

GE 6757 TOTAL QUALITY MANAGEMENT

LECTURE NOTES

UNIT 5

The Quality System is the organizational responsibilities, Procedures, Processes and resources for implementing quality management.

The family of ISO 9000 standards is made up of three core standards:

ISO 9000 - 2000 Quality Management system
Fundamentals and Vocabulary

ISO 9001 - 2000 Quality Management system
Requirements

ISO 9004 - 2000 Quality Management system
Guidelines for performance improvement

Required documents for the ISO certification

1. Quality policy manual
2. Quality system procedures
3. Work instructions and
4. Records formats forms

The Four Stages Of Quality Auditing are :

1. Auditing Planning
2. Audit Performance
3. Audit reporting and
4. Audit follow up

The ISO 14000 standards are a set of norms for Environmental Management System (EMS) either at organization and process level or product level.

The family of ISO 14000 standards can be divided into two areas as :

1. Organization evaluation standards, and
2. Product evaluation standards

The categories of organizations evaluation standards are

1. Environmental Management System (EMS)
2. Environmental Auditing (EA), and

International Organization for Standardization

History of ISO

Post World War II – BS 5750 ISO founded in 1946 Switzerland, Geneva.

1987 - ISO 9000: 1987 - Three models of quality

ISO 9001: 1987 – Design Development etc

ISO 9002: 1987 – Production, installation, service etc

ISO 9003: 1987 – Quality assurance, inspection, testing etc

ISO 9000:1994 ISO 9001: 2000 combined the three to one standard. ISO 9000: 2008 latest with technical committee

Similar Certifications

- ANSI – American National Standard Institute
- EC – European Community
- ASQ 9000 – American Society for Quality
- DOD – Department of Defence
- FDA – Food and Drug Administration
- ISI – Indian Standards Institute
- BIS Hallmark – Bureau of Indian Standards

Basic Requirements of ISO 9001

1. Procedure to cover all processes in the business
2. Monitoring process to ensure effectiveness
3. Keeping adequate record
4. Defect verification and appropriate correction
5. Regular review of individual processes
6. Facilitating continual improvement

Benefits of ISO Registration

1. Increase in internal quality – reduction of scrap, rework etc
2. Production reliability – measure of breakdowns, time and shift management etc
3. External quality – acceptance by customers, less claims, return of goods
4. Time performance – marketing, delivery, production time etc
5. Cost of poor quality – scraps and rework

ISO 9000 Family ISO 9000:2000 QMS – Fundamental and Vocabulary

- Basic QMS

- Guidance document for certification
- Revised in ISO 9000:2005

ISO 9001:2000 QMS – Requirements

- Design, development and installation
- Customer satisfaction through products and service

ISO 9004:2000 QMS – Guidelines for Performance

- Continuous improvement
- Enhance the mature system

Elements of the ISO 9000 Quality System

The ISO-9000 norm is made of 20 different elements referring to different operations and therefore to different parts of the company's organization. A useful exercise consists in drawing a mapping between the company's functions and the elements of the norm.

1. Management Responsibility

In order to have a coherent approach to quality, the initiative and the control should come from the top management. It insures you will get the product the marketing claims is selling. Practically, the management is required to define a policy and objectives (i.e. a strategy in terms of defect, delay, service ...); to define an organization (who's doing what and who's reporting to whom and when); and to review the system (that is, to define review meetings and procedures for checking whether the organization and the objectives remain adequate).

2. Quality System

The first component of the quality system is the set of procedures which will be used to guarantee the quality in accordance with the policy and the objectives defined above. These procedures, the way they are organized and the way they work together must be described formally (Say what you do). Most of the procedures will be described in the following sections.

3. Contract Review

Quality here means that when a contract is signed, it will be fulfilled as contracted. This means that only clear contracts will be accepted; that any difference between the offer and the contract will be checked; that any modification of the contract will be taken into account adequately and that, above all, we have the means for fulfilling the contract. Again clear procedures are needed here.

Examples: ordering a PC with an English version of Windows

(get an English PC with English plugs !!!) Modify the order to get a QWERTY keyboard

(the preloaded software still assumed an azerty keyboard)

4. Design Control

This part is proper to the ISO 9001 norm (not in ISO 9002). To control the design you must first define the successive phases of the conception (the route), their organization and their interfaces. You must then describe the acceptance/selection procedures used in each phase (this allows the design to be proved). A special effort must be devoted to the input and to the output of the design. Show how the input (of the design) is checked as being: legal - coherent - complete - in agreement with the contract) and show how the output of the design is checked as being legal, coherent and in agreement with the requirements.

These procedures must namely specify:

1. How you check that output is correct (have the procedures been followed?);
2. how you check that output is conformable to requirements;
3. How you manage subsequent changes in the design.
4. Note on the level of details needed: compare the level of job descriptions in:
5. a pizza hut : every job is clearly described; and in

6. A restaurant: the Maitre d'hôtel knows what he has to do.

5. Document Control

This ensures that documents are available and accessed by who needs them. It also ensures that the right version has been obtained and is in use. This is in favor of using rather procedural form to distribute documents. Example: school (communication of important and unimportant information) For very important changes, one may ask to return or destroy the old versions.

6. Purchasing

The question here is how you guarantee that the products you buy are of quality. In order to solve it you need: Prod 2100-2110 Total Quality Management 12

1. To define which guarantee your subcontractors must present and

2. To check these guarantees and to record your measures.

In order to guarantee the products you get are those you wanted, you need:

1. To define clearly the purchase data and

2. To make a control or to get the assurance one is done.

7. Customer-Supplied Material

How do you handle the products which are supplied by the customers?

(Example: containers, material to be sent).

Detail the procedure you use to inform the customer of any loss or damage.

8. Product Identification and Traceability

If necessary, define clear procedure for identifying a product from the moment it has been received up to the moment it has been installed again.

The two basic operations are:

Identify (give a unique number, maybe a lot number) and

Trace (where it has been, with which components it has been manufactured,)

Examples: bar code systems; carriers must be able to trace all the products (DHL)

9. Process Control

Here you need to plan all the processes (production, installation, services) which have an impact on quality. This means:

To write the procedures;

To define what are the adequate tools and environment;

To define the norms and check whether some equipments should not be certified

To define how the process must be controlled and on which basis;

To define the maintenance.

10. Inspection and Testing

You need to verify that the product you are producing satisfies the requirements. Describe which parameters will be measured, where and how. If needed, describe also the machines required for these measurements and describe the actions to be taken if something is NOK. You can distinguish between the checks at the input, during processing and at the end.

If some necessary checks are skipped, then the product must be traceable and marked explicitly as such in order to find it back later if needed. If you use sampling plans or acceptance intervals, refer to 20. Example: taste coffee

11. Inspection, Measuring, and Test Equipment

You must ensure that the adequate testing equipment is used and that they are adequately calibrated. You therefore need

- To list the needed testing/measuring equipment and for each,

- To determine the required accuracy and
- To determine the operating conditions (warehousing, calibration,).

12. Inspection and Test Status

You must ensure that the controlled items are properly marked (identified) and recorded. Define how to recognize not tested products, tested products ok, tested products nok. Define which charts must be used for processes and how to record them. Prod 2100-2110 Total Quality Management

13. Control of Non-conforming Product

You need to ensure that the adequate actions are taken for non-conforming products in order to avoid using or delivering them. Tell also how they will be handled afterwards.

14. Corrective Action

The treatment of non-conformance must follow the following general scheme:

1. Describe clearly the problems (which test did fail, which criteria was used ...);
2. Define immediate short-term responses (13) and avoid new NOK ;
3. Identify the basic reason for the non-conformance;
4. Define long-term corrective actions;
5. Define the follow-up of these actions.

15. Handling, Storage, Packaging and Delivery

We must ensure that the product remains ok from the final test up to its delivery.

The following operations are relevant:

- Handling (how to manipulate it);
- Packaging (including identifying and labeling);
- Storing (conditions on the storage area);
- Preserving (not getting stolen or taken inadvertently);
- Delivery (use the right carrier mode and conditions).

16. Quality Records

All the actions related to quality must be recorded and stored. The objectives are:

1. To prove you are behaving well (for certification audit);
2. To provide you with the material needed for conducting quality improvement actions.

You should thus:

- Define how you will store these documents
- Define how you will organize these documents
- Define how you will make their access possible and efficient

17. Internal Quality Audits

The need for internal audits must be clear to everybody. If you want a system to work well you should check it from time to time. These audits must be performed by internal people who have been trained and who are not in direct contact with the audited services. They must check whether:

- The tasks are performed as documented and well;
- The proper documents and material are used;
- The procedures are adequate (to review the efficiency of the quality system)
- You may refer to ISO 10011 for how to conduct audits.

18. Training

The training of all your people is a requirement if you want your organization to improve. With respect to ISO-9001, you must

- Be sure the worker can use the new machine that has been bought and

- Be sure the worker can follow the procedures which have been defined.

Practically, the training requires a complete planning.

19. Servicing

Examples of services are : a help line, a full service one year guarantee, the formation of the customer for using the product.

The notion of quality for a service is not different than that of a product. You must:

Select the quality of the service (the performance);

- Discuss what is really needed to reach these performances;
- Define the requirements, the formation, for achieving the performances.

20. Statistical Techniques

With reference to the points 9 or 10, you defined earlier how the processes (9) and how the products (10) would be tested. These tests could be based on sampling plans or statistical process control (SPC). In both cases, you must motivate the technique you use and describe how you parameterize the method. Refer to the part of the course on statistical techniques.

5.5 TQM CULTURE:

Total Quality is a description of the culture, attitude and organization of a company that aims to provide, and continue to provide, its customers with products and services that satisfy their needs. The culture requires quality in all aspects of the company's operations, with things being done right first time, and defects and waste eradicated from operations. Many companies have difficulties in implementing TQM. Surveys by consulting firms have found that only 20-36% of companies that have undertaken TQM have achieved either significant or even tangible improvements in quality, productivity, competitiveness or financial return. As a result many people are sceptical about TQM. However, when you look at successful companies you find a much higher percentage of successful TQM implementation.

Some useful messages from results of TQM implementations:

1. If you want to be a first-rate company, don't focus on the second-rate companies who can't handle TQM, look at the world-class companies that have adopted it
2. The most effective way to spend TQM introduction funds is by training top management, people involved in new product development, and people involved with customers
3. It's much easier to introduce EDM/PDM in a company with a TQM culture than in one without TQM. People in companies that have implemented TQM are more likely to have the basic understanding necessary for implementing EDM/PDM. For example, they are more likely to view EDM/PDM as an information and workflow management system supporting the entire product life cycle than as a departmental solution for the management of CAD data

Important aspects of TQM include customer-driven quality, top management leadership and commitment, continuous improvement, fast response, actions based on facts, employee participation, and a TQM culture.

Customer-driven quality

TQM has a customer-first orientation. The customer, not internal activities and constraints, comes first. Customer satisfaction is seen as the company's highest priority. The company believes it will only be successful if customers are satisfied. The TQM company is sensitive to customer requirements and responds rapidly to them. In the TQM context, 'being sensitive to customer requirements' goes beyond defect and error reduction, and merely meeting specifications or reducing customer complaints. The concept of requirements is expanded to take in not only product and service attributes that meet basic requirements, but also those that enhance and differentiate them for competitive advantage. Each part of the company is involved in Total Quality, operating as a customer to some functions and as a supplier to others. The Engineering Department is a supplier to downstream functions such as Manufacturing and Field Service, and has to treat these internal customers with the same sensitivity and responsiveness as it would external customers.

TQM leadership from top management

TQM is a way of life for a company. It has to be introduced and led by top management. This is a key point. Attempts to implement TQM often fail because top management doesn't lead and get committed - instead it delegates and pays lip service. Commitment and personal involvement is required from top management in creating and deploying clear quality values and goals consistent with the objectives of the company, and in creating and deploying well defined systems, methods and performance measures for achieving those goals. These systems and methods guide all quality activities and encourage participation by all employees. The development and use of performance indicators is linked, directly or indirectly, to customer requirements and satisfaction, and to management and employee remuneration.

Continuous improvement

Continuous improvement of all operations and activities is at the heart of TQM. Once it is recognized that customer satisfaction can only be obtained by providing a high-quality product, continuous improvement of the quality of the product is seen as the only way to maintain a high level of customer satisfaction. As well as recognizing the link between product quality and customer satisfaction, TQM also recognizes that product quality is the result of process quality. As a result, there is a focus on continuous improvement of the company's processes. This will lead to an improvement in process quality. In turn this will lead to an improvement in product quality, and to an increase in customer satisfaction. Improvement cycles are encouraged for all the company's activities such as product development, use of EDM/PDM, and the way customer relationships are managed. This implies that all activities include measurement and monitoring of cycle time and responsiveness as a basis for seeking opportunities for improvement. Elimination of waste is a major component of the continuous improvement approach. There is also a strong emphasis on prevention rather than detection, and an emphasis on quality at the design stage. The customer-driven approach helps to prevent errors and achieve defect-free production. When problems do occur within the product development process, they are generally discovered and resolved before they can get to the next internal customer.

Employee Involvement

Employee involvement is a means to better meet the organization's goals for quality and productivity at all levels of an organization. Benefits of employee involvement: Employee Involvement improves quality and increases productivity because Employees make better decisions using their expert knowledge of the process. Employees are more likely to implement and support decisions they had a part in making. Employees are better able to spot and pinpoint areas for improvement. Employees are better able to take immediate corrective action. Employee involvement reduces labor management hassle by more effective communications and cooperation. Employee involvement increases morale by creating a feeling of belonging to the organization. Employees are better able to accept change because they control the work environment. Employees have an increased commitment to unit goals because they are involved.

5.10 EMPOWERMENT

Empowerment means invest people with authority. Its purpose is to tap the enormous reservoir of creativity and potential contribution that lies within every worker at all levels. Empowerment is an environment in which people have the ability, the confidence, and the commitment to take the responsibility and ownership to improve the process and to initiate the necessary steps to satisfy customer requirements within well-defined boundaries in order to achieve organizational values and goals. The three conditions necessary to create the empowered environment are:

- i. Everyone must understand the need for change.
- ii. The system needs to change for the new paradigm
- iii. The organization must enable its employees.

5.7 Quality Council :

In order to build quality in the culture, a quality council is established to provide overall direction. It is the driver for the TQM engine. In a typical organization the quality council is composed of the chief executive officer (CEO); the senior managers of the functional areas, such as design, marketing, finance, production, and quality; and a Coordinator or consultant.

Duties of the quality council:

- a) To develop the vision, mission and quality statement of the organization, with the input from all the personnel.
- b) To develop strategic long-term plan with goals and annual quality improvement program with objectives.
- c) Create a total education and training plan
- d) Determine and continuously monitor the cost of poor quality.
- e) Determine the performance measures of the organization and monitor.
- f) Continuously determine those projects that improves and affect external and internal customer satisfaction.
- g) Establish multifunctional project and work group teams and monitor their progress.
- h) Establish and revise the recognition and reward system to account for the new way of doing business.

The typical quality council meeting agenda of a well established TQM organization :

- a) Progress reports on teams

- b) Customer satisfaction report
 - c) Progress on meeting goals
 - d) New project teams
 - e) Recognition dinner
 - f) Benchmarking report
- Recognition is a form of employee motivation in which the organization publicly acknowledges the positive contributions an individual or team has made to the success of the organization.

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

5 Introduction to Software Quality

The definition of the ISO 8204 for quality:

Totality of characteristics of an entity that bears on its ability to satisfy stated and implied needs. This means that the Software product delivered should be as per the requirements defined. We now examine a few more terms used in association with Software Quality.

Quality Planning: In the Planning Process we determine the standards that are relevant for the Software Product, the Organization and the means to achieve them.

Quality Assurance: Once the standards are defined and we start building the product. It is very important to have processes that evaluate the project performance and aim to assure that the Quality standards are being followed and the final product will be in compliance.

Quality Control: Once the software components are built the results are monitored to determine if they comply with the standards. The data collected helps in measuring the performance trends and as needed help in identifying defective pieces of code.

Software Quality Management :

Software Quality Management simply stated comprises of processes that ensure that the Software Project would reach its goals. In other words the Software Project would meet the clients expectations.

The key processes of Software Quality Management fall into the following three categories:

- 1) Quality Planning
 - 2) Quality Assurance
 - 3) Quality Control
- The Software Quality Management comprises of Quality Planning, Quality Assurance and Quality Control Processes.

We shall now take a closer look at each of them.

1) Quality Planning : Quality Planning is the most important step in Software Quality Management. Proper planning ensures that the remaining Quality processes make sense and achieve the desired results. The starting point for the Planning process is the standards followed by the Organization. This is expressed in the Quality Policy and Documentation defining the Organization-wide standards. Sometimes additional industry standards relevant to the Software Project may be referred to as needed. Using these as inputs the Standards for the specific project are decided. The Scope of the effort is also clearly defined.

The inputs for the Planning are as summarized as follows:

- a. Company's Quality Policy
- b. Organization Standards
- c. Relevant Industry Standards
- d. Regulations

- e. Scope of Work
- f. Project Requirements

Using these as Inputs the Quality Planning process creates a plan to ensure that standards agreed upon are met

Hence the outputs of the Quality Planning process are:

- a. Standards defined for the Project
- b. Quality Plan

To create these outputs namely the Quality Plan various tools and techniques are used. These tools and techniques are huge topics and Quality Experts dedicate years of research on these topics.

We would briefly introduce these tools and techniques in this article.

a. Benchmarking: The proposed product standards can be decided using the existing performance benchmarks of similar products that already exist in the market.

b. Design of Experiments: Using statistics we determine what factors influence the Quality or features of the end product

c. Cost of Quality: This includes all the costs needed to achieve the required Quality levels. It includes prevention costs, appraisal costs and failure costs.

d. Other tools: There are various other tools used in the Planning process such as Cause and Effect Diagrams, System Flow Charts, Cost Benefit Analysis, etc.

All these help us to create a Quality Management Plan for the project.

2) Quality Assurance : The Input to the Quality Assurance Processes is the Quality Plan created during Planning. Quality Audits and various other techniques are used to evaluate the performance of the project. This helps us to ensure that the Project is following the Quality Management Plan. The tools and techniques used in the Planning Process such as Design of Experiments, Cause and Effect Diagrams may also be used here, as required.

3) Quality Control: Following are the inputs to the Quality Control Process: - Quality Management Plan.

- Quality Standards defined for the Project
- Actual Observations and Measurements of the Work done or in Progress
- The Quality Control Processes use various tools to study the Work done.

If the Work done is found unsatisfactory it may be sent back to the development team for fixes. Changes to the Development process may be done if necessary. If the work done meets the standards defined then the work done is accepted and released to the clients. Importance of Documentation: In all the Quality Management Processes special emphasis is put on documentation. Many software shops fail to document the project at various levels. Consider a scenario where the Requirements of the Software Project are not sufficiently documented. In this case it is quiet possible that the client has a set of expectations and the tester may not know about them. Hence the testing team would not be able test the software developed for these expectations or requirements.

This may lead to poor —Software Quality| as the product does not meet the expectations. Similarly consider a scenario where the development team does not document the installation instructions. If a different person or a team is responsible for future installations they may end up making mistakes during installation, thereby failing to deliver as promised. Once again consider

a scenario where a tester fails to document the test results after executing the test cases. This may lead to confusion later. If there were an error, we would not be sure at what stage the error was introduced in the software at a component level or when integrating it with another component or due to environment on a particular server etc. Hence documentation is the key for future analysis and all Quality Management efforts.

Steps: In a typical Software Development Life Cycle the following steps are necessary for Quality Management:

- 1) Document the Requirements
- 2) Define and Document Quality Standards
- 3) Define and Document the Scope of Work
- 4) Document the Software Created and dependencies
- 5) Define and Document the Quality Management Plan
- 6) Define and Document the Test Strategy
- 7) Create and Document the Test Cases Execute Test Cases and (log)
- 8) Document the Results
- 9) Fix Defects and document the fixes
- 10) Quality Assurance audits the Documents and Test Logs

TQM Framework

