties of the product and the customer's requirements, appropriate actions can be taken at every stage of the product's development, so that the customer needs are anticipated, prioritized and effectively incorporated into the product.

The products that only satisfy the basic needs of performance and specification, but miss out on additional desirable or 'excitement' features available elsewhere, will probably cause the intending purchaser to select the competitor's product.

Therefore, the management of QFD ensures that vital customers satisfaction and excitement attributes are recognized and developed, so that the company can achieve a competitive edge. QFD is used as a planning tool to fulfill the customer requirement/expectations to achieve product design, engineering, production and a methodology for indepth evaluation of a product.

QFD when implemented can improve knowledge, productivity and quality. In addition, this also reduces cost and product development time.

15. Kaizen-Continuous Improvement

Kaizen concept have already been discussed in the section on "quality concept". Kaizen means gradual unending improvement, doing little things, better settings and achieving higher standards. Following this strategy Japanese, during the past three decades, improved productivity, quality and flexibility and emerged as a leader of world market. Now-a-days Kaizen philosophy is being extended to such fields as labour management, relations, marketing practices and supplier relations. Middle managers, supervisors and workers are also actively involved.

Kaizen is the process oriented rather than individual task oriented where most emphasis is placed on individual performances and rewards.

Salient features of Kaizen philosophy :

- (i) It has a long term and long lasting but undramatic effect.
- (ii) Small steps of improvements.
- (iii) Continuous process resulting in gradual change.
- (iv) It involves everybody.
- (v) Its approach is collective and system oriented.
- (vi) It requires little investment but great efforts to maintain it.

This Kaizen concept is based on Daming's P-D-C-A cycle.

16. Poka Yoke (Fool-Proofing)

Poka-Yoke is a Japanese word which means "to avoid unintentional errors". The basic philosophy behind Poka Yoke is that human beings are liable to commit error unknowingly during any operation they perform. If there is a system which prevents them from committing the error, the mistake can be eliminated. Poka-Yoke aims at the total elimination of the possibility of human error. Thus Poka Yoke is an effective method of achieving zero defect objective.

Thus Poka-Yoke is designing the work process to eliminate human mistakes. Fool proofing create devices that can discover defectives/disorders. The process of fool proofing is standardised

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to ensure that stable quality can be assured. Fool proofing can be achieved by following ways:

- (i) by designing of the machines and tools so as to make human error impossible,
- (ii) by providing redundancy,
- (iii) by magnifying normal human muscle strength and senses through programmed indexing of fixtures, optical magnification, viewing through closed-circuit television, simultaneous signals to multiple senses etc.

Some of the commonly used methods for fool-proofing are :

1. If any step is missed during production process, the device does not allow goods to be mounted to jigs or the machine does not start processing.
2. If a disorder is found in goods, the device does not allow the machine to start processing.
3. The disorder that has occurred in preceding process is examined at the next process, the device will stop defectives.

Thus, in the poka-yoke, emphasis is placed on preventing defects, during the production process instead of correcting defects after the item is produced.

Objective of the fool proofing can be accomplished by following principles :

- (i) Eliminate the possibility of error.
- (ii) Substituting a more reliable process.
- (iii) Making the work easier to perform.
- (iv) Detecting the error before further processing.
- (v) Minimizing the effect of the error.

17. Kanban System

The word *Kanban* means a signboard of a store or shop, but here it means any small sign displayed in front of a worker. Kanban has two functions :

- (i) To contain information that serves as a work order which gives information that about what, how much, when, by what means to produce and how to transport it ; and
- (ii) To move with actual material.

Since material and Kanban moves together no overproduction will occur, control of material and production becomes easier. For implementing Kanban following rules are followed :

- (i) Do not send defective products to subsequent process.
- (ii) Subsequent process comes to withdraw only what is needed. This is known as the "path system of demand".
- (iii) Produce only the exact quantity withdrawn by the subsequent process.
- (iv) Equalise production.
- (v) Stabilise and rationalise the process.

In this system chain of withdrawal and production is continuous from the end product to the beginning of the process.

18. "5-S" (The principles of house-keeping)

The upkeep of workplace is of most important as it helps in quality and productivity improvement. It has been proved that the first step towards quality improvement is workplace utilisation. The Japanese have developed five simple words as a directive for achieving workplace utilisation. The five words starting from letter "S" are :

1. **SEIRI (Sort out)—Proper Arrangement**: "Seiri" means sort out unnecessary items. Unwanted things at workplace occupy precious space and create confusion and obstacle to working.

2. **SEITON (Set)—Orderliness**: The word "Seiton" means a place for every thing in its place. Everything should be kept in a predetermined place and maintained so that it need not to be searched whenever it is required by any body.

3. **SEIKETSU (Sound)—Cleanliness**: In Japanese the word "Seiketsu" means prevent problems by keeping things clean. It is important to keep the work area very clean with no oil spots, burns, dirt or dust. This will provide a pleasant working environment and result in quality products.

4. **SEISO (Shine)—Clean up**: "Seiso" means after work cleaning up and maintenance. To have consistent quality output, it is important to clean the machine and work place and to maintain the machine by carrying out routine checks like, lubrication, check-ups etc.

5. **SHITSUKE (Self Discipline)**. The word "shitsuke" means maintaining good habits like following work instructions/standards, safety precautions, punctuality etc., to achieve consistent desired quality of products and good work culture.

19. Just-in-time (JIT) Philosophy

Just-in-time is not just an inventory reduction programme or kanban, or material requirement planning, or a production control technique. It is a corporate strategic philosophy and aims at elimination of waste. It is based on following factors:

1. Unnecessary complexity in the design of products should be removed for producing it at least cost.
2. Plant layout should be changed to eliminate or shorten material movement and reduce time loss.
3. Provide incentives to workers to tap their knowledge to develop methods of eliminating waste of all forms.
4. People should be accountable for accuracy and institute programmes to measure it.
5. Reduce paper work. Use of on-line, real-time data update and retrieval and interaction decision making is important.
6. Scrap should be completely avoided, as scrap is more costly than mere material.
7. Reduce inventories by eliminating large queues and many kinds of safety stocks. When ordering purchase of parts from vendors, negotiate prices based on long term commitments and then schedule frequent releases to support the flow of production with minimal inventory.
8. In order to strive for continuous improvement, set goals and when they are achieved, set them higher.

JIT means a structural approach in a manufacturing organisation focussed on improving timeliness, quality, productivity and flexibility utilising various methods of work simplification and waste elimination. The company following the JIT philosophy want to do work systematically, remove excess work, eliminate waste, un-evenness and unreasonableness and thereby raise their productivity.

JIT concept when applied results in smaller set-up costs which justifies smaller lot sizes and provide greater flexibility for changeovers from one product to another. Companies adopting JIT concept found improvement in productivity, reducing set-up time, reducing inventory,

improving quality, saving space and reducing lead times. Reduction in economical batch sizes lead to reduction in-process inventory. This leads to productivity improvement in the following way :

- Smaller lot size inventories
- Less indirect cost of inventories
- Less equipment to handle inventories
- Less physical inventory control effort
- Less direct labour wasted on rework.
- Reduction in delays and scrap also improve market response.
- Because of speedy changeover, reduces production lead times, better delivery dates can be promised, as the product mix and quantities can be changed quickly as demand and forecasts of demand change.
- Smaller buffer inventories
- Less space for inventories
- Less inventory accounting
- Less scrap

For reduction in in-process inventories use of Kanban is very helpful.

JIT purchasing : JIT purchasing emphasises on supplying materials just in time for use on factory floor, equally important are the close relationships with suppliers on long-term basis who are geographically close for frequent deliveries of small and exact quantities. For the success of JIT, cooperation from the company's vendors is essential. In this concept vendors are virtually an extension of the company. JIT vendors have to deliver goods to production line at the required time ; which may be quite frequent — say every 3 or 4 hours. In view of this JIT purchase agreements need be simple, specifying price, specifications, and an overall quantity to be delivered in accordance with long-term production schedules. The specifications are focused on product performance rather than being highly detailed.

The objective of this system alongwith Kanban is to have right number of parts or components at the right place at the right time.

JIT Production System. In this concept, factory produces the required goods only at the times when they are needed in the quantity that is needed, and in this situation the inventory of the finished goods and work in progress would be almost zero. If we make raw material suppliers also agree to deliver their goods only at a time in quantities we need them, then we are almost eliminating raw materials as well. In such a situation we shall have near zero inventories.

In this system, workers go to the preceding process to withdraw the required parts or components for their operations using the Kanban system. If there are fluctuations in the rates of which these materials are withdrawn, then the preceding process must hold buffer in-process inventories to give off-the shelf service. This require minimising production fluctuations on the final assembly line by scheduling small lots of individual models.

In JIT, production processes are so designed that it need less specialisation of workers, and the physical layout is so arranged that a worker can operate two or three different machines for providing flexibility in processes. The organisation of multi functional workers have following benefits :

- (i) A decrease in the number of workers required, resulting for increase in productivity.
- (ii) Increased worker satisfaction because of more broadly defined jobs.

20. Cause and Effect Diagram (Fishbone diagram)

This diagram is a useful tool for formulating possible causes of quality problems. This is an effective technique to obtain the leads to improve the understanding of problems experienced in

work area. Any defect or a problem or an effect on quality/performance of a component, a product or service could be due to one or more causes.

The "Cause and Effect diagram" was developed by Koran Ishikawa of Japan (hence also known as Ishikawa Diagram) and represents the relationship between some "effect" (problem) and all the possible "causes" influencing it. The effect or problem is stated on the right side of the diagram and the major causes are listed on the left. For every effect there are likely to be several major categories of causes. The major causes might be summarized under four categories referred to as the 4 M's, i.e. Manpower, Machines, Methods and Materials. In administrative areas it may be 4 P's i.e. Policies, Procedures, People and Plant. Other major categories as emerges can also be listed e.g. Design, Customer etc. so that there is no chance of leaving out any.

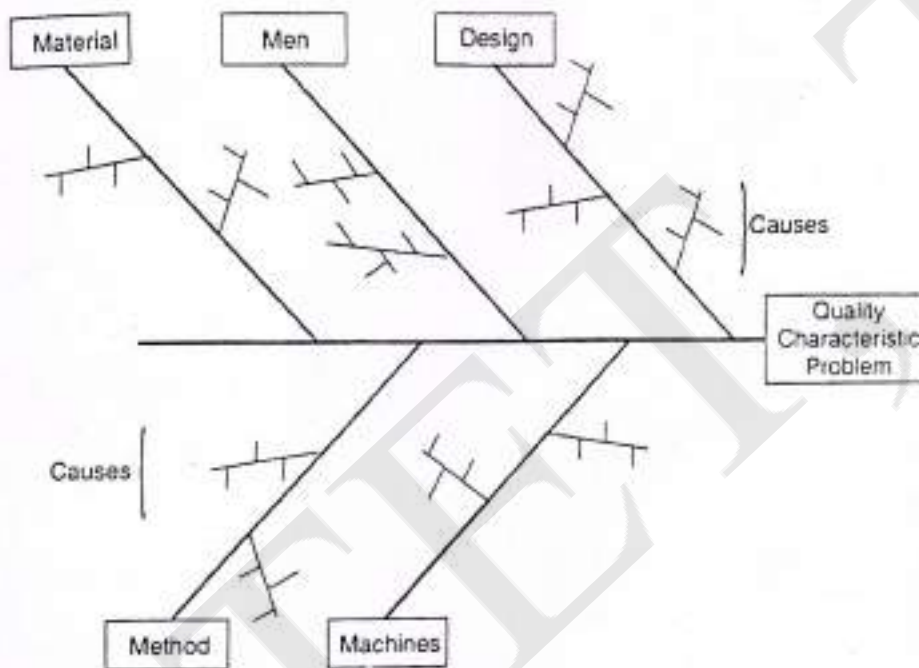


Fig. 46.9. Causes and Effect Diagram.

Preparation of the diagram will need a brain-storming session among representatives of different functional groups so that the problem is looked at in its totality. All possible factors suspected to have some influence on the problem are listed systematically. In this emphasis is given only to listing of suspected causes and does not identify the real culprit. As identification shall require a process of elimination which will require further collection of facts or experimentation. Pareto technique will be useful at this stage of investigation. Cause and Effect diagram is also known as "Fishbone diagram" because a well detailed cause and effect diagram will take on the shape of fishbone. Cause and effect diagram is not an answer to a problem, but it helps in keeping a track of the issue and helps in quickening the process.

I.S.O-9000 SERIES

46.11. ISO-9000 QUALITY MANAGEMENT SYSTEM Introduction

ISO is the International Organisation for Standardization. It is located in Switzer-

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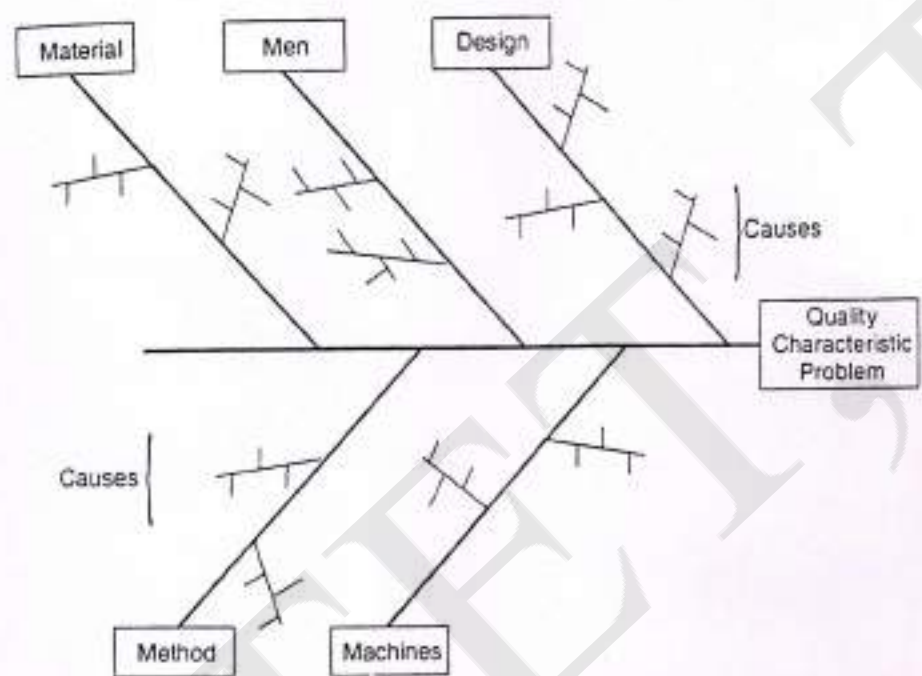


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I.S.O-9000 SERIES

46.11. ISO-9000 QUALITY MANAGEMENT SYSTEM
Introduction

ISO is the International Organisation for Standardization. It is located in Switzer-

land and was established in 1947 to develop common international standards in many areas. Its member come from over 130 national standards bodies. ISO first published its quality standards in 1987, revised them in 1994, and then republished an updated version in 2000. Standards presently applicable are known as "ISO : 2000 Standards", and facilitate international trade by providing a single set of standards that people everywhere would recognise and respect.

ISO-9000 refers to a set of standards and is the only available internationally accepted standard for quality management system in the world. It is rapidly becoming the most important quality standard and hundreds of thousands companies in over 100 countries have already adopted it. ISO-9000 is applicable to all types of organisations in manufacturing or service sectors. It is a documentation oriented system which allows complete freedom selection and use of process and framing of operating procedures and work instructions. This is a widely recognised quality management tool and meet the quality requirements of every kind of products or services. Production of consistently good quality product or service is very important for customer confidence company who wants to survive and grow, have either adopted this standard or in the process of adopting it.

A properly established quality management system will help to reduce cost, improve quality, develop confidence and a good image in the minds of customers and public. This requires consistent implementation, careful auditing and total commitment of the whole organisation.

ISO-9000 set of standards are "**generic management system standards**". This means that the same standards can be applied :

- to any organisation, large or small, whatever its product;
- including whether its "product" is actually a service;
- in any sector of activity ; and
- whether it is a business enterprise, a public administration, or a government department.

The "ISO-9000 quality management system" adopting organisations fulfill :-

- the customer's quality requirements ;
- applicable regulatory requirements ;
- enhance customer satisfaction ; and
- achieve continual improvement of its performances

Many companies require their suppliers to adopt ISO-9000 and get registered. Registered companies find that their market opportunities have increased as it ensures a sound quality management system. Registered companies had reduction in customer complaints, significant reductions in operating costs and increased demand for their products and services. Other benefits can include better working conditions, increased market share, and increased profits.

History and Origin of the ISO-9000

After issuing several inspection system documents in the 1950's the U.S military later integrated them into a set of requirements documents and issued them in December 1963 with the names of *Inspection System Requirements* and *Quality Programme Requirements*. There after, documents issued were on standard clauses in procurement, contracts, required control over final inspection and testing, and then on *Calibration System Requirements*.

Similarly, Canadian series of standards were issued, in four levels, in the mid 1970's ; and the British standard, was issued, in three levels, in 1977 as quality management systems.

In the meantime, in December 1979 the United States issued *Generic Guidelines for quality systems*. This was a menu of quality management elements, and each organisation could choose the elements they felt were helpful, allowing them for almost infinite degree of tailoring.

Since different standards for different countries were creating problems international trade, necessity was felt for developing internationally recognised quality management standards. The ISO Technical Committee (TC - 176) was therefore constituted, which had its first meeting in 1980, and issued its first standard ISO 8402 - regarding "Quality System-Vocabulary". Thereafter, in 1987, they issued ISO-9001, 9002, 9003, and 9004. These standards were later on revised in 1994, and then extensively revised in the year 2000.

Before going into the details of ISO-9000 series of standards we shall first discuss the term "standard" and "standardisation".

Standard. A standard is defined as a document, establish by consensus and approved by a recognised body, that provides ; for common and repeated use, rules, guidelines or characteristics for activities of their results, aimed at the achievement of the optimum degree of order in a given contest.

Standardization. A standardisation is an activity consisting of the process of formulating, issuing and implementing standards.

International Organisation for Standardization, popularly known as I.S.O. started the work on quality standardization through their technical committees and issued six standards related to quality.

I.S.O. 8402 in the year 1986 followed by I.S.O. 9000, I.S.O. 9001, I.S.O. 9002, I.S.O. 9003, and I.S.O. 9004 in the year 1987. The latter five of these are popularly known as I.S.O. 9000 series. When we refer to I.S.O. 9000, we mean the whole series or a particular standard belonging to the series.

This helped in avoiding confusion, because different terms like quality control, quality assurance, quality management, quality policy, quality plan, quality system etc. have acquired different or conflicting meaning in different countries.

Since most international firms in their tender notices now clearly mention that only I.S.O. 9000 certified firms need apply, therefore Indian companies expanding their overseas base, have to obtain this certificate.

While the use of most sophisticated machinery, high technological inputs and trained man power are essential, they are not themselves adequate, greater importance is given to the well documented systems, which guide each one of business processes to precisely tell what to do, when and how. The degree of standardisation extends towards systemisation at all levels of operations of the enterprise.

I.S.O. 9000 series promote standardised management of quality systems in order to achieve commonly established global quality standards. These standards primarily provide assurance to the buyer that the supplier has in fact well documented, well maintained and practiced quality systems covering all his operations, thereby ensuring consistency in quality of his processes, products and services. I.S.O. 9000 series of standards reflect refinements in all practical and generally applicable principles of quality systems. Implementation of I.S.O. 9000 standards by an organisation provides opportunity to move from a state of disorganised system into high degree of system standardisation.

I.S.O. 9000 insists on existence and adoption of internal quality audits which help in identification of non-conformities from the set procedures, if any, and for taking necessary corrective steps well in time.

In order to evolve and implement appropriate procedure, documents and records, the company has to train every single employee towards these quality system. I.S.O. 9000 standards involve all employees, workmen upwards to the level of directors. All these need to be trained to understand and appreciate both implicit and explicit requirements of the I.S.O. 9000 standards.

I.S.O. 9000 also necessitate the periodic review of implementation. The review may be in the form of market feedback, customer complaints and improvement in methods are systematically planned and executed.

Following steps should be taken to attain the I.S.O. registered status :

- | | |
|---|-----------------------|
| (i) Management commitment. | (ii) I.S.O. Education |
| (iii) Organisation to work on systems. | (iv) Documentation. |
| (v) Study of existing systems. | |
| (vi) Align existing systems towards I.S.O. standards. | |
| (vii) Audits and accreditation. | |

Characteristics of I.S.O. 9000

- I.S.O. 9000 is the only available internationally accepted standard for quality management system.
- It does not replace but complements the product standards.
- I.S.O. 9000 is applicable to all types of industries or organisation in manufacturing or service sector.
- It stands for systematic standardisation and certification rather than product standardisation and certification.
- I.S.O. 9000 is a documentation oriented system which allows complete freedom on selection and use of processes and framing of operating procedures and work instruction.
- A mistake made in selection of proper product standard can never be compensated by I.S.O. 9000 implementation.

Advantages Of ISO-9000

It is widely acknowledged that proper quality management improves business, often having a positive effect on investment, market share, sales, sales growth, sales margins, competitive advantage, and avoidance of litigation. The quality principles in ISO 9000:2000 are also sound, and ISO 9000 guidelines provide a comprehensive model for quality management systems that can make any company competitive. Implementing ISO often gives the following advantages.

1. Creates a more efficient, effective operation
2. Increase customer satisfaction and relation
3. Reduces audits
4. Improves marketing
5. Improves employee motivation, awareness, and morale
6. Promotes international trade
7. Increases profit
8. Reduces waste and increases productivity
9. Common tools for standardization.

Criticisms of ISO-9000

1. A common criticism of ISO-9000 and 9001 is the amount of money, time, and paper work required for registration.
2. Some believe that ISO standards elevate inspection of the correct procedures over broader aspects of quality, and therefore, the work place becomes oppressive and quality is not improved.
3. Some other believe that it is effective only as a guideline; but mislead companies to think that certification means better quality.
4. Certifications are often based on customer contractual requirements rather than a desire to actually improve quality.

The quality has a positive effect on return on investment, market share, sales growth, better sales margins and competitive advantage; but taking a quality approach is unrelated to ISO-9000 registration. In fact, ISO itself advises that ISO-9001 can be implemented without certification, simply for the quality benefits that can be achieved.

Effectiveness of ISO-9000

Effectiveness of the ISO system being implemented depends on a number of factors, the most significant of which are:

1. Commitment of senior management to monitor, control and improve quality. Organizations that implement an ISO system without this desire and commitment often take the cheapest road to get a certificate and ignore problem areas uncovered in the audits.

2. How well the ISO system integrates into current business practices. Many organisations that implement ISO try to make their system fit into a ready-made quality manual instead of creating a manual that documents existing practices and only adds new processes to meet the ISO standard when necessary.

3. How well the ISO system focuses on improving the customer experience. The broadest definition of quality is "Whatever the customer perceives good quality to be." This means that a company doesn't necessarily have to make a product that never fails; some customers will have a higher tolerance for product failures if they always receive shipments on-time or have a positive experience in some other dimension of customer service. An ISO system should take into account all areas of the customer experience and the industry expectations, and seek to improve them on a continual basis. This means taking into account all processes that deal with the three stakeholders (customers, suppliers, and organization); only then will a company be able to sustain improvements in the customer's experience.

4. How well the auditor finds and communicates areas of improvement. Many auditors simply rely on submitting reports that indicate compliance or non-compliance or non-compliance with the appropriate section of the standard. Auditors that can clearly identify and communicate areas of improvement in language and terms executive management understands facilitate action on improvement initiatives by the companies they audit. When management doesn't understand why they were non-compliant and the business implications associated with non-compliance, they simply ignore the reports and focus on what they do understand.

46.12. AREAS COVERED IN I.S.O. 9000 : 1994 SERIES

1. I.S.O. 9000 provides the guideline for selection and use of the quality standards.
2. I.S.O. 9001 is a quality system model for quality assurance in design/development, production, installation and servicing. This is most exhaustive standard. The engi-

- neering organisation, where the manufacturing capabilities are based on in-house designs have to work for I.S.O. 9001 certification. Manufacturers of (a) household good like TV, refrigerator etc. (b) perishable consumer goods like tooth-paste etc. which have both servicing and design/development have to work towards I.S.O. 9001.
3. I.S.O. 9002 provides a model for quality assurance only in production and installation. This does not cover areas of design/development and servicing. I.S.O. 9002 also looks at internal quality audits. Steel plants, departmental stores, hospitals, chemical plants etc. where the designing and servicing do not constitute the key activities, may prefer I.S.O. 9002.
 4. I.S.O. 9003 deals only with quality systems related to final inspection and testing.
 5. I.S.O. 9004 provides guideline for quality management and quality system elements.

In addition to the I.S.O. 9000 series, I.S.O. 8402 deals with vocabulary used in the I.S.O. 9000 series.

46.13. ISO-9000 : 2000 SET OF STANDARDS

ISO-9000 : 1994 series revised to ISO-9000 : 2000 set of standards, which included three quantity standards : ISO-9000 : 2000, ISO-9001 : 2000 and ISO-9004 : 2000. In these standards ISO-9001 : 2000 presents **requirements**, while ISO-9000 : 2000 and ISO-9004 : 2000 presents **guidelines**. All of these are process standards (not product standards). The certificate is awarded to an organisation in respect of compliance of standards ISO-9001 : 2000.

Following standards make up the ISO 9000 : 2000 family :

Standards and Guidelines	Purpose
ISO-9000 : 2000, Quality Management Systems-Fundamentals and vocabulary.	For understanding the standards and defines the fundamental terms and definitions used in the ISO-9000 family
ISO-9001 : 2000, Quality Management Systems-Requirements,	This is the requirement standard used to assess the ability to meet the customer and applicable regulatory requirements and thereby address customer satisfaction. It is now the only standard in the ISO-9000 family against which third-party certification can be granted.
ISO-9004 : 2000, Quality Management Systems - Guidelines for performance improvements.	This guideline standard provides guidance for continual improvement of your quality management system to benefit all parties through sustained customer satisfaction.

From the above it is clear that, in order to develop a quality management system, you are required to only meet the requirements specified by ISO - 9001 : 2000. You can consult the ISO-9000 : 2000 and ISO - 9004 : 2000 guidelines only when you need clarification. Your quality management system must simply meet *requirements* as specified in ISO-9001 : 2000. When your quality system has been fully developed and implemented, you carry out an internal assessment to ensure that you have not every single ISO-9001 : 2000 requirement. When you are ready, you ask an external auditor to audit the effectiveness of your quality management system. If your auditors find that you have introduced and implemented the ISO-9001 : 2000 standard, they will certify that your quality system has met ISO's requirements. They will then issue an official certificate to you and will record your achievement in their registry. You can

then announce to the world that the quality of your products and services is managed, controlled, and assured by a registered ISO-9001 : 2000 Quality Management Systems.

46.14. ISO - 9000 : 2000 STANDARDS—QUALITY MANAGEMENT PRINCIPLES

ISO - 9000 : 2000 standards are based on eight quality management principles. ISO choose these principle because they can be used to improve organisational performance and achieve success. These principles can be used by senior management as a framework to guide their organisation towards improved performance. The eight quality management principles as given in the ISO -9000 : 2000, Quality management systems - Fundamentals and vocabulary; and in ISO - 9004 : 2000, Quality management systems - Guidelines for performance improvements are :

Principle 1 : Focus on your customer

Organisations depend on their customers. Therefore

- Organisations must understand customer needs.
- Organisations must meet customer requirements.
- Organisations must exceed customer expectations.

Principle 2 : Provide Leadership

Organisations rely on leaders. Therefore :

- Leaders must establish a unity of purpose and set the direction the organisation should take.
- Leaders must create an environmental that encourages people to achieve the organisation's objectives.

Principle 3 : Involvement of People.

People at all levels are the essence of an organisation and therefore :

- Organisations must encourage the involvement of people at all levels.
- Organisations must help people to developed use their abilities.

Principle 4 : Use a Process Approach

Organisations are more efficient and effective when they use a process approach. Therefore:

- Organisations must use a process approach to manage activities and related resources.

Principle 5 : Take a System Approach

Organisations are more efficient and effective when they use a systems approach. Therefore:

- Organisations must identify inter-related processes and treat them as a system.
- Organisations must use a systems approach to manage their inter-related processes.

Principle 6 : Encourage Continual Improvement

Organisations are more efficient and effective when they continually try to improve. Therefore :

- Organisations must make a permanent commitment to continually improve their overall performance.