FROM QUALITY INSPECTION TO TOTAL QUALITY MANAGEMENT

"While the 20th century has been the century of productivity, the 21st century will be the century of quality".

Joseph M. Juran

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ABSTRACT

If Pakistan's economy is to be directed towards prosperity, not only we should produce more but it is also necessary that we should produce quality goods. This article discusses the whole range of quality management activities. The experience of two industrial giants - Japan and America - with - reference to quality management and its correlation, with their industrial development, has been reviewed. Ever evolving and ever changing term "quality" is discussed in the light of the views of contemporary scholars. The whole range of quality management activities during distinct philosophical and chronological eras of evolution has also been examined . Initially, the era of "quality inspection after actual production" was the main point of emphasis. Later emphasis shifted from "quality inspection" to "defect prevention". It was recognized that the "quality" is the responsibility of whole organization and not the production

people alone. The latest thought in this field is that it is a philosophy of managing and doing things where quality is the obsession of every one in the organization. The paper explains how this thought can be inculcated amongst all involved in producing goods and services for the customers.

INTRODUCTION

It was 1945 when Japan surrendered after complete devastation by Allied Powers. The country was in shamble. Only one major city, Kyoto, had escaped wide-scale destruction. At that time, because of air raids and dislocations, the industrial activity was virtually reduced to none. As the country is not bestowed with enough natural resources therefore neither she had anything to sell nor anything to eat. Even to restore their food supply the Japanese had no option but to manufacture something that could be sold in the international market. Before the World War II, in international market, Japanese goods had reputation of "cheap, inferior products". For the reconstruction of their war-worn country the only viable alternative for Japanese was to learn the art of producing superior quality good. Under the auspices of "The Japan Management Association" a new organization "The Japanese Union of Scientists and Engineers", (JUSE), was established in 1948. JUSE took the responsibility to acquaint Japanese with the methods of Statistical Quality Control, (SQC). The Japanese engineers, technicians and workers made quality control their religion.

It was the era of "Made in U.S.A.", when post World War II Japanese were curiously learning how to produce quality. A stamp "Made in U.S.A." was regarded as the seal of quality. 1950s were boom years for American industry. There was high demand for whatever American industry

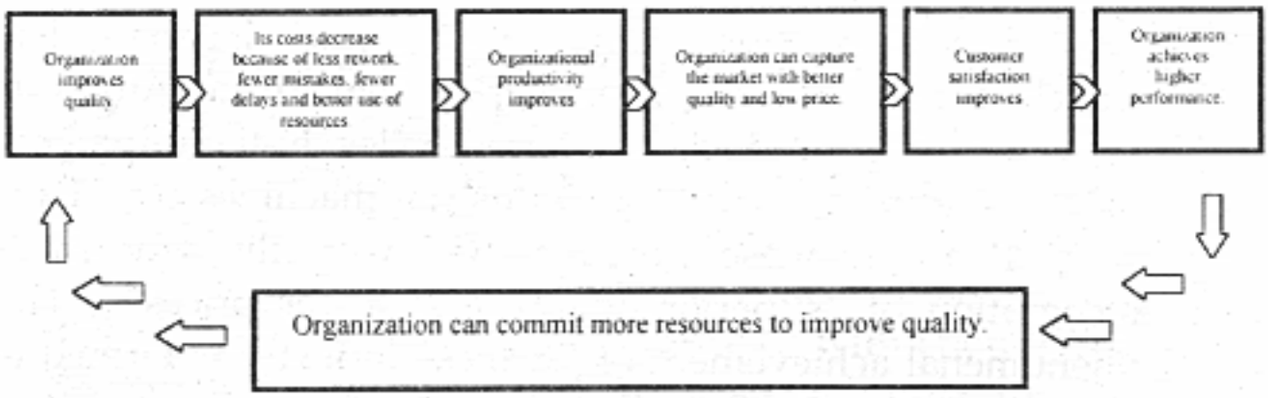
could turnout. Neither there was any competition of American goods in international market nor there was any perceived threat of serious competition of U.S. products in near future. It looked certain that the future of American industry would remain prosperous. As a result American business managers became more involved with productivity and forgot to emphasize quality.

Within a short period of 20 years Japanese had snatched a major portion of market share from American firms for many products like automobiles, hi-fi equipments, videos, electronics, cameras, industrial machines etc. Upto early 1970s Japanese products had won the worldwide recognition of "superior quality and lower prices". This phenomenal achievement of Japanese industry is termed as *Japanese Miracle*. Stung by the defection of customers rushing to buy Japanese products, manufacturers in United States, in Europe, and elsewhere realized that good quality is the essential condition for effective global competition. Earlier managers believed that quality improvement efforts generally lower productivity. But from the Japanese experience it was discovered that concentrating on improving product quality, throughout all phases of a production process actually, improves the productivity of the manufacturing system[1].

By the late 1970s and early 1980s, American managers were making frequent trips to Japan to learn about the Japanese Miracle. Perhaps no other management issue has received as much attention in recent years as quality. Today a quality revolution is taking place throughout the world. When an organization improves quality, a *chain reaction* starts that leads to reduced cost, improved productivity and to improved customer satisfaction, which, in turn leads to higher organizational performance. Now because organization has more resources to use for improving

quality, the cycle starts again. This "Quality, Productivity, and Customer Satisfaction Cycle" is depicted below[2].

The Quality, Productivity, and Customer Satisfaction Cycle.



The reason behind the success or even survival of a business organization is "customer satisfaction". In the present day competitive environment, merely satisfying customer needs do not guarantee an organization's success. To beat the competition, organizations must exceed customer expectations by providing products and / or services that delight and excite them. Therefore, most progressive organizations now define quality as meeting or exceeding customer expectations[3]. Quality is not a static concept. What is quality? The customer determines it. As customer's preference changes over time, definition of quality changes. This ever-changing nature of the concept of quality suggests, to ensure their success or even their survival, business organizations must continuously and ceaselessly strive to improve quality. That is why Joseph M. Juran has remarked, " While the 20th century has been the century of productivity, the 21st century will be the century of quality".

WHAT IS QUALITY?

"Obviously, the term quality is not an absolute; quality is a diamond with many facets"[4].

Kenneth L. Arnold.

Quality means different things to different people. In fact, the term quality is sometimes used when the more appropriate term grade should be used[5]. For example, Suzuki Cultus is a higher grade of automobile than Suzuki Alto. Cultus has more features, space and comfort. Both may be high quality cars built to give trouble-free performance.

In order to clearly understand meaning of the term quality a few popular definitions of the term are given in the following lines.

- Quality = Customer Satisfaction[6]. *(Dale H. Bestrefield).*
- Quality means fitness for use[7]. *(Joseph M. Juran).*
- Quality is a measure of how closely a good or service conforms to predetermined standards, especially the needs and expectations of customers[8]. *(Joseph G. Monks).*
- How well a product does what it is intended to do---how closely it satisfies the specifications to which it was built[9]. *(Samuel C. Certo).*
- Quality is a measure of the degree to which a process, product, or service conforms to the requirements that

have been established for it[10]. *(Lester R. Bittel & John W. Newstrom).*

- The totality of features and characteristics of a product or service that bears on its ability to satisfy given needs[11]. *(The American National Standards Institute & The American Society for Quality Control).*

- The total composite product and service characteristics of marketing, engineering, manufacturing and maintenance through which the product or service in use will meet the expectations of the customer[12]. *(Armand V. Feigenbaum).*

From a careful study of the above noted definitions one can easily draw following inferences regarding the nature of quality:

1. As quality is customer's satisfaction, therefore, *customer decides* what quality is.

2. Customer means *user*. The user or the customer may be one outside the organization i.e. an external customer, or it may be within the organization i.e. an internal customer. *External Customer* may be a trader or an industrial user of the product or he may be a consumer. *Internal Customer* means the next stage in the process. For example, stitching department of a garments factory is the internal customer of its cutting department. Stitching department is also one of internal customers of storeroom, repair and maintenance department, time keeping department, payroll department, personnel department etc. Stitching department is an internal supplier of finishing and packing department.

3. Needs and expectations of customers change over time, so *changes the definition* of quality. Moreover, goods and services must be improved over time as competitors improve. What was a quality product yesterday may not be one tomorrow. Therefore it requires a *permanent commitment and continuous effort* to maintain high standard of quality.

4. Quality means different things to different people. From the *customer's viewpoint,* quality is often associated with usefulness, value or even price. From the *producer's viewpoint,* quality is associated with conformance to specifications i.e. producing the product according to its design[13].

5. Customer's perception of quality is associated with a number of attributes, characteristics, or features. These attributes are also termed as dimensions of quality. (While going through the literature of quality management we find reference to at least eight such dimensions of quality for manufactured products, and at least ten such dimensions of quality for service products. See table A). Customers give different weights to the different attributes for different products and in different situations. The characteristics important for the target customers must be identified through research and translated into specific product attributes and incorporated into design specifications of the product.

6. Quality is not the responsibility of a single department but the whole organization; marketing, R&D, designing, purchasing, production, customer service, accounting etc., contributes to customer's satisfaction. Therefore, maintaining and improving

quality standard requires *commitment of the whole organization* i.e. a total system approach.

The *conclusion* drawn from the above inferences, as to what quality is, can be depicted in the form of following diagram. *Inner circle* of the diagram shows, a quality product is one that is designed, manufactured and/or delivered according to customer's needs and wants; and the *outer circle* shows, everyone in the organization contributes to quality of product. That's why, the term *"total quality"* is becoming popular, since 1980's, instead of quality.

Fig. 2. The Concept of Quality[14]

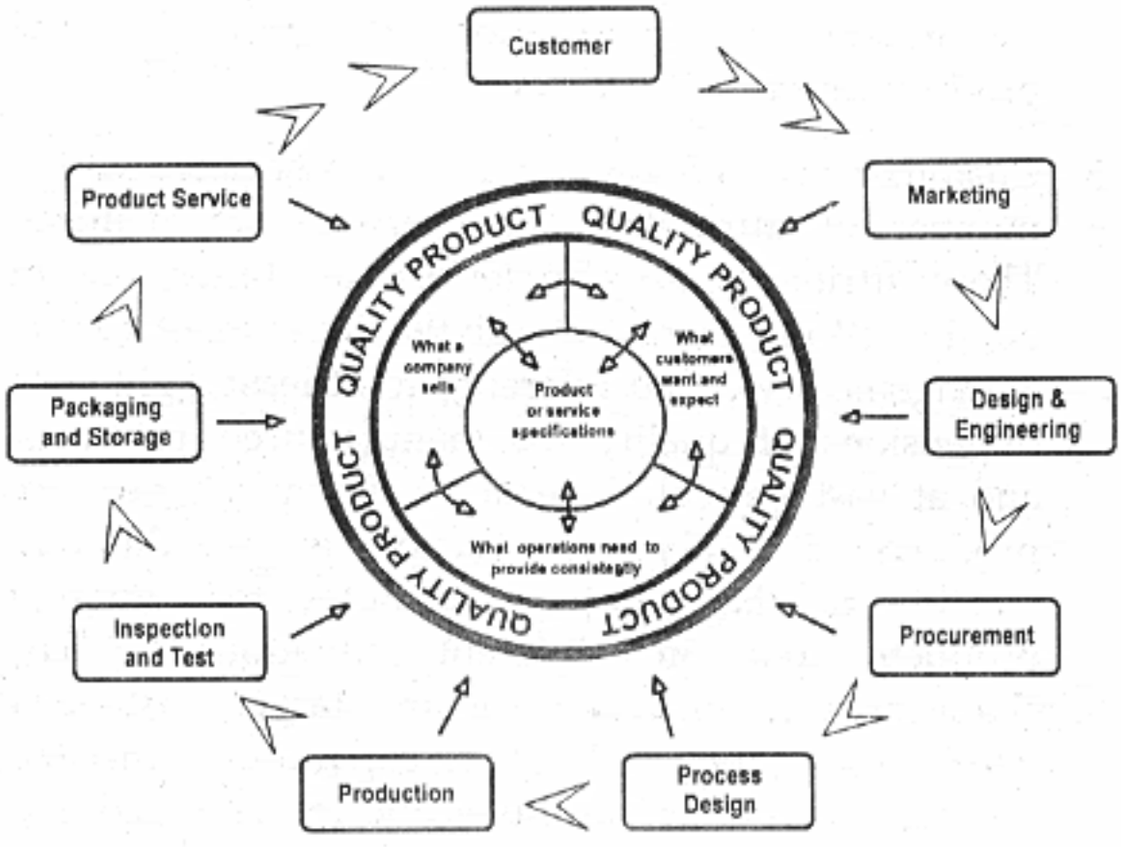


TABLE A.
Eight Dimensions of Quality for Manufactured Products[15].

Dimensions	Brief Explanation.
Performance	Primary product characteristics. Clarity and loudness of sound for a mobile telephone. Sharpness of picture for TV.
Features	Secondary characteristics, less central to user, added features. Storage capacity of CLI device of a mobile telephone. Channel lock system in a TV. set.
Reliability	Probability that the product will not malfunction or fail within a specific, reasonable period. Continuous use without time lost for repair.
Conformance	The degree to which physical and performance characteristics of a product match pre-established standards.
Durability	Useful life, includes repair. The amount of use one gets from a product before it physically deteriorates or until replacement is preferable.
Serviceability	Ease of resolution of problems and complaints. The ability of a product to be repaired quickly and easily.
Aesthetics	Sensory characteristics. How a product looks, feels, sounds, tastes, or smells. Involves customers' subjective judgment.
Perceived quality	Customers' subjective assessment of product resulting from brand name, company's image, past experience of customers with other products of the same company, advertisement etc.

Ten Dimensions of Quality for Services[16].

Dimension	Brief Explanation
Reliability	Consistency of performance and dependability. Performing the right service right the first time. Honoring promises. Accuracy.
Responsiveness	Willingness or readiness of employees to provide service. Timeliness.

Competence.	Possession of the skills and knowledge required to perform the service.
Access	Approachability and ease of access. Waiting time. Hours of operation.
Courtesy	Politeness, respect, consideration and friendliness of contact personnel.
Communication	Keeping customers informed in language they can understand. Listening to customers. Adjusting language to different needs of different customers. Explaining the service itself.
Credibility	Trustworthiness. Believability. Honesty. Company reputation. Personal characteristics of personnel delivering service.
Security	Freedoms from danger, risk, or doubt. Physical safety. Financial security. Confidentiality.
Understanding the customer	Making effort to understand the customer's needs. Learning the customer's specific requirements. Providing individualized attention. Recognizing the regular customer.
Tangibles	Physical evidence of the service. Physical facilities. Appearance of personnel. Tools or equipment used to provide service. Physical representation of the service. Other customers in the service facility.

The tools, techniques, methods and measures used today for quality management activities are result of a gradual and steady evolution rather than a dramatic break through. In order to develop full appreciation of the very recent philosophy of Total Quality Management the evolution from quality inspection to Total Quality Management (hereafter referred to as TQM) is presented below.

Quality Inspection --- Era of Craftsmen.

"Thousands of factories, even today, use testing and inspection of the final product as the sole vehicle for assuring quality".

Tapan B. Bagchi[17].

Craft Era extends from Stone Age when men started making tools from stone for hunting and survival to Industrial Revolution in the second half of 18th century. However, for the purpose of classifying quality management activities the era of quality inspection can be extended upto 1920s when under the influence of *"Taylorism"* the concept of division of labor became popular and modern factory system characterized by mass production came into existence. Even in 18th and 19th centuries, skilled artisan and craftsmen manufactured most of the products. Each craftsman performed all of the manufacturing operations required to produce a product and he was himself responsible for the quality of unit(s) produced by him. In order to ensure that unit(s) produced met its specifications; the concerned artisan himself inspected the quality during all stages of production, and of course ultimate judge was the customer. In most of the post Industrial Revolution industry, the craftsmen working in factories were supervised by masters of the trade, who made formal or informal quality checks after the unit had been produced. Upto early 1800s inspection of quality was limited to subjective evaluation by the inspector.

Here it is pertinent to quote the experiment of *Eli Whitney*, inventor of cotton gin, who in 1787 for the first time applied the concepts of interchangeable parts, division of labor and use of specialized machinery for the production a complicated product i.e. 10,000 flintlock military rifles for the U.S. arsenal. Whitney had considerable difficulty in

making all the parts exactly the same. It took him ten years to complete the 10,000 rifles that he contracted to deliver in two years. As a result of this experience, Whitney and others realized that creating parts exactly the same was not possible and, if tried, would prove to be very expensive[18]. However, from quality control standpoint, *development of jig, fixture and gauge* in early 1800s can be regarded as major breakthrough. .Two inspectors using a gauge were much more likely to reach the same result than two who were relying on personal judgment alone. This added greater legitimacy to quality inspection.

Inspection activities were linked more formally to quality control in 1922, with the publication of G.S. Radford's "The Control of Quality in Manufacturing". The emphasis of the book was on *conformance to specifications and its link with quality inspection.* The book primarily focused on the topics like purpose of inspection, types of inspection, sampling methods, gauging techniques and organization of the inspection department. For the first time, quality was viewed as a distinct management responsibility and as an independent function. The book also touched topics; like quality of design, need of coordination among various departments affecting quality, relationship between quality productivity and cost. These topics are still regarded as central to modern day quality control[19].

Inspection, after the units have been produced, did not prove a satisfactory method of quality control because it implies wastage of resources. In the first instance the resources are employed to produce defective units, then resources are used to detect the defective units and the defective units are either scraped or reworked. All of these activities mean lower efficiency, higher cost, higher price and lower profit, which cannot be allowed in a competitive

environment. Therefore, the emphasis of the quality experts shifted from the detective measures to preventive measures.

Statistical Quality Control.

Prevention is better than cure.

The next development in the realm of quality management came in 1924 when *Walter A. Shewhart,* father of statistical quality control, developed a *Control Chart* at Bell Telephone Laboratories to monitor the units being produced in a process in such a way that production of defective units can be prevented. This technique was termed as Statistical Process Control (SPC). Although SPC relies on the data collected by quality inspection of units but it involves "feedback control" of manufacturing system based on observed deviations.

Later in the same decade *H. F. Dodge* and *H. G. Roming,* two associates of *Shewhart* at Bell Telephone Laboratories, developed a technique of sampling for quality inspection as a substitute for 100% inspection. The technique was termed as *Acceptance Sampling.* Advent of acceptance sampling added to the utility of SPC.

Many SPC methods were subsequently evolved as the outcome of extensive studies of actual production data and measurements obtained in the Western Electric Company's telephone manufacturing factories. How the control charts are constructed and how inferences are drawn from the control charts are explained below to illustrate the nature of SPC.

SPC is based on the assumption that *variability* is basic to any production process. No matter how perfectly a process is designed, there will be some variability in quality characteristics from one unit to the next[20]. Therefore, the

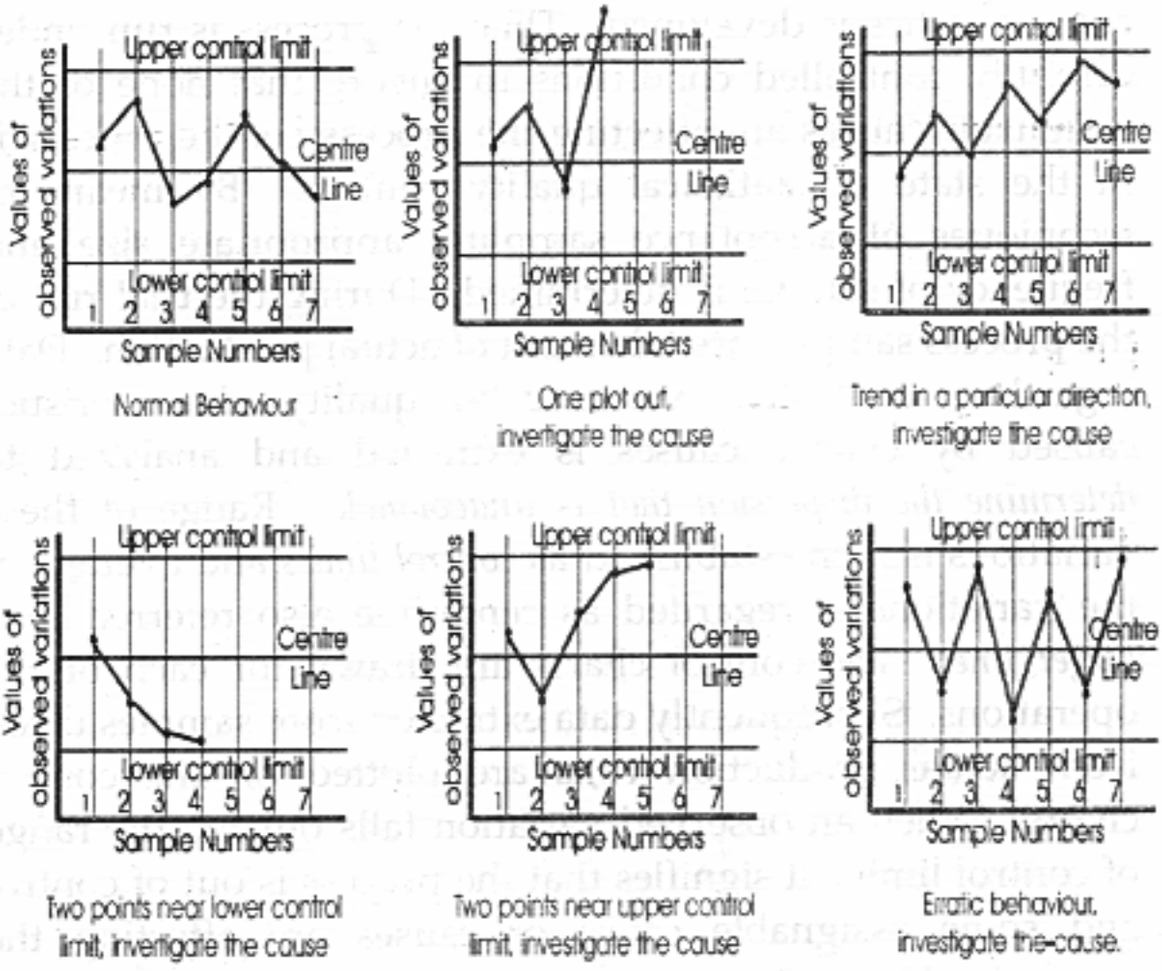
issue is not the existence of variation but to understand and control the causes of variation.

Shewhart classified variations as controlled or uncontrolled. A *controlled variation* is a consistent pattern of variation over time. He believed that the reason or reasons of controlled variation are inherent in the process e.g. in shoes industry the basic input leather being a natural stuff is subject to unavoidable variation of texture, strength, elasticity etc. Shewhart termed such inherent causes of variation as *Random or Chance Causes* and he termed such inherent variation in the process as *Controlled Variation*. Effect of any one of the chance causes on quality of output is relatively small and predictable. It is possible to reduce chance causes behind controlled variation but it is not realistic or cost effective to remove all of them. Shewhart stated, a process that is being affected only by chance causes of variation is said to be in a *state of statistical control*. The second type of variation, i.e. *uncontrolled variation*, is an inconsistent or changing pattern of variation over time that is due to what Shewhart termed as *assignable causes* e.g. defective materials, worn-out tools, untrained worker etc. The assignable causes are of temporary nature and can be completely removed after they have been discovered. Because effects of assignable causes of variation are relatively large as compared to chance causes, therefore, they must be identified and removed. According to Shewhart a process is said to be *out of statistical control* when it is affected by assignable causes. A process can be brought to a state of control and can be maintained there by the use of quality control charts.

In order to exercise SPC, quality control charts are developed for each operation in the process that is likely to be affected by assignable causes. For this purpose all of the quality characteristics that must be controlled to ensure

conformance to the pre-established quality specifications are determined and some objective criteria of measuring these characteristics is developed. Then the process is run under carefully controlled conditions to ensure that none of the assignable causes are affecting the process i.e. the process is in the state of statistical quality control. By means of techniques of acceptance sampling appropriate size and frequency of sample is determined. During the trial run of the process samples are taken out of actual production. Data regarding controlled variance in quality characteristics caused by chance causes is extracted and analyzed to *determine the dispersion that is unavoidable.* Range of these variations is then established as *control limits* and average of the variations is regarded as centerline also referred to a *target line.* The control charts are drawn for each of the operations. Subsequently data extracted from samples taken from actual production runs are plotted on the control charts. When an observed variation falls outside the range of control limits, it signifies that the process is out of control and some assignable cause or causes are affecting the process. The assignable cause is detected and corrected which brings the process in the state of statistical control and the process is run again. How the control charts look like and how inferences are drawn is illustrated in figure No. 3 below[21].

Fig. 3. CONTROL CHARTS, INFRENCES TO BE DRAWN



Techniques of SPC are prone to at least two types of *sampling errors*. First one is that a sample from actual output of a process may lead to the conclusion that the process is out of control when actually it is not. The second one is opposite to the one that a sample of actual output may lead to the conclusion that the process is in a state of control when actually it is not. Therefore, probability of making each of these errors must be calculated carefully.

Although the statistical techniques were developed in 1924 but these techniques largely remained confined to telephone manufacturing factories of Western Electrical Company. *Edward W. Deming* popularized these techniques

in Japan in late 1940s. About two decades later these techniques got attention of the American industrialists.

Quality Assurance.

"Quality is too important to be left to inspectors".
Lindsay & Petrick[22].

By late 1940s quality control had got full recognition as a separate discipline. However, its methods were mainly statistical and confined to the factory conditions. During the decades of 1950s and 1960s defect prevention got more emphasis as a result of some notable works. In 1951 Joseph M. Juran, introduced the concept of *"costs of quality"*. In 1956 *Armand Feigenbaum* put forth the idea of *"total quality control"*. In 1957, Ad Hoc Group on Reliability of Electronic Equipment of U.S. Defence Department published its report that eventually resulted in the development of branch of *"reliability engineering"*. Lastly the experiment at Martin Marietta Corporation in 1961-62 culminated in *"zero defect"* movement led by *Philip Crosby*. Problem prevention remained the primary goal, but the profession's tools expanded far beyond statistics. The above-noted four developments that collectively constitute the era of quality assurance are briefly discussed below.

Cost of Quality. In order to make the term self-explanatory, it is better to restate the term as 'cost of producing defective quality'. *Juran* classified these costs in four groups. (1) *Prevention Costs* including quality planning, new-product review, training, process planning, quality data, improvement projects. (2) *Appraisal Costs* including incoming materials inspection, process inspection, final goods inspection, quality laboratories. (3) *Internal Failure Costs* including scrap, rework, downgrading, retest, downtime, and (4) *External Failure* Costs including warranty, returned merchandise, complaints, allowances etc. Still there

is another cost of *losing future sales* because quality failure resulted in an unsatisfied customer[23]. First two groups of cost of quality are jointly termed as *Control Cost* and the next two as *Failure Cost*. Total cost of quality can be expressed in the form of following equations.

Total cost of quality = (control costs) + (failure costs)

Total cost of quality = (prevention costs + appraisal costs) + (internal failure costs + external failure costs)

Juran estimated cost of quality for American industry as from 500 to 1000 dollars per productive worker in 1951 and described it as *gold in mine*. Subsequently in 1979 *Crosby* estimated it for United States as 10 percent of sales with range from 5 to 15 percent[24]. Since these figures are equal to profit margins in many companies, the concept "cost of quality" gained attention of managers. Measurement of cost of quality also provides objective data in terms of rupees to decide how much to spend for quality improvement efforts. A manager should continue to invest in quality improvement as long as the reduction in cost of quality is greater than or equal to the investment. Experience of managers over a long time proved that better quality is less costly than inferior goods and services. Moreover, customers want both high quality and low price and businesses need low cost in order to price competitively.[25]

Total Quality Control. *Armand Feigenbaum* in 1956 coined the term "total quality control", although the term became popular in 1980s. In 1983 third edition of his book "Total Quality Control" was published. In his book he argued that in order to produce high quality products, responsibility for quality must be shared and should not rest only with the production people or with quality control function. He suggested a total system approach to the

problem of quality whereby the quality is attended to through all stages of the industrial cycle and the ultimate responsibility for quality lies with top management. He noted that as the product passes from product design to the market, various departments like marketing, engineering, purchasing, manufacturing, shipping, accounting and customer service become involved. Therefore, the responsibility for quality lies on each of the functions and there should be active coordination among them. He stated the control must start with identification of customer quality requirements and end only when the product has been placed in the hands of a customer who remains satisfied. Total quality control guides the coordinated actions of people, machines, and information to achieve this goal[26].

Lindsay & Petrick explain the concept in the following words. "The 'total' in total quality is total in three senses: it covers every process, every job, and every person. First, it covers *every process*, rather than just manufacturing or production, design, construction, R&D, accounting, marketing, repair, and every other function must also be involved in quality improvement. Second, total quality is total in that it covers *every job*, not just those involved in making the product. Secretaries are expected not to make typing errors, accountants not to make posting errors, and presidents not to make strategic errors. Third, total quality recognizes that *each person* is responsible for the quality of his or her work and for the work of the group"[27].

In order to highlight the importance of defect prevention and to provide a measure to quantify the loss caused by not producing the goods right the first time *Feigenbaum* introduced the concept of *"Hidden Plant"*. He defines hidden plant as the proportion of plant capacity that is being used in order to rework unsatisfactory parts. He

estimated it as generally ranging from 15 to 40 percent of the plant capacity.

Reliability Engineering. In 1950s this branch of the discipline emerged as result of unacceptable field failure rate of some complex products. For example, in 1950 only one-third of U.S. Navy's electronic devices were working properly at any given time. A study by Rand Corporation at that time indicated that every vacuum tube the military had plugged in is backed by nine others in warehouses or on order. Moreover, these field failures had their origin mainly in the original product development and design rather than in manufacturing errors. To deal with this new major source of field failures there emerged a new specialty that came to be known as "reliability engineering". The specialists who came to be known as reliability engineers offered to minimize the field failure rates by applying skills in design review, reliability quantification, environmental testing, structuring of reliability data systems etc.[28] Like *Juran* and *Feigenbaum* reliability engineers aim at preventing defects from happening in the first place, however, the basic objective is to assure acceptable product performance over time.

Zero Defects. Zero Defects philosophy, the last significant development in quality assurance era, had its emphasis on management expectations, employees' motivation and human relation aspects of management. In January 1961 Martin Marietta Corporation, Orlando, Florida, accepted the request of U.S. army to deliver the first Pershing missile one month ahead of schedule and the missile should be perfect i.e. with zero defects. At that time *Philip Crosby* was quality manager at Martin Marietta Corporation. Since little time was available for the usual inspection and after-the-fact correction of errors, all employees were asked to contribute to building the missile exactly right the first time.

The result was a big surprise. Within the prescribed time the perfect missile was delivered. After careful review management concluded that the project's success was primarily a result of its own changed attitude: The reason behind the lack of perfection was simply that perfection had not been expected. The one time management demanded perfection, it happened. Later *Philip Crosby* joined ITT and moved up to the rank of vice president of quality control operations. He continued his experiments with zero defects philosophy. In 1979 his book "Quality Is Free: The Art of Making Quality Certain" was published. *Crosby* claimed that perfect quality is both technically possible and economically desirable. After all, if 99.9 percent quality were acceptable, then 16,000 pieces of mail would be lost every hour by the U.S. Postal Service; 22,000 checks would be debited to the wrong bank accounts every hour[29] and a large number of newly born babies will die due to carelessness of nurses every hour.

Era of quality assurance extends to 1980s when the concept of "total quality management" got formalized and quality assurance became an integral part of TQM. Era of quality assurance is also termed as *Era of Quality Gurus*. Apart from Juran, Feigenbaum, and Crosby, mentioned earlier, Kaoru Ishikawa of Japan, Professor Joseph Kelada of Canada, Walter Masing of Germany and Hans Dieter Seghezzi of Switzerland are also professionals of similar status and recognition who contributed to the field of quality assurance. Up till now nothing has been mentioned about *Edwards W. Deming* whose philosophy is the foundation of next development termed as Total Quality Management. He is regarded as *guru* of the *quality gurus*.

To sum up quality assurance means all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given

requirements for quality[30]. Implementing a quality management system in an organization without basic formal quality assurance systems is like trying to run before you can walk.

Total Quality Management.

Total quality management (TQM) is a new term in English vocabulary. What does the term literally means? The term has not been translated into the German language, as a suitable interpretation was not found[31]. It may be considered as the time tested Japanese way of management, a philosophy of doing things. It is a management philosophy that regards quality, i.e. customer satisfaction, as the be all and end all of every activity of the organization, as the obsession of every one in the organization. TQM requires all activities of the enterprise to be managed with the single focus: satisfy the customer. All other objectives of the enterprise ---profits, market share, expansion, improved competitive position, capital productivity, cost reduction etc.--- follow as its consequence[32]. Here the term customer is used in a broader sense to include an internal customer also. Internal customer means, the next process that uses output of the former process as well as the next person in the process that uses output of the former person in the process. Stitching department of a garments factory is a customer of cutting department, payroll department is a customer of time keeping department. Similarly cashier making payment of wages is a customer of payroll clerk and the worker receiving wages is a customer of the cashier. What does the word 'total' signifies. Firstly, it means a total system approach to quality management. Secondly, it means "total quality" i.e. total customer satisfaction. Japanese regard 'customer satisfaction' as static and non-progressive definition of quality. To them, quality is not only meeting but also exceeding customer expectations. The phrase "total

customer satisfaction" or "total quality" is used to incorporate both meeting and exceeding customer expectations over time, which signifies a need for continuous improvement. Continuous improvement is the main thrust in TQM concept.

TQM is both a philosophy and a set of guiding principles that represents the foundation of a continuously improving organization[33]. TQM emphasizes on objectivity, on fact oriented discussions i.e. statistical process control methods. A myriad of techniques and ideas related to activities of quality control, quality assurance, quality improvements etc. fall under the huge TQM umbrella[34]. TQM theoretically includes all known tools and methodologies of quality improvement programs.[35]. TQM embraces the collection of management theories, approaches, tools and practices that help an organization reap greater profits by increasing product/service quality and decreasing costs, with improvements being undertaken on a continuous basis by everyone[36].

Edwards W. Deming is regarded as father of TQM. Deming's 14 points constitute philosophical foundation of TQM[37]. These points are briefly explained as following:

1. Create constancy of purpose for improvement of product and service. The organization should *constantly strive to improve* quality, productivity, and customer satisfaction to improve performance. Once a company commits to quality improvement it must not permit any change in this focus. The pursuit of short-term profit defeats the constancy of purpose and sacrifices long-term growth. Organizations that change direction in response to every fluctuation and every new opening in the market cannot achieve *competency* that is foundation of excellence. Moreover, continuous improvement is not merely the responsibility of production and marketing departments rather the aim of continuous

improvement should be reflected in all operations, at all levels and in all plans, short, medium and long-term. Quality improvement cannot be bought and installed like a software program, it requires continuous and never ending efforts like the efforts to build a garden.

2. Adopt the new philosophy. It must be recognized by all that *defects are expensive and undesirable.* Defects cause factory rework, spoiled output, returned goods, warranty cost, complaint handling etc. All these things cost money that is ultimately born by the customer, therefore, undesirable. The organizations with defective materials, poor workmanship, and unacceptable delays and mistake cannot survive in competition.

It is a fact that *defects are product of system and not inevitable.* In at least 80% of the cases quality deficiencies are due to defective design, unsuitable materials, poor tools, machine faults inadequate training, unsuitable environment etc. and not due to the workers. Instead of trying to find someone to blame, the management should ponder upon the system to find the real factor responsible for quality deficiency. The variation in the process is the chief culprit of quality deficiency. If you can control the variation, you can keep the defects from happening.

3. Cease dependence on mass Inspection. Quality does not come from inspection but through improving the system. Planning 100% inspection is planning for defects and recognition that the process cannot meet quality specifications. It is not a suggestion to eliminate the inspection but in fact stresses the need for statistical evidence that the causes of defects have been eliminated, not just detected. In other words inspection alone cannot ensure quality unless the quality is designed in the product. How much inspection should be done and who makes the

inspection, it is determined by the method of statistical quality control.

4. End the practice of awarding business on the basis of price alone. The general commercial practice of buying goods and services from the cheapest source should not always be followed. Pressurizing suppliers on price gives them a temptation to manipulate in those areas of quality that are not visible to the buyer. It should be accepted that you cannot get more than what you pay for. Therefore, it is not the initial cost that is important, it is total cost that must be counted. Materials bought at low price may cause a significant loss in the form of "cost of poor quality" simply because the materials were of low quality and caused a significant variation in the process and resulted in large number of defects.

The principle suggests *"Single-source Suppliers"* i.e. to buy goods and services from as minimum number of suppliers as possible, and to cultivate long-term relations with the suppliers. It will result in minimum variation. A material of same specification, when purchased from a different supplier' may cause significant variation in the process, and poor quality. The specifications and performance are not synonymous. *'Statistical assurance of quality'* should be the criteria for the selection of supplier because a supplier who can give a better statistical proof of quality also means that the supplier is more productive and more cost effective.

5. Improve the system constantly and forever. Continuous improvement as a competitive imperative. The *product design* is the area where the greatest potential for improvement often exists. Quality needs to be built in at every stage, starting with design and then by increasing uniformity in the process to reduce the variation. Secondly *waste* must be reduced in every part of the system. All non-value-adding operations must be eliminated. This needs

measuring the process and not the defects. Lastly *using statistical data, adjusting the process and observing the effects* should be considered as a way to improve.

6. Institute Training. The need for training for each member in the organizations should be recognized. Generally organizations make unrealistic assumptions about what people know and what they can do.

7. Adopt and Institute Leadership. Leaders concentrate upon improving the system rather than seeking to apportion blame to individuals. Managers should devote their energies to making improvements, translating vision into action and acquiring in-depth knowledge about the work they supervise, rather than focusing upon outcomes such as "management by objectives' and 'zero defects'[38].

8. Drive out fear. The fear should be equated with loss. Fear inhibits people from taking sensible actions. Fear forces people to concentrate upon satisfying rules and playing the system at the expense of making real contribution. The management should create an environment in which employees are not afraid of reporting problems or recommending improvements. This fear usually results from imagined retaliation that will affect the reporting worker or fellow workers[39].

9. Break down barriers between departments. People in research, design, marketing, procurement, production and other departments must understand each other's problems. Each function must change its attitude from optimizing its own contribution to a team-based approach for corporate advantage. Top management must resolve conflicts between various departments according to the best interest of the whole organization.

10. Eliminate slogans, posters and exhortations. The slogans, posters and exhortations are of no use unless workers are provided with means to achieve the goals.

11. Eliminate numerical quotas. The numerical quotas are often harmful as they are based on average performance. Whereas statistic proves that half of the workers can perform better than the quota, but they will restrict their performance due to peer pressure, and other half of the workers will be struggling to meet quotas beyond their reach which will result in loss of quality and frustrated workers. All of this will lead to loss of potential to continuously improve.

12. Remove barriers to pride in work. Most people want to do a good job but are prevented from doing so by misguided management, poor communication, faulty equipment, defective materials, and other barriers. Managers must remove these barriers to improve quality.

13. Encourage education and self-improvement for everyone. Organizations should encourage and invest not only in job related training but also in education in its broadest sense. Education, which is unrelated to an employee's job, may be the most critical of all.

14. Take action to accomplish the transformation. A proper plan to implement these points should be adopted. It is suggested that the organizations should begin with activities with greatest potential. It is advised that patience is essential because significant improvement may take five years or more. The philosophy should be communicated to everyone in the organization and should be proudly adopted.

CONCLUSION

Deming's theory is in such a sharp contrast to the Western management theory that many of his views become difficult to swallow for people educated in Western system of management. TQM approach requires a different attitude towards different type of workers. Every worker is himself his inspector and it is believed that no one can inspect his work better than he himself. It requires a high degree of self-consciousness, integrity, motivation and pride in work. TQM needs an atmosphere where people are encouraged to disclose problems. The emphasis is not on who and why but on how. Perhaps it is due to this sharp contrast between these two approaches that Americans became interested in TQM philosophy 30 years later than Japanese when Japanese sudden and growing penetration in international market became a threat for U.S. industry. Today even its strong critics regard TQM to be a proven technique to outpace open competition[40]. An article of Harvard Business Review (May-June 1990) comments: "Both the theory and practice of Western management have created a drag on our forward motion. It is the principles of management that are in need of reform[41].

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