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Remodelling the Quality Management System to Calculate the Quality Cost in Building Construction: A Review

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Abstract - *Quality Management System (QMS) for concrete construction is considered as an important part of the construction project. The quality of a project will be dependent from the start to end activities involved in the whole project. This starts with the procurement of construction materials till the curing of the casted structural member. Every step between these stages must be performed with utmost quality. Quality Cost is calculated using, BOQ (Bill of Quantity) PCM (Process Cost Model) and COQ (Cost of Quality). A Process Cost Model projects the mechanism for measuring the quality expenses of construction projects. Cost of quality is a methodology that allows an organization to determine the extent to which its resources are used for activities that prevent poor quality, that appraise the quality of the organization's products or services, and that result from internal and external failures. This study aims at comparing the various quality management systems to find the best method for quality cost calculation and remodeling this method for more accurate result.*

Key Words: *Bill of Quality (BOQ), Cost of Quality (COQ), Process Cost Model (PCM), Quality Management System.*

1. INTRODUCTION

Quality is one among the major aspect for the accomplishment of construction projects. In structure related projects the satisfaction of the customers as well as the project participants are given prime importance. Quality, Cost and Time tends to be the chief concern of the client. Quality management system (QMS) could be instigated at the company level and at the assignment level. Applicability of Quality Management System (QMS) in the construction industry is in fact numerous. From the viewpoint of a construction company, quality management system means sustaining the quality of construction works following the needed norms thus to obtain customer's satisfaction that would fetch long term competitiveness and business endurance for the companies. This study aims at comparing the overall quality and quality cost in order to access Quality management system. To assess how quality has been managed and to identify the problem areas. And Moreover to attract the attention towards the presence of unplanned costs and the cost of failure.

2. QUALITY MANAGEMENT

Quality is one of the main factors in the success of construction projects. Quality of construction projects, as well as project success, can be regarded as the fulfillment of expectations (i.e. the satisfaction) of the project participants. Quality, cost and time have been recognized as the main factors concerning the client. However, for the majority of projects, the cost and time parameters are the main pre occupying factors for construction project. The authors emphasize more attention towards quality. The quality in the construction industry is linked with client's satisfaction and the implementation of a quality management system is a key tool in consistently and reliably managing the goal of client satisfaction. Quality management system (QMS) could be implemented either at the organization level or at the project level itself.

The concept of quality management is to ensure efforts to achieve the required level of quality for the product which are well planned and organized. From the perspective of a construction company, quality management in construction projects should mean maintaining the quality of construction works at the required standard so as to obtain customers' satisfaction that would bring long term competitiveness and business survival for the companies (Tan & Abdul-Rahman, 2005). Quality management is critically required for a construction company to sustain in current construction market which is highly challenging and competitive. Harris and McCaffer (2001) explained that quality management has to provide the environment within which related tools, techniques and procedures can be deployed effectively leading to operational success for a company. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the company.

3. OBJECTIVES OF QUALITY IN CONSTRUCTION

The quality in construction relates to the following objectives

- Satisfaction of Contract Specifications
- Completion of Project within Time
- Enhancing Customer/ Owner Satisfaction
- Motivation and Empowerment of Employees

- Avoiding Disputes and Claims
- Performance based on Purpose

3.1 Elements of Quality

The basic element of quality in construction is

- Quality characteristics
- Quality of design
- Quality of conformance

3.1.1 Quality Characteristics

A quality characteristic is related to the parameters with respect to which quality – control processes are judged. Quality characteristic includes strength, colors, texture, dimension, height etc. Example in compressive strength of concrete, usability of concrete in slump, etc.

3.1.2 Quality of design

It refers to the quality with which the design is carried out. It primarily related to meeting the requirement of the standard, functionally efficient system and economical maintainable system.

3.1.3 Quality of conformance

It is referred to the degree to which the constructed facility conformed the design and specification. Quality of conformance is affected by field construction methodology and Inspection

4. PRACTICES OF QUALITY MANAGEMENT

Total quality management (TQM) is often defined as a complete management philosophy that permeates every aspect of a company and place quality as a strategic issue. It is accomplished through an integrated effort between all levels of a company to increase customers' satisfaction by continuously improving current performance (Biggar, 1990). The adoption of TQM in construction industry has been promoted in some literatures (Low & Teo, 2004; Biggar, 1990; Haupt & Whiteman, 2004). ISO certification is nowadays a trend in most industries including construction industry. The ISO 9001 standard is now on its year 2000 revision. The five clauses for its implementation are quality management system, management responsibility, resource Management, product realization, and measurement, analysis, and improvement. The application of ISO standards has received much attention from researchers. Moatazed-Keivani, Ghanbari-Parsa and Kagaya (1999) argued that the ISO 9000 standards series can form and have formed the basis for an efficient and advantageous quality management system in the construction industry. Dissanayaka, Kumaraswamy, Karim and Marosszeky (2001) stressed that the motivators behind the implementation of ISO 9000-certified quality systems for Hong Kong constructors appear to be to qualify for public works tenders, to meet clients'/customers' expectations and to improve the quality of work done. Love, Li, Irani and Faniran (2000) commented that ISO 9000 certification is not an option but rather a reality for construction companies that wish to retain and sustain their competitiveness in today's highly competitive markets. Liu (2003) stated that it is indicative that ISO 9000 has an impact on the contractors' attitude towards quality. As for the implementation of quality management in project management, the concepts of quality planning (identification of quality standards), quality assurance (evaluation of overall project performance) and quality control (monitoring of specific project results) in the quality management processes were defined by Project Management Institute (2000). Several tools and techniques were identified as part of the implementation process, there are, benefit/cost analysis, benchmarking, flow-charting, design of experiments, cost of quality, quality audits, inspection, control charts, pareto diagrams, statistical sampling, flow-charting and trend analysis.Mathews, Ueno, Kekale, Repka, Pereira and Silva (2001) divided quality tools and techniques that are in support of quality programs into three main types, i.e., hard quality tools, mixing methods and soft methods. Hard quality tools are formal quality systems, documented quality systems, quality costs, control charts, and statistical sampling standards. Mixing methods are strategy and action plans review, flexibility of organization structure, control charts, quality circles, and quality planning tools. Soft methods are training, customer satisfaction surveys, regular contact with vendors and external organizations, actions to optimize environment impact, empowerment, self-assessment, and benchmarking.

5. APPLICATIONS OF REMODELLING THE QUALITY MANAGEMENT SYSTEM TO CALCULATE THE QUALITY COST IN BUILDING CONSTRUCTION

AbdulAziz et al. (1999), quality systems involve internal and external aspects. An internal quality system covers activities aimed at providing confidence to the management of an organization that the intended quality is being achieved. This is called a "quality management system".

S.L.Tang et al**,** A 'Process Cost Model (PCM)' approach has been proposed for measuring the quality costs of construction projects. It is simple and more feasible to be applied in construction projects. The current paper describes two case studies using the PCM to capture quality costs on two construction projects. It is possible to use the model to achieve the quality costs of a particular construction process.

P.P.Mane et al, (2015) The best quality, time and cost are the important aspects of successful construction project which fulfills the main goal of construction industry. The quality management system (QMS) in construction industry refers to quality planning, quality assurance and quality control. The paper includes the outcome of the research methodology decided by authors based on interview of project participants and analysis of scrutinized interview data.

Selles et al, (2015) The paper proposes a model which helps illustrate how the various elements of the cost of quality (COQ) might be employed by the general contractor within the Construction project. The study concludes by suggesting possible ways of measuring the costs of construction. The construction industry needs to experience two true paradigm shifts; one moves the industry from resources spent on quality non-conformance to resources spent on quality conformance.

Rosenfeld's (2012) research concluded, as reasonably expected, that the more you invest in prevention and appraisal, the less you will have to spend on internal and external failures. The quality cost of conformance (prevention and appraisal) is a known amount which is manageable and limited. The quality costs of nonconformance (internal and external failure) are not manageable and are involuntarily imposed on the contractor.

P. indhira devi et al**,** In quality management, the use of cost as a measure of performance has been recognized and this is usually known as the Cost of Quality (COQ) or Quality Cost. Theoretically, it seems easy to apply the quality cost concept into the design and construction phases of a civil engineering project. This paper initially presents a methodology for assessing the COQ for construction projects. It also presents COQ model for determining optimum level of quality cost. Finally, to reduce the COQ in construction industries were investigated. This paper attempts to address the concept of Cost of Quality, especially as an aid to identifying and reducing failures during construction of Civil Engineering Projects.

Amirhosein Jafari et al**,** The effectiveness of a quality program implemented during the initial 18 months of the Qom monorail project in Iran is examined. A limited number of case studies have examined quality costs in construction and engineering projects. In this paper, the quality costs for the Qom monorail project within the first 18 months of construction were examined. An in-depth analysis of the contractor's quality cost program revealed that its onsite quality program was 2.78% of the total project costs, of which 2.32% was attributable to supervisory costs. The quality failures during construction were revealed to be 0.05% of the total project costs.

Priya Thersia Abraham et al, Quality Cost is measured by Process Cost Model (PCM) and Cost of Quality (COQ). The quality costs in the PCM are called process costs, which can be divided into two parts: the costs of conformance (COC) and the costs of non-conformance (CONC). The data is collected from responses of the Quality engineer and Site Engineer of the project. The result is analyzed by using the Linear Regression analysis and it is found that COQ method is better than PCM method in quality cost calculation by maintaining the sufficient quality.

6. CONCLUSION

Quality Cost is measured by Process Cost Model (PCM) and Cost of Quality (COQ). The quality costs in the PCM are called process costs, which can be divided into two parts: the costs of conformance (COC) and the costs of non-conformance (CONC). Quality is the most significant factor in the success of construction projects. The questionnaire was used as the primary tool for collecting data. Intended methodological approach through questionnaire survey based on literature review and discussion. Cost is analyzed by Linear Regression Analysis. It can be concluded that COQ method is better than PCM method in quality cost analysis. This study aims at comparing the various quality management systems to find the best method for quality cost calculation and remodeling this method for more accurate result.

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