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An Overview of Total Quality Management Tools and Techniques on Construction Projects

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Abstract: ***The role of construction quality and continuous improvement is vital in the development of construction industry of growing nations. Construction quality and regular improvement is linked with the adoption of quality management systems in construction companies. This paper shows the importance of TQM (Total Quality Management) and presents the benefits of TQM gained by construction organizations in worldwide construction sector. It examines the current practices and process of execution of TQM in construction sector of India. The study also identifies the barriers in adoption of TQM and advantages of implementing TQM in construction sector of India. And will also provide a simple framework for small and medium scale firms to implement TQM. In the end, the paper presents some suggestions and steps for the implementation of TQM in construction companies of India. The findings and recommendations of the study are not only beneficial for the construction sector of India but also these will be helpful to other developing countries having similar scenarios.***
Keywords: Total Quality Management (TQM), Construction Projects, Continuous Improvement, Quality Circles, Quality Standards, Quality Tools

I. INTRODUCTION

The construction sector is a big industry that builds things like houses, offices, roads, and bridges. It's important because it creates jobs and helps communities grow. Lots of people work in construction, like builders, architects, and engineers. The industry has rules to make sure things are safe and protect the environment. But construction can be difficult because it needs skilled workers, money, and materials that can be expensive. As new technology develops, construction will change and get better.

TQM embraces the philosophy, principles, procedures, and practices necessary for providing customer satisfaction as well as achieving productivity and business performance in the construction industry. Commitment and perseverance are necessary. The sources of costs associated with the no achievement of quality include the costs of rework, correcting errors, reacting to customer complaints, having deficient project budgets due to poor planning, and missing deadline. [1]

A. Problem Statement

In today's construction industry, companies face many challenges such as tight deadlines, high costs, increasing client demands, and problems with quality. Even though Total Quality Management (TQM) can help solve these issues by improving processes and focusing on quality at every stage, it is not being fully used in many construction projects.

Common problems like construction defects, rework, delays, and low client satisfaction still occur. These are often caused by a lack of proper training, poor communication among teams, limited support from top management, and resistance to changing old ways of working. Also, modern quality tools like Lean Construction, BIM, and Six Sigma are not being used to their full potential.

B. Objective

1) To study the importance and necessity of total quality management on construction projects.
2) To find out the problems arising while implementing TQM on small to medium construction projects and latest TQM practices in construction industry.

C. Significance of Study

The construction industry is important for building construction in a country, but it can be complicated. Total Quality Management (TQM) is a way to help construction companies do better work. TQM means always trying to do better and making customers happy. TQM can help companies save time and money by doing things right the first time.

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TQM also helps people who work on a construction project talk to each other better, so there are fewer fights. TQM can make a construction company better than other companies, so they get more work.

In different production industries are organising the TQM (general high-quality management) device however in construction enterprise we cannot establish even QMS (great control system). The cause at the back of is every construction undertaking is unique and satisfactory is ever converting factor i.e. exceptional exchange time to time, region to area. Construction works are affected by some major factors like quality of material, quality of manpower, construction detailing, concrete work, etc. in this work it is very much helpful for find out the major factors and give result with cost of poor quality. Also for creating cost oriented quality awareness to low level construction companies. [2]

TQM in the construction industry can also lead to safer working conditions. When construction companies focus on quality, they also focus on safety, which is an essential aspect of any construction project. By identifying potential safety hazards and implementing safety measures, TQM can reduce the risk of accidents and injuries on construction sites. This not only protects workers but also helps to prevent costly delays and legal issues. Ultimately, TQM can help construction companies create a culture of safety that benefits everyone involved in the project.

II. LITERATURE REVIEW

(Egwunatum S.I. et.al 2022) The study found that the major practice of TQM principles with respect to the structural failure rate are purchasing: ensuring the procurement of materials of the specified quality standard, ensuring the use of a quality improvement construction process of the organization, site management responsibility this entails ensuring quality supervision by the project management leadership and monitoring and control of quality during the construction to guarantee firm observance quality standards.[16]

(Coelho C. et.al 2022)This study endorsed the application of TQM as a tool which Australian construction organizations can utilize to improve their competitive position through improved performance as globalization continues to accelerate competition. The organizational cultural profile of Australian construction organizations appears to present the dominant characteristics of the external focus culture. This cultural typology was identified to entail a market and adhocracy focus as classified according to the results of the cluster analysis.[19]

(Rajan T. et.al 2017)This paper focus on increasing trend of TQM in Construction Industry with the key TQM factors. The study states partnering as a solution to all the barriers and a way to effective implementation. Partnering brings the various stakeholders to form a united multifunctional project team to improve quality.[25]

(Adeyemi B.S. et.al 2022) TQM implementation in the construction industry such as absence of benchmarking, employee confrontation to change, absence of understanding, inadequate preparation, absence of top management obligation, absence of customer focus, absence of rewards and acknowledgment, inadequate evaluation processes, insufficient fund, inefficient management, inadequate raw materials, lack of proper communication and unproductive leadership.[26]

(Neyestani B. et.al 2016) As mentioned earlier, the main purpose of this study was to develop an appropriate performance measurement framework for TQM implementation in construction industry. Oakland (2003), and Kalpande et al. (2012) asserted the practitioners and scholars should review TQM empirical studies in different sectors with the aim of specifying most significant performance measures (KPIs) to evaluate the performance of TQM implementation on critical elements in different areas of the organization. Thus, the study examined 26 TQM models that extracted from main databases, these frameworks were developed for measuring the effects of TQM and its elements on the organization's performance by authors in different industries and countries. In data analysis, the 20 KPIs identified that were derived from 26 TQM frameworks.[30]

III. METHODOLOGY

A detailed literature review was conducted to identify common themes, barriers, and success factors in TQM implementation within the construction industry. Academic journals, industry publications, books, and case studies from reputable sources were analyzed. The literature review helped in identifying frequently cited challenges such as resistance to change, insufficient training, lack of resources, and the fragmented nature of the construction industry. This initial research phase provided a theoretical foundation and framework for identifying the challenges and categorizing them systematically.

We will gather background information on respondents, including their role in the organization, years of experience, company size, and project types. Questionnaire will include questions related to specific TQM practices adopted by the company, the frequency of these practices, the tools and techniques employed, and the commitment level from management and employees.

Also ask about challenges faced in TQM implementation, the perceived benefits, and the overall effectiveness of TQM practices in improving project quality and customer satisfaction.

IV. DATA ANALYSIS

For data collection purpose we have prepared a google form questionnaire and approved by our project guide. Also, we can get desired data which will help to achieve our objective.

Google form questionnaire was used to collect data. The questionnaire includes 20 questions related to latest TQM practices, tools, techniques. They received 28 responses and analyzed the data to extract necessary information such as the most recent TQM practices, tools in use, and knowledge of TQM techniques.

Here questionnaire based on 5 point likert scale, the data analysis is done and Interpretation table given below,

Sr. No.	Statements	N	Minimum	Maximum	Mean
1.	Importance & Familiarity	28	1	5	4.10
2.	Understanding role	28	1	5	4.32
3.	Training & Education	28	1	5	3.84
4.	Reduced construction defects	28	1	5	4.32
5.	Improved project quality standards	28	1	5	4.39
6.	Reduced rework cost	28	1	5	4.28
7.	Decreased overall project cost	28	1	5	4.07
8.	Improve project delivery times	28	1	5	4.10
9.	Client satisfaction	28	1	5	4.17
10.	Employees satisfaction	28	1	5	4.10
11.	Inadequate training resources	28	1	5	3.75
12.	Resistance to change traditional practices	28	1	5	3.82
13.	Insufficient top management commitment	28	1	5	3.75
14.	Communication between stakeholders challenging	28	1	5	3.82
15.	Project delivery timelines	28	1	5	4.00
16.	Quality Circle	28	1	5	4.00
17.	BIM for quality management	28	1	5	3.96
18.	Lean construction principles	28	1	5	4.10
19.	Six sigma	28	1	5	3.82
20.	Just in time delivery	28	1	5	3.89

Note- 5Strongly Agree 4 Agree 3 Neutral 2 Disagree 1 Strongly Disagree

A structured questionnaire survey was conducted with 28 respondents to evaluate the effectiveness, challenges, and awareness of TQM strategies in construction projects. Each statement was rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

V. RESULTS & DISCUSSION

1) Improved project quality standards received the highest mean score of 4.39, indicating that respondents strongly agree on the positive impact of TQM on quality outcomes.

2) Understanding of roles (4.32) and reduction in construction defects (4.32) were also highly rated, reflecting strong internal alignment and process improvements.

3) Reduced rework cost (4.28) and client satisfaction (4.17) were other notable areas where respondents agreed on TQM's effectiveness.

4) Moderate agreement was found in areas such as Lean construction (4.10), Just-in-Time delivery (3.89), and Six Sigma (3.82), indicating awareness but possibly limited implementation.

5) Challenges such as inadequate training resources (3.75), resistance to change (3.82), and insufficient top management commitment (3.75) scored relatively lower, pointing to areas that need attention.

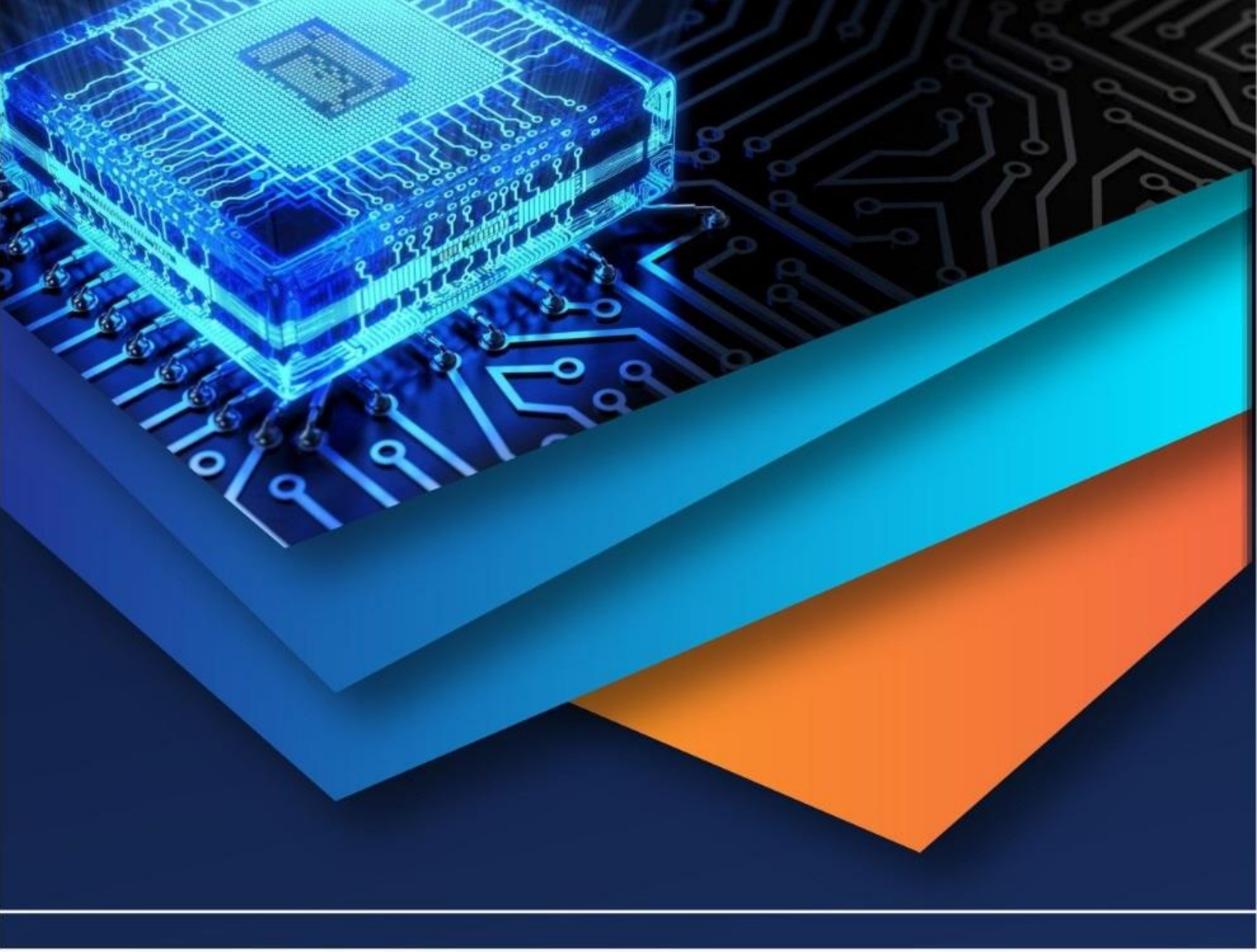
VI. CONCLUSION

The survey findings clearly indicate that Total Quality Management (TQM) strategies have a positive and measurable impact on the quality, cost efficiency, and stakeholder satisfaction in construction projects. High mean scores for statements such as "Improved project quality standards" (4.39), "Understanding of roles" (4.32), and "Reduced construction defects" (4.32) demonstrate that TQM principles are not only recognized but are also being effectively practiced in many areas of the construction sector. However, the data also reveals critical challenges that must be addressed to fully realize the benefits of TQM. Issues like inadequate training resources, insufficient top management commitment, and resistance to changing traditional practices scored lower, signaling barriers to effective implementation. These findings suggest the need for greater emphasis on education and training, leadership involvement, and change management strategies. Modern quality management tools such as Lean Construction, Building Information Modeling (BIM), and Six Sigma are gaining traction but still require broader adoption and integration into standard practice.

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