



Application of Information Technology in Total Quality Management

DR. MCCHESTER ODOH

Department of Computer Science Michael Okpara University of Agriculture, Umudike, Abia State Nigeria

ABSTRACT:- In industries, even in government and public agencies, the watchword these days is ‘quality’ often heard as ‘total quality’ or ‘total quality management. This phenomenal spread of total quality management (TQM) has generated an ironic controversy. We will call it “TQM” for short. The controversy pits TQM advocates, who see it as a uniquely effective method for improving organizational performance, against opponents, who see it as the latest of many organizational fads. The irony is that the controversy sets advocates of TQM against scholars whose expertise encompasses the very root of the TQM methods. Advocates of TQM have used it to build a position from which they criticize academics for their failure to study TQM. Yet those academics should understand TQM better than the advocates, because TQM employs technical methods scholars have studied for years. Our aim in this paper is to arrive at a common understanding of TQM, highlighting those elements or aspects shared by most or all definitions.

I. INTRODUCTION

Meaning Of Total Quality Management (TQM)

The term “Total Quality Management” means different things to different people. TQM is both a philosophy and methodology for managing organizations. The TQM provides the overall concept that fosters continuous improvement in an organization. The TQM philosophy stresses a systematic, integrated, consistent, organization-wide perspective involving everyone and everything. It focuses primarily on total satisfaction for both internal and external customers, within a management environment that seeks continuous improvement of all systems and processes. It is a long term continuous improvement in product quality covering such areas as cost reduction, reduction in product defect and reduction in production and distribution circle time. It about increasing worker’s empowerment that is, giving every worker adequate training and requisite authority to deal with problems as they arise even if those problems are not primarily within their decision making jurisdiction. Jones, George, and Hill (2000:651) have seen TQM as “a management technique that focuses on improving the quality of an organization’s products and services”. Conceived as an organizational wide program, TQM requires the cooperation of managers in every function of an organization in controlling and continually improving how work is done.

Lewis, Goodman, and Fandt (2002) have said that TQM “focuses on managing the entire organization in the manner that allows it to excel in the delivery of a product or services that meets customers’ needs”. (Nickel, Mchugh, and Mchugh, 1999) see TQM as “the practice of striving for customer satisfaction by ensuring quality from all departments in an organization”. (Stoner, Freeman, and Gilbert, 1999) see TQM as “an organizational culture commitment to satisfying customers through the use of an integrated system of tools, techniques, and training” TQM involves the continuous improvement of organizational processes, resulting in high-quality products and services. TQM is the totally integrated effort in getting competitive advantage by continuously improving every facet of an organization’s activities (Samuel, 1995) defines TQM by looking at each word as:

Total – Everyone associated with the company is involved in continuous improvement (including its customers and suppliers if feasible).

Quality – Customers’ expressed and implied requirements are met fully.

Management – Executives are fully involved”.

According to Kreitner, TQM involves “creating an organization culture committed to continuous improvement of skills, team work, processes, product, services quality, and customer satisfaction. It is not so much a management technique as a whole style of working. It is an approach to improvement which has

established itself because there is a notion in people's mind that the status quo is not sufficient, (Scur, 1999). According to Mac Donald (1995) "TQM is a change agent which aimed at improving customer driven organizations". From the aboved definitions, the TQM philosophy stresses a systematic, integrated and organizational way of life directed at the continuous improvement of an organization. It involves all the people in the decision making process in such a way that, management personnel becomes responsible for managing change and for deciding everything.

Some other scholars have defined TQM as a management strategy for managing quality, it is viewed as a means for attaining an end. According to the international organization for Standardization (ISO) "TQM is a management approach for an organization centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction and benefit to all members of the organization and to the society , ISO8402, (1994). It is the practice of striving for maximum internal and external customer satisfaction by developing and providing them with high quality, high values, wants satisfying goods and services as well as ideas (Nickel et al, 1999). It is a technique that focuses on improving the quality of an organizations product and services. Jones et al (2000). TQM is a comprehensive strategy for managing internal and external quality, the purpose of which is to provide clients with a suitable offer with controlled processes while ensuring that this improvement dose not translate into additional cost. The central focus of TQM therefore is quality which corresponds to the improvement of company's internal operation and employee empowerment. Dean and Bowen (1994) review of TQM literature suggest that its key principles are customer focus, continuous improvement and team work. Each of these principles is then implemented through a series of practice, such as collecting customer's information and analyzing processes, supported by the use of specific quality management techniques such as team building and pareto analysis. According to Oakland (1993), quality is simply meeting the customer requirements. This is expressed in many ways by other authors such as Deming (1982), who says that quality should be aimed at the needs of the consumer, present and future (Feigenbaum, 1991) defines quality as the total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectation of the customer.

Ratti (1992) adds that employee involvement and senior management commitment to these as the principles of TQM, while Hart and Borgan (1992) identify TQM's destruction features as a strong and pervasive customer orientation and an approach of managing quality for competitive advantages. Others emphasize TQM as culture change. Cauldron (1993). Powell (1995) combined the features promoted by Deming, Juran, Crosby and the American afterwards to establish twelve factors: "Committed leadership, adoption and commutation of TQM, closer customers relationship, benchmarking, zero defect mentality, flexible manufacturing process, improvement concept for continuously improving the quality of goods and services delived through the participation of all levels and function" (Stangard and Fiz-Gibbons, 1993) defines TQM as a "self techniques and procedures used to reduce or eliminate variation from a production process or source delivery system in order to improve efficiency, reliability and quality". Oakland (1989) defined TQM as a "way of managing to improve the effectiveness, flexibility and competitiveness of the business as a whole".

However, Hill (1991) claimed that the proponents of TQM have understood the difficulties in getting staff at all levels in the organization to buy into the idea of TQM, and that they focus on too narrow a range levels. Traditionally working practices and management styles may be inconsistent with and resistance to the ideals of TQM, may be encountered into only at shop floor level where it may cut across traditional working and industrial relation practices but also amongst professional, supervisory and management staff.

TQM is an operations management system that creates structures within an organization that ensures satisfaction at every stage from internal and external customers as well as suppliers. It creates quality through continuous improvement development of systems and products by creating an organizational culture of quality. TQM combined with effective leadership results in an organization doing the right thing right, first time. Total quality management (TQM) is a senior management-led company-wide initiative, intended to improve effectiveness and to build quality into the service delivered. Involvement of the whole work force and a commitment to doing the right things correctly are emphasized. The principles apply equally to manufacturing industry and service industry.

These definitions entail that total quality management (TQM) means:

- Intense focus on the customer: Meeting the customers' requirements by satisfying their stated (expressed) and implied needs.
- Concern for continual improvement: TQM is commitment to never being satisfied. "Very good is not good enough". Quality can always be improved.
- Improvement in the quality of every of everything the organization dose: TQM uses a very board definition of quality. It relates not only to the final product but how the organization handles deliveries, how rapidly it responds to complaints, how politely the phones are answered, and the like.

- Accurate measurement: TQM uses statistical techniques to measure every critical variable in the organization's operations. These are compared against standards or benchmarks to identify problems, trace them to their roots, and eliminate their causes.
- Empowerment of employees: TQM involves the people on the line in the improvement process. Teams are widely used in TQM programs as empowerment vehicles for finding and solving problems. Empowerment means increasing the decision-making discretion of workers.

II. REVIEW OF RELATED LITERATURE

Origins of total quality management

The American Walter A. Stewart of Bell Laboratories developed a system of measuring variance in production systems known as statistical process control (SPC). SPC is one of the major tools that TQM uses to monitor consistency, as well as to – diagnose problems in work processes. His student W. Edwards Deming, a mathematical physicist and U.S. Department of Agriculture and Census Bureau research scientist, was hired to teach SPC and quality control to the U.S. Defense industry. These methods were considered so important that they were classified as military secrets known as ZI. After World War II, U.S. occupation forces in conjunction with the Japanese Union of Scientists and Engineers (JUSE) invited W. Edward Deming to lecture throughout Japan on SPC and quality control methodology. Although these teachings were valuable, they were not accepted at face value. The Japanese were quick to adapt and modify Deming's techniques to suit their social background and other circumstances. Even today, the highest award in Japan for quality is named after W. Edwards Deming. Deming received one of Japan's highest awards, the Emperor's medal for his contribution to the economic reconstruction of Japan.

Other Americans, for example, Joseph M. Juran also stressed to the Japanese the importance of involving all departments in the pursuit of quality and the importance of customer satisfaction, rather than simple adherence to technical specifications. Kaoru Ishikawa enlarged the ideas of Juran and Feigenbaum to include as customers, internal customers, those in an organization who depend on the work output of others. TQM today, as practiced in Japan, the U.S. and Europe, is a holistic management philosophy that has evolved over time, not simply a set of specific techniques like SPC, quality circles, and continuous improvement procedures. TQM if implemented correctly, is a fundamental organizational change. www.dti.gov.uk/quality/evolution

III. BASIC PRINCIPLES OF TQM

Total quality management is based on certain principles. These principles appear in different forms. Dean and Brown (1994) identified three (3) main principles

1. Customer Focus: This is the most important principle of TQM. TQM is a customer driven management technique with cardinal objective of ensuring the total customer satisfaction. The goal of satisfying the customer is expressed by the organization in its attempt to design and deliver product, reliability of their product, and cost effectiveness and improved internal operations.

From the point of view of TQM, organization serves two categories of customers, the external customer and the internal customer. The former is the end user of the product while the employee inside the organization who uses the end product or service of another employee as an input for his own work is the internal customer. E.g. manufacturing can be considered the customer of engineering.

TQM focus on improving the lot of both the internal and external customer. The rationale behind this is that, it allows the company to work with its beneficiaries in the best conditions which translates into a relationship of trust and gains that both financial (increased profits, high retention rates, increased market share) as well as personal clarification of roles employee motivation, productivity in terms of quality and quality in nature.

2. Continuous Improvement: TQM is directed at the continuous improvement of the organization. This means a commitment to a continual search for new and better ways of doing things in the organization. It involves planning and operating processes, providing input, evaluating output, examining performances and modifying process includes a series of corrective and preventive actions.

Through the continuous improvement process greater customer satisfaction is attained, its adoption recognizes that quality is a moving target; as a product believed to be reliable today could be of average standard next month. The TQM culture is regardless of how good the present performance is, it can be improved so long as the customer's expectation will continue to rise. TQM emphasize the dynamism of the organization in order to meet dynamic customer needs.

3. Teamwork: Customer focus and continuous improvement can best be achieved by collaboration throughout the organization as well as with customers and suppliers. It involves collaboration between managers and non-manager as well as between functions. The theory of synergy points to the fact that there is increase in output/achievement when two or more factor/sub units are combined that the total of what individuals or sub-

units would have achieved independently. This is the underlying factors to teamwork. According to Scur (1991) working as a team brings benefit that individuals cannot necessarily achieve and maximizes the use of skill resulting in better decision.

Teamwork is based on the notion that the organization as a system cannot be effective if sub-units emphasize their own outcome over those of others. Teamwork practice includes identifying the needs of all groups and organizations involved in decision making, trying to find solutions that will benefit everyone and sharing responsibilities and credits. Clampa (1991) cited in Dean and Bowen (1994).

These three (3) principles related to one another they form the bedrock of total quality management. Teamwork result in continuous improvement which is undertaken to achieve customer satisfaction and is most effective when driven by customer needs.

IV. SEVEN BASIC TOOLS OF QUALITY

According to Kenneth .J. Kiser and Marshall Shaskin, the seven basic tools of quality is designation given to a fixed set of graphical techniques identified as being most helped in trouble shooting issues related to quality. They are called basic because they are suitable for people with little formal training in statistics and can be used to solve the vast majority of quality – related issues. The tools are:

- Control Charts
- Pareto Charts
- Fishbone Diagrams
- Flow Chart
- Scatter Diagrams
- Histogram
- Check Sheet

Control Charts: These charts display the result of statistics process control measures. They show whether produce samples conform to specified limits or tolerances. It gives a clear usual display that quickly tells when a process is “out of control” when random sampling fields measurement above the upper control unit or below, this triggers a search for the cause of the problem. The production process can then be corrected and bought back “unto control”.

Pareto Charts: This is an even simpler tool, used to chart the number of defects or problems of various types in a product over time. A pareto chart can help identify the relatively few categories of causes that account for most problems. The chart can also be useful for identifying points in the production process at which defeats of certain types are most likely to occur.

Fishbone Diagrams: These are also called “cause and effect diagrams” or Ishikawa diagrams. The chart looks somewhat like a fishbone with the problem or defect the – “effect” – defined at the “head”. On the bones growing out of the spine one lists possible causes of production problems, in order of possible occurrence. The chart shows how possible causes occur with respect to one another, overtime, helping start the problem solving process.

Flow Charts: Sometime called input-output charts gives a visual description of the specific steps in a work activity. This is helpful for understanding exactly how things are being done and then determining how a process might be improved. The procedure can be applied to the entire organization to usually track and chart the way the organization operates. Using certain standard symbols to refer to certain types of activities.

Scatter Diagrams: These diagram provide a standard way of showing how one variable, relates to another is a type of mathematical diagram using Cartesian coordinates to display values for two variables for a set of data one of the most powerful aspect of a scatter diagram however is its ability to show nonlinear relationship between variables.

Histograms: it is also known as a “bar chart”. On this chart, the number of products in each “control category” is represented by the length of a bar. Each category is labeled and the bars are placed next to one another horizontally or vertically. This shows which categories account for most of the measured values as well as the comparative size of each category. Histograms give a picture of the actual distribution of measures.

Check Sheet: This is a simple document that is used for collecting data I real-time and at the location where the data is generated. A defining characteristic of a check sheet is that data is recorded by making marks (“check”) on it. A typical check-sheet is divided into regions and made in different regions and have different significance.

V. BENEFITS OF ADOPTING TQM IN ORGANIZATION

Short term and long term benefits are present in any management style. TQM has few short benefits most of its benefits are long term in nature and come into effect only after it is running smoothly. In large organizations it may take several years before long-term benefits are realized. The benefits expected from

adopting TQM are higher productivity, increased morals, reduced costs and greater customer commitment. These benefits may lead to improvement of an organization's public image. Secondly from the financial performance perspective, careful design and implementation of consistent and documented quality management systems can contribute significantly to superior financial performance (Corbet et al, 2005). Lemark and Reed (1997) also claims that had demonstrated a commitment to TQM for at least five (5) years.

Eliminating errors and doing things right the first time saves time and resources. The saving may then be used for expansion of services or machine available to employees in their efforts to increase service quality Simon and Schuster (1990).

Furthermore a firm with an effective TQM implementation can significantly outperform on the stock price performance Handicts and Singhad (2001). According to Anderson et al (1994) and Eklof et al (1999) research has shown that one goal of TQM which is customer satisfaction has a significant positive impact on the market value as well as accounting returns.

Instead of mistake being hidden from management or denied and this being allowed to blossom into large and less easily rectified problems, they are tolerated and employees are encouraged to try again. Hence employers note that when employees feel they are in an integral part of the organization, they feel needed, motivated and enjoy work more which further increases service quality and boost productivity (proceedings of the international multi conference of Engineers and computer Scientist (2009). TQM's extensive use of team work gives employees the experience of problem solving. Finally the adoption of TQM in organization has also helped in reducing failure rate as well as less waste.

VI. METHODOLOGY

How TQM worked in organizations that adopted it

TQM can produce unbelievable results as the following examples below. The reject rate at Bally shoes fell from 2.7-0.3% between 3 years. Lead time from receipt of order to delivery improved from 28-30 days. This followed training in team building, continuous improvement and waste reduction. Using TQM techniques Apex Company has gained annual fuel saving of RS325,000 against management time worth RS 12,000 and a capital investment of RS35,000. The payback was $7\frac{1}{2}$ weeks. Parcel Carrier Company has increased its customer from 62,000 to 105,000 in 4 years. Unit cost have fallen over 5 years, 91% of the company's 600 workers believe that it is committed to developing people.

A car company has increased its sales per employee from 68,000 to 126,000 in 5 years, a success which it attributes to its TQM program, 92% of its employees say they are proud to work for the company compared with 69% 4years previously. The Company landed 30 new cars in 5 years. TQM companies out perform others. A survey by business week magazine showed that leading TQM companies (such as AT & T, Motorola and Federal Express)yielded a return of 89% against the standard and poor 500 index average of 33%, (proceedings of the international multi conferences of Engineers and Computer Sciences 2009, Vol.II).

Why TQM fail in some company

According to Juran (1980), the most frequent reason why TQM programs fail is lack of top management support and commitment. This means, failure of upper management to be personally involved in their company's effort towards quality. There are non delegable authorities that managers often delegate. The CEO should be personally involved by imitating quality programs rather than it is a "get the workers to do it mentally". Dale argues that top managers have to take change personality, lead the process, provide direction, and, exercise forceful leadership including dealing with those employees who disrupt improvement.

A second reason why TQM effort fails is because they are mounted as a stand-alone program unconnected to marketing strategies. Rigidly and narrowly applied and expected to produce a miraculous transformation of the company (Lewis, P.S. Goodman, S.H. and Fandt, P.M. (2002).management challenges in the 21st century. Another reason why TQM programs fails is lack of genuineness of the organizations commitment. Often time companies look at TQM as another business change that must be implemented due to the market pressure without reality changing the values of the organization. According to Ahire and O'shaighnessy (1998), companies with high to management commitment have the ability to produce high quality products in contrast with firms with low top management support.

TQM program also fail because they are often not customer focused but rather run as internal programs by technocrats. Ultimately the business must be designed around the goal of customer satisfaction. Every employee serving the customer or assisting those who serve the customer must view every activity, every procedure and every process through the perspective of "how close this contribute to serving the customer". Lastly, according to Haria (1993), inadequate resources for TQM to ensure meaningful changes in the system could also be a reason why TQM programs fail.

VII. STEPS NECESSARY TO MAKE TQM WORK

According to Greg Bounds, Lyle Yorks, Mel Adams, Gipsie Ranney (1994), steps necessary to make TQM work are:

- 1. Build Organizational Commitment to Quality:** Beyond Total Quality Management (TQM) will do little to improve the performance of an organization unless all employees embrace it, and this often requires a change in an organization's culture. The need to engineer a cultural change must be at the forefront of management thinking when managers introduce TQM
- 2. Focus on the Customer:** TQM practitioners see a focus on the customer as the starting point. According to TQM philosophy, the customer, not managers in quality control or engineering "defines" what quality is.
- 3. Find Ways to Measure Quality:** A crucial element of any TQM program is the creation of a measuring system that managers can consistently use to evaluate quality. Devising appropriate measures is relatively easy in manufacturing companies where quality can be measured by criteria such as defects per million parts. It is more difficult in services companies where outputs are less tangible but with a little creativity, suitable measures can be devised.
- 4. Set Goals and Create Incentives:** Once a measure has been devised, managers next step is to set a challenging quality goal and to create incentives for teaching that goal. One way of creating incentives to attain a goal is to link rewards such as bonus pay and promotional opportunities to the goal.
- 5. Solicit Input from Employees:** Employees can be major source of information about the sources of poor quality. Therefore it is important for managers to establish a framework for soliciting employee suggestions about improvements that can be made.
- 6. Identify Defects and Trace them to their Source:** A major source of product defects is the production system. TQM preaches the need for managers to identify defects in the work process, trace those defects back to their source, find out why they occurred and make correction, so that they do not occur again. To identify defects. Deming advocates the use of statistical procedures to spot variations in the quality of goods or services (planning and control).
- 7. Introduce First-in-Time Inventory System:** Just-in-time inventory system, parts or suppliers arrive at the organization when they are needed, not before.
- 8. Work Closely with Suppliers:** To decrease product defects, managers must work closely with suppliers to improve the quality of the parts they supply.
- 9. Design for ease of Manufacturer:** The more steps that are required to assemble a product, the more opportunities there are making a mistake. It follows that designing products that have fewer steps are easier.

FUNCTIONS OF THE TQM MANAGER

- To make everybody in the organization conscious of the need to consider quality in all the processes.
- To familiarize employees with the technique for identifying and analyzing problems as well as finding solutions to them.
- The TQM manager also encourages the formation of quality groups within the organization that will help in problem solving.
- TQM manager is seen as the facilitator of work process.
- Lastly the TQM manager coordinates all the process related to quality improvements.

VIII. CONCLUSIONS

TQM and organizational culture

From the literature, the conclusion is that TQM implies an open management style with devolution of responsibility. According to Gbodimowo (1997), TQM arose out of the need by private sector organizations for improvements in the quality of products and services they were rendering to customers in order to stay ahead of competition. He reported that "it is widely believed that the origin of TQM in American, although the profound application of the concept took place in Japan". Some of the early proponents of the concept identified by him include Joseph Juran, Edwards Deming, Philip Crosby and Kaoru Ishikawa.

TQM aims at developing a quality culture whereby everyone in the organization shares a commitment to continuous improvement aimed at customer satisfaction. However, according to an institution of personnel management studies by Williams (1991), "Despite the growing awareness of cultural issues, comparatively little attention has been paid to the practical, day to day process involved in creating, managing and changing organizational culture". Furthermore, much of academic literature emphasizes the difficulties in changing organizational culture, and in recent years, there has been intense debate in the literature on the issue of culture can be managed? Williams (1991), Ogbonna (1992), Edger Scheri (1985) sees culture as very deep seated, consisting of three levels.

First, artifact and creation are the visible environment and behavior of people in the organization, including such things as layout of offices, dress norms, and the way in which people in the organization express and deal with disagreements. On the second level, the literature identified the “values” of an organizations’ view on what ought to be and how things should be done. Such values often emerge early in the life of an organization, or when it faces a novel challenge, and will gain acceptance and be incorporated into the culture of the organization to the extent that they provide workable solution to the problem the organization faces. The third level of culture in TQM culture is that which operates at the preconscious level. Scheme’s account thus underlines the complex nature of organization culture and counsels against the view that is something which can be easily manipulated by management.

- Mayerson and Matri (1987) point to the existence of sub cultures and competing occupational cultures, influenced by factors both internal and external to the organization questioning the motion of single, shared culture which is easily manipulated by management. The culture literature, then suggests a complex and far-reaching agenda for the implementation of TQM, encompassing management style, human resource policies and the work environment generally.

TQM AND SIX SIGMA

Six sigma is a relatively new concept as compared to TQM, however when it was conceptualized it was not intended to be a replacement for Total Quality Management (TQM). Both six sigma and TQM have many similarities and are compatible in varies business environments, including manufacturing and service industries. While TQM has helped many companies in improving the quality of manufactured foods, Six Sigma has the potential of delivering even shaper result.

Comparisons to Six Sigma

In comparison, six sigma is more than just a process improvement program as it is a concept that focus on continuous quality improvements for achieving near perfect by restricting the number of possible defects less than 3.4 defects per million. Although both six sigma and TQM help in improving quality they often reach a stage after which no further quality improvement can be made. Six Sigma on the other hand is different as it focuses on talking quality improvement to the next level. Six Sigma is a business improvement approach that seeks to find and eliminate causes of mistakes or defects in business processes by focusing on process output that are of critical importance to customers, Snee (2004). The basic difference between six sigma and TQM is the approach, while TQM views quality as conformance to internal requirements, six sigma focuses on improving quality by reducing the number of defects.

REFERENCE

- [1]. Armand V. Feigenbaum (1991), Total Quality Control, 3rd Edition, McGraw-Hill, New York.
- [2]. Beat. A Custom Publication for Unilever Central Africa.
- [3]. Crosby, P.B. (1979), Quality is free; The art of making Quality Certain. New York: McGraw-Hill.
- [4]. Deming, W.E. (1986), Out of Crisis, Cambridge, Massachusetts, MIT.
- [5]. Greg Bands, Lyle Yorks, Mel Adams & Gipsie Ranney (1994), Beyond Total Quality Management. New York: McGraw-Hill.
- [6]. Johnson, W.C. and Chvala, R.J. (1991) Total Quality in Marketing, New York: SI Lucie press.
- [7]. Jones, G.R., George, J.M. and Hiu, C.W.L. (2000), Contemporary Management. 2nd Ed. Boston: Irwin McGraw-Hill.
- [8]. Juran, J.M. (1988), Juran on Planning for Quality. New Delhi: Total McGraw-Hill.
- [9]. ISO (1994). ISO 9000: (1994) Quality Management Standard. International Organisation for Standardizing, Geneva.
- [10]. Lewis, P.S. Goodman, S.H. and Fandt, P.M. (2002), Management Challenges in the 21st Century. Minneapolis: West Publishing Company.
- [11]. Marshall, S. & Kenneth, J.K. (1992), Total Quality Management, Maryland: Ducochon Press.
- [12]. Nickels, W.G., McHugh, J. and McHugh, S.M. (1991), Understading Business, 5th Ed. Boston: Irwin McGraw-Hill.
- [13]. Oakland, J.S. (1993), Total Quality Management, 2nd Edition, Butterworth Heineman, Oxford, United Kingdom.
- [14]. Proceedings of the International Multiconference of Engineers and Compputer Scientist (2009). Vol.II.
- [15]. Stoner, J.A.F., Freeman, R.E and Gilbert, Jr. D.R. (1999), Management. Sixth Edition. New Delhi: Prentice Hall of India.
- [16]. Samuel K.H.O.(1995), TQM an Integrated Approach. London: Kogan page Limited.
- [17]. TQM and Organizations Development, <http://www.improve.org/tqm.html>
- [18]. www.dti.gov.uk/quality/tqm
- [19]. <http://www.sixsigmaonline.org>
- [20]. www.dti.gov.uk/quality/evolution
- [21]. <http://en.wikipedia.org/wiki/sevenbasictoolsofquality>
- [22]. <http://www.pmhut.com/sixsigma-ustotal-quality-management>
- [23]. www.qualityassurancesolutions.com/tqm
- [24]. www.wiley.com/college/sc/reid/chapt5.pdf