International Journal of Engineering Research and Development
e-ISSN: 2278-067X, **p**-ISSN: 2278-800X, www.ijerd.com
Volume 8, Issue 3 (August 2013), PP. 07-13

Empirical Research on TQM Practices of Organizations – Development and Validation of Critical Factors & Comparison of Manufacturing and Service Organizations

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Abstract:- Total Quality Management (TQM) is an integrative management philosophy aimed at continuously improving the quality of products and processes to achieve customer satisfaction. The objective of this paper is to describe an empirical research on the development of a tool to measure the quality management in different organizations. It provides empirical evidence on top management's awareness and understanding of the quality management and its role towards business survival and competitiveness. Through a detailed analysis of literature, this paper identifies thirteen critical factors of quality management .Using a survey of twenty organizations, the critical factors are empirically tested and validated. SPSS is used for this purpose. This provides reliable and valid critical factors of total quality management and develops a measurement instrument for evaluating the TQM implementation process and to target improvement areas. In this paper, we compare the quality management practices between Indian manufacturing and service organizations based on the survey of 104 organizations by using non parametric test. The results presented here are focused on thirteen critical factors of quality management. The study shows significant differences between manufacturing and service organizations with manufacturing organizations performing better in quality management practices. Opportunities for improving quality management practices in Indian service organizations were identified.

Keywords:- Total quality management (TQM), Reliability,Validity,Internal consistency method, Factor analysis, Multitrait multimethod matrix (MTMM),Mann Whitney U Test,Non parametric test .

I. INTRODUCTION

Total quality management (TQM) allows firms to obtain, on the one hand, a high degree of differentiation, satisfying customer's needs and strengthening brand image, and on the other, to reduce costs by preventing mistakes and waste of time and by making improvements in the corporation's processes. In this respect, both researchers and managers have been interested in studying quality management, and identified a number of elements for a successful implementation. Thus, various studies have been carried out for the identification of those critical factors ensuring its success, as a way to develop a theory of quality management from three different areas: contributions from quality leaders (Crosby, 1979; Deming, 1982; Ishikawa,1985;Juran, 1988; Feigenbaum, 1991), formal evaluation models (European Quality Award, Malcolm Baldrige National Quality Award, The Deming Award) and empirical research (Saraph, Benson and Schroeder, 1989; Flynn, Schroeder and Sakakibaru, 1994; Badri, Davis and Davis, 1995; Ahire, Golhar and Waller, 1996; Black and Porter, 1996; Grandzol and Gershon, 1998; Quazi *et al.*, 1998) [2].

Thus, managers need to understand what elements are necessary in order to change a firm's culture towards a quality culture. Starting from a review of these studies, the purpose of this paper is to contribute to: a) identify critical factors of total quality management b) developing measures for change towards a quality culture c) testing these measures for reliability and validity using data collected from different organizations by using a suitable questionnaire and d) evaluate the performance of manufacturing and service organizations.

Global competition and increasingly sophisticated and demanding customers are two important factors that are driving organizations around the world to create, develop and sustain higher levels of quality. In this study the similarities and differences of quality management practices of manufacturing and service sectors were analyzed. The experience and strength in the quality management of the manufacturing sector can prove to be valuable to improve quality management in the service sector.

II. CRITICAL FACTORS OF QUALITY MANAGEMENT

The companies should develop a number of TQM constructs in an integrated way for successful quality management implementation. The theory of quality management has been studied from different areas: quality leaders' ideas, empirical research and formal evaluation models. This has helped to identify a set of critical factors for a successful implementation, as a way to improve customer satisfaction and performance. Through a

detailed analysis of literature, this paper identifies thirteen critical factors with eighty five items for the successful implementation of TQM.

Table I: Critical Factors of Quality Management

Critical Factors	**Significance of Critical Factors**
Leadership and top management commitment	Management's commitment to quality through communication and motivation of employees. The behavioural patterns which show senior management's personal involvement in the quality improvement process, acceptance of responsibility for quality performance, visibility in developing and maintaining an environment of organizational quality excellence and sharing the vision and quality goals with the entire company.
Customer focus	Increasing contacts between the organization and customers, identifying their requirements, assessing their satisfaction and supporting activities improving customer satisfaction.
Supplier quality management	Relation with suppliers in order to find the quality specifications demanded by the firm.
Continuous improvement	Indicates whether the firm has created an organizational structure (quality committee, a person in charge of quality and work teams) responsible for this improvement by identifying actions through information management.
Employee involvement	Employees, if they fully participate in quality improvement activities, will acquire new knowledge; realize the benefits of the quality disciplines; and obtain a sense of accomplishment by solving quality problems. Cross-functional quality improvement teams and quality circles, along with an appropriate evaluation and reward system for quality improvement projects, are helpful for improving quality Employees should be encouraged to submit suggestions and ideas for quality improvement.
Rewards and recognition	Companies must develop formal systems to encourage, track, evaluate, reward and recognize the individual or team effort for quality enhancement and improved customer satisfaction. Employees should be made aware of the reward and penalty system.
Education and training	Measures whether the firm shows an interest in employees learning about all the basic aspects of the firm and its business by encouraging continuous learning. It should also include training in problem-solving and teamwork.
Strategic quality planning	The integration of quality management and customer satisfaction in the organizational strategic and operational plans, the organization's long-term quality vision, and the deployment and understanding of quality goals and policy within the organization
Process management	Reflects how the organization controls and improves its processes by setting quality measures (level of customer satisfaction, quality cost).
Product innovation	Customer requirements should be thoroughly considered for product innovation. Approaches such as quality function deployment, and experimental design help companies translate customer requirements into action by cross functional product innovation teams.
Quality information and analysis	The availability of quality-related data, timeliness of quality-related data, and the usage of quality-related data at all levels in the organization
Quality assurance	Sound procedures for design and introduction of new or improved products and services. Design of process that meets and exceeds product/service quality requirements. Error and failure prevention activities along the value-added chain.
Quality citizenship	Consideration for public health, safety, and environmental issues as company's responsibility. Extension of company's quality leadership to the external community.

III. DEVELOPMENT AND VALIDATION OF CRITICAL FACTOR USING PILOT STUDY

Based on a review of TQM literature and expert opinions, thirteen TQM critical factors were identified. A detailed questionnaire was developed with the items for thirteen TQM factors along with the questions on quality performance and information about the respondents. The questionnaire was then sent to randomly selected manufacturing and service organizations in India. Based on the data from the survey, reliability and validity of the questionnaire was determined. Internal consistency analysis was done to ensure the reliability of the constructs. Content validity and construct validity were evaluated statistically to ensure that the set of measures correctly represents the constructs, and the degree to which they are free from any systematic or non-random error.

A. Data Collection

In order to achieve the objective different manufacturing and service organizations working in India was considered as the population. While the database was being selected, a questionnaire was designed meeting the objectives that had been set. Based on the review of literature thirteen critical factors were identified, but it can't measure directly. So to measure how the TQM is implemented in organizations indirectly a questionnaire was developed with 101 items covering different factors. Following the methodology adopted in similar studies (Ahire et al., 1996), a seven-point likert scale was used for all items to ensure higher statistical variability among survey responses. Items of all the constructs were measured as: 1 – strongly disagree, 2 – disagree, 3 – somewhat disagree, 4 – neutral, 5 – somewhat agree, 6 – agree, 7 – strongly agree [3]. Experts on the subject were consulted, to ensure that the questions were properly phrased, and the suitability of the questionnaire was tested on a sample of firms. The process of developing the questionnaire finished with a pilot survey, which was used to modify and eliminate a number of variables, until the final questionnaire was designed. Finally the questionnaire was developed with eighty five items covering domains of each factor. The data collected from twenty different organizations were used to test the reliability and validity of tool developed. The data were collected by means of personnel interview and based on a closed questionnaire plus a set of open questions to clarify certain points. The questionnaire was answered by employees who have thorough knowledge about the quality practices implemented in the organization.

B. Reliability

Reliability is the ability of the instrument to measure consistently. As the internal consistency method is the most general form of reliability estimation (Nunnally, 1978), it has been used in this study. The internal consistency method assesses the equivalence, homogeneity and inter-correlation of the items used in a measure. The most popular test within the internal consistency method is the Cronbach's coefficient α (Nunnally, 1978; Cronbach, 1951). Cronbach's α computes internal consistency reliability among a group of items combined to form a single scale. It can also be computed for any subset of items. Nunnally (1978) advocates that new developed measures can be accepted with Cronbach's α of more than 0.60, otherwise 0.70 should be the threshold. The measure with Cronbach's α 0.80 or more is significant and reliable [3]. For this purpose, the reliability for each set of items of the thirteen critical factors of TQM is calculated by using SPSS.Table 2 summarizes the Cronbach's α for individual critical factors. The Cronbach's α for the thirteen critical factors ranged from 0.9511 to 0.9908 indicating a high reliability of the instrument.

Table II: Internal Consistency Method (Cronbach's Alpha (α)) Using SPSS

Factor	**No: of Items**	**Cronbach's Alpha (α)**
Leadership and top management commitment	7	.9707
Customer focus	7	.9917
Supplier quality management	5	.9511
Continuous improvement	7	.9609
Employees involvement	8	.9777
Rewards and recognition	4	.9700
Education and training	9	.9908
Strategic quality management	7	.9633
Process management	7	.9693
Product innovation	5	.9612
Quality information and analysis	6	.9674
Quality assurance	7	.9807
Quality citizenship	6	.9646

C. Validity

The validity of a measure is defined as the extent to which a construct or a set of measures correctly represents the concept of study, and the degree to which it is free from any systematic or non-random error. Validity is concerned with how well the concept is defined by the measure(s), whereas reliability relates to the consistency of the measure(s).

Content validity: A measure has content validity if there is a general agreement among the subjects and researchers that the instrument has measurement items that cover all aspects of the variable being measured. The thirteen critical factors for measuring TQM implementation should have content validity, as the measurement items were developed based on both an extensive review of the literature and detailed evaluations by academicians and practicing managers. Moreover, the pre-test subjects indicated that the content of each critical factor was well represented by the measurement items employed.

Construct validity. A measure has construct validity, if it measures the theoretical constructs that it was intended to measure. Factor analysis can be used for evaluating construct validity. Factor analysis helps to analyse the interrelationships among a large number of variables and explains these variables in terms of their common underlying dimensions (constructs). It also helps reduce data that do not correlate with any of the underlying dimensions. This measurement is calculated through a factor analysis for each of the thirteen factors. In this analysis, each factor must be one dimensional. Hence the developed tool is found to be valid. The summary of factor analysis of each measure is shown in Table III.

Table III: Summary of Factor Analysis for Each Measure

Construct	**KMO**	**Item Loading Range for Factor 1**	**Eigen Value**	**Percentage Variance Explained by Factor 1**
Leadership and top management commitment	.617	.82-.97	6.037	86.239
Customer focus	.799	.95-.99	6.670	95.288
Supplier quality management	.805	.89-.96	4.189	83.786
Continuous improvement	.766	.80-.95	5.706	81.518
Employee involvement	.796	86-.97	6.969	87.107
Rewards and recognition	.853	.93-.97	3.677	91.924
Education and training	.784	.95-.97	8.394	93.271
Strategic quality planning	.909	.69-.97	5.992	85.605
Process management	.767	.81-.98	6.059	86.559
Product innovation	.722	.89-.97	4.350	86.999
Quality information and analysis	.704	.89-.97	5.220	87.002
Quality assurance	.715	.91-.97	6.289	89.838
Quality citizenship	.668	.85-.96	5.131	85.516

The construct validity is also determined by using multitrait multimethod matrix (MTMM). Multitrait multimethod matrix analysis allows us to detangle correlations between instruments due to similarity of test methods form and similarities due to tapping the same attribute. The MTMM is simply a matrix or table of correlations arranged to facilitate the interpretation of the assessment of construct validity. The basic principle of MTMM matrix is coefficients in the reliability diagonal should consistently be the highest in the matrix. The intra attribute correlation (correlation between the items of same attributes) are to be higher than the inter attribute correlation (correlation between the items of different attributes). The average inter attribute and intra attribute correlations are given in Table IV.

Table IV: Average Inter Attribute and Intra Attribute Correlations

Critical Factor	**Intra Attribute Correlation**	**Inter Attribute Correlation**
Leadership and top management commitment	0.843	0.697
Customer focus	0.922	0.700
Supplier quality management	0.866	0.586
Continuous improvement	0.831	0.640
Employee involvement	0.892	0.729

Rewards and recognition	0.926	0.703
Education and training	0.929	0.581
Strategic quality planning	0.869	0.593
Process management	0.876	0.704
Product innovation	0.891	0.460
Quality information and analysis	0.887	0.689
Quality assurance	0.908	0.734
Quality citizenship	0.873	0.671

IV. ANALYSIS OF QUALITY MANAGEMENT PRACTICES OF MANUFACTURING AND SERVICE ORGANIZATIONS

The final reliable and valid questionnaire was used to collect data from different organizations in India to analyze the quality management practices. Based on the survey of 104 organizations, the quality management practices were evaluated using non parametric test.

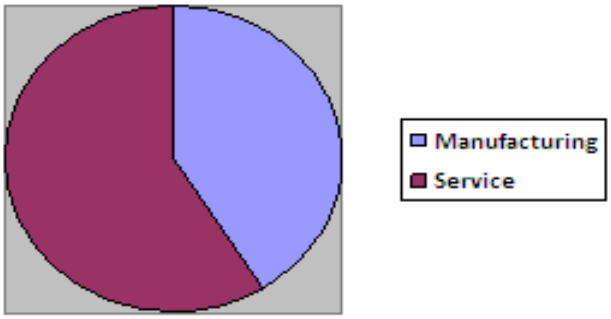

Fig.1: Manufacturing and Service Organizations

A. Non parametric test

A non-parametric statistical test is a test whose model does NOT specify conditions about the parameters of the population from which the sample was drawn. It does not require measurement so strong as that required for the parametric tests. Most non-parametric tests apply to data in an ordinal scale, and some apply to data in nominal scale. In this study, we compare the quality performance of manufacturing and service sectors. The Mann-Whitney *U* test or Mann-Whitney-Wilcoxon rank sum test is used to evaluate the significant differences between two independent groups. The Mann-Whitney *U* test or Mann-Whitney-Wilcoxon evaluates whether the medians on a test variable differ significantly between two groups. To conduct the Mann-Whitney *U* test, each case must have scores on two variables, the grouping variable (independent or categorical variable) and the test variable (dependent or quantitative variable). The grouping variable divides cases into two groups or categories, and the test variable assesses individuals on a variable with at least an ordinal scale. Unlike its parametric counterpart, the t test for two samples, this method does not assume that the differences between the samples have normality distributed, or that the variances of the two populations are equal. In this study the null hypothesis of Mann Whitney U test is that both manufacturing and service sectors have same quality management practices. If the asymptotic significance is less than or equal to the significance level, then there is significant differences between quality management practices of manufacturing and service organizations. The result of this test is shown in Table V.

Table V: Mann Whitney U Test

Critical factor	**Mann Whitney U**	**Asymptotic Significance**
Leadership and top management commitment	1305.0	0.918
Customer focus	918.0	0.004
Supplier quality management	846.0	0.001
Continuous improvement	1030.5	0.036
Employee involvement	1280.5	0.783
Rewards and recognition	1181.0	0.342
Education and training	1221.0	0.485
Strategic quality planning	1252.5	0.633

Process management	1206.0	0.436
Product innovation	1117.5	0.169
Quality information and analysis	1275.5	0.761
Quality assurance	1236.5	0.564
Quality citizenship	978.5	0.019

According to Mann Whitney test, obtained a result that manufacturing organizations have better quality practices in the following constructs.

a) Customer focus

The result show that manufacturing organizations excel over service organizations in the following customer orientation features:

- Building and maintaining relationship with customers to retain the customers and building their market share.
- Meeting the requirements and trying to exceed the expectations of customers in every life cycle of product.
- Determining satisfaction level of customer and compare it with the competitor and bench markers.
- Following up with customers on the quality of product, customer support, after sales service to receive immediate feedback.
- Effectively making use of the voice of the customer data and information (including complaints) to develop operational and strategic quality plan and for product innovation.
- Adopting new strategies to improve company responsiveness to customer's complaints

So the service companies need to adopt new strategies to improve company responsiveness to customer's complaints. One of the success factors in service sector is the ability to meet the customer expectations and respond faster to customer complaints and concerns.

b) Supplier quality management

- Manufacturing organizations ensure that supplier selected are qualified and positioned to enhance performance and customer satisfaction and
- Continuously evaluate supplier performance and discard poorly performing suppliers.

c) Continuous improvement

- Manufacturing organizations identifies the importance of continuous improvement of all of its products, processes and services.
- By self assessment activities and creating an organizational structure, they identified areas and actions for improvement through information management.

d) Quality citizenship

- Manufacturing companies exhibiting higher levels of community involvement through quality, and higher levels of responsibility for different social concerns than service companies.
- They concerned about the impact on society due to the current and future product and process.
- Pay attention to the workforce environment ,their safety
- Government rules and regulations and certain safety standards are followed by manufacturing sectors.
- Sustainable environment is also considered as factor in making their quality policies (including optimum use of natural resources).

Service companies need to extend their quality leadership to their surrounding community. Companies that are socially responsible for the impact they have in the community reinforce their quality image and build a path for customer's loyalty.

V. CONCLUSIONS

The research develops an empirically based instrument for measuring the TQM implementation in different organizations in India. This study provides thirteen critical factors of TQM as a model allowing managers to have a better understanding of quality management practices. By periodically using this model, it may serve to evaluate a firm's quality standards, finding those areas where improvement is necessary and, therefore, planifying the quality management effort.

From the detailed analysis of comparison of individual items of the quality practices, we find that service organizations can learn from the experience of top quality performers in the manufacturing sector. In this study we found that manufacturing companies outperform service companies in almost all quality factors. That manufacturing companies excel service organization shows that it takes time to develop both a strong quality and a customer orientation culture successfully. However, service companies in India can accelerate their quality implementation process and learning by benchmarking the quality practices of top quality manufacturing companies.

ACKNOWLEDGMENT

Gratitude goes to the employees of different organizations for their immense contribution towards this research.

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