

# When Technology Ends Art Begins -The Art and Science of TQM

<sup>1</sup>M.Pradeep Kumar, <sup>2</sup>Dr. N.V.S Raju, <sup>3</sup>K.Amarnath

<sup>1,3</sup>Assistant Professor, Dept. of Mechanical Engineering, KITS(S), Karimnagar – TS, India

<sup>2</sup>Vice-Principal and Professor, Dept. of Mechanical Engineering, JNTUH CE, Karimnagar –TS, India

**Abstract:-**The word “quality” came into existence over many years ago, though there was no proper definition. From few decades, philosophers such as Feigenbaum, Deming, Crosby, Ishikawa, Juran, Taguchi and others have put their thought to define the term quality and also accomplished to the quality management principles. Every individual philosopher has his own philosophy and definition towards quality. Quality Gurus also included the management principles to achieve the greater quality, such as the Poka-Yoke approach of Shigeo Shingo, Zero Defect concept of Philip Crosby etc., Quality management has extended its bounds and grown to new heights that it has become a separate area in every field and emerged as “total quality management” which is popularly abbreviated as TQM. Although many concepts were developed in the past decades which aims for higher quality, but each concept has separate view and ideology. These concepts can be clearly understood when applied to the practical life for a system or a process. The objective of this paper is to interpret the quality concepts of quality management based on manufacturing process. It is also important to focus on the area in which no quality definition has been developed. After a thorough analysis, it was found that no philosophy has explained the quality of a service which is important to achieve totality of the quality. This paper also proposes a five step model for improving the quality of the service.

**Index Terms:-**Quality management, TQM, Service Quality, totality of quality, manufacturing process.

## 1. INTRODUCTION

Any customer will always think of quality and ask for quality products. Quality conveys the desirable values in the product and also the impression what customer expects from the product. It is the fitness for the purpose at the lowest cost, and thus, the quality of any product is regarded as the degree to which the product fulfils the requirement of a customer. Quality is always the result of an intelligent effort. In any organization, the quality function involves efforts of all the groups in the organization. Quality control is a deliberate and planned activity to integrate quality development, quality maintenance, and quality improvement, which plays a pivotal role for survival in the competitive world.

There were many old conceptualizations regarding quality. However, no clear cut path was made to put all the concepts in order. Due to the enhanced demand on quality, the philosophies of quality gurus are made in an order and all the philosophies have been focused as total quality management. Producing the right products and service at the first time and every time is one of the philosophies of TQM. This goal can be attained by best practicing TQM tools and techniques continuously wherever, whenever required. The concept of TQM suggests that everybody in the organization should be involved to improve their skills, knowledge, and perfection to satisfy their immediate customers or internal customers. In this customer satisfaction chain, links should become strong and robust by satisfying each internal customer and finally the ultimate customer.

In this paper, first the quality concepts of quality gurus are reviewed at a glimpse. Then various quality concepts are interpreted to a manufacturing process. Their teachings and obligations made to cope the knowledge and understand the quality today. After interpreting the quality concepts to a manufacturing process, it is

important to focus on the area which is not concerned. After reviewing all the quality concepts and applying to the real life situation, it was understood that the concepts were able to explain the quality at all the stages of manufacturing. No concepts have focused after the manufacturing process. However, the product after manufacturing will reach the customer. If service rendered by the customer is not good, then ultimately it leads to customer dissatisfaction, which violets the definition of quality. Therefore, to achieve the totality of the quality, it is important to focus on every aspects of product stage. After maintaining the quality standards of product during manufacturing, it is much important to maintain the quality of the service. In this paper, a five step model for service quality has been proposed and elucidated.

### 1.1 OBJECTIVES OF THE PRESENT STUDY

- Review of Quality Concepts
- Application of quality concepts to real life
- Implementation of five step model for quality service

### 1.2 THE DEFINITIONS OF QUALITY

Based on the perspective of the humans, the definition of quality may vary. Different perspectives have been derived from last 3 decades to understand the term “quality”. Every customer established some needs and these needs should be transformed into measurable characteristics. The final aim is to make the customer satisfied for what he paid for a service or a product. Some of the definitions are as follows:

- Quality is fitness for the purpose
- Quality is degree of customer satisfaction
- Quality is accuracy in meeting the specification or design
- Quality is meeting the standards or norms
- Quality is degree of excellence

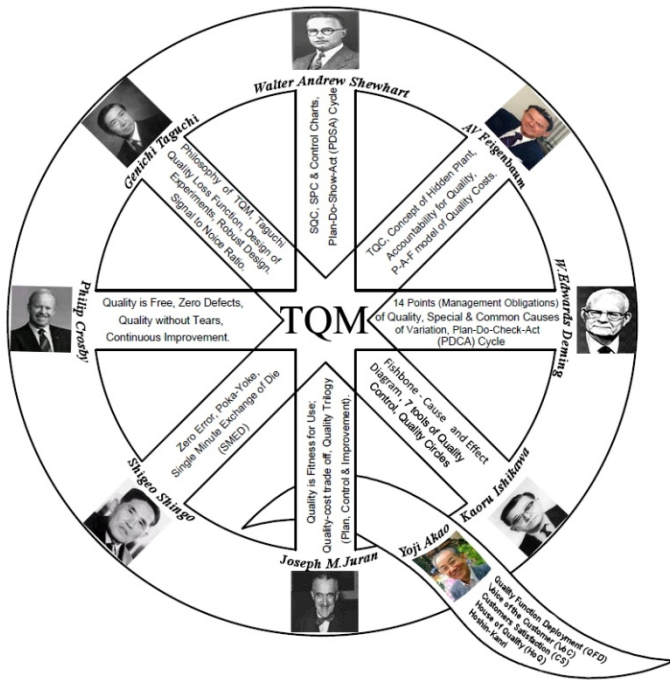


Figure: 1The Quality Wheel

**2. LITERATURE REVIEW**

**S. Selva Arul Pandian & P. Puthiyannayagam** in a paper used the control charts technique to study the process stability and reduce the number of defects in the software product. Firstly they analysed the problems in software industry by using statistical process control with real time scenario. They constructed Multiple Regression model for the Injected Defect Density. The data reveals that in 3 projects predicted values are within the control limit. In the Project 4, sample values happen to outliers as they are above upper control. In the project 8, Development effort per requirement is high when compared with the projects in that group. In the project 9, Development effort per requirement is high among the projects in that group. They suggested that study can further extended by Bayesian or Markovian model for prediction. The advanced control charts such as CUSUM or EWMA can used to study the impact. [1]

**Rizwan U. Farooqui and Syed M. Ahmed** have studied the state of implementation of Deming’s 14 points for achieving quality in the construction industry. In the first phase, they have gone through deming’s 14 points and in the second phase they have understood the implementation of the 14 points in the construction industry, and a structured survey has been conducted targeted to major construction industry stakeholders. They concluded that the companies are recommended to relate their quality implementation ideas with Deming’s 14 points in order to achieve total quality management to the maximum extent. [2]

**Shantanu Welekar and Shantanu Kulkarni** have discussed various features of Quality Circle, Quality Improvement Group and Work Group/Project Team. They conducted a case study of Quality Circle concept in a chemical industry which illustrates the effectiveness of QC

approach. They used PDCA (Plan Do Check Act) and done the problem identification, problem analysis, problem solution and implementation process for Quality circle approach. In their study a group of 8 members are formed with 1 manager as steering member. Finally they have gone with fish bone diagram to improve the overall productivity of the plant. Using quality circle, they have identified excessive gas consumption in the furnaces is the main problem which is due to reasons attributed to deficiency in man, material, method and machine. They summarized that Optimization of gas consumption in the furnaces led to reduction in maintenance costs, enhancement in reliability and availability of the equipment.[3]

**Kapil Banker, Amit Patel and Diptesh Patel** used Statistical quality control (SQC) tools, such as x bar chart, R-chart, C-chart, P-chart to measure the variability in the process in a welded stainless steel pipe manufacturing industry. They adopted the control chart method to observe and control the process along the manufacturing process line. After the study they observed that the main defect was ovality in stainless welded pipe. The ovality defect has been eliminated by adjusting the expanding pressure in the expanding machine. Finally, The control charts are used for online inspection process in the industries. Online defect detection has been occurred by control charts. [4]

**Yash Dave and Dr. Nagendra Sohani** implemented the poka-yoke technique in a gear industry. They conducted a case study on a drilling machine in a gear manufacturing company. After a detailed study they recognized two prominent reasons which caused the rejection of components, one is due to drilling on the opposite surface of gear which is due to inadequate training of the operators and second is, there was a problem in the drilling fixture in the sense that there was no such arresting system in the fixture which can prevent the placing the gears on the fixture, if it is placed wrongly by operator. With the help of Poka-yoke, they enhanced the performance of drilling machine by controlling the rejection of gears. Finally, the number of gears drilled wrongly on the opposite face was reduced considerably. [5]

**3. STAGES OF PRODUCTION/MANUFACTURING PROCESS**

Manufacturing can be defined as the transformation of materials and information into goods for the satisfaction of human needs. Manufacturing can be considered as a system in which product design is the initial stage, and the delivery of finished products to the market is the final output. There are basic steps in manufacturing processes, these includes design, drawing , approval, raw material order, manufacturing, stage testing, final assembling, final testing, packing and dispatching. Based on the requirement of the customer, a product can be designed and drawn into a pictorial view. Designs should dictate the utility of the product to the end

customer. Then after, the design should be approved by the concerned authorities and processed to the next stage. Once the design got approved, required raw material is purchased and sent to the manufacturing department. After the completion of the manufacturing, the individual

parts are sent to stage testing. If no errors are found in the parts, the parts are assembled and again sent to the final testing. In the final testing, the final product is inspected and checked so that no problem occurs during its functioning.

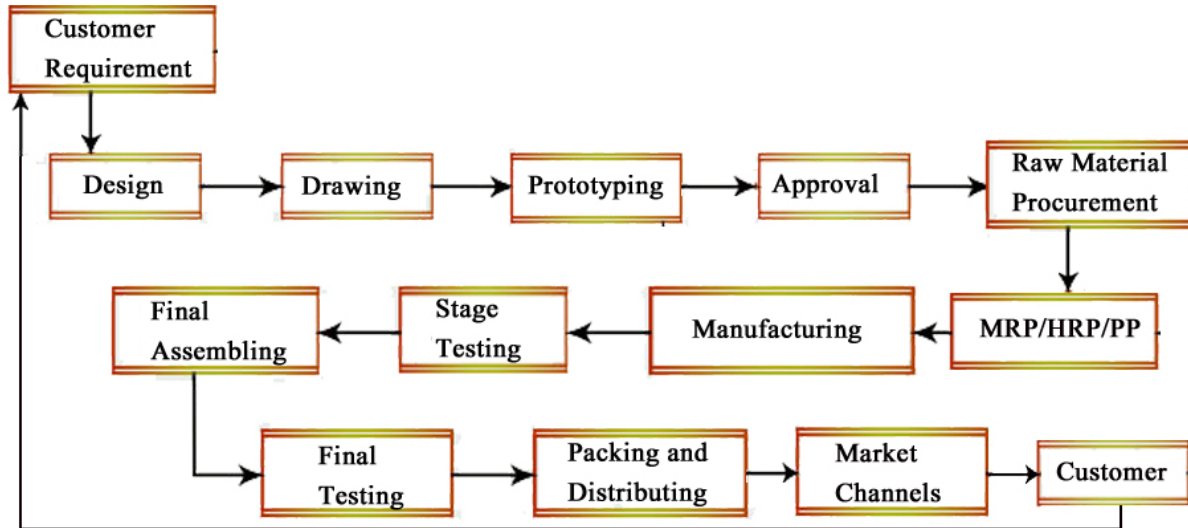


Figure: 2 Stages of Production/Manufacturing Process

After going through various quality concepts of quality gurus, it is directed to interpret these concepts to various stages of manufacturing process so that one can easily understand the essence of philosophy and its application to the practical field. First, it has shown the several stages of manufacturing process, and then an attempt has been made to imply the quality concepts to each stage based on the philosophy and application.

**A. Walter Andrew Shewhart – SQC, SPC**

The major contributions of Shewhart are Statistical quality control (SQC), Statistical process control (SPC), Process Capability and Control charts. All these concepts meant to measure the variability in the process or to study the process stability to minimize the number of defects. Among all the stages of the manufacturing process, statistical process control concept can be applied at manufacturing stage. In the flow diagram show in the figure no. 2, only manufacturing stage is the process where a raw material is transformed to a product and remaining all the stages are events where a product is designed, assembled or inspected. Shewhart's ideology lies in reducing the number of defects occurred in the products by plotting the graph. This graph shows whether the process is stable or varying. The concept of statistical quality control uses some sort of statistical method for monitoring and maintaining the quality of the

3. Quality Improvement

product. This concept is applied after the manufacturing of the product.

**B. Joseph Moses Juran-Quality Trilogy**

Quality Trilogy is the basic concept of Juran. This strategy works on the principle of proper planning with regard to customer's need and then developing the product accordingly with good control over the process. The concept of quality trilogy can be implied to the entire manufacturing stages. Juran identified and categorised quality trilogy as there cyclic steps viz., quality planning, quality control and quality improvement which stand as pillars of TQM.

1. Quality Planning

Juran describes that the quality planning starts with knowing the customer and the purpose of the product. Based on the customer need, the product designs are made and transformed into drawing. The major stages for developing a quality product are its requirement, design and drawing. If these were planned with a sound design, maximum defects can be reduced. So, quality planning is applied to the first three stages of manufacturing process.

2. Quality Control

Quality control is mainly concerned with the investigation and evaluation of the performance of the system and also emphasizes on correcting the defects. So, quality control can be applied from the Material purchase stage to the defect stage.

This is applied to the final stage of manufacturing process. Juran states than an



improvement in the product can be achieved by predicting the causes and providing the remedies.

**Table: 1 Quality concepts analysis through manufacturing process**

		Walter Andrew Shewhart	Joseph Moses Juran	Kaoru Ishikawa	W Edwards Deming	Armand Vallin Feigenbaum	Shigeo Shingo	Philip B. Crosby		
1	Customer Requirement	-	Quality Planning	Cause and effect analysis	Quality Circle	Plan-Do-Check-Act Cycle	Total quality control	Poka-Yoke (Material Focus) (DIRT-DIRET) Zero defects (HR Focus)		
2	Design								Quality Control	Plan
3	Drawing/ Prototyping		Do							
4	Raw Material Procurement									Check
5	MRP/HRP/PP		Act						Act when standards are exceeded	
6	Manufacture	SQC								Pride in workmanship
7	Stage Testing		Quality Improve ment							
8	Final Assembly	Yes								
9	Final Testing		No							
10	Defect	Final Product								
11										

**C. Kaoru Ishikawa – Cause and effect diagram and Quality circles**

Ishikawa’s major contribution to the quality field is Cause and Effect diagram. This diagram investigates the problem or effect of the system and its causes, and to take action to correct the causes or to learn those causes that are responsible. Many problems may occur during production of a product from the starting stage to the end stage. This concept can be applied to any stage of the manufacturing process where a problem is found. Majorly product defects are found after its final assembly. If any defects are found after the assembly of the product, it is suggested to apply this concept to find the problems for the defects and their causes.

**Quality circles**

Ishikawa diagram gives various problems and its causes of a system. After finding out the problem and its causes, it is desirable to analyse the reasons and to take the action to minimize the problems. These can be done by the use of quality circles. Quality circles are group of employees aimed to discuss the problems and improve the production. So, this quality circle can be applied to any stage of manufacturing where a problem is found.

Mostly quality circles concept is applied to enhance the quality of the product.

**D. Walter Edwards Deming -"Plan-Do-Check-Act Cycle"**

Deming’s P-D-C-A cycle, often called the “quality cycle,” is a very powerful methodology that can be used for any process improvement at any stage and at any level and can be comfortably coupled with any other philosophy. Each element of "Plan-Do-Check-Act Cycle" is applied to different stages of manufacturing.

**Plan:** This is applied to the first three stages of manufacturing process, where planning and design of the product is done.

**Do:** What ever planned in the first three stages, should be implemented in the fourth and fifth stage. So, this element is applied to the fourth and fifth stage. ( Raw material purchase and manufacturing stages)

**Check:** After the manufacturing, product should be tested, assembled and again tested. This element is applied for stage testing, assembling and final testing stages.

**Act:** If any errors are occurred, an action should be taken.

**E. Armand Vallin Feigenbaum-Total quality control**

Total quality control focuses on reduction of unnecessary and unproductive costs and wastage. By reducing the cost on rework or rejection, quality can be improved. TQC can be achieved by four steps

1. Design the quality standards

This is applied to the second stage of the manufacturing process, where the quality standards are designed after knowing the customer requirement.

2. Appraise conformance to the standards

Process is evaluated to conform the standards which are set in the first stage. This step is applied from the design stage to final testing.

3. Act when standards are exceeded

After the final testing, if any defects are found or the standards have been exceeded, action should be taken to correct the standards. So, this is applied to the defect stage.

4. Planning for improvement in the standards.

If no defects were found, planning should be done to improve the standards of the product.

#### F. Shigeo Shingo -Poka-Yoke

The concept of Poka-Yoke leads to zero quality control, which is the pathway for Total quality control. The essential idea of Poka-Yoke is to design the process so that mistakes are impossible or at least easily detected and corrected. In the process of manufacturing, each and every activity should be designed such that no defect can occur. The concept of poke-yoke can be applied to all the stages of manufacturing process in the material point of view.

#### G. Philip B. Crosby -Zero defects

Zero-defects program demands the employees and employers to make zero defect a slogan. The success or failure of implementation of zero-defect program largely depends on the attitudes and commitment of the management and the employees of the organization. So the organization needs to create a suitable environment in the company and build a culture among its employees. This concept is also applied to the all the stages but employee point of view.

#### 4. THE QUALITY OF PACKING AND DISTRIBUTING – FINAL STAGE

In this study, the quality concepts of gurus have been applied to various stages of manufacturing process. In the table no. 1 it is seen that the concepts cover all the stages of manufacturing process except the last stage i.e., packing/distributing stage. Packing provides safe handling and preservation to prevent damage of product and to ensure safe packaging of product such that the product is delivered to customer without any damage or deterioration during transportation. Most of us think that it is an inessential stage where quality is not involved.

But observations made in our daily life remind that, in a lot of items there will be at least one defective item which is due to improper packing. Even though the product is well assembled or arranged without any defect

or errors, may cause trouble after reaching the customer. This is because, after the final assembly, the product is sent to packing stage. Here, due to the overlook of the workers or due to the over stock the product may get distorted. Also for the product to reach the customer, it has to drive to various places by means of a transport facility. Here, there is a little chance to damage of the item, which affects the quality and brings negative shade to the customer. It is much important to avoid the defects from its bottom to enhance the quality.

#### Measures to be followed in final stage

- Establishing a system for packing evaluation
- Storage of products in a convenient environment and location
- Building employees concern towards effective packing
- Designing a transportation pattern for easy and safe dispatch

#### 5. THE QUALITY TOWARDS SERVICE

##### -A NEW DIMENSION FOR CUSTOMER SATISFACTION

Quality is a multi-dimensional phenomenon. Customer satisfaction is a vital entity in formation of customer's desires for future purchase. Furthermore, the satisfied customers will probably talk to others about their good experiences. Although many philosophers have put their views and thoughts to define, measure, maintain and improve the quality of a product from its beginning stage to the end stage. But no philosophy has made an attempt to focus on the quality in the service point of view. The product after manufacturing process it reaches the customer. It is known fact that, some products during its use may lead to some kind of problem which irritates the customer. As a remedy for this, every organization will provide their service to satisfy the customer.

Services are increasingly becoming a larger portion of many organizations' regionally, nationally, and globally and are considered as a tool for revenue streams. If the quality of the service is not admirable, the customer may not satisfy which violets the definition of the quality. So, the quality of service is important for every organization and also delivering an excellent service is a winning strategy. Quality service sustains customer's confidence and is essential for a competitive advantage. This paper also emphasis to analyse about the role of service quality for creating customer satisfaction.

##### 5.1 AMENDMENTS NEEDED TO EMEND SERVICE QUALITY

"Attainment towards a greater services and support" is the slogan that every organization should precede to improve the service quality. Based on our daily observation we framed five steps model to be followed for improving the service quality. This includes Assurance, Empathy, Reliability, Responsiveness and Tangibles.

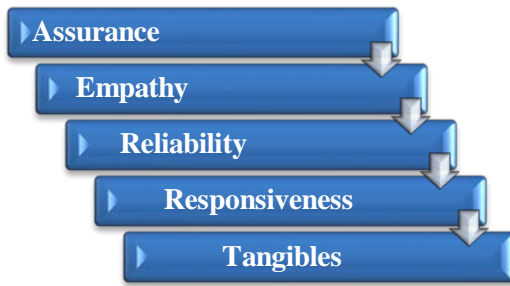


Figure: 3 Five step model for service quality

- **Assurance**-Belief in organisation and their abilities are important to the customer. For this, Attention and knowledge of employees to express trust and confidence in the customer are essential.
- **Empathy**- The firm should understand the feelings of customer, and focus on individual attention and caring.
- **Reliability**-Accurate and dependable services are absolutely vital for the customer.
- **Responsiveness**- Readily reacting and replying to the customers and also willingness to help customers and provide prompt service enhances the service quality
- **Tangibles**-Impression of having physical facilities, personnel, equipment, and communication materials will add a factor for the service quality

## 6. CONCLUSION

The concepts of quality gurus act as tools for driving quality products to the customers. Every quality concept has its own importance in maintaining the quality standard while manufacturing a product. This study enables to understand the philosophies of various quality gurus by reviewing and implying the philosophies to a manufacturing process. In order to achieve quality in totality, all the organizational activities from purchasing to production, manufacturing to marketing, inspection to shipping should attain in a greater quality. Total quality management can't be achieved by looking only at the product manufacturing, but also on the service point of view. Apart from the quality concepts, the present day technology helps in maintaining the quality standards in the manufacturing process, but when coming to the service point of view, technology has a less role. When the manufacturing is completed, the role of technology ends. "When technology ends, art begins." Providing a quality service is an art that every organization should practice. All the aspects between customer to customer should be considered to achieve total quality management. Providing Totality of quality is not only a philosophical and technological approach, but it is an Art.

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