



## ADAPTING PRINCIPLES FROM TOTAL QUALITY MANAGEMENT (TQM) TO CONSTRUCTION PROJECTS

M. Alsharqawi<sup>1,2,\*</sup>, C. Samuel<sup>3</sup>, J. Eresanara<sup>4</sup> and M. Mouazen<sup>5</sup>

<sup>1</sup> Dept of Construction Management, California State University, Sacramento, California, United States

<sup>2,3,4,5</sup> Project Management Program, School of Business, St. Lawrence College, Ontario, Canada

\* [alsharqawi@csus.edu](mailto:alsharqawi@csus.edu) (Corresponding Author)

**ABSTRACT:** Globally, the construction industry faces persistent challenges in quality management, leading to frequent delays, cost overruns, and reduced stakeholder satisfaction. A 2024 study revealed that 98% of contractors in North America encountered significant quality issues, including errors, omissions, and rework. Total Quality Management (TQM) presents a strategic approach to mitigating these challenges by fostering continuous improvement, stakeholder collaboration, and employee engagement. This research examines the integration of TQM principles into construction projects, emphasizing customer focus, process efficiency, and data-driven decision-making. Using qualitative assessments from case studies, structured interviews, and surveys, the study demonstrates that TQM adoption results in improved project timelines, defect reduction, and enhanced communication. Findings reveal that TQM implementation leads to a 15% faster project completion rate, a 25% reduction in defects, and an 80% improvement in communication channels. Moreover, 90% of stakeholders in TQM projects report higher satisfaction compared to 65% in non-TQM projects. These results underscore TQM's ability to optimize workflows, enhance accountability, and create a culture of quality excellence. The study recommends targeted training programs, structured feedback mechanisms, and innovation-driven quality assessment frameworks to sustain long-term improvements in the construction sector.

### 1. INTRODUCTION AND LITERATURE REVIEW

Quality issues in construction often lead to delays, budget overruns, and frustrated stakeholders. Common problems like poor workmanship, design flaws, and miscommunication result in costly rework. A 2024 study by Dodge Construction Network revealed that 98% of contractors in the U.S. and Canada encountered significant quality problems—such as errors, omissions, and rework—over the past three years (Dodge Construction Network, 2024). To tackle these challenges, projects need a smarter, more structured approach to quality management.

Total Quality Management (TQM) is a comprehensive approach focusing on continuous improvement in quality across all organizational processes. In the construction industry, where projects are complex and involve multiple stakeholders, integrating TQM principles enhances project quality and efficiency. TQM fosters collaboration and communication among all parties, leading to improved coordination and reduced errors (Arditi and Gunaydin, 1997; Harrington et al., 2012). Customers or end users are the ultimate evaluators of the quality of service provided; therefore, it is extremely important to assess their satisfaction (Alsharqawi et al., 2017). The TQM holistic approach promotes shared responsibility for project success, ultimately increasing stakeholder satisfaction.

Given the industry's challenges, including fluctuating quality standards and the need for effective stakeholder engagement, TQM presents a viable solution. Figure 1 below shows the principles of total quality management.



Figure 1: Principles of total quality management, adopted from Ghaz (2024)

According to Ghaz (2024), the principles of Total Quality Management (TQM) presented in Figure 1 encompass the following:

- **Customer Focus:** TQM places a strong emphasis on understanding and meeting customer needs and expectations. It involves gathering customer feedback, conducting market research, and using that information to improve products, services, and overall customer satisfaction.
- **Continuous Improvement:** TQM promotes a culture of continual improvement throughout the organization. It encourages all employees to actively participate in identifying opportunities for enhancement, eliminating waste, and implementing incremental improvements in processes, products, and services.
- **Employee Involvement:** TQM recognizes the importance of involving employees at all levels in quality improvement initiatives. It fosters a collaborative and empowered work environment, where employees are encouraged to contribute ideas, make decisions, and take ownership of quality-related activities.
- **Process-Oriented Approach:** TQM focuses on managing and improving processes rather than individual tasks or departments. It involves mapping, analyzing, and optimizing workflows to enhance efficiency, effectiveness, and consistency.
- **Data-Driven Decision-Making:** TQM relies on the collection and analysis of relevant data to support decision-making. It emphasizes the use of facts and figures to identify areas for improvement, measure performance, and monitor progress toward quality objectives.
- **Supplier Relationships:** TQM recognizes the significance of strong relationships with suppliers. It emphasizes collaboration, communication, and mutually beneficial partnerships with suppliers to ensure the quality of inputs and optimize the overall value chain.
- **Leadership Commitment:** TQM requires committed leadership that actively supports and promotes quality principles throughout the organization. Leaders serve as role models, set clear quality goals, provide necessary resources, and foster a culture that prioritizes continuous improvement and customer satisfaction.
- **Integrated System:** TQM integrates all organizational systems and processes to work toward common quality objectives. Goals are aligned across teams to ensure coherence and collaboration.

Total Quality Management (TQM) principles can be effectively tailored to construction workflows and enhancing project quality and efficiency. Key adaptations include:

- **Customer Focus:** Engaging clients throughout the project lifecycle ensures their needs are met, fostering satisfaction and loyalty (Arditi and Gunaydin, 1997).
- **Employee Involvement:** Promoting collaboration among diverse teams, (e.g. including architects and contractors), encouraging shared responsibility for quality outcomes (Harrington et al., 2012).
- **Process Orientation:** Mapping construction processes allows for the identification of critical stages, enabling the implementation of standard operating procedures (SOPs) that minimize variability and enhance efficiency (Harrington, Voehl, and Wiggin, 2012).
- **Data-Driven Decision Making:** Utilizing performance metrics helps monitor progress facilitates informed adjustments, and enhances accountability and transparency (Arditi and Gunaydin, 1997).

Despite advancements in construction management, quality issues remain a prevalent concern, resulting in inefficiencies, delays, and stakeholder dissatisfaction. Poor workmanship, design flaws, and miscommunication contribute to costly rework and reduced project performance. Current quality management approaches often lack a structured framework for continuous improvement, leading to inconsistencies in execution. Figure 2 illustrates the author’s analysis of quality issues in construction management using the fishbone diagram technique.



Figure 2: Analyzing quality issues in construction

Arditi and Gunaydin (1997) were among the early researchers to explore TQM in the construction sector, emphasizing the theoretical benefits of adopting quality systems. Zou and Lee (2010) provided a comprehensive review of TQM practices, identifying critical success factors such as leadership, training, and employee participation. More recently, Ali and Kamaruddeen (2018) conducted a review of TQM implementation in construction, identifying gaps in systematic adaptation strategies and the need for localized case studies. More recent studies have aimed to refine the understanding of TQM success factors. Alzahrani and Emsley (2013) found that leadership commitment, communication, and employee training are critical to achieving project success in quality-focused environments. Love et al. (2021) investigated defect causation and quality failure costs, emphasizing that better quality management systems could significantly reduce rework. Additionally, Hwang and Ng (2013) and Reichelt et al. (2020) evaluated how organizational culture and stakeholder engagement influence quality performance, reinforcing the idea that quality systems must be customized to specific project settings.

Several case studies demonstrate the effectiveness of TQM in reducing project inefficiencies. For instance, a large infrastructure project that implemented quality circles reported a 20% reduction in rework and a 15% decrease in completion time due to improved communication and proactive problem-solving (Harrington et al., 2012). In another case, a residential construction company that adopted TQM principles through regular training sessions saw a 30% reduction in customer complaints related to quality issues, significantly improving client satisfaction (Arditi and Gunaydin, 1997). While these studies have laid foundational knowledge, few have provided recent data-driven evaluations of TQM adoption in North America. Additionally, most focus on theoretical frameworks or general industry surveys, rather than detailed qualitative assessments involving direct stakeholder interviews and measurable outcomes such as defect reduction, improved timelines, and satisfaction metrics.

The novelty of this study lies in its development of a practical framework for adapting Total Quality Management (TQM) principles to construction workflows, with a strong emphasis on employee engagement, hands-on participation, structured feedback loops, and targeted training strategies tailored for construction teams. This operational-level perspective addresses key implementation gaps often overlooked in traditional TQM theory and literature. The research presents real-world case studies supported by structured interviews and surveys with project managers, site supervisors, and employees. Through qualitative assessments and measurable performance indicators, the study provides quantifiable evidence of the benefits of TQM in practice—including improvements in project timelines, defect reduction, communication efficiency, and stakeholder satisfaction. By exploring how core TQM principles—such as customer focus, process orientation, and data-driven decision-making—can be effectively implemented on construction sites, the study identifies actionable strategies that enhance project quality, foster stakeholder collaboration, and increase workforce ownership. As such, this paper offers a timely and necessary contribution to the evolving discourse on quality management in the construction industry.

## 2. METHODOLOGY

This study adopts a qualitative case study approach to assess the practical adaptation and effectiveness of Total Quality Management (TQM) principles in construction projects. The methodology was designed to explore real-world implementation, capture stakeholder perceptions, and evaluate measurable project outcomes. The methodology is illustrated in Figure 3. The diagram follows a logical flow from research design to data collection methods, analysis techniques, and finally to the key findings.

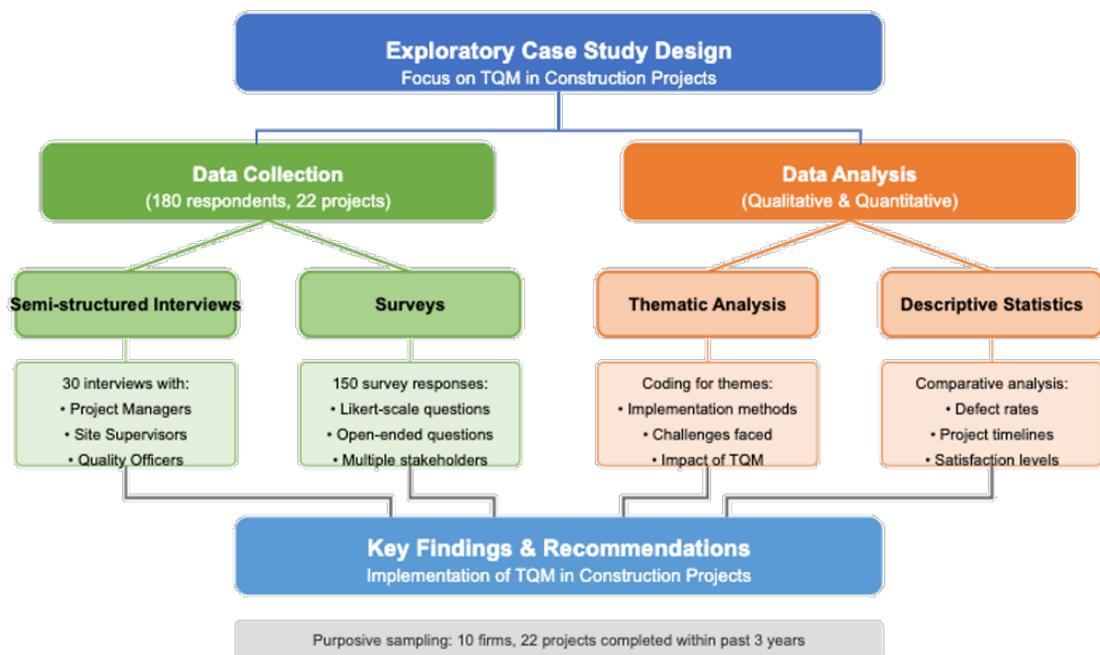


Figure 3: An overview of the research methodology

The research follows an exploratory case study design, focusing on multiple construction projects across North America that have incorporated TQM practices. The study aimed to assess how key TQM principles—such as customer focus, employee involvement, continuous improvement, and data-driven decision-making—were implemented and how they influenced project performance.

### 3. DATA COLLECTION AND ANALYSIS

Qualitative data were gathered through structured interviews and surveys with key stakeholders in selected construction projects. The purpose from the structured interviews was to ensure practicality for real-life analysis and credibility (Alsharqawi et. al., 2024). Interview questions are included in Appendix A. Project managers, site supervisors, and employees directly involved in quality management practices participated in the study. Thematic analysis was employed to identify key trends and insights related to the implementation of TQM in construction industry.

#### 3.1 Data Collection

Data were collected through two primary sources:

- Semi-structured interviews with key project personnel (e.g., project managers, site supervisors, and quality officers).
- Surveys distributed to employees and stakeholders involved in project execution.

The study collected data from a total of 180 respondents across 22 construction projects, involving 10 different construction firms engaged in medium to large-scale residential, infrastructure, and institutional developments. The data collection process included 30 semi-structured interviews with project managers, site supervisors, and quality officers, along with 150 survey responses from various stakeholders involved in project execution. The respondents provided a wide range of perspectives based on their professional backgrounds and levels of experience. The distribution of work experience among participants is illustrated in Figure 4. This diverse representation ensured the findings were grounded in practical, on-the-ground insights into TQM implementation across different project types and organizational contexts.

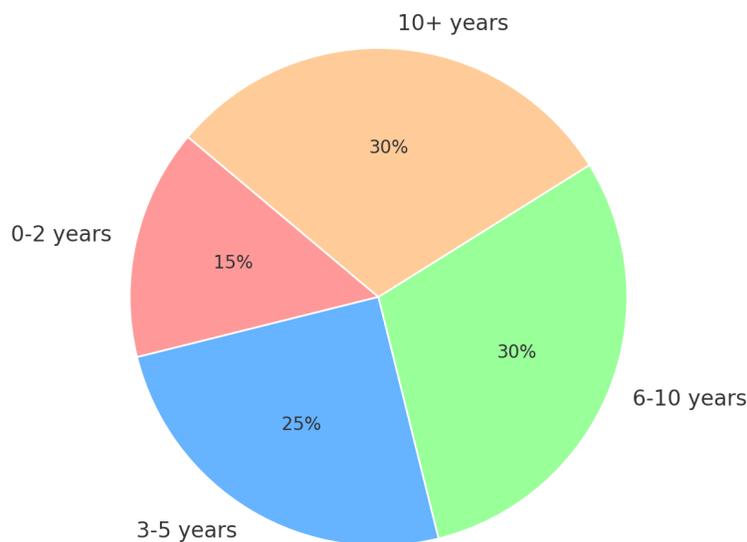


Figure 4: Respondents' classification with years of experience

Interview questions were designed to evaluate how TQM principles were applied, the challenges faced, and the perceived benefits (see Appendix A for full instrument). The surveys included Likert-scale and

open-ended questions measuring employee engagement, communication effectiveness, quality outcomes, and stakeholder satisfaction. A purposive sampling method was used to select projects and participants who had direct experience with TQM practices in the field. This ensured the relevance and depth of insights collected. Projects were chosen based on two main criteria: (1) explicit integration of TQM strategies and (2) completion within the past three years.

### 3.2 Data Analysis

Data were analyzed using thematic analysis for qualitative data and descriptive statistics for survey responses. Interview transcripts were coded to identify recurring themes related to the implementation, challenges, and impact of TQM. Survey data were analyzed using frequency distributions and comparative analysis (e.g., comparing defect rates, project timelines, and satisfaction levels between TQM and non-TQM projects).

## 4. FINDINGS AND DISCUSSION

### 4.1 Results

The analysis identified which principles were most and least adopted, providing valuable insights for future improvements as shown in Table 1.

Table 1: Most and least adopted TQM principles

Most Adopted TQM Principles	Least Adopted TQM Principles
Customer Focus: 85% of respondents indicated that this principle was effectively integrated, emphasizing the importance of meeting client needs and expectations.	Process Approach: Only 50% of respondents felt this principle was adequately implemented, highlighting a potential area for development in process optimization.
Continuous Improvement: 78% reported regular practices aimed at enhancing processes and outcomes.	Decision Making: 55% indicated that decisions were not consistently based on data analysis, suggesting a need for improved data utilization.
Employee Involvement: 75% of participants noted strong engagement of employees in quality initiatives, fostering a culture of collaboration.	Integrated System: 60% reported challenges in aligning various organizational processes under a unified TQM framework.

Further, analyses of data collected from case studies reveal improvements in project timelines, reduced defects, and enhanced communication channels among stakeholders. Key findings indicate that construction projects implementing TQM principles experience higher levels of quality assurance and stakeholder satisfaction. The study reveals that construction projects implementing TQM principles achieve significant improvements in various areas:

#### 4.1.1 Improvement in Timelines

TQM implementation resulted in a 15% faster completion rate compared to non-TQM projects. For instance, a project initially scheduled for 12 months was often completed in approximately 10 months. While TQM practices contributed to a 20% reduction in project delays, with average delays decreasing from 4 weeks to 3 weeks in projects that adopted TQM principles, 85% of TQM projects meet deadlines, compared to 70% of non-TQM projects.

#### 4.1.2 Reduction in Defects

Projects that adopted TQM principles witnessed a remarkable 25% reduction in defects. For example, a typical project with an average of 40 defects would have yielded only 30 defects under TQM

implementation. Moreover, the average quality assurance rating for TQM projects stood at 8.5, significantly higher than the 6.3 rating observed in non-TQM projects.

#### 4.1.3 Enhanced Communication

TQM practices, such as regular quality meetings, feedback loops, and clear reporting structures, enhanced communication among stakeholders. By actively involving stakeholders in decision-making and fostering open dialogue, TQM increased transparency. Consequently, 80% of participants from TQM projects reported feeling more informed and engaged, leading to a collaborative environment that promptly addressed issues.

#### 4.1.4 Stakeholder Satisfaction:

90% of stakeholders in TQM projects reported higher satisfaction, compared to 65% in non-TQM projects. This 25% difference highlights TQM's effectiveness in fostering transparency, efficiency, and stakeholder confidence. Additionally, 80% of TQM projects saw improved communication, reducing inefficiencies and delays. These findings highlight TQM's role in enhancing stakeholder engagement.

## 4.2 Discussion

The interpretation of results highlights the importance of fostering a culture of continuous improvement within construction teams. By encouraging regular feedback loops, organizations can identify areas for enhancement and implement changes effectively. The study also underscores the necessity of stakeholders collaboration, facilitating a shared vision for quality outcomes. Employees involvement is crucial; engaging workers in quality management initiatives leads to increased ownership and accountability.

To engage workers in quality management initiatives, several strategies can be implemented. Training and education play a crucial role, as conducting TQM workshops and providing ongoing learning opportunities help employees understand quality principles. Involvement in decision-making fosters ownership by establishing feedback mechanisms and empowering employees to contribute to quality-related decisions. Recognition and rewards further enhance motivation through incentive programs and by highlighting success stories. Encouraging a collaborative team environment through quality circles and interdepartmental cooperation strengthens teamwork and shared responsibility. Additionally, clear communication ensures transparency by setting clear quality goals and providing regular updates on initiatives. Hands-on participation can be promoted by involving employees in audits and problem-solving workshops. Lastly, mentorship and support enhance engagement by implementing mentorship programs and encouraging an open-door policy for inquiries, ensuring that employees feel supported in their quality improvement efforts.

Successful implementation of TQM in the construction industry relies on a structured approach that integrates effective training and clear communication. Comprehensive training programs equip employees with the skills needed to uphold TQM principles, fostering quality awareness and process improvement. Continuous professional development ensures alignment with organizational quality objectives, while strong feedback loops and collaborative decision-making help identify and resolve issues early. Clear communication frameworks, including regular meetings and transparent feedback mechanisms, reduce confusion and enhance teamwork. By embedding TQM principles into construction workflows and emphasizing ongoing training, structured communication, and a culture of continuous improvement, construction projects can achieve higher quality standards, drive innovation, and ensure long-term success.

## 5. CONCLUSIONS

This study highlights the transformative impact of adapting TQM principles to construction projects, demonstrating significant improvements in project quality, stakeholder collaboration, and employee engagement. Findings indicate that TQM adoption results in faster project completion, fewer defects, and

enhanced communication, ultimately increasing stakeholder satisfaction. By fostering a culture of continuous improvement and implementing structured feedback loops, construction firms can address systemic inefficiencies and optimize resource allocation.

To sustain these benefits, organizations should invest in comprehensive TQM training programs, establish clear communication frameworks, and implement structured quality assessment methods. The integration of TQM not only enhances project outcomes but also ensures long-term industry competitiveness. Future research should focus on the least adopted principles to enhance overall TQM effectiveness in construction projects and explore the long-term sustainability of TQM in construction, particularly its role in fostering innovation and resilience in evolving project environments.

## **ETHICAL STATEMENT**

This study was conducted in full compliance with institutional ethical standards by the Institutional Review Board of California State University, Sacramento and the Research Ethics Board of St. Lawrence College. All participants provided informed consent, and data were collected and managed in accordance with institutional and national ethical guidelines for research involving human participants.

## **APPENDIX A: INTERVIEW QUESTIONS**

- **Participant Information:**

- Name:
- Position:
- Project Name:

- **Survey Questions:**

1. What TQM principles have you implemented in your project?
2. How have these principles impacted project quality and stakeholder satisfaction?
3. Can you provide specific examples of improvements observed since implementing TQM?
4. What challenges did you face in integrating TQM into your project?
5. How would you rate the overall quality of the project? (1-5 scale)
6. Were TQM principles effectively communicated throughout the project? (Yes/No)
7. How engaged were employees in quality management initiatives? (1-5 scale)
8. What improvements would you suggest for future projects?

## **REFERENCES**

- Ali, A. S. and Kamaruddeen, A. M. 2018. Implementation of TQM in Construction: A Review. *Journal of Engineering Science and Technology*, 13(8), 2459-2470.
- Alsharqawi, M., Abu Dabous, S., and Zayed, T. 2017. Performance-based contracting for maintaining transportation assets with emphasis on bridges. In *MATEC Web of Conferences* (Vol. 120, p. 08012). EDP Sciences.
- Alsharqawi, M., Abu Dabous, S., and Zayed, T. 2024. Designing a fuzzy-based framework for implementing performance-based contracts in bridge asset management. *Innovative Infrastructure Solutions*, 9(4), p.126.
- Alzahrani, J. I., and Emsley, M. W. (2013). The impact of contractors' attributes on construction project success: A post construction evaluation. *International Journal of Project Management*, 31(2), 313–322. <https://doi.org/10.1016/j.ijproman.2012.06.006>
- Arditi, D. and Gunaydin, H. M. 1997. Total quality management in the construction process. *International Journal of Project Management*, 15(4), 235-243.
- Crosby, P. B. 1979. *Quality is Free: The Art of Making Quality Certain*. New American Library.
- Dodge Construction Network. 2024. *Better coordination on construction projects can improve a contractor's profitability*. Construction Dive. <https://www.constructiondive.com/press-release/20240911-better-coordination-on-construction-projects-can-improve-a-contractors-pro/>

- Ghaz, E. 2024. Comprehensive guide to plan optimization: Strategies and benefits. Retrieved February 23, 2025, from <https://hbsmartfactory.com/plan-optimization/>
- Harrington, H. J., Voehl, F., and Wiggin, H. 2012. Applying TQM to the construction industry. *The TQM Journal*, 24(4), 352-362.
- Hwang, B.-G. and Ng, W. J. (2013). Project management knowledge and skills for green construction: Overcoming challenges. *International Journal of Project Management*, 31(2), 272–284. <https://doi.org/10.1016/j.ijproman.2012.05.004>
- Juran, J. M. 1999. *Juran's Quality Handbook*. McGraw-Hill.
- Kumar, M. and Antony, J. 2008. Does Quality Management Strategy Affect Quality Management Practices? *International Journal of Quality & Reliability Management*, 25(2), 116-137.
- Latham, M. 1994. *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the UK Construction Industry*. HMSO.
- Love, P. E. D., Sing, M. C. P., and Wang, X. (2021). Quality failures in construction: A meta-analysis of their causes and prevention. *Engineering, Construction and Architectural Management*, 28(4), 1120–1142. <https://doi.org/10.1108/ECAM-10-2019-0590>
- Reichelt, S., Ahmed, V., and Wamuziri, S. (2020). Barriers to effective quality management in construction: A case study in the UK. *Built Environment Project and Asset Management*, 10(4), 511–526. <https://doi.org/10.1108/BEPAM-01-2019-0006>
- Zou, P. X. W. and Lee, D. 2010. Total Quality Management in Construction: A Review. *Journal of Construction Engineering and Management*, 136(3), 293-303.