

Assessment of Factors Affecting Cost of Quality in Construction Project

Tushar Sarkari¹, Zishan Raza Khan²

¹M.Tech Student (Construction Technology and Management) Integral University Lucknow

²Associate Professor, Civil Engineering Department, Integral University Lucknow

Abstract – Quality management is one of the most important consideration in any infrastructure construction project. Cost of Quality is one of the most significant parameter for analyzing the quality performance of any construction Project. It becomes increasingly necessary to pay attention to measurement of cost of Quality and optimizing it. This research paper deals with identifying the major types of cost of quality and the prime factors which affect this. The data collected through survey analysis was analyzed through Pareto Analysis to obtain the desired results. The field survey showed that the Internal Failure cost have the utmost impact on the Cost of Quality. Prevention and Appraisal cost also provide huge Impact on Cost of Quality as compared to External Failure Costs. Based on these results, several points of Optimizing Cost of Quality have been suggested.

Key Words: Quality Management, Cost of Quality, Quality Performance, Pareto Analysis

1. INTRODUCTION

Due to the development of the economy in the developed countries, competition has led to the survival of the fittest. Due to increased competition in the market, there is an increasing obligation on the construction companies to improve their internal quality and strengthen management. It specifically means that companies need to improve quality control in order to satisfy the needs of quality assurance of customers. [1]

Quality is a quite wide word that has a lot of meanings and for different people often means different things. Quality control and safety represent increasingly important concerns for project managers. [2]

Defects or failures in constructed facilities can result in very large costs. Even with minor defects, re-construction may be required and facility operations impaired. Increased costs and delays are the results [3]. In the worst case, failures may cause personal injuries or fatalities. Accidents during the construction process can similarly result in personal injuries and large costs. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents occur on the project. [4]

1.1 Quality Costs

Quality costs may be regarded as a criterion of quality performance but only if valid comparisons can be made between different sets of cost data. Clearly the comparability

of sets of data is dependent on the definitions of the categories and elements used in compiling them.

Quality is one of the most important and significant dimension of any construction project. From the inception to completion of any activity involved in construction, quality is one parameter which is kept on constant check at every stage [5]. There are different standards and procedures for checking the quality at each and every stage which involves different kinds and types of costing required. Quality costs generally refers to the cost involved or incorporated in maintaining and adhering to the necessary specific standards and desirable outcomes.

No matter which quality costing approach is employed, the most basic idea behind the Cost of Quality analysis is the linking of improvement activities with associated costs and customer expectations, thus allowing targeted action for reducing quality costs and increasing quality improvement benefits. Therefore, a sensible estimate of Cost of Quality, which is that the appropriate trade-off between the amount of conformance and non-conformance costs, should be considered an important element of any quality initiative and an important issue for any manager. Variety of organizations are now seeking both theoretical advice and practical evidence about quality related costs and therefore the implementation of quality costing systems. [6]

1.2 Major Categories of Quality Costs

a. Internal Failure Costs

Internal failure costs are incurred because products and services do not conform to specifications or Client needs.

b. External Failure Costs

External failure costs are incurred because products and services fail to conform to requirements or satisfy customer needs after being delivered to Client.

c. Prevention Cost

Prevention costs are incurred to prevent poor quality in the products or services being produced.

d. Appraisal Costs

Appraisal costs are incurred to determine whether outcomes are conforming to their requirements or Client needs.

2. LITERATURE REVIEW

During the beginning of 20th century, a new technique of quality control i.e. statistical process control was introduced by Stewart. After the mid of 20 the century, several other notable persons such as B G Dale, Crosby and Juran gave some phenomenal concepts about quality assurance, quality control and Total Quality Management.

Since the onset of the 21st century much debate is about how to improve quality with minimal effect on other parameters such as time, cost, etc. Many researchers focused on this aspect of construction and tried to carve out new inferences and conclusions which would be beneficial for the academic sector as well as the industrial sector.

Dickson sam J Danam says that in today's construction industry, quality and its concepts are vital. The authors are of the view that Total quality management principles and philosophy apply to construction industry. He emphasizes the total quality principles should be impregnated construction industry in an innovative manner. Several contradictions to this could be possible which need to be studied thoroughly. [7]

Several strategies are formed keeping in view the leadership aspect of Quality. Paul Schiltz focussed on the effect of leadership on quality in an organization. This research demonstrates that what type of leadership characteristics best support the quality management function. The author provides valuable insights into questions concerning which leadership characteristics best support the leadership prescribed by Deming, Juran and others concerned with quality [8]. Peter Hoonakker discussed the difficulties in construction industry for defining quality, determined benefits quality implementation, and at barriers to implementation of quality in construction. They collected data with the help of questionnaire. They showed development which may help to overcome failure. From the finding they stated that contractors do know the value of quality but there are obstacles for implementation. [9]

A.I. Romanova researches into creating a unified approach to the organization of the control system and the evaluation of the quality of construction at the facilities of the investment. The author specifies some particular problems related to quality and finds out the possible solutions related to quality in construction. The author tries to provide an approach which aims towards building a self-regulatory organization. [10]

Sahil sanjeev Salvi focussed on the point that the construction industry faces a huge economic loss due to loss of quality in construction projects. He emphasized on internal quality control and quality assurance as the key two factors which would greatly impact the quality on construction site. He argues about the point that there are several contradictions to quality which needs to be monitored. [11]

Vishal Patil focussed on cost of poor quality in construction. The author tries to review the use of quality in construction industry. The author throws light on the issue that defective building construction not only contributes to added construction cost of the project but also the cost of maintenance, which can be substantial. According to research done by author, the cost of quality is equivalent to 1% of the total project cost. [12]

Maysoon Abdullah Mansor draws attention to the measurement and determination of cost of quality so as to

Identify qualitative problems and opportunity for improvement of work done. The author identifies the categories and item of cost of quality through theoretical literature then uses Pareto analysis to find the high impact categories and items on the cost of quality. The findings show that prevention and appraisal items have an important influence in minimizing the failure cost where the quality audit cost is of utmost importance. This research uses a very reliable technique such as Pareto analysis for coming to conclusions. [13]

3. METHODOLOGY

A thorough literature review was conducted in order to gain a profound and deep knowledge about the cost of Quality. A questionnaire survey was prepared by choosing the major factors which impact the cost of Quality in Construction. A scale of 1-5 was taken representing from very low to very high for each factor stated below.

This Survey was floated among the major stakeholders of construction for data collection.

Factors Chosen for the Survey Analysis

- Quality Audits i.e. Internal Audit, Third Party Audit, etc.
- Process monitoring i.e. Quality checks, documentation, quality test scheduling, process reviews etc.
- Supplier Quality Assurance i.e. Procurement, supplier evaluation, etc.
- Quality Training Programmes i.e. Quality improvement training, Quality assurance workshops, etc.
- Quality Strategy i.e. quality plans, Quality records, etc.
- Quality circles i.e. employees who meet regularly to consider ways of resolving problems
- Field Testing of Quality
- Quality tests such as laboratory equipment, materials, etc.
- Maintenance of Quality records and documents
- Inspection costs i.e. stock assessment, site inspection, etc.
- Maintenance of inspection and measuring equipment.
- Quality of product inspection i.e. wages of inspectors, etc.
- Design changes
- Rework
- Downtime (defect-related)
- Repair of work
- Re inspection of activity
- Scrap of work
- Scope Creep i.e. changes in scope due to clients change of mind
- Hidden costs i.e. repair cost after product delivery

- ❑ Returns: investigation of rejected or recalled products, including transport costs
- ❑ Warranty Costs i.e. cost of Re checking on Clients complaint
- ❑ Cost of Claims i.e. liability to bear defects
- ❑ Grievance Redressal

To ensure the stability of the questionnaire, Alpha Cronbach was measured using SPSS V16.

Following shows the stability coefficient of the research. This indicates that the stability coefficient of the questionnaire is good, where the stability coefficient should not be **less than 70%**.

Reliability Statistics

Cronbach's Alpha	N of Items
.713	24

Figure -1: Reliability of Survey

Pareto Analysis was performed on the data gathered for getting the most crucial points for cost of Quality.

4. RESULT AND DISCUSSIONS

After performing the Pareto analysis following results were gathered:

For Internal Failure Costs

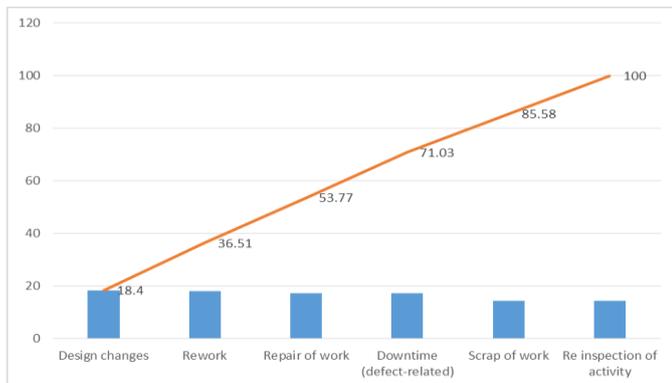


Figure -1: Result of Pareto Analysis for Internal Failure Cost

For External Failure Costs

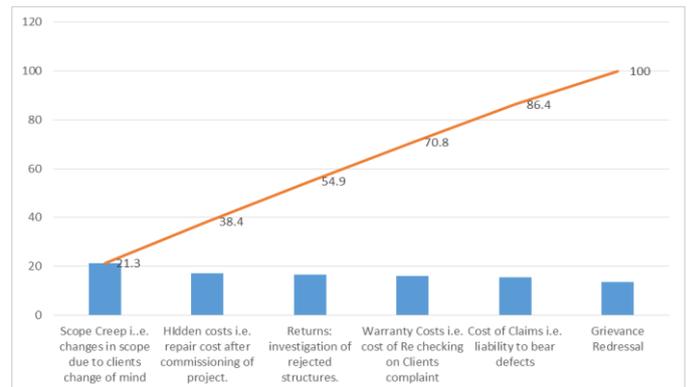


Figure -2: Result of Pareto Analysis for External Failure Cost

For Prevention Costs

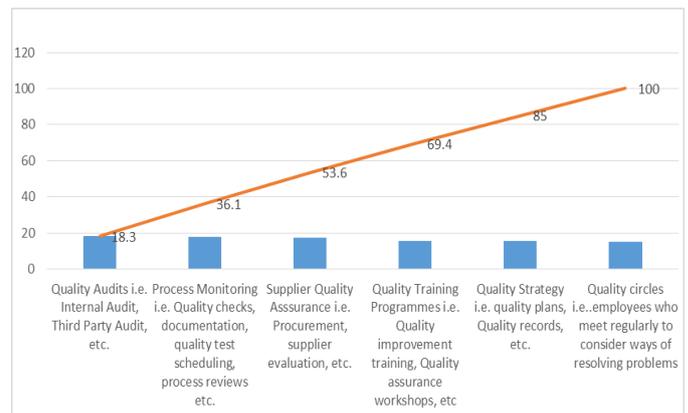


Figure -3: Result of Pareto Analysis for Prevention Cost

For Appraisal Costs

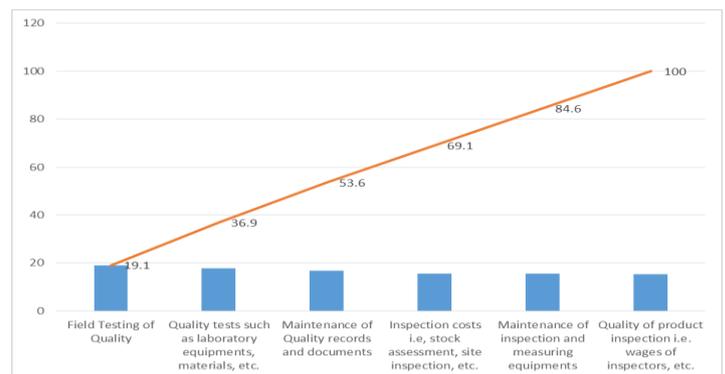


Figure -4: Result of Pareto Analysis for Appraisal Cost

For Total Costs

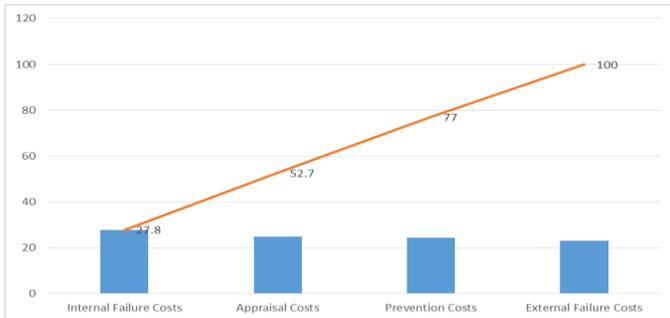


Figure -5: Result of Pareto Analysis for Total Costs

According to majority of respondents, their perception of cost of quality was just about procuring best materials and using best standard practises, however cost of quality is a wider and broader term with several interlinked factors. This implies that cost of quality is still a less known topic among the construction players.

Results of some introductory questions of survey also bring significant information about the notion of quality. It reflects that **83.33%** of people believed that there is a dire need of quality improvement in construction while **7%** of people believed that maybe there is a need.

About **52.4%** people defined *quality as the best fit for purpose being served* while **31%** of the people defined it as *high conformance to standards ad specifications*. Only a few people of about **16.7%** defined it as having zero defects in the system.

The results of field study clearly depict that Internal Failure cost have the most impact on cost of quality. Within Internal Failure costs, design changes and rework are the topmost factors responsible for increasing the cost of Quality in construction.

Table -1: List of Most Crucial Factors

Type Of cost	Most Crucial Factor
Internal Failure Costs	Design changes
Appraisal Costs	Field Testing of Quality
Prevention Costs	Quality Audits i.e. Internal Audit, Third Party Audit, etc.
External Failure Costs	Scope Creep i.e. changes in scope due to clients change of mind

5. CONCLUSIONS

Based on above results it could be concluded that there is need to assess the crucial points impacting cost of quality in construction.

Based on above analysis and results, some points which could be recommended for improving cost of quality are as follows:

Personnel must be certified as competent supported education, training, skills, and knowledge. Personnel qualification processes must be standardized and documented. A Supplier Portal is quite an area to post files for the supplier. It's an area to collaborate online with suppliers by exchanging communications and dispatching tasks. Secure cloud-based portals let suppliers view open Actions or correction, helping resolve problems faster.

Addressing adverse events before they become systemic issues is a key to reducing quality costs. Looking at the factors highlighted from the survey, it's clear the costliest problems are those that weren't effectively managed from the beginning.

In today's economy, the ability to grow and excel is necessary to keep up with the competition. Unfortunately, the sheer cost of any proposed and revised change can make it difficult for companies to stay agile. Effective Risk Management is significantly critical to reducing quality costs. Quality Audits generate a lot of structured and unstructured of data, frequently leading to a long list of potential action items. This data could help in identifying items which are at high risk (and likely contributing the most to quality costs), helping you prioritize follow-up in a strategic way.

The intangible costs of external quality failures (including customer dissatisfaction, loss of respect and loss of future sales) might be difficult to calculate, but are not hard to picture as having a huge negative impact on the future prospect. The best way to minimize external failure cost is to not have them at all. The best way to ignore external quality failure costs is to focus on improving the other three parameters of costs of quality.

REFERENCES

[1] Cao, Y. (2010). Quality Control of Construction Projects. Savonia University.
 [2] Amit A Mahadik, U. P. (2014). Necessity of Quality Control in Construction Industry. Indian Journal of Research, 3(4), 106-107.
 [3] Ogwueleka, A. C. (2013). A Review of Safety and Quality Issues. KICEM Journal of Construction Engineering and Project Management, 42-48.
 [4] S. Senaratne, H. M. (2015). Importance of Quality for Construction Project Success. 6th International Conference

on Structural Engineering and Construction Management, (pp. 84-89). Sri Lanka.

[5] Christine Hattar, L. J. (2016). Quality in construction Management. International Journal of Quality and Reliability Management, 33(7), 920-941.

[6] James, T. V. (2006, September). Managing cost of quality: Insight into industry practice. The TQM Magazine • .

[7] Dickson Sam J Danam, A. G. (2019). Total Quality Management in Construction. Journal of Emerging Technologies and Innovative Research, 6(5), 434-441.

[8] Paul D Hirtz, S. L. (2007). The Effects of Leadership on Quality. Engineering Management Journal, 19(1), 22-27.

[9] Peter Hoonakker, P. C. (2010). Barriers and Benefits of Quality Management in the Construction Industry- An empirical Study. Total Quality Management, 21(3), 953-969.

[10] Romaova, A. (2016). Improving the Quality of Construction Works in terms of Self Regulation. International Conference on Industrial Engineering (pp. 2108-2112). Elsevier.

[11] Sahil Sanjeev Salvi, S. S. (2020). Quality Assurance and Quality Control for Project Effectiveness in Construction and Management. International Journal of Engineering Research and Technology, 9(2), 26-29.

[12] Vishal Patil, V. V. (2013). Cost of Poor Quality in Construction. Journal of Mechanical and Civil Engineering, 16-22.

[13] Mansoor, M. A. (2020). Studying and evaluating the cost of Quality in Construction Projects. Journal of Cellular Automata, 12(15), 119-132.