ABSTRACT

TQM is an organization wide philosophy with its core value centered on continually improving the quality of the product and services and the quality of its process to meet and exceed customers expectations. Everyone in the organization from top management to employees plays a role in providing a quality product and services to customers. Even the suppliers and customers are part of TQM. In this paper an attempt is made to trace the evolution of TQM, key principles of TQM, tools of TQM and also the paper covers the entire range of TQM in 20 units, in four modules with brief explanation and practical applications.

Total quality management (TQM) is achieved and becomes part of the overall organizational culture when the five principles - produce quality work the first time, focus on the customer, have a strategic approach to improvement, improve continuously and encourage mutual respect and teamwork - are practiced by all.

Key words: Quality, Control, Circle


1. TQM - AN OVERVIEW

Total Quality Management is a management approach that originated in the 1950s and has steadily become more popular since the early 1980s. Total quality is a description of the culture, attitude and organization of a company that strives to provide customers with products and services that satisfy their needs

2. EVOLUTION OF TQM

In the late 1970s and early 1980s, the developed countries of North America and Western Europe suffered economically in the face of stiff competition from Japan’s ability to produce high-quality goods at competitive cost. For the first time since the start of the Industrial Revolution, the United Kingdom became a net importer of finished goods. The United States undertook its own soul-searching, expressed most pointedly in the television broadcast of If Japan Can... Why Can’t We? Firms began reexamining the techniques of quality control invented over the past 50 years and how those techniques had been so successfully employed by the Japanese. It was in the midst of this economic turmoil that TQM took root.
The exact origin of the term “total quality management” is uncertain. It is almost certainly inspired by Armand V. Feigenbaum’s multi-edition book *Total Quality Control* (OCLC 299383303) and Kaoru Ishikawa’s *What Is Total Quality Control? The Japanese Way* (OCLC 11467749). It may have been first coined in the United Kingdom by the Department of Trade and Industry during its 1983 “National Quality Campaign”. Or it may have been first coined in the United States by the Naval Air Systems Command to describe its quality-improvement efforts in 1985.

3. DEVELOPMENT IN THE UNITED STATES

In the spring of 1984, an arm of the United States Navy asked some of its civilian researchers to assess statistical process control and the work of several prominent quality consultants and to make recommendations as to how to apply their approaches to improve the Navy’s operational effectiveness. The recommendation was to adopt the teachings of W. Edwards Deming. The Navy branded the effort “Total Quality Management” in 1985.

From the Navy, TQM spread throughout the US Federal Government, resulting in the following:

- The creation of the Malcolm Baldrige National Quality Award in August 1987
- The creation of the Federal Quality Institute in June 1988
- The adoption of TQM by many elements of government and the armed forces, including the United States Department of Defense, the United States Army, and United States Coast Guard

The private sector followed suit, flocking to TQM principles not only as a means to recapture market share from the Japanese, but also to remain competitive when bidding for contracts from the Federal Government since “total quality” requires involving suppliers, not just employees, in process improvement efforts.

4. FIVE PRINCIPLES OF TQM

In order to exceed customer expectations, an organization must embrace five principles:

- Produce quality work the first time
- Focus on the customer
- Have a strategic approach to improvement
- Improve continuously
- Encourage mutual respect and teamwork

5. TOTAL QUALITY MANAGEMENT (TQM) TOOLS

Total quality management (TQM) tools help organizations to identify, analyze and assess qualitative and quantitative data that is relevant to their business. These tools can identify procedures, ideas, statistics, cause and effect concerns and other issues relevant to their organizations. Each of which can be examined and used to enhance the effectiveness, efficiency, standardization and overall quality of procedures, products or work environment, in accordance with ISO 9000 standards (SQ, 2004). According to Quality America, Inc. the number of TQM tools is close to 100 and come in various forms, such as brainstorming, focus groups, check lists, charts and graphs, diagrams and other analysis tools. In a different vein, manuals and standards are TQM tools as well, as they give direction and best practice guidelines to you and/or your staff. TQM tools illustrate and aid in the assimilation of complicated information such as:


6. THE FOLLOWING ARE SOME OF THE MOST COMMON TQM TOOLS IN USE TODAY

Each is used for, and identifies, specific information in a specific manner. It should be noted that tools should be used in conjunction with other tools to understand the full scope of the issue being analyzed or illustrated. Simply using one tool may inhibit your understanding of the data provided, or may close you off to further possibilities.
Dr. S. S. Sheik Mohamad and A. Anthoni Samy, “TQM - An Overview” – (ICAM 2016)
12. MODULE ONE – LEADERSHIP
This module describes about the Leadership’s (CEO & Managers) Responsibilities in the first four units.

12.1. Chief Executive Officer: Managing Policy
The full implementation of TQM requires the commitment of the Chief Executive Officer and senior managers. As CEO, you must take personal charge, providing a vision of where your company is going, and the leadership to realize the vision. This requires that you, with your Senior Managers, define your company philosophy, and develop long-term (5 years) and mid-term plans (3 years) based on this philosophy.

Then translate these plans into annual management policies, and deploy down through the organizational levels, from higher level to lower level departments and sections. Check regularly that policies are being implemented as planned. Reflect on your annual management policies at the end of each year. Use the PLAN, DO, CHECK AND ACT cycle to carry out the appraisal, while implementing Policies.

12.2. Chief Executive Officer: Ensuring Quality
He has to take all possible steps for ensuring quality.

12.3. Managers: Managing Systems
As a manager, your responsibility is to receive the CEO’s annual management policies, examine them carefully, and implement them. The journey from the receipt of an order to the final delivery of the product often goes through a lot of different departments. To ensure that your employees understand and carry out their job assignments correctly, you, as a manager, should:

- Consider carefully how to give job assignments
- Communicate your superiors’ instructions clearly to your employees.

There are five primary areas where quality assurance activities are implemented, and where authority for their implementation must be defined: Product Designs, Process Designs, Manufacture Designs, Inspection and Packing and Transporting manufactured goods. Use numerical data and graphs to show trends in the manufacturing processes. You may find yourself having to deal with defects (especially in production), non-conformities or abnormalities.

There are four actions that you, as a manager, have to take with defects: (i) respond quickly when a defect is reported to you. (ii) Deal with the defective products. (iii) Gather information about the causes of the defect. (iv) Check that causes of the defect are being properly analyzed and acted on.

Establish report writing procedures as your habitual practice. Present information visually in the form of graphs or reference tables which allow an easy review of the time sequence.

12.4. Chief Managers: Managing People
As a manager you can take actions to maximize the contribution of your employees to the success of your department and of your company. Train and motivate them, delegate to them, and involve them in making improvements.

1. Ensure that your employees understand and follow the standards.
2. Raise your employee’s technical skills levels.
3. Delegate authority.
4. Take steps to motivate your employees.
5. Encourage your employees to make suggestions.
6. Involve your employees in asking improvements: support QC circle activities

13. MODULE TWO – THE WORK ENVIRONMENT
This module covers next three units from five to seven which describes the importance of the work environment.
13.1. Disposal and Storage
A workplace that is neat and well organized is always more efficient. It is also more pleasant to work in. The texts in this unit present a number of actions you can take to achieve this.

A). Remove unnecessary items from the workplace.
B). Remove defective goods from the workplace.
C). Set up a storage system. Use a FIFO
D). Set up a good inventory system.
E). Mark passageways
F). Pack and move goods carefully

13.2. Hygiene and Health
Everyone should work in a comfortable, healthy environment. To keep your workplace clean, set up a system for collecting and storing waste. Prepare separate boxes for burnable waste, dirty rags, metal shavings, and glass waste. Remove them from the workplace at least once a day. Divide garbage by different type as well as color Taps and dispose of each in the appropriate boxes:

Paper Garbage
(White tap box)
Rags
(Blue tap box)
Shavings
(Yellow tap box)
Glass
(Red tap box)

13.3. Use the 5S Activities
The 5S activities are a way of maintaining cleanliness and tidiness in the workplace. These activities are central to the Japanese practice of TQM. The name 5S is taken from five Japanese words beginning with “S”.

- Seiri (Organizing): Separate necessary and unnecessary items and eliminate the latter.
- Seiton (Keeping things neat): Store necessary items in their designated place so that they can be easily found.
- Seiso (Cleaning): Remove dirt and rubbish from the workplace.
- Seiketsu (Cleanliness): Clean the workplace systematically and prevent dirt recurring.
- Shukanka (Make cleanliness as habit): Train employees in these practices and attitudes so that they become a habit.

Making the 5S activities a regular practice in your workplaces will bring three important benefits: consistent quality, improved efficiency and safety, and a comfortable workplace.

Maintain Appropriate Levels of Lighting, Temperature And Humidity

Keep down noise, odor, vibration, and dust

Prevent Environmental pollution: treat Industrial waste
Industrial waste – which includes trash, waste oil, paint, solvent, waste water and exhaust vent gas – is causing more and more environmental pollution. The main pollution categories,
1. Air Pollution:

2. Water Pollution:

3. Solid/Chemical substances:

13.4. Safety

Each year thousands of employees are killed or seriously injured at work. There are nine key sets of actions that you can take to improve safety in your company.

a. Mark emergency exits and put up warning signs so that people can leave the building quickly when there is an emergency.

b. Every company should provide protective clothing and tools wherever there is any risk to employees.

c. Employees must have safety conscious.

d. Establish safety standards and regulations

e. Set up safety committees and patrols

A primary function of a safety committee is to discuss countermeasures and recurrence prevention measures whenever an accident occurs or some danger emerges. The key procedures are: Members of the committee hold a meeting within 24 hours of an accident. Gather information relevant to the identification of the cause of the accident. Listen carefully to what they have to say. In implanting countermeasures ask the 5 Ws and 1H questions such as –Who? Where? When? Why? What? and How?

f. Ensure facilities and equipment are safe

g. Keep accident records: Records are a valuable way of learning from past accidents and preventing them recurring. Keep permanent records of all accidents.

h. Set safety targets to lower your accident rate compare to other companies.

i. Be prepared to deal with disasters such as earthquakes, flood and Tsunami.

14. MODULE THREE – SYSTEMS AND TOOLS

This module consists of five units from eight to twelve. It talks about Quality measures as follows:

14.1. Standardization

Standardization is an essential tool for maintaining and improving quality in a company. A standard is a written description of the best way to do a job, carry out an operation, or complete a process. Its purpose is to ensure that jobs, operation and processes are always carried out in the same way. A work instruction is a clear, simple written description of the daily production plans and related information, based on standards, that is given to the employees before they begin operations. The types of standards for manufacturing process are as follows:

a. Product standards

b. Raw materials standards.

c. Inspection standards

d. Job standards

e. Standards for maintaining equipments

f. Standard for maintaining measuring devices.

g. Packaging standards

h. Work standards

i. Supplementary standards

Make sure that employees are following the standards.
14.2. Problem Solving

There will always be problems in work processes. There are few steps in problem solving techniques:

a. Recognizing abnormalities
b. Reporting abnormalities
c. Emergency actions with non-conforming product
d. Preventing the recurrence of abnormalities
e. Rules for processing abnormalities
f. Control charts

Control charts are a key tool in interpreting data. A control chart consists of a central line (CL), upper control limits (UCL) and lower control limit (LCL). The UCL and LCLs are calculated based on calculated values.

When characteristic values that indicate process conditions are plotted as data points on the control chart, and all the points fall within the upper and lower control limits, the process is said to be “under control”.

When characteristic values that indicate process conditions are plotted as data points on the control chart, and all the points fall outside the upper and lower control limits, the process is said to be “out of control”.

14.3. Quality Control Circles

A QC circle is a small group of frontline employees who meet regularly to try to improve the quality of their work. QC circle activities are at the core of TQM. They can play a major role in creating a dynamic atmosphere in the workplace. There are sixteen general guidelines steps in active participation of QC.

14.4. Statistical Methods

Statisticians gather data from a sample. They use this information to make inferences about the population that the sample represents. There are many ways to sort the data. If the observations are measured in numbers, we can list the data points from lowest to highest in numerical value. One useful way to organize data is to divide them into similar categories or classes and then count the number of observations that fall into each category. The purpose of organizing data is to enable us to see quickly some of the characteristics of the data we have collected.

14.4.1 Data

To make a decision in any business situation you need data. Facts expressed in quantitative form can be termed as data. Success of any statistical investigation depends on the availability of accurate and reliable data.

Data may be classified either as primary data or secondary data. When the data was collected by the investigator – himself, then it is called Primary data; when the data was not collected by the investigator and it is derived from others sources, then such sources are called as Secondary data.

14.4.2. Population

A population is a collection of all the elements we are studying and about which we are trying to draw conclusions. In other words, a group of entities whose characteristics are to be investigated or studied or a group of entities from which samples are to be taken, is called Population. For example, we can say the population of a class student’s strength is fifty.

14.4.3. Sample

A sample is subset of the population. A sample is a collection of some, but not all, of the element or part of a population selected to find out its characteristics. A representative sample contains the relevant characteristic of the population. Studying samples is easier than studying the whole population; it costs less and takes less time. For example, the DEO (District Educational Officer) selects 10 students as a sample (from total students of 50 as population) when an average class
performance is inspected, during his annual visit to the Schools. The data which statistical techniques are to be applied is obtained by measuring items sampled from processes, lots, or populations.

14.4.4. Sample Size
The larger the variability, the larger is the sample size required. Also the larger the sample size, the higher will be the confidence of the inference or conclusion.

14.4.5. Variable
A quality characteristic value that can be measured as a continuous quantity, but not counted as separate items, is known as Variable. For example, Length, color. Data derived from such values is referred to as variable data.

14.4.5. Expressing Central Tendency (Mean) and Dispersion
We can use statistical techniques on collected data to estimate the central tendency (mean), and dispersion of the population. Information before it is arranged and analyzed is called raw data, or unprocessed data. The data array is one of the simplest ways to present data. It arranges values either in ascending or descending order. We can quickly notice the lowest and highest values in the data.

Another way of arranging the collected data is to use a frequency distribution. A frequency distribution shows the number of observations from the data set that fall into each of the classes. If you can determine the frequency with which values occur in each class of a data set, you can construct a frequency distribution. Showing how many times a value appears by using frequency distribution is even more effective than array.

14.4.6. Measure of Central Tendency
Frequency distributions help us to make useful inferences about the data and also provide yardstick for comparing different sets of data. The main three types of averages commonly used are:

A) The Mean value or arithmetic mean
B) The Median
C) The Mode.
D) The dispersion
E) The standard deviation

14.5. Education and Training
The quality of the education and training that your company provides for its staff will determine the quality of the products and services you offer. The first step in training your staff is to have an employee development policy, and to communicate this policy to your staff.

The objectives of the policy should be: To improve employees’ competence in their work. To improve their understanding, and their responsibilities; To improve their ability to make good judgments; To improve their capacity to solve problems.

Train employees in using machinery and equipment. In most companies a primary focus of training is on using machinery and other equipments. This training will be both off – the – job training and on – the – job training. These will deal with:

- How to handle, operate, and maintain machinery and equipment.
- How to avoid danger, promote safety, and prevent breakage and damage.

Off – the – job training use the operation manuals for the machinery and equipment as defined in the job standards. Instruction should cover machinery, inspection and equipment, measuring devices, constituent components, jigs, tools and spare parts.

On – the – job training is provided on the work site. The instructor demonstrates and explains the correct procedure using the actual machinery, measuring device, raw materials, components, Work in progress, and finished products. It is also essential to keep training records.

Provide TQM education and training to all. TQM members must attend the external and internal TQM seminars and they must share their suggestions and ideas.

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Maintain a resource of good training materials. Good training materials are an essential training resource. You should evaluate what your employees gain from each course. Encourage employees to pursue self development. Your company should encourage and facilitate such employees to undertake training in the skills and knowledge, and for the licenses, that each is interested in, and which are necessary both in their own work area and company-wide.

15. MODULE FOUR – PRODUCTION AND SALES
This last module deals with some control measures to meet the requirements of Customer satisfaction. It is discussed from thirteen to twenty units.

15.1. Production Control
Production control is the management of the production processes to ensure that the company produces the goods of the quality that the market wants, in the right quantity, and ready for delivery at the right time – and that it continues to improve the efficiency with which it does so.

Prepare Production and shipping plans. There are three key plans that the production department must prepare in order to have effective production control:

i. An annual production Plan, based on the sales plan: This plan will cover your company’s accounting period. The annual production plan will be largely determined by your sales plan.

ii. A daily or monthly production plan: It is important to prepare daily or monthly plans based on annual plan.

iii. A shipping plan: The purpose of a shipping plan is to make sure that products are delivered from the production site to the delivery site on time. This is essential to keep customers satisfied.

Ensure that production keeps to plan. To ensure, that production keeps to this plan, organize your production line in the best possible way; know your production capacity and prevent delays in production.

15.2. Process Control
Process control is about making sure that the manufacturing processes produce goods of the required quality in a continuous and stable manner. There are several mechanisms for maintaining process control.

Process control plan and process capability study.

A process control plan can check all of these factors, such as employees, equipments, materials, facilities, and methods and identify where any problems may exist, while a Process Capability Study shows if the process is actually capable of producing products of the require quality.

15.2.1. An Essential Tool in Investigating The Cause of Out – of – Controls Is A Control Chart
Use control charts to examine the process and determine whether it is in a stable condition in terms of both quality and quantity.

15.3. Inspection
Inspections are essential to make sure that your products have the specific quality features that your customers want.

Establish Inspection standard: There are four common inspections in manufacturing: acceptance inspections, intermediate inspections, final inspections and delivery inspections. Acceptance inspection is carried out when accepting raw materials and parts into your factory or work place. The inspector certifies that the quality and quantity of order placed to the supplier are conformed. Intermediate or process inspection will be carried out to inspect whether the work in progress product quality is up to the customer’s specified requirements. Final inspection will be conducted for the finished goods by following proper sampling techniques. Delivery inspections are carried out before shipping out finished products. Inspection records will provide a clear picture of the quality of processes and finished products.
15.4. Management of Facilities & Equipment
Managing facilities and equipment involves carrying out regular inspections; dealing with any problems and making sure they do not happen again; deciding which forms of maintenance to use; and keeping records of maintenance. Keep the workplace neat and clean. Give recognition to employees who follow the principles of cleanliness and neatness. Use the user manual to train them in the operation procedures so that they will not cause abnormalities or failures.
   a) Carry out daily and periodic inspections.
   b) Deal with abnormalities, and failures
   c) Manage periodic repairs
   d) Break down maintenance
   e) Total preventive maintenance

15.5. Measurement Control
The purpose of measurement control is to ensure that the right measuring equipment is used to measure, within an acceptable range of precision, the conditions in which your products are manufactured and their quality characteristics. This is essential if your products are to meet the required standards.
   Maintain your measuring equipment: When you have purchased the measuring equipment there are a number of steps that you need to take to make sure that it is properly looked after and used correctly. Establish procedures for calibrating, maintaining precision storing and using the measuring equipment. Clarify responsibility and authority for measurement control. Train operators to use the equipment. Prepare manuals which will provide specification for the purchase, installation, repair, maintenance and disposal of measuring equipment.

15.5.1. Errors in Measurement
- Errors due to parallax.
- Errors due to elastic deformation.
- Errors due to thermal expansion.
- Other errors.
   In addition to these types of errors, you should also take into account humidity, dust, atmospheric pressure, vibration, light and noise to ensure precise measurement.
   Calibrate your measuring equipment: Calibrate all your measuring equipment at appropriate intervals. You may do this in-house or get an outside agency to do it.
   Record the calibration results in calibration certificates and report them to the related departments. Clearly mark the calibration expiry date on each piece of equipment.

15.6. External Suppliers
The quality of the products that you are selling on the market will often be determined by other companies – your suppliers. The Raw materials and parts that you receive from your external suppliers will have a major impact on the quality and competitiveness of your products.
   a) Taking on new external suppliers:
   b) Carry out an in-depth investigation of potential external suppliers:
   c) Evaluate the records of goods delivered.
   d) Maintain a good long-term relationship with your external suppliers:

15.7. After – Sales Service
Your responsibility for your products does not end when you sell them. The success of your company depends, above all, on whether your customers are satisfied with your products. No matter how good your quality and inspection systems are, some defective products can always get through to your customers. The CEO should take an active interest in the after sales service, since it has an important quality assurance function. The CEO should also check the after sales feedback on products that have been sold. Prepare a product guarantee certificate.

Dr. S. S. Sheik Mohamud and A. Anthoni Samy, “TQM - An Overview” – (ICAM 2016)
The product guarantee certificate is an essential document for both preventing and dealing with after sales problems. You need to have an organizational structure and procedures in place when customers present claims about failed products. This will allow you to deal quickly and efficiently with the claim; to receive the claim; to analyze the failed product; to take corrective measures; and recurrence preventive measures; and to keep record of all essential data.

15.8. Product Design and Development

Product design and development is the process of creating a new product to be sold by a business to its customers. It involves identifying a market need, creating a product to meet this need, and testing and improving this product until it is ready for production. It consists of a series of activities: research, analysis, design, engineering, and building prototypes, and then testing, modifying, and re-testing until the design is perfect.

Plan for the design and development of the new product: To plan for the design and development of a new product, establish design standards that will cover all the design requirements. The design and development of a new product is normally a big investment. To bring a good return on this investment the new product must hold its position in the market well into the future. In taking long term perspective it is essential that you allow for trends in environmental protection for example pollution control, energy efficiency without reducing performance.

16. CONCLUSION

Each enterprise with a quality management system is responsible for application of Continuous quality improvement through enhancement of processes and activities in the Whole production cycle. As quality improvement is better understood, all activities will lead to a new level of Performance regarding employees, processes, products, and management. Positive effects of quality improvement are reflected especially in profit of the enterprise. Techniques of quality improvement should be implemented in all organization structures of Enterprise.

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