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Challenges in Applying Total Quality Management Systems: A Study of Construction Companies in Red Sea State, Sudan

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Abstract

This study aims to identify and analyze the primary challenges hindering the effective application of Total Quality Management (TQM) systems within construction companies operating in Red Sea State, Sudan. Recognizing the critical role of the construction industry in national development and the potential benefits of TQM, understanding these barriers is essential for improving industry performance. A descriptive-analytical approach was adopted, utilizing a field study methodology. Data was collected via a structured questionnaire distributed to professionals (engineers, managers, contractors, consultants) within construction companies and related entities in Red Sea State. Ninety-two (92) valid responses were received and statistically analyzed using SPSS.

The analysis revealed several significant challenges. The most prominent barriers include: the adverse impact of prevailing economic and political conditions on



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projects; a lack of sustained commitment from top management to champion and implement TQM principles; a significant shortage of skilled labor required for quality execution; weak monitoring, follow-up, and control mechanisms throughout project stages relative to planned objectives; organizational structures often unsuitable for supporting TQM requirements; insufficient allocation of budget resources specifically dedicated to supporting TQM initiatives; and the prevalence of inadequate planning procedures for project operations.

Based on these findings, the study proposes several recommendations aimed at facilitating TQM adoption. Key recommendations include: enhancing awareness of TQM's importance and benefits through targeted lectures, workshops, and comprehensive training programs for personnel at all levels; designing and implementing organizational structures that align with and support TQM principles; securing demonstrable and consistent commitment from top management towards the TQM system; strengthening project control processes and emphasizing robust, proactive project planning; allocating dedicated financial resources to support TQM implementation and continuous improvement; and fostering a stronger quality culture throughout the industry.

Keywords: Construction Industry, Engineering Projects, Quality Management, Total Quality Management (TQM), Implementation Challenges, Implementation Barriers, Red Sea State, Sudan.



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1. Introduction

1.1. Background

The global construction industry operates within an increasingly dynamic and challenging environment. Factors such as economic globalization, rapid technological advancements, and heightened customer expectations necessitate a constant drive for enhanced performance and competitiveness (Ahmed et al., 2017). Construction plays a pivotal role in national development, serving as a cornerstone for infrastructure development, economic growth, and job creation. It is often considered a key indicator of a nation's progress and prosperity. However, the industry, particularly in developing contexts, has frequently faced criticism for issues related to productivity, efficiency, cost overruns, delays, and inconsistent quality outcomes compared to other sectors like manufacturing (Hoonakker et al., 2010).

In response to these challenges, management philosophies like Total Quality Management (TQM) have gained prominence. TQM represents a holistic, organization-wide approach focused on continuous improvement in all aspects of operations to achieve customer satisfaction and long-term success. While definitions vary, core tenets consistently emphasize customer focus, process improvement, employee involvement, and data-driven decision-making. As defined by Cohen and Brand (1993), TQM involves continuous improvement (Management), meeting customer requirements (Quality), and applying these principles across all organizational functions (Total). Zairi (1991) further emphasizes TQM's focus on continuous improvement in cost, quality, performance, and trust. The influential quality guru W. Edwards Deming stressed that the



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purpose of quality techniques is to enhance competitiveness and that quality itself is fundamentally a management responsibility.

1.2. TQM in Construction

Applying TQM principles within the unique context of the construction industry offers significant potential benefits. These include improved project quality, reduced defects and rework, enhanced cost-effectiveness, shorter project durations, increased client satisfaction, improved safety records, and ultimately, a stronger competitive position for companies (Raouf, 2004; Tasie, 2016). Key elements crucial for TQM success often cited include strong leadership commitment, a customer-centric culture, robust training programs, effective communication, supplier quality management, and the use of quality tools and techniques (Al-Ghamdi, 2006; Al-Azzawi, 2014).

Despite these potential advantages, the implementation of TQM in construction is often fraught with difficulties globally. The project-based nature of the industry, fragmented supply chains, transient workforce, traditional adversarial relationships, and resistance to change are commonly cited barriers (Hoonakker et al., 2010; Abdel Azim, 2008).

1.3. The Sudanese Context and Red Sea State

In Sudan, the construction industry is witnessing development but continues to grapple with significant challenges, including project delays, low productivity, and variable quality standards (Hussein et al., 2015). These issues negatively impact project outcomes and hinder the sector's contribution to national development goals. Red Sea State, with its strategic location and economic activities, represents an important hub for construction. However, companies operating in this region



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likely face both generic industry challenges and potentially unique local obstacles related to economic conditions, resource availability, and institutional factors.

1.4. Problem Statement

While the importance of quality management is acknowledged, there appears to be a gap between the potential benefits of TQM and its actual implementation level within the construction sector in Red Sea State, Sudan. The absence or ineffective application of robust quality management systems like TQM can lead to suboptimal project outcomes, including poor quality, increased costs (due to rework, failures, etc.), and time delays. Understanding the specific challenges preventing construction companies in this region from successfully adopting and integrating TQM is crucial for developing targeted strategies for improvement. Limited empirical research has specifically focused on identifying and analyzing these obstacles within the Red Sea State context.

1.5. Research Questions

This study seeks to address the following key questions:

- 1. What is the current level of awareness and understanding regarding TQM principles and practices among construction professionals in Red Sea State?
- 2. To what extent are TQM systems formally implemented within construction companies in Red Sea State?
- 3. What are the primary challenges hindering the successful implementation and sustained application of TQM in these companies?
- 4. Are the necessary prerequisites (e.g., management commitment, skilled workforce, appropriate structures, resources) for TQM implementation adequately present?



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1.6. Research Objectives

The primary objective of this research is:

• To identify and assess the significance of the challenges that impede the application of Total Quality Management (TQM) systems in construction companies within Red Sea State, Sudan.

Secondary objectives include:

- To gauge the level of TQM awareness and application in the surveyed companies.
- To analyze the influence of factors such as management policies, organizational structure, operational processes, cost considerations, and external environmental factors on TQM implementation challenges.
- To provide practical recommendations for overcoming the identified challenges.

1.7. Significance of the Research

This research holds significance for several reasons:

- **Industry Improvement:** By identifying specific challenges, the findings can inform construction companies in Red Sea State about areas needing attention to improve quality performance and competitiveness.
- **Policy Formulation:** The results can provide valuable input for policymakers and industry bodies seeking to promote quality standards and support TQM adoption in the Sudanese construction sector.



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- Academic Contribution: The study contributes empirical data to the body of knowledge on TQM implementation challenges, particularly within the specific and under-researched context of Red Sea State, Sudan.
- **Practical Guidance:** The recommendations offer actionable strategies for managers and stakeholders aiming to navigate the challenges and successfully implement TQM.

1.8. Scope and Limitations

- Geographical Scope: The study focuses exclusively on construction companies and related entities operating within Red Sea State, Sudan.
 Findings may not be directly generalizable to other regions of Sudan or other countries without further investigation.
- Temporal Scope: Data collection was conducted during 2023.
- Methodological Limitations: The study relies on survey data (questionnaires), which reflects respondents' perceptions and may be subject to self-reporting bias. The sample size (92 respondents), while reasonable for the specific context, limits the statistical power for certain sub-group analyses. The use of a 3-point Likert scale simplifies responses but may capture less nuance than a 5- or 7-point scale.

1.9. Structure of the Thesis

This thesis is organized as follows: Section 1 provides the introduction, background, problem statement, research questions, objectives, significance, and scope. Section 2 presents a review of relevant literature on TQM and its implementation in construction. Section 3 details the research methodology employed. Section 4 presents the analysis of the collected data and discusses the



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results. Section 5 concludes the study, summarizes the key findings, and offers recommendations for practice and future research. (*Note: Renumbered sections to reflect removal of Chapter names*)

2. Literature Review

2.1. Foundational Concepts of Total Quality Management (TQM)

Total Quality Management (TQM) emerged as a comprehensive management philosophy aiming to achieve organizational excellence through a relentless focus on quality and customer satisfaction. While evolving over time and influenced by various quality pioneers (Deming, Juran, Crosby, Ishikawa), several core principles underpin the TQM approach:

- **Customer Focus:** The primary goal is to meet and exceed customer expectations. Understanding current and future customer needs is paramount (Zairi, 1991).
- **Continuous Improvement (Kaizen):** TQM is not a one-time program but an ongoing process of incremental improvements in products, services, and processes. It involves a cyclical approach (e.g., Plan-Do-Check-Act).
- Employee Involvement and Empowerment: Recognizing that employees at all levels are crucial to quality, TQM emphasizes teamwork, training, empowerment, and participation in improvement efforts (Al-Azzawi, 2014).
- **Process Approach:** Activities are managed as interconnected processes. Understanding and optimizing these processes is key to achieving desired outcomes efficiently.
- Leadership Commitment: Visible, unwavering commitment from top management is essential for driving the TQM culture, providing resources,



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and overcoming resistance to change (Deming, cited in various sources; Ahmed et al., 2017).

- Data-Driven Decision Making: Decisions should be based on the analysis of relevant data and information, rather than intuition or anecdotal evidence. This involves measurement, monitoring, and statistical thinking.
- **Supplier Partnership:** Quality inputs are essential for quality outputs. TQM often involves developing long-term, collaborative relationships with suppliers based on trust and mutual benefit.

2.2. TQM in the Construction Industry

The application of TQM in construction presents both unique opportunities and significant challenges. The potential benefits, as outlined earlier, include improved quality, reduced costs, timely delivery, enhanced safety, and increased client satisfaction (Raouf, 2004; Tasie, 2016). However, the inherent characteristics of the industry often complicate TQM implementation compared to manufacturing settings:

- **Project-Based Nature:** Each project is unique in terms of design, location, team, and client requirements, making standardization difficult.
- **Fragmentation:** The industry involves numerous stakeholders (clients, designers, contractors, subcontractors, suppliers) with often conflicting interests and poor integration.
- **Temporary Teams:** Project teams are often assembled for a specific project and disbanded upon completion, hindering the development of a consistent quality culture and long-term learning.



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- Workforce Characteristics: A reliance on transient, sometimes less-skilled labor, and traditional work practices can impede quality initiatives.
- Adversarial Relationships: Traditional contracting models can foster adversarial relationships rather than the collaboration needed for TQM.
- External Factors: Construction is highly susceptible to external factors like weather, economic fluctuations, and regulatory changes.

Despite these challenges, adapting TQM principles to focus on project processes, stakeholder collaboration, supply chain management, and continuous learning within project cycles is crucial for improving sector performance (Hoonakker et al., 2010).

2.3. Previous Studies on TQM Implementation Barriers/Challenges in Construction

Several studies have investigated the obstacles to TQM implementation in construction, both internationally and within the region.

- Hoonakker et al. (2010), in an empirical study, identified significant barriers including lack of management commitment, inadequate training, resistance to change, and difficulty in applying TQM tools, while also confirming benefits like improved quality and customer satisfaction.
- Ahmed et al. (2017) conducted a study specifically on TQM implementation barriers in construction companies in Khartoum State, Sudan. Their findings resonate strongly with the potential issues in Red Sea State. They highlighted weak knowledge of TQM, lack of top management commitment, an organizational structure misaligned with TQM needs, and poor control over operational processes as major impediments.



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- Hamdan (2015) investigated TQM application in infrastructure projects in Syria. This study found that companies often lacked a clear, documented quality system, required increased awareness and a stronger quality culture, suffered from a lack of incentives, and faced resistance from management regarding addressing worker issues.
- Abdel Azim (2008) examined TQM implementation in Egyptian construction companies. The study suggested that a lack of TQM adoption weakened competitiveness and that insufficient employee participation hindered success. It concluded that TQM could reduce project costs by preventing errors and emphasized the importance of top management commitment and teamwork.
- Othman Ahmed (n.d.) also studied TQM in Sudanese construction, linking poor planning and non-conformance to specifications with TQM implementation failure and highlighting deficiencies in safety protocols.
- Qutb et al. (2018) assessed the impact of quality systems on construction project management in Egypt, indicating a strong positive impact of TQM on efficiency but pointing to a lack of qualified personnel as a key barrier.
- Tasie (2016), in a general review, emphasized that organizational performance is linked to TQM adoption.
- Zairi (1991) provides the engineering context for TQM, stressing its role in achieving competitiveness through continuous improvement.

2.4. Identifying the Research Gap

While existing literature identifies common barriers, there is a need for contextspecific investigation in Red Sea State, given its distinct economic activities and



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local dynamics. This research specifically addresses this gap by focusing on the challenges encountered by construction companies operating within the Red Sea State environment, comparing findings with broader studies like Ahmed et al. (2017) in Khartoum.

3. Research Methodology

3.1. Research Approach

This study adopted a **descriptive-analytical research approach**. The aim was to describe the current situation regarding TQM implementation challenges in construction companies in Red Sea State and to analyze the relationships and significance of various factors contributing to these obstacles. A **field study** involving primary data collection was the core method employed.

3.2. Study Population and Sample

- **Population:** The target population comprised all entities involved in construction activities within Red Sea State, Sudan. This included construction companies (contractors), engineering consulting firms, and design offices.
- Sample: A sample of professionals working within these entities was selected using likely a combination of purposive sampling (targeting specific roles) and convenience sampling.
- Sample Size: One hundred (100) questionnaires were distributed, and ninety-two (92) valid questionnaires were returned and analyzed (N=92, 92% response rate).



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3.3. Data Collection Instrument

The primary instrument was a **structured questionnaire** developed based on literature and research objectives, administered in Arabic. It comprised two sections:

- 1. Section A: Demographic Information: Collected respondent and organizational details.
- 2. Section B: Challenges to TQM Implementation: Contained 33 Likertscale items grouped into six constructs: Awareness, Top Management Policy, Organizational Structure, Administrative Operations, Cost of Quality, and External Factors.
- Likert Scale: A three-point Likert scale (1=Disagree, 2=Agree to some extent, 3=Agree) was used.

3.4. Validity and Reliability

- Validity: Content validity was addressed through literature review and supervisor review. Face validity was assumed.
- **Reliability:** Internal consistency (e.g., Cronbach's Alpha) was assumed to be adequate, though specific coefficients were not reported in the source material.

3.5. Data Analysis

Data was analyzed using SPSS. Methods included:

- **Descriptive Statistics:** Frequencies and percentages for demographics.
- Item and Construct Analysis: Mean, Standard Deviation, Percentages, and Ranking for Likert items.



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- Interpretation Scale: Mean scores were interpreted using a predefined scale (High Agreement: 2.34-3.00; Moderate Agreement: 1.67-2.33; Low Agreement: 1.00-1.66).
- **T-Test:** One-sample t-tests (indicated by original analysis) likely confirmed the statistical significance of respondent agreement on perceived challenges.

4. Results and Discussion

4.1. Introduction

This section presents and discusses the findings from the analysis of the questionnaire data (N=92).

4.2. Demographic Profile of Respondents

The sample primarily consisted of experienced (56.5% 10+ years), degree-holding (56.4% Bachelor's) engineers (51.1%) and contractors (22.8%), mostly aged 35-45 (51.1%) and working in the public sector (62%).

4.3. Analysis of Challenges to TQM Implementation

4.3.1. Awareness of the Importance of TQM (Mean=2.34) Significant challenges included lack of specialized lectures (Mean=2.43), insufficient training (Mean=2.37), and resistance to cultural change (Mean=2.34).

4.3.2. Top Management Policy (Mean=2.18)

The most critical barrier was lack of management commitment (Mean=2.57). Other key challenges included the belief that TQM is costly (Mean=2.41) and weak post-project evaluation (Mean=2.35).



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4.3.3. Organizational Structure (Mean=2.38)

Major challenges were the shortage of skilled labor (Mean=2.52), unsuitable structure for TQM (Mean=2.48), and weak incentives (Mean=2.40).

4.3.4. Essential Administrative Operations (Mean=2.33)

Significant weaknesses were found in project monitoring & control (Mean=2.51), planning procedures (Mean=2.47), lack of pre-project study (Mean=2.45), and absence of a safety plan (Mean=2.41).

4.3.5. Cost of Quality (Mean=2.38)

The primary challenge was lack of specific budget allocation for TQM (Mean=2.48), despite accounting for failure costs (Means 2.40-2.46). Lack of safety budget (Mean=2.39) was also noted.

4.3.6. External Factors (Mean=2.35)

The impact of economic/political conditions was the top external challenge (Mean=2.73). The lowest-bid system (Mean=2.36) and construction variability (Mean=2.41) were also significant.

4.4. Overall Ranking of Challenges (Based on Construct Means)

- 1. Organizational Structure (Mean = 2.38) Tied
- 2. Quality Cost (Mean = 2.38) Tied
- 3. External Factors (Mean = 2.35)
- 4. Awareness of TQM Importance (Mean = 2.34)
- 5. Essential Administrative Operations (Mean = 2.33)
- 6. Top Management Policy (Mean = 2.18)



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Discussion of Ranking: While all areas present challenges, structural/resource and cost/budgeting issues ranked highest overall based on average scores. However, individual items like lack of management commitment and skilled labor shortage remain critically important regardless of their construct's average rank.

4.5. Synthesis and Link to Research Questions

The findings indicate TQM implementation is low and faces significant challenges. Awareness is superficial (Q1), implementation is minimal (Q2), key challenges include external factors, lack of commitment, labor shortage, poor controls, unsuitable structures, and lack of budget (Q3), and essential prerequisites are largely missing (Q4). Results align with previous Sudanese studies but highlight Red Sea State's specific context regarding economic instability and labor shortages.

5. Conclusion and Recommendations

5.1. Introduction

This section synthesizes the research on TQM application challenges in Red Sea State's construction sector, summarizes key findings, draws conclusions, and proposes recommendations.

5.2. Summary of Key Findings

The study identified substantial challenges, with the most impactful being:

- 1. Adverse Economic and Political Conditions
- 2. Lack of Top Management Commitment
- 3. Shortage of Skilled Labor
- 4. Weak Project Monitoring and Control



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- 5. Unsuitable Organizational Structures
- 6. Lack of Dedicated TQM Budget
- 7. Inadequate Planning Procedures
- 8. Insufficient TQM Training and Awareness
- 9. Lowest-Bid Contract Award System
- 10. Weakness in Incentives and Teamwork

5.3. Conclusions

- 1. **Significant Hindrances:** TQM implementation faces multi-faceted challenges, making adoption partial at best.
- 2. **Major External Constraints:** Economic/political instability and the lowestbid system severely impede quality efforts.
- 3. **Critical Internal Deficiencies:** Lack of management commitment, skilled labor shortage, poor controls, and unsuitable structures are major internal roadblocks.
- 4. **Persistent Resource/Knowledge Gaps:** Insufficient funding and inadequate training prevent capability development.
- 5. Need for Stronger PM Foundations: Basic project management disciplines require improvement.
- 6. Alignment with Broader Context: Findings resonate with other studies but highlight Red Sea State's specific pressures.

5.4. Recommendations

Addressing these challenges requires concerted effort:



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- 1. Enhance TQM Awareness/Education: Conduct workshops, integrate TQM into curricula, develop relevant materials.
- 2. Secure Management Commitment: Leaders must champion TQM, allocate resources, communicate policy.
- 3. **Invest in Workforce Development:** Implement training, partner with vocational centers, set standards.
- 4. **Strengthen PM Processes:** Improve planning, monitoring, control, risk, safety; conduct post-project reviews.
- 5. Adapt Org. Structures/Culture: Redesign for collaboration, foster teamwork, link incentives to quality.
- 6. Allocate TQM Resources: Earmark specific budget lines for TQM activities.
- 7. Advocate for Procurement Reform: Move beyond lowest bid to include quality criteria.
- 8. **Improve Stakeholder Collaboration:** Promote partnering and clear communication.
- 9. Enhance Safety Management: Implement rigorous safety plans, training, and budgeting.
- 10.Classify Companies: Refine classification based on quality capability and performance.

5.5. Suggestions for Future Research

• Quantify the cost of poor quality in Red Sea State.



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- Conduct in-depth case studies of local TQM implementation attempts.
- Compare challenges across different Sudanese states.
- Examine supply chain quality management locally.
- Evaluate specific quality improvement interventions in the context.
- Investigate challenges in specific construction sub-sectors (e.g., housing, infrastructure).
- Perform longitudinal studies to track progress.



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