

# Methodology for Assessing TQM Practices and Critical Factors Affecting Quality Performance in Construction Industry

Gowthami Vidya G  
PG Student, Civil Engineering  
NMAMIT, Nitte  
Karkala, India

Roshan Rai  
Assistant Professor, Civil Engineering  
NMAMIT, Nitte  
Karkala, India

**Abstract**— The paper presents the methodology for assessing the present Total Quality Management (TQM) practices and also the Critical Success Factors (CSFs) in the implementation of Total Quality Management (TQM) in construction industries. A detailed review of literature has been carried out to understand various concepts of Quality Management and also to identify the factors affecting Quality performance, which were then used to develop a questionnaire. The research methodology adopted for assessing data is questionnaire survey.

**Keywords**—Construction Industry; Total Quality Management; Critical Success Factors;

## I. INTRODUCTION

### A. Background to the Study

Worldwide competition has increased as countries increasingly embrace the free market model and open up their borders for external investments and trading. To stay competitive, companies have to focus their business strategies on strategic advantages through the enhancement of business excellence and performance. Quality management provides an effective approach to achieving this goal. Companies are determined to adopt and implement different forms of quality management systems such as International Organization for Standardization (ISO), British Standards (BS) and Total Quality Management (TQM). Quality-based companies have become highly regarded and attract more customers through the provision of higher quality services and products when compared with non quality-based companies

Total Quality Management is a quality management system which pursues excellence in customer satisfaction through continuous reviews and improvement of products and process by the total participation and commitment of everyone involved in the process or the products. When applied efficiently, TQM enables a company to improve long-standing relationships, build a satisfying team spirit, improve professionalism and skills in all areas of the business sector, promote open addressing of troubles and help to attain the designed project objectives and benefits.

### B. General

Quality professionals use various definitions to define project quality. Quality in its simplest form can be defined as: 'meeting the customer's expectations,' or 'compliance with customer's specification.' No matter what definitions we follow for quality, it becomes very difficult when we try to put

it into real practice. For a customer, quality is nothing but satisfaction with the appearance, performances, and reliability of the project for a given price range. Quality management is critical elements of successful management of construction projects. Construction industries must generate high quality products consistently and which are satisfy to their customers/clients.

## II. OVERVIEW

### A. Problem Statement

Studies on quality management in construction industries and on projects in developing countries like India are limited and as such relatively limited research has been dedicated to studying the factors that affect the success of quality management and successful implementation of TQM. This study finds to fill this research gap by identifying and the critical success factors that affects the quality performance and suggests ways to improve the quality performance in construction projects for an effective Total Quality Management implementation in construction industry in India. Thus if TQM has been implemented in construction industry and are resulting into huge benefits, then its implementation in the construction industry in India will improve quality practices and promote continuous improvement and hence, effective quality management system which will direct them in achieving quality in their things, amenities and higher organisational performance.

### B. Objectives of the Study

The specific objectives of the study are,

- To identify current quality management practices in the Construction industries.
- To determine critical factors affecting TQM in construction projects.
- To come up with the methodology through which the above two objectives can be achieved.

### B. Need for the Study

Due to the lack of quality in construction projects the consequences may rather be in terms of loss in production, added expenditures by way of modifications and repair, -

inspection and retest in the short term. In the long term, poor quality can affect the reputation, and if the company continues in the same way it might have to shut its shop for want of new projects. If the same is continued by number of construction companies of a country this also starts reflecting on the reputation of the country. Helping the construction companies to identify the critical factors influence in achieving the desired quality level (critical success factors) and also to find the factors negatively affecting the project quality (critical failure factors) has been the inspiring factor behind this study. It is realized that maximization of the success factors and minimization of failure factors will make sure the construction industry realizes its quality objectives. To overcome these consequences, there is a need for the study to be carried out which suggests the methodology to identify present TQM practices as well as to take care of certain critical factors that may lead to loss of quality.

### C. Outline of Methodology

The research adopted quantitative approach spanning on four processes. In the preliminary process, an extensive literature review on the subject was undertaken. The literature review covered the concepts of quality and Total quality management in the construction sector to surface and ultimately establishing constructs for implementation of TQM in the Construction Industry. Based on the literature review, a standardized questionnaire was developed to collect data from members of construction industry about their quality management practices and their perception of factors contributing to the successful implementation of TQM. The targeted respondents were project managers, project engineers, Quality managers. A total of 44 construction firms were targeted to respond to a set of close-ended questionnaires. The third process was data analysis. The data were analyzed using Statistical Package for Social Scientist (SPSS.16). Factor Analysis, and Ranking Analysis using importance index. Finally, the information was obtained, regarding the quality management practices and critical success factors contributing to the successful implementation of TQM.

## III QUALITY MANAGEMENT

### A. Concept of Quality

Quality is a significant subject in the current competitive business world and it is recognized by most researchers and practitioners, hence, defining it is very essential for any organization embarking on quality improvement. Thus, it allows workers and management to channel their efforts in the vision of the company and their quality improvement objective. However, there is no commonly accepted definition for it. The definition of quality has gone through a range of opinions based on the one putting it forward was able to support the definition by particulars, perception of excellence or supporting literature. Hence, one can find a variety of definitions of quality. For instance, ISO defines it as "the total of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs" (ISO 8402, 1994). W. Edward Deming defines quality as a product or service "that helps somebody and enjoys a good and sustainable market". Joseph Juran describes it with the phrase "fitness for use by the

customer" as a definition of quality. Crosby defines it as "Conformance to requirements or standard", Feigenbaum 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 expectations of the customer".

### B. Quality Management

Quality Management refers to all actions of overall management functions, especially top management leadership, that indicates quality policy objectives and responsibilities for all members of the firm. It includes all activities that managers execute in an attempt to execute their quality policy. These activities include quality planning, quality control, quality assurance and quality enhancement. Quality management is also defined as "coordinated activities to direct and control an organization with regard to quality" (ISO 9000:2000). The activities are usually management driven and incorporated into a system. This is known as the systems approach to managing quality and people are required to take part or are motivated to participate. The most common quality management implemented in recent history is ISO quality management system and Total Quality Management (TQM).

### C. Total Quality Management

TQM is a management approach that originated in Japan, was intended in the 1950s, and slowly improved in status from the early 1980s to the 1990s. Its roots have been traced through the progress inspection, quality control, and quality assurance. Tools that have been mentioned in combination with TQM include the seven quality control tools, the seven management tools, and the improvement cycle (i.e., plan, do, study, and act). TQM is a continuously developing program that focuses on organizational development. Whereas no individual person is responsible for its improvement, the primary contributors, known as the big four, are Edwards Deming, Joseph Juran, Philip B. Crosby, and Kaoru Ishikawa. Some recognizable companies documented for implementing TQM include Ford Motor Company, Phillips Semiconductor, SGL Carbon, Motorola, and Toyota Motor Company.

### D. TQM constructs for Implementation

The implementation of TQM programmes has been considered by a number of scholars in recent decades. The subsequent factors and associated issues are considered as critical and important for achieving successful TQM accomplishment within any organization, therefore the features important in them are the key elements that influence the TQM implementation programme within any organization.

*Management Commitment & Leadership:* Leadership is defined as, the interpersonal authority, exercised in a condition, and intended through the communication process, toward the achievement of a particular goal or goals" Leadership with the client focus is the two major elements for the TQM where the consumers offer the common focus or objective for TQM.

*Teamwork:* Teamwork is very significant for achieving organizational objectives; teams are a main part of any TQM attempt. It is widely accepted working in a team or group is normally more effective than working independently. However, to become successful in business, teamwork is also a

key element of TQM. With the teams, the business will obtain faster and improved solutions to problems. Teams also present more lasting enhancement in processes and operations. In teams, people feel more comfortable bringing up problems that may arise, and can obtain assistance from other personnel to find a solution and put into place

*Training and Education:* Empowerment and participation is not efficient unless all workers received proper, regular training in quality management. Training and education is essential in determining the success of total quality management. Training is an necessary aspect for any successful quality management programme.

*Communication:* Good communication will result in reducing ones fear as this will allow TQM to be more accessible. Deming (1986), advises to “drive out fear” for management to change. Communication is a element of the cement that holds collectively the bricks of the total quality process. Good communication and a good feedback system are very important in transmission of ideas to the management and to integrate the essential change necessary. The best system to communicate, 1. Direct Communication between workers and supervisors. 2. Face-to-face communication.

*Customer Focus:* Client focus can be defined as the extent to which a firm always satisfies customer needs and as can be expected a successful organization will identify the requirement to put the customer first at every stage of decision making. The key to the quality management is maintaining a close and strong bond with the customer in order to completely find out the customer requirement; hence the client should be closely concerned in the product design and improvement by giving important inputs at every stage.

*Employees Involvement and Participation:* Successful implementation of a TQM environment or culture requires a committed and skilled workforce to fully participate in the activities carried out to improve the quality. All the employees at all levels within the organization should be encouraged to take responsibility and communicate effectively toward improving the quality at all production stages.

*Culture:* Culture can be described as the attitude which encompasses the organization concerning the actions used to carry out the business and how the workers should perform and the way they desire to be treated. Within the TQM culture a supportive and open culture has to be shaped by the organization management in which all the workers are made to feel that all of them are accountable for fulfilling the organization’s customers.

## IV METHODOLOGY

### A. Introduction

Research methodology involves the systemic set of laws and procedures upon which this research program is based and against which the information collected is interpreted and the results evaluated. In general, to achieve the objectives of a study, one of the significant areas to consider is the type of method that is adopted. For this reason, the research methodology adopted in this study is in three different phases, but corresponding to each other. The three phases upon which these methods were applied to are;

- Preliminary phase;
- Second phase; and
- Finally, data analysis phase

#### (1) Preliminary Phase

Information on TQM was collected from literature and the sources of the reviewed literature were in two categories:

- *Primary source:* This includes desk review of both published and unpublished material which includes policy documents, newspapers, internet, journals, articles and reports on quality and quality management.

- *Secondary source:* This includes textbooks on construction management and quality management.

The Preliminary phase was to identify, analyze and to understand the theoretical concepts related to the TQM in depth. To improve the understanding of the theory regarding quality management in the construction industry and also to give an overall view of the problem statement which helps to meet the objectives that are highlighted was the main purpose. The data collected from the preliminary phase helps in guiding the second phase of the fieldwork, which is distribution of questionnaires and collection of data from the key respondents.

#### (2) Second Phase

The second phase of the study includes:

- Research method adopted
- Data collection

In gathering data for analysis the strategy and approach to organize are very critical for successful and consistent data to address the purpose of the research.

#### Questionnaire Development

The data required for study was collected through questionnaires focusing quality managers:

- To investigate current quality management practices in the Construction industry;
- To identify critical success factors in TQM;
- To assess how the quality managers in the Construction industry perceive these Critical success factors and;
- Finally to find the barriers in successful implementation of TQM and suggesting ways to improve Quality performance.

The Questionnaire was in two Parts.

- Part one was developed to draw out information addressing objective (i)
- Part two was developed to address objectives (ii), (iii) and (iv)

*(i) Part One*

Part one is divided into two sections, Section A and B. Section A is to identify the types of companies and the kind of employees from whom data is being required and certainly this is to establish the reliability of the data. The information incorporated in Section A of Part one was work experience of personnel, position in company, age group. Section B covers questions on eight key areas of Quality Management (QM) and this includes insight of quality, data attainment methods, quality enhancement, evaluation/audits, training, teamwork, tools and techniques, quality policy and one question on barrier in quality management execution.

*(ii) Part Two - TQM Construct Development and Measure*

Concerning the development of the instrument for the quality factors (construct), the method adopted is quantitative survey. This method was initially developed by psychologists and now it has been extensively accepted in the development of an instrument for measuring variables in social sciences. For this study, the method was pursued in three stages namely,

- Stage 1- identification of critical success factors
- Stage 2 – measurement of construct by selecting initial quality items
- Stage 3 – performing reliability, detailed item analysis and constructs validity measurement.

*Stage 1*

Stage one involves carrying out review of literature in order to identify critical success factors on TQM. The process of developing the questionnaire was based on the review of literature. Ten constructs were developed.

*Stage 2*

Stage two involves ensuring that the questionnaire covers all the important areas of quality management and the entire planned investigation is well worded and understood. Thus, content validity. The questionnaire has content validity if researchers agree that the questionnaire is made up of a group of items considering the issues to be measured. Content validity is judged by the researchers personally. An initial questionnaire was sent to four experts on the subject to check the comprehensiveness of the items under each construct. The advice from these experts was used to improve the content as well as ease understanding to reduce uncertainty and duplication of test. The final questionnaire had 10 initial quality items for assessment. In all, 10 items the questions were developed and measured within a five point Likert scale of 1-5 where;

1=not important; 2=slightly important; 3=moderately important; 4=very important; 5=extremely important.

*B. Sample Size Calculation*

Sample size is defined as a subset or proportion of the total population. The sample size, depend on the proportions of the population that have the characteristics the researcher is interested in.

Z-Test was carried out to determine the sample size required for the unknown population. The z-test is calculated by using the below formula.

$$\text{Sample Size} = \frac{(\text{Z score})^2 \times \text{Std. deviation} (1 - \text{Std. Deviation})}{(\text{Margin of error})^2}$$

Where,

Confidence Interval: 90%

Margin of error: 10%

Standard Deviation: 20%

Z- Score for 90% Confidence Interval: 1.645

Hence, Sample Size= 43.29 ≈ say 44 respondents

*C. Questionnaire*

Section A

*Personal Data*

1. Name:
2. Gender:
3. Designation:
4. Age group (years):
5. How long have you worked at this company?

Section B

6. According to you, which of the following words define total quality?
7. Which Quality enhancement Programme you have adopted?
8. What are the major objectives of the Quality Programmes?
9. In your own view, what are the problems affecting Total Quality Management in your firm.

Section C

9. Do you gather information to check performance of works or processes?
10. How do you measure performance?
11. Is proper training given to employees in Quality Policy or TQM?
13. How frequently is the training given?
14. What type of training is given to employees?
15. What for the training is done?

**Section D**

**TABLE 1: TQM CONSTRUCTS (FACTORS)**

No	Factors
I	<b>PLANNING PHASE</b>
1	Careful and thorough evaluation of contract document.
2	Company’s dedication in performing continuous (or regular) inspection and audits.
3	Company’s involvement in improving the quality assurance plan and program for workforce with time.
II	<b>EXECUTION PHASE</b>
1	Organization inputs in maintaining quality.
2	Top management’s commitment in adopting employees to quality policy.
3	Policy for defective resources/procedure.
III	<b>IMPROVEMENT PHASE</b>
1	Company’s concern towards adoption of continuous quality improvement program
2	A documented process to re-look at the implementation of quality program
3	Availability of quality certification from an external agency
4	Improvement of laboratory facilities with time and on requirement to achieve better performance.

*D. Analysis of the responses*

Analysis of the questionnaire survey responses is done using SPSS Software. Reliability test is to be conducted by using internal consistency method (Cronbach’s Alpha). The minimum advisable level is taken as 0.7. The success factor who’s calculated Cronbach’s alpha greater than the critical point of 0.7 is said to be highly reliable and internally consistent.

*Construct (Factor) validity*

The Kaiser Meyer Olkin (KMO) & Burtlett’s test should be conducted. KMO quantifies the degree of inter-correlation among the variables and appropriateness of factor analysis. KMO in range of 0.5-0.6 is considered as poor, 0.8-0.9 is great and greater than 0.9 as superb. If KMO value greater than 0.7 then it indicates that the data are adequate and appropriate for FA.

**CONCLUSION**

This study has proposed the method through which the current TQM practices adopted in construction industries as well as the factors which influence the successful implementation of TQM can be identified. The study also briefs about the questionnaire development and analysis of the responses.

**REFERENCES**

- [1] Badri, M.A., Davis, D. and Davis, D. A study of measuring the critical factors of quality management. *International Journal of Quality & Reliability Management* (1995), Vol. 12 No. 2, pp. 36-53.
- [2] Arditi, D. and Gunaydin, H. M. Total quality management in the Construction Process. *International Journal of Project Management*, (1997). Vol 15 No.14, pp 235-243.
- [3] Deming, W. E. (2000). *Out of the Crisis*. MIT Press, Cambridge, MA.
- [4] Jha, K.N., and Iyer, K.C., “Critical Factors Affecting Quality Performance in Construction Projects”, *Total Quality Management* Vol. 17, No. 9, 2006, pp 1155–1170.
- [5] A. Shibani, R., Soetanto and E. Ganjian., “An Investigation on The Critical Success Factors Of Total Quality Management Implementation In Libyan Construction Organisations” *Third International World of Construction Project Management Conference*, Coventry University 2010.
- [6] Nawal Gherbal, Abdussalam Shibani, Messaoud Saidani and Amrit Sagoo., “Critical Success Factors of Implementing Total Quality Management in Libyan Organisations”, *Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, 2012*.
- [7] Nana Yaa Adusa-Poku., “Assessing Total Quality Management (TQM) In the Ghanaian Construction Industry”- *An Exploratory Study in Kumasi, A Dissertation Submitted to the Department Of Building Technology, Faculty Of Architecture And Building Technology Kwame Nkrumah University Of Science And Technology, November 2014*.
- [8] Firas Mohamad Al-Sabek., “Critical Factors Affecting the Implementation of Total Quality Management in the Construction Industry in U.A.E”, *World Academy of Science, Engineering and Technology International Journal of Social, Behavioural, Educational, Economic and Management Engineering* Vol: 9, No: 5, 2015.
- [9] ISO 8402, 1994, *Quality Management and Quality Assurance*.
- [10] ISO 9000, 2000, *Quality Management Systems-Fundamentals*