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Evaluation of Quality Control in Construction Project

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Abstract

Quality management is a fundamental aspect of any construction project, intertwined with all operational and managerial processes within a company. It plays a pivotal role in attracting customer satisfaction, which in turn ensures long-term competitiveness and business survival in the highly challenging and competitive construction market. This paper aims to evaluate the practices of quality management in construction projects by examining the tools and techniques applied and assessing the level of commitment towards its implementation. Additionally, the paper seeks to identify and address the challenges faced by companies in the industry, offering a set of proposals and recommendations aimed at improving the overall quality management practices. It is imperative for construction companies to provide an environment conducive to deploying related tools, techniques, and procedures effectively, thereby ensuring operational success. The paper concludes with an illustrative example demonstrating the application of quality management in construction projects, grounded in scientific principles. Furthermore, it proposes the development of systems and specifications tailored to the construction industry through collaborative efforts involving professionals within the field. By soliciting input from various stakeholders and offering solutions and proposals, the paper endeavors to mitigate challenges associated with implementing quality management in the construction industry and foster continuous improvement in this critical area.

Keywords: *Construction Quality Assurance; Quality Control Systems; Project Management; Process Optimization; Construction Standards; Risk Management*

1. Introduction

1.1 General Introduction

Over the past decades, the construction industry has faced criticism for its comparatively poor performance and productivity compared to other sectors. Many traditional management practices within construction organizations are being questioned as clients increasingly demand enhanced service quality, faster project completion, and technological innovations. To meet these evolving expectations, the construction industry has looked towards the manufacturing sector for inspiration and innovation. Concepts like Total Quality Management (TQM), Lean Production, and Reengineering, proven successful in manufacturing, are now being integrated into construction practices. However, the effective implementation of these concepts relies heavily on fostering a culture of teamwork and cooperation both within organizations and across different stakeholders. Quality management, therefore, becomes paramount in ensuring that efforts are systematically planned and organized to achieve the required level of quality for products and services. From the standpoint of a construction company, quality management in construction projects entails maintaining construction standards to

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meet customer satisfaction, thereby ensuring long-term competitiveness and business sustainability. In today's highly competitive construction market, quality management is indispensable for companies aiming to thrive. It requires creating an environment conducive to deploying relevant tools, techniques, and procedures effectively, thus driving operational success. Quality management is not an isolated endeavor but intricately intertwined with all operational and managerial processes within a construction company, emphasizing its overarching importance across the organization.

1.2 Quality Management in Construction Project

Building construction encompasses a multifaceted process, starting from planning, design, and financing, and continuing until the structure is ready for occupancy. It involves intricate coordination and management by professionals such as project managers, construction managers, design engineers, and architects [1]. Effective planning is crucial for successful project execution, requiring consideration of various factors like zoning requirements, environmental impact, scheduling, budgeting, safety measures, material logistics, and public inconvenience caused by construction activities. Construction project management entails overseeing the entire project lifecycle, aiming to meet client requirements and deliver a functional and financially viable outcome. The construction industry comprises sectors including residential, commercial, heavy civil, industrial, and environmental, with construction managers responsible for similar processes across sectors, differing mainly in site-specific knowledge. Project stages involve design, pre-construction, procurement, construction, and warranty periods, each requiring meticulous planning and execution. Quality management is integral to construction projects, balancing cost, time, and quality objectives. While high-quality outcomes are desirable, they must be balanced with project constraints such as time and budget. The design team endeavors to meet client-defined quality standards, reflected in briefing documentation and contract specifications. Contractors are obligated to execute the works with skill and care, as per contract documents, ensuring satisfactory completion of the project. Effective communication, resource efficiency, and conflict resolution are vital functions of construction management, contributing to project success. Overall, achieving quality outcomes in construction projects necessitates careful planning, efficient execution, and adherence to client requirements and contractual obligations [2].

1.3 Construction Quality Problems

Construction quality issues are typically categorized into defects, common problems, and quality accidents. Defects refer to instances where construction fails to meet technical standards. Quality accidents entail significant damage to construction structures, functions, or form, potentially affecting safety. Various forms of quality problems exist, stemming from factors such as construction procedures and regulations, design and calculation issues, substandard materials, inadequate construction management, natural conditions, and improper facility usage. When quality problems arise, specific procedures are typically followed to address them. These procedures encompass several segments and steps, including identification, assessment, and resolution. Detailed measures are implemented across six key aspects to effectively manage and rectify construction quality issues.

1.4 Objectives

1. Examination of quality management practices in construction projects, with a specific emphasis on the tools and techniques employed.
2. Dedication levels towards integrating quality management principles into construction projects.

1.5 Research Methodology

The methodology employed in this paper involved conducting a comprehensive literature review and soliciting opinions from industry experts to explore various quality theories and concepts. These insights were then incorporated into a survey questionnaire comprising 29 questions, categorically divided into six sections. These sections encompassed inquiries about respondents' knowledge of Total Quality Management (TQM), their perception of quality, the data acquisition methods utilized, the state of quality

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within their organizations, the extent of training provided to employees on TQM principles, and the obstacles encountered in implementing TQM initiatives. The questionnaire was administered to some construction companies through personal interviews, during which respondents were asked to rank and score quality factors based on their professional experience. Subsequently, the feedback obtained from the questionnaire survey was meticulously assessed, and responses were analyzed to ascertain the most significant and least significant obstacles faced by companies in implementing Quality Management in construction projects in Ahmedabad. The analysis aimed to identify potential strategies and approaches to effectively implement quality management practices within construction projects in Ahmedabad, thereby enhancing overall project outcomes and performance [3-5].

1.6 Literature Review

P.P. Mane (2015), The paper explores the crucial aspects of quality management in construction projects, emphasizing its significance alongside time and cost considerations. It delves into the implementation of quality management systems (QMS) at both organizational and project levels, highlighting the interconnectedness of quality with overall project success and client satisfaction. Through a comprehensive literature review, the authors underscore the importance of quality planning, assurance, and control, supported by various tools and techniques. The research methodology involves a three-step model comprising quality planning, control, and assurance, utilizing a five-point scale questionnaire survey among project participants. Findings reveal the prominence of tools like checklists and measures such as workmanship quality, with customer satisfaction identified as paramount. The study underscores the integral role of quality management in ensuring project success, advocating for attention to all elements of QMS for optimal outcomes.

Hesham Abdel Khalek (2016), The previous chapter underscores the prevalent challenge within the construction industry regarding the implementation of Total Quality Management (TQM) programs. Despite the widespread recognition of TQM's importance, there remains a dearth of established methods and techniques to effectively integrate quality management principles into construction practices. This deficiency is attributed to a lack of expertise or resources in TQM, compounded by the prevalent prioritization of schedule and cost over quality improvement initiatives within companies. The report identifies several areas where customer satisfaction can be significantly enhanced through improvements in construction practices, such as addressing underestimation, adherence to specifications, project management coordination, and managing design changes and procurement-related change orders. Crucially, it highlights the dynamic nature of client expectations, necessitating a continuous cycle of identifying, measuring, and enhancing both tangible and intangible products and services. The report's top findings reveal a series of systemic challenges hindering the effective implementation of TQM within construction firms. These include weak familiarity with quality management concepts, insufficient institutional support for TQM adoption, inadequate training and standards raising initiatives, underutilization of computer technology for quality control, lack of focus on creating conducive work environments and sophisticated problem-solving models, absence of committed leadership and strategic planning for quality improvement, and a general lack of specialization in TQM application. Addressing these challenges is essential for construction firms to establish robust quality management systems and meet the evolving demands of their clientele effectively .

Harshil Shah (2018), This paper provides a comprehensive review of quality management practices within infrastructure construction projects, with a particular focus on the perspective of contractors. It highlights the necessity for effective quality management to ensure the delivery of high-quality infrastructure to society while meeting the requirements of all stakeholders involved.

2. Data Collection

2.1 Questionnaire Design

The questionnaire design process was meticulously planned to align with the study objectives and address the research questions effectively. Extensive effort and collaborative brainstorming sessions were undertaken to ensure the questionnaire's efficacy. Industry professionals were consulted in meetings to identify pertinent questions and ensure clarity in presentation. Careful attention was paid to crafting questions in a straightforward and unambiguous manner, taking into account the diverse linguistic backgrounds of potential respondents. Recognizing that not all participants may be proficient in English, a parallel Arabic version of the questionnaire was developed to cater to a wider range of respondents.

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This approach aimed to enhance inclusivity and ensure that language barriers did not impede participation or comprehension among respondents. Overall, the questionnaire design process was conducted with meticulous care and attention to detail to facilitate comprehensive data collection for the study [6-8].

2.2 Questionnaire Model

The target population under study comprises multiple respondents, including managers and engineers. The approach involved the application of a questionnaire designed for any company to input their data and respond to the questions. Subsequently, we analyzed these responses to provide them with the percentage of Quality Management implementation in their company. Based on this analysis, we offered recommendations aimed at enhancing Quality Management implementation and improving their market share.

2.3 Data Analysis

Evaluation of quality management for construction projects in Ahmedabad will consider various viewpoints. We'll analyze data provided by respondents to guide our selection of cases. Factors will be ranked and grouped based on their scores. The results from one site responders who answered a questionnaire with 29 questions divided into six sections: Knowledge of TQM, Perception of Quality, Data Acquisition Methods, Quality in Organizations, Training, and other aspects.

2.4 Scoring

In this system, companies provide answers to questions based on how essential they believe each answer is for ensuring quality in their project. Answers that are deemed highly important receive a score of 10, indicating their critical role. Answers considered moderately important receive a score of 5, showing their significance but to a lesser degree. This scoring method helps highlight which aspects of quality management are most crucial according to the companies' perspectives. Upon determining the percentage of quality management through the specified calculations:

$$\%\ Of\ Score = \frac{Total\ Achived\ Score}{Total\ Value} x\ 100\%$$

Results falling below 50% are considered unacceptable. Results ranging from 50% to 70% are accepted, but they indicate a requirement for system development. Results between 70% and 100% are fully accepted without any need for further development. This framework categorizes the assessment outcomes based on the calculated percentage, ensuring clarity and alignment with the specified criteria.

2.5 Case Study

In this research, a case study highlights a project manager, site engineer and supervisor based in Ahmedabad, shown in Table 1.

2.6 Analysis Table of Case Study

Table 1 Analysis Table of Case Study

Question No.	Project Manager	Site Engineer	Supervisor
1.	2.5	2.1	0.36
2.	10	10	0
3.	3.9	1.4	2.5
4.	10	10	5
5.	5	3.35	1.65
6.	5	5	1.65
7.	10	10	10
8.	0.74	1.1	7.1
9.	20	10	10
10.	6.7	6.7	3.3
11.	6.7	6.7	3.3
12.	10	10	10
13.	5	5	0
14.	5	10	5
15.	2.5	2.5	2.5
16.	10	10	0
17.	6.3	8	5
18.	3.3	3.3	3.3
19.	10	10	10
20.	1.1	2.5	1.1
21.	0	0	0
22.	5.5	0.34	0.02
23.	5	5	5
24.	5	5	5
25.	0	5	0
26.	0	4	0
27.	0	0	0
28.	0	2.1	0
29.	0	1.8	0
Total	149.24	150.89	90.13

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2.7 Average Percentage

% score of Project Manager=57.4%
% score of Site Engineer=58.03%
% score of Site Engineer=34.66%

$$Avarage\ of\ \% = \frac{57.4\% + 58.03\% + 34.66\%}{3}$$

$$\boldsymbol{Avarage\ of\ \% = 49.03\%}$$

2.8 Analyzing and Discussion

An analysis of the questionnaire revealed that the company's quality management percentage stood at 49.03%, which is below acceptable standards. To address this, several recommendations were made to enhance quality management and boost market share:

1. Senior management must enhance their understanding and knowledge of quality management principles and their significance.
2. The company should adopt a more effective problem-solving approach by establishing specialized teams to tackle problems, either permanently or on a case-by-case basis.
3. Employee awareness of quality management concepts and their importance must be increased.
4. A comprehensive training program should be established to educate employees on customer satisfaction, teamwork, operational control, and other essential aspects.
5. Despite familiarity with quality management concepts, the company fails to utilize any quality management programs, necessitating prompt action to implement these programs and drive improvement and development.
6. Employees should be empowered to make decisions and take necessary actions during operations, where appropriate, to facilitate significant changes.

2.9 Case Study Conclusion

Analysis of the previous questionnaire revealed that the company's implementation of quality management practices was limited, with a mere 49.03% adoption rate, which falls short of acceptable standards. Despite having some familiarity with quality management concepts, the company needs to enhance its understanding and take concrete steps to integrate quality management programs, thereby driving improvement and development. This requires a commitment to knowledge enhancement and strategic implementation to achieve desired outcomes.

Conclusion

The construction industry's adoption of Total Quality Management (TQM) has been limited, despite its popularity. The main obstacles include a lack of expertise and resources, prioritizing schedule and cost over quality, and inadequate implementation methods. To enhance customer satisfaction, construction companies must improve estimation, conformance, project management, and design changes. However, companies struggle to meet evolving customer expectations due to inadequate systems for identifying, measuring, and improving their products and services.The key findings of the report highlight several challenges:

1. Limited understanding of quality management concepts and processes due to inadequate training opportunities.
2. Inefficient application of Total Quality Systems in construction companies, with unnecessary institutional complexity.
3. Lack of clear training plans and low participation in quality-related courses due to insufficient management support and conviction.
4. Limited use of computers in construction businesses, despite their potential for quality control.
5. Inadequate work environments and lack of sophisticated problem-solving models in construction departments.
6. Absence of committed leadership, strategic planning, and effective communication channels for quality improvement.
7. Insufficient empowerment of individuals to drive quality success.
8. Lack of specialization in applying total quality management principles.

Recommendation

To enhance quality management in the construction industry, several steps are necessary:

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1. Promote knowledge sharing through studies, seminars, and workshops.
2. Establish a dedicated quality management and control entity.
3. Foster international collaboration and exchange best practices.
4. Encourage implementation through incentives and recognition.
5. Develop strategic plans and innovative solutions.
6. Leverage technology, such as computers, to support quality management.
7. Establish a quality management unit within the Ministry of Housing to raise awareness and provide support.

To successfully implement Total Quality Management (TQM), companies should:

1. Gradually introduce changes, avoiding sudden disruptions.
2. Secure top management commitment and resource allocation.
3. Align organizational structures with TQM philosophy.
4. Provide training programs to build confidence and embrace change.
5. Continuously adapt quality systems, standards, and processes.
6. Establish an information system to support continuous improvement.
7. Encourage employee participation and motivation.
8. Foster a shared responsibility culture among all employees.

By prioritizing quality management, companies can enhance customer satisfaction, increase market share, and improve overall performance. This study aimed to demonstrate the implementation of a continuous improvement system through quality management adoption in the construction industry.

Future Study

This research study achieved its objectives, but also uncovered avenues for future investigation, including:

1. Identifying and prioritizing the obstacles that hinder the implementation of quality management in various construction projects.
2. Determining and ranking the factors that contribute to the successful and profitable application of quality management in construction projects.
3. Developing software to accurately measure and predict the level of quality management integration throughout all phases of construction projects.
4. These potential research directions could provide valuable insights and practical tools to enhance the adoption and effectiveness of quality management in the construction industry.

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