

**Quality Management Implementation effectiveness
in Construction Sector, Saudi Arabia, Ahsa
(MMS Construction company)
(Case Study)**

Aish Mohsen Mahdi Al-Mashgari
2021201736

Graduation Project – 1
Faculty of Management - Midocean University

Supervisor
Dr. Mona Moustafa
Elashry

Faculty member- Faculty of management- Midocean University

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Chapter One

Introduction

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1-Overview:

The construction industry plays a pivotal role in global economies, contributing significantly to GDP and employment. As the demand for infrastructure and urban development grows, ensuring quality in construction projects becomes paramount. In this context, effective **Quality Management (QM)** practices are essential for achieving project success, meeting client expectations, and enhancing overall industry performance. (construction industry Energy Science and Research 2012 Volume (issues) 29(2): 883-890)

Due to the uncertainty and complexity of construction management and variability within project environments, quality should be closely scrutinized and controlled throughout each stage of construction. Based on experience from construction experts and extensive literature review, there are three factors which contribute to difficulties in quality management. First, the quality control criteria for individual components are scattered in different national, industrial and local quality control codes for construction. It is also common for these specifications to cross-reference each other, creating complex dependencies between specifications. (Joseph M. Juran Quality Control Handbook 1998)

Implementing QM in the construction industry remains a complex task due to its unique characteristics. Unlike other sectors, construction work involves high risk, safety concerns, and intricate project dynamics. Many construction companies perceive quality as an expensive accessory rather than a strategic necessity. Bridging this gap and understanding the barriers to effective QM implementation is crucial. (Total quality management implementation, 2008)

Quality management directly influences project outcomes, safety, and long-term sustainability. It enhances client trust, reduces rework, and ensures compliance with regulations. As the construction industry strives for excellence, understanding the nuances of QM becomes imperative. (Critical factors for total quality management implementation, 2021)

This research aims to:

1. Investigate the challenges associated with signifying quality in the construction industry (MMS Company).
2. Explore the advantages of QM implementation in construction projects of MMS Company.
3. Identify barriers hindering the successful adoption of QM practices.

Understanding the impact of QM on construction projects can lead to several benefits:

- **Higher Productivity:** QM practices reduce rework, enhance efficiency, and improve overall productivity.
- **Budget Performance:** Effective QM ensures adherence to project budgets and cost control.
- **Employee Satisfaction:** A focus on quality positively impacts employee morale and job satisfaction.

By addressing these objectives, this research contributes to the body of knowledge on QM in the construction industry and provides practical insights for companies like MMS Construction. The findings will guide stakeholders in making informed decisions, fostering a culture of quality, and ultimately elevating the industry's performance.

In the subsequent sections, we delve deeper into the challenges, benefits, and strategies for successful QM implementation in construction.

The roots of quality management trace back to the early 20th century when pioneers like Walter Shewhart and W. Edwards Deming introduced statistical process control and quality improvement methodologies. Their work laid the foundation for modern QM practices. Over time, frameworks like ISO 9001 emerged, emphasizing process standardization, continuous improvement, and customer focus. (Obstacles to implementing total quality management in the UK construction industry,1998)

Previous research has explored various aspects of quality management in construction. Studies have investigated the impact of QM on project performance, cost control, and stakeholder satisfaction. Researchers have highlighted the role of leadership, organizational culture, and

employee engagement in successful QM implementation. By building upon these insights, our study aims to contribute to the existing body of knowledge and address specific gaps.

his introduction sets the stage for our research journey into the intricacies of quality management. In subsequent sections, we explore case studies, analyze data, and provide actionable insights for practitioners and organizations like MMS Construction.

2-Research problems

- Research problems related to Quality Management Implementation in the Construction Industry are crucial for improving practices and outcomes. (Implementing total quality management in construction firms LS Pheng, JA Teo - Journal of management in Engineering, 2004). Here are some potential research problem areas might consider (Theoretical/ Theoretical gaps):
 1. Barriers to Quality Management Implementation:
 - Investigate the challenges faced by construction companies (such as MMS Construction) when implementing quality management practices. What are the specific obstacles, and how can they be overcome?
 - Explore the reasons behind slow adoption of quality management principles in the construction industry.
 2. Benefits of Quality Management:
 - Examine the tangible and intangible benefits of implementing quality management systems in construction projects. How does it impact productivity, rework reduction, budget performance, and employee job satisfaction?
 - Assess the financial implications of quality management implementation for construction companies.
 3. Cultural Factors and Quality Management:
 - Investigate how organizational culture influences the successful implementation of quality management practices. Are there cultural barriers or enablers specific to the construction industry?
 - Explore strategies to foster a quality-oriented culture within construction companies.
 4. Leadership and Management Support:
 - Analyze the role of leadership and management support in driving quality initiatives. How can top management actively promote and sustain quality practices?

- Identify best practices for engaging leadership in quality management efforts.
- 5. Skilled Workforce and Training:
 - Study the impact of skilled workers on quality outcomes. How can construction companies enhance workforce competence and ensure effective training in quality management?
 - Investigate the correlation between employee training and quality performance.
- 6. Cost-Effectiveness of Quality Programs:
 - Assess the perceived cost of quality management implementation in construction. Is quality truly an expensive accessory, or does unimplemented quality lead to higher costs?
 - Develop cost-benefit models to demonstrate the economic value of quality practices.

The importance of researching Quality Management Implementation in the Construction Industry, particularly for companies like MMS Construction, cannot be overstated. Here are some key reasons why this research area is significant: (Implementation of total quality management in construction industry, 2013)

1. Enhanced Project Performance:
 - Effective quality management practices lead to improved project outcomes. Research can identify specific quality interventions that positively impact project completion time, cost control, and overall performance.
2. Customer Satisfaction and Reputation:
 - High-quality construction work directly influences client satisfaction. Research can explore how adherence to quality standards enhances customer trust, repeat business, and positive word-of-mouth referrals.
3. Risk Mitigation:
 - Quality management helps mitigate risks related to safety, defects, and rework. Investigating risk reduction strategies can contribute to safer construction sites and fewer legal disputes.
4. Competitive Advantage:
 - Companies that prioritize quality gain a competitive edge. Research can highlight how quality practices differentiate construction firms in a crowded market.
5. Resource Optimization:
 - Efficient quality management minimizes waste, rework, and material losses. Understanding resource optimization techniques can lead to cost savings and sustainable practices.
6. Compliance with Standards and Regulations:

- Research can delve into the alignment of quality management systems with industry standards (e.g., ISO 9001) and local regulations. Compliance ensures legal and ethical practices.
- 7. Employee Morale and Productivity:
 - A focus on quality positively impacts employee morale. Investigate how training, empowerment, and recognition contribute to a motivated workforce.
- 8. Innovation and Continuous Improvement:
 - Quality research encourages innovation. Explore novel approaches, technologies, and best practices that elevate construction quality.
- 9. Sustainability and Environmental Impact:
 - Quality management extends beyond physical structures. Research can address sustainable construction practices, minimizing environmental harm.
- 10. Industry Reputation and Longevity:
 - Companies known for quality endure in the industry. Research contributes to the long-term success and legacy of construction firms.

3-Main Research Question?

How can quality management implementation effect the Construction Industry growth, Saudi Arabia, Ahsa (MMS Construction company as case study)?

4-Importance of Research

importance and relevance of the study's findings in the context of **Quality Management Implementation** within the **Construction Industry** in Saudi Arabia, specifically focusing on the **Ahsa region (MMS Construction company)**.

1. Theoretical Level:

- **Advancing Knowledge:** The study's findings contribute to the theoretical understanding of quality management practices in construction. By identifying effective strategies, challenges, and gaps, the research enriches existing knowledge.
- **Conceptual Framework Refinement:** The study may refine existing theoretical frameworks related to quality management, providing practitioners and researchers with a more robust foundation for decision-making.
- **Guidance for Future Research:** The findings guide future research directions, suggesting areas for exploration and hypothesis testing.

2. Empirical Level:

- **Practical Applications:** The study's empirical findings directly impact real-world practices. For instance:
 - If the research identifies successful TQM practices, construction companies can adopt these methods to enhance project quality.
 - If gaps are revealed, practitioners can address them to improve overall performance.
- **Policy Implications:** Policymakers can use empirical evidence to shape regulations and guidelines related to quality management in the construction industry.
- **Competitive Advantage:** Companies implementing effective quality management practices gain a competitive edge, leading to better project outcomes, client satisfaction, and market positioning.

5-Research Sub Questions:

- How can quality assurance implementation help the MMS firm succeed?
- How can quality control implementation help the MMS firm succeed?

6-Research objectives:

Ensuring the effectiveness of quality assurance (QA) and quality control (QC) practices can significantly impact the success of **Mobarak Merai Al-Salomi and Partners** in the construction industry. Let's explore how QA contributes to their success:

1. Consistent Quality Standards:

- QA establishes consistent quality standards across all projects undertaken by the company.
- By adhering to these standards, Mobarak Merai Al-Salomi and Partners can deliver high-quality work consistently, enhancing their reputation.

2. Risk Mitigation:

- QA processes identify potential risks early in the project lifecycle.
- By addressing these risks proactively, the company minimizes costly errors, delays, and rework.
- Successful risk management contributes to project success.

3. Client Satisfaction:

- QA ensures that the final deliverables meet or exceed client expectations.
- Satisfied clients are more likely to recommend the company to others and provide repeat business.
- Positive client relationships contribute to long-term success.

4. Efficient Processes:

- QA streamlines processes, reducing waste and inefficiencies.
- Efficient project execution leads to cost savings and timely completion.
- Mobarak Merai Al-Salomi and Partners can allocate resources effectively.

5. Compliance and Accreditation:

- QA practices ensure compliance with industry standards, codes, and regulations.
- Achieving relevant certifications or accreditations demonstrates the company's commitment to quality.
- Accreditation can enhance their market position and attract more clients.

6. Continuous Improvement:

- QA encourages a culture of continuous learning and improvement.
- Regular audits, feedback loops, and lessons learned contribute to refining processes.
- Mobarak Merai Al-Salomi and Partners can adapt to changing industry trends and stay competitive.

7-Research Hypotheses:

research hypotheses related to the impact of quality assurance on the success of **Mobarak Merai Al-Salomi and Partners** in the construction industry:

1. Hypothesis 1 (Client Satisfaction):

- **Hypothesis (H₁):** Effective quality assurance strategies positively influence client satisfaction, leading to project success.

2. Hypothesis 2 (Project Performance):

- **Hypothesis (H₁):** Rigorous quality assurance practices contribute to improved project performance, resulting in successful project outcomes.

3. Hypothesis 3 (Risk Mitigation):

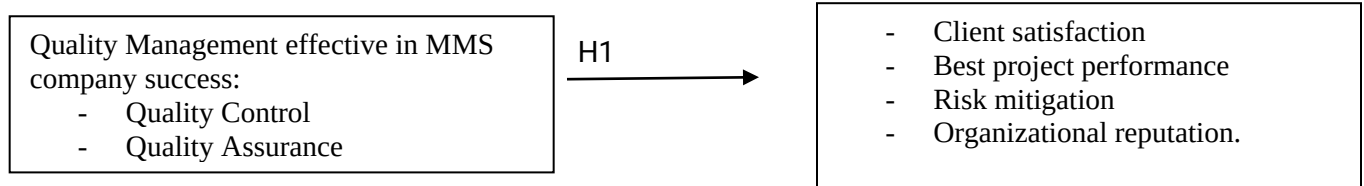
- **Hypothesis (H₁):** Effective quality assurance minimizes risks, leading to smoother project execution and successful project delivery.

4. Hypothesis 4 (Organizational Reputation):

- **Hypothesis (H₁):** A strong quality assurance framework enhances the company's reputation, attracting more clients and fostering long-term success.

8-Research model:

Below shows the relationship of research variable and research hypothesis:



Source: student

9-Scope of Research:

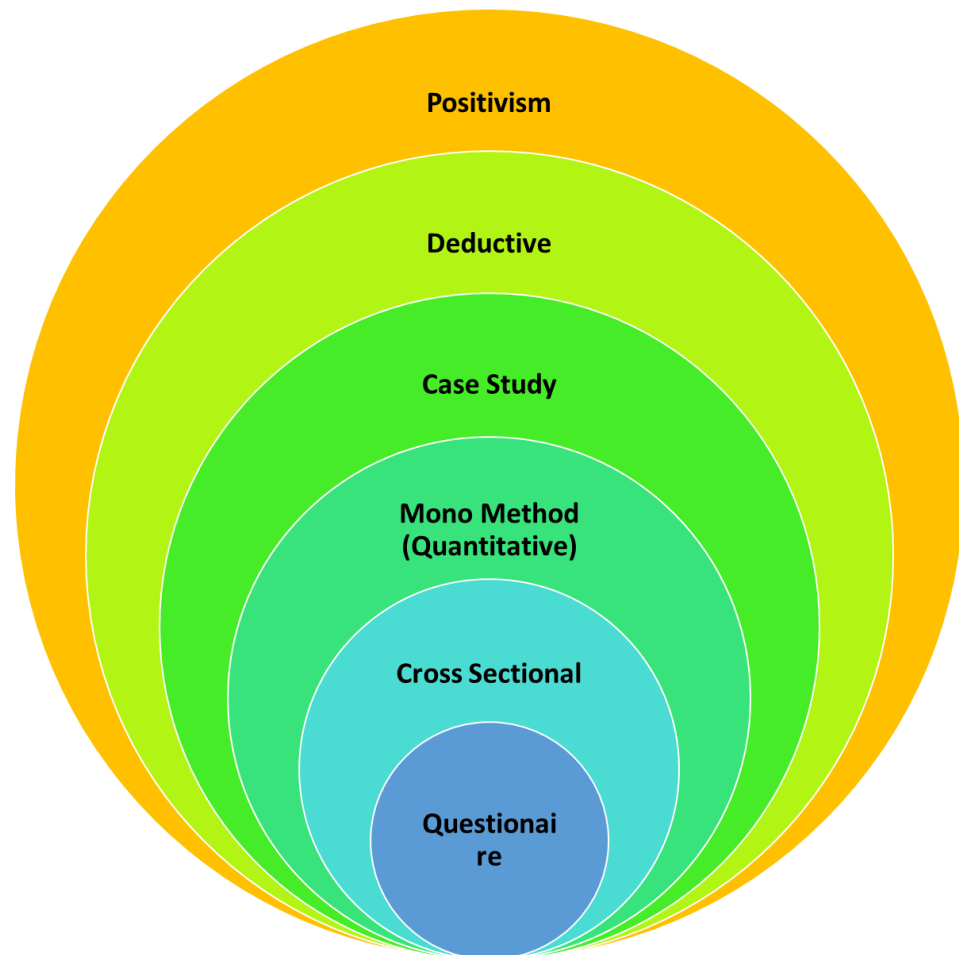
This research is case study, we will study the Quality Management Implementation effectiveness in Construction Sector, Saudi Arabia, Ahssa (Mobarak Merai Salomi and Partners for Construction company).

10-Research Methodology:

Research methodology refers to the structured and logical process used to plan, execute, and report research. It involves selecting appropriate research methods, techniques, and tools to address specific research questions or problems.

- Research Philosophy: this research depends on Positivism philosophy
- Research Approach: the approach for this research is deductive approach.
- Research Strategy: this research using case study strategy.
- Research Choices: this research using mono method (quantitative method).
- Time Horizon: this research using cross sectional.
- Techniques and procedures: this research depends on questionnaire on collecting Datta.

Research Onion:



Resource: Student Aish Mohsen

11-Suggested Structure for The Research:



Chapter 2

Literature Review

1. Introduction

The construction industry in Saudi Arabia is the largest and fastest-growing market in the Gulf region ([Samargandi et al., 2013](#)). Its organisational culture, labour and material supply chain, business strategies, and management skills are different from other parts of the globe. For example, the Kingdom of Saudi Arabia (KSA) has a strong economic standing, which leads its government to take the opportunity to spend money on many public-funded infrastructure projects. The KSA has experienced a construction boom with over 5,200 ongoing public infrastructure projects having a total value equal to US\$819 billion ([Argaam, 2021](#)). However, Saudi Arabia failed to make real progress in achieving good management and organisational performance as most projects are experiencing delays and cost overruns ([Abdellatif and Alshibani, 2019](#); [Mahamid, 2013](#); [Mosley and Bubshait, 2016](#)). A proper QMS development and its practice throughout the project's life-cycle and its associated organisations are essential to overcome these poor project delivery performances.

Accordingly, [Al-Otaibi et al. \(2015\)](#) discovered that Saudi Arabian construction firms' performances could be promoted over their counter companies by effectively practising the Total Quality Management (TQM) system. In particular, the TQM has a strong positive correlation improving construction quality culture, which is a critical issue to the project owners. [Mazher et al. \(2015\)](#) studied the effectiveness of TQM in the Saudi construction industry considering four dimensions, such as quality control, management, assurance, and inspection. They applied regression analysis and found quality management and assurance have strong positive significance to the project quality assurance. [Aichouni et al. \(2014\)](#) conducted an empirical study on the adaptation challenges of some already developed quality management systems in the Saudi construction industry. They discovered that organizational culture is the main barrier to

implement those tools and techniques in this region. In a further study in Saudi Arabia, [Abazid and Gökçekuş \(2019\)](#) discovered that organizational culture, higher authorities' willingness to adapt and customize the TQM system, reliability and tangibility dimensions are the main problems in implementing a quality management system. Previous research in other countries also identified that specific company culture, business performance, strategy to quality control, country's development policy, etc., are distinct and directly linked to the QMS of a company or organization ([Bhatia and Awasthi, 2018](#); [Fundin et al., 2018](#)). Thus, a country or company-specific QMS development and practice is a critical need. However, no study in the KSA proposed any QMS model, which can readily be adopted or accommodated local construction issues and culture in construction quality management.

As construction projects usually involve large quantities of resources and many dynamic processes, achieving high quality is end-product-based and depends on managing interrelated organizational processes ([Masuin et al., 2020](#)). Among many factors, information system management, quality of reporting documents, recording of quality-related data like inspection, identified issues, and collaboration among the stakeholders to resolve the issues ensuring intended quality control are significant to develop and practice standard QMS for an organization ([Lee et al., 2020](#); [Ma et al., 2018](#)). The mere existence of information management and quality documentation does not necessarily reflect the presence of deep-rooted operational practices and procedures needed for ensuring the ultimate delivery of a well-operated Quality Management System (QMS). Some human factors such as level of learning, building dynamic capability, knowledge integration with a flexible strategy to a product or service are also significant to practice QMS throughout the production supply chain ([Gutierrez-Gutierrez et al., 2018](#)). *These particular issues, i.e., the company's culture and strategies to quality assurance, information documentation and management, and human factors in QMS, did not*

discover any previous study in the KSA. Thus, this paper aims to develop the Quality Management System (QMS) for construction companies in the KSA. In recent years, many researchers have focused on developing and adopting company-based QMS systems using the SERVQUAL model, TQM, and International Organization for Standardization (ISO) tools (Bhatia and Awasthi, 2018). Towards developing QMS for the KSA construction industry, this study conducted a structured focus group interview with the experts of specific construction companies, followed by two case studies to develop company-specific QMS and its implementation guidelines based on ISO tools.

2. Literature Review

2.1 Quality Management System Overview

There is no single, universally accepted definition of quality, which underlines that quality is viewed in various ways (Watson and Howarth, 2011). ISO 9000:2015 defines ‘quality’ as ‘*the degree to which a set of inherent characteristics of an object fulfils requirements*’ (BSI-Standards, 2015). In construction projects, quality is about the product and equipment used in the construction and the overall management approach to complete the project (Rumane, 2017). It can be said that, in construction projects, quality is to be achieved whenever the needs of all stakeholders involved in projects or production or provisions of services, such as consultants, constructors, project customers, and other related stakeholders, are fulfilled. However, as the control of construction depends mainly on contractors, it can be argued that contractors have the primary responsibility for the construction quality. Therefore, understanding the concepts of quality is essential for a construction company in developing and implementing a ‘quality management system’ as a strategic management tool to gain benefits from the successful implementation of a quality system.

The American Society for Quality ([ASQ, 2021](#)) defines quality management as ‘the application of a quality management system in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while improving the process.’ Quality management can include establishing quality policies and quality objectives and processes to achieve these quality objectives through quality planning, quality assurance, quality control, and quality improvement ([BSI-Standards, 2015](#)). Quality management is essential for facilitating commercial organisations’ competitiveness and keeping them competitive and successful ([Watson and Howarth, 2011](#)).

A quality management system (QMS) can be defined as a formalized system that documents the structure, responsibilities and procedures required to achieve effective quality management ([ASQ, 2021](#)). It is part of an organization’s management system concerning quality ([BSI-Standards, 2015](#)).

QMS is the main element of the management system directed to managing and controlling quality processes and operations. It helps construction companies to produce highquality products and services that consistently meet their clients’ and regulatory requirements, in addition to the applied standards and specifications. Quality management system establishes a supportive internal organization for the construction contractors allowing them to sustain in the Construction Market ([Oyewobi et al., 2013](#)). An effective QMS is needed to ensure a construction company meets the reference standards and the clients’ requirements ([Rumane, 2017](#)). Therefore, construction companies need to have a QMS that enhances the balance between the four main objectives of delivering construction projects (Cost, Time, Quality, and Safety) by considering requirements and conditions that vary from one project to another ([Lee and Arditi, 1997](#)).

A Quality Management System (QMS) requires precise and applicable Quality Control and Quality Assurance (QC/QA) programs. It includes all processes and deliverables that the company provides at both the company based level (CBL) and the project-based level (PBL) (Lee and Arditi, 2006). Furthermore, one of the key elements of a QMS is the management commitment and leadership, which provides enough resources and supports the QMS awareness among all organization individuals and meets the requirements of the interested parties (Pheng and Tan, 2005). The management commitment is also reflected in establishing a systematic approach to management and continual improvement.

2.2 QMS in the Construction Industry

Several studies addressed the main barriers and enablers of developing and implementing QMS in the construction industry. Fundin et al. (2018) studied the barriers to implementing a quality management system (QMS) and how current studies address those challenges. They identified 49 challenges of implementing QMS eliciting expert judgment using the Delphi technique and exploratory factor analysis. The major QMS adaptation challenges are the organisation's adaptability to the volatile market environment, strategic concern for quality services/products, and managerial ownership of quality. Accordingly, further research is suggested to focus on making QMS the owner's strategic concern and exploring its contribution to organisational adaptability. Lee et al. (2020) discovered the key practical components to ensure quality management practice for delivering an outstanding quality of highway projects. They studied the QMS of the United States of American state practices focusing on material and workmanship quality management in highway projects using content analysis of relevant documents and interviews with the experts involved in the US highway projects. The critical components of quality management are nonconformance reports, agency acceptance techniques, the strategy of quality assurance budgeting, etc. Maetal. (2018) develop Building Information Modeling (BIM)-based QMS for construction projects to facilitate quality inspection and

collaboration among multiple stakeholders. They develop system architecture, inspection tasks generating algorithm and indoor positioning techniques and demonstrate the QMS in an on-site application. While the construction industry is one of the largest industries, it lacks information and other data recording.

Proper quality management can be enhanced if the previous failure or success factors are recorded and managed throughout the project's execution phases. Accordingly, [Wang et al. \(2018\)](#) develop a text-big data management technique in BIM and a material quality prediction model integrating recurrent neural network (RNN) and long short-term memory neural network ensuring lesson-learned based QMS for future projects. Their model can predict the quality problem and detect the quality problem events in project execution phases, reducing the quality-related incidents. [Olafsdottir et al. \(2016\)](#) identified the variables of developing a dynamic QMS model for the construction industry by arranging group discussions with stakeholders. In a further study, [Olafsdottir et al. \(2019\)](#) applied a system dynamics approach evaluating the practice of QMS in the construction industry. Their approach offers to reduce the construction cost related to total quality management. System dynamics has a feedback loop by which cost impacts of poor quality and good quality can be studied and simulated for comprehensive understanding and decision-making regarding the quality cost of a project.

The product or service quality highly are correlated with human factors. Thus, [Gutierrez-Gutierrez et al. \(2018\)](#) studied how human factors in QMS relate to learning orientation, dynamic capability building, knowledge integration and flexible strategy in new product development. Their findings show that human factors significantly contribute to developing a learning culture, knowledge integration and strategic flexibility firmly attached to the quality product development. Practising a sustainable QMS throughout the supply chain is a prerequisite to deliver a quality product or process, or service. [Bastas and Liyanage \(2018\)](#)

discovered a new but highly emerging research area, which integrates three distinct approaches: sustainability, supply chain, and QM by a systematic review of existing literature in supply chain areas. They emphasize the relationships between three pillars of sustainability (social, ecological, and economical) and QM in supply chain management, which is yet to be explored. [Zakuan et al. \(2014\)](#) discovered the QMS's roles for the total quality management of a construction project studying previous published relevant literature. They discuss the soft and hard quality practice, project performance, and technical and nontechnical approaches towards quality management in construction industry. They also stated that a few studies paid attention to study construction quality management as the specific company performances, and recommended for future research considering country-specific cultural, organisational and other factors, which have influences in practicing the QMS.

Previous research overlooks understanding the relationship between the QMS and the organization's business performance, which is critical to the project's intended quality. [Bhatia and Awasthi \(2018\)](#) developed a framework illustrating the QMS implementation impact through different factors such as product quality, information quality, design and operation performances, etc., on an organization's business performance. The relationships between those factors and business performance are established through the structural equation model (SEM). Design performance with quality information was discovered as a significant factor towards practising QMS and better business performance. [Masuin et al. \(2020\)](#) proposed an integrated management system (IMS) for the construction industry boosting organisational performance. They showed how environment, health and safety, and quality could be integrated to comprehensively manage a project and identify critical variables to practice IMS.

Being the largest and fastest-growing construction market in the Gulf region, quality products and processes are becoming essential to the KSA construction industry. For

example, [Bubshait \(2001\)](#) and [Bubshait and Al-Atiq \(1999\)](#) discovered that quality performances of construction projects in the KSA were at substandard levels. A further study in KSA also indicated that quality problems are among the leading causes of the conflicts between construction contractors and engineering consultants ([Sha'ar et al., 2017](#)). [Bubshait and AlAtiq \(1999\)](#), for example, argued that one of the main reasons for the ineffective implementation of QMS in the *Saudi construction market* was that most Saudi contractors did not have a good understanding of document management concepts. Therefore, it was then necessary to first adopt an effective documentation system.

Moreover, a documentation system was also considered one of the main enablers necessary for initiating QMS in construction companies ([Battikha, 2002](#); [Chini and Valdez, 2003](#); [Ezeldin and Abu-Ghazala, 2007](#); [Koehn and Datta, 2003](#); [Lam and Tang, 2002](#); [Pheng and Tan, 2005](#)). The unique characteristic of the construction industry also leads construction companies to adopt a flexible QMS capable of dealing with a wide range of reference standards and special conditions of project requirements ([Chini and Valdez, 2003](#); [Koehn and Datta, 2003](#); [Samuels and Young, 2013](#)). A computer-based QMS could solve the difficulties that construction companies face in dealing with various applied reference standards in the construction industry ([Battikha, 2002](#)). The variation in the applied standards creates an interference between the adopted QMS requirements and the unique characteristics/properties ([Chini and Valdez, 2003](#)).

From the literature review, it can be summarized that the relationship between QMS and an organization's business performance, adaptability to the unpredictable market environment, strategic concern to quality services/products, and managerial skills are essential to practice a QMS in a particular construction industry environment. Besides, previous studies also recommend future research considering country-specific cultural, organisational and market factors towards developing QMS. In addition, *no study in Saudi Arabia focuses on these organisational factors and country-specific management*

strategies for the development and implementation of a QMS. Thus, this study developed a QMS model for a specific company/organization considering its characteristics and the characteristics of the KSA construction industry. The QMS implementation guidelines are also prepared, taking expert judgments and conducting case studies from better QMS practice in this region. The following sections introduce model development methodology and demonstrate the proposed QMS model to overcome this research gap identified in the literature.

3. Conclusion and Recommendation

Effective implementation of a Quality Management System (QMS) in the Saudi construction market becomes necessary to deliver high-quality projects and services. Despite this necessity, no QMS guideline fits the nature of the Saudi construction industry. This research aims to develop a QMS and implementation guideline for the Saudi construction companies. Accordingly, a suitable QMS is developed based on a structured interview in the form of FGD with experts involved in the Saudi construction industry.

International standard should be adopted for developing a QMS. They recommended adopting ISO 9001:2015 QMS model. This study identified the gaps for adjustment of company culture, strategy to quality assurance, and the characteristics of the Saudi construction market. the QMS for MMS was developed consisting of three themes: company-based, project-based, and evaluation and corrections. The company-based QMS includes three components from ISO 9001:2015, i.e., management system, documentation, and actions. The project-based QMS indicates the significance of developing a QA/QC plan along with an inspection and testing schedule. The correction and evaluation emphasize top management evaluation and discussion of the model's outcome for further correction and improvement.

The application of the QMS needs to consider five main components. They include top management commitment, facilitation of QMS application, company and project-based QMS, and evaluation and correction. The significant barriers of the QMS application in the Saudi

construction companies are mostly related to the leadership commitment, organisational aspects, the absence of QMS guideline that fits the Saudi construction market, and difficulties in building QMS culture. Enablers, for instance, training, process-oriented thinking, organisational structure, documentation plan, information modelling technology, 'QA/QC, QMS flexibility, continuous improvement, cultural change', risk-based thinking, researcherwork, and adaptation with market changes, could help Saudi construction companies overcoming the identified barriers.

The study recommends that the MMS develop their own QMS by themselves to have a sense of ownership of the QMS and accommodate the organisational cultures and practices. It is also recommended to consider the local construction markets' characteristics, including quality and training of the workforce, construction regulations, nature of contracts and project delivery systems, and local culture. As the limitations, this study did not consider the advancement of information technology in the proposed QMS model; and conducted only focus group discussion-based qualitative assessment instead of large-scale experts' interviews or surveys. Thus, further studies are recommended to address these issues as a continuous improvement for sustainable QMS development for the KSA construction industry.

4. Quality Management System Framework

Top management commitment is crucial in developing and implementing a QMS in the MMS. This statement also was proved by the previous study in Saudi Arabia (Aichouni et al., 2014). The top management of a company should participate in developing QMS vision, mission, and long-term objectives. They should clearly define the company mission and vision by considering their employees' participation in

preparing the stated mission and vision. Management commitment, organisational culture, and employees' motivation to adopt and implement a QMS are significant improvement areas towards construction quality development (Panuwatwanich and Nguyen, 2017; Willar et al., 2016).

The company should form a researcher to facilitate QMS development and application, which can later be converted into a department or unit responsible for managing the QMS implementation. They should establish a clear organisational structure, develop processes for documentation, communication, control, and the measurement, inspection, and testing system (Panuwatwanich and Nguyen, 2017; Willar et al., 2016; Wu et al., 2011). The company should specify the quality level for both materials and works as per the international and local standards and the contractual requirements.

4.1 The Proposed QMS Guideline for the MMS

The proposed QMS guideline consists of three elements: Company-based QMS, Project-based QMS, and Evaluations and Corrections. The following sub-sections explain those elements in more detail.

4.1.1 Company based QMS

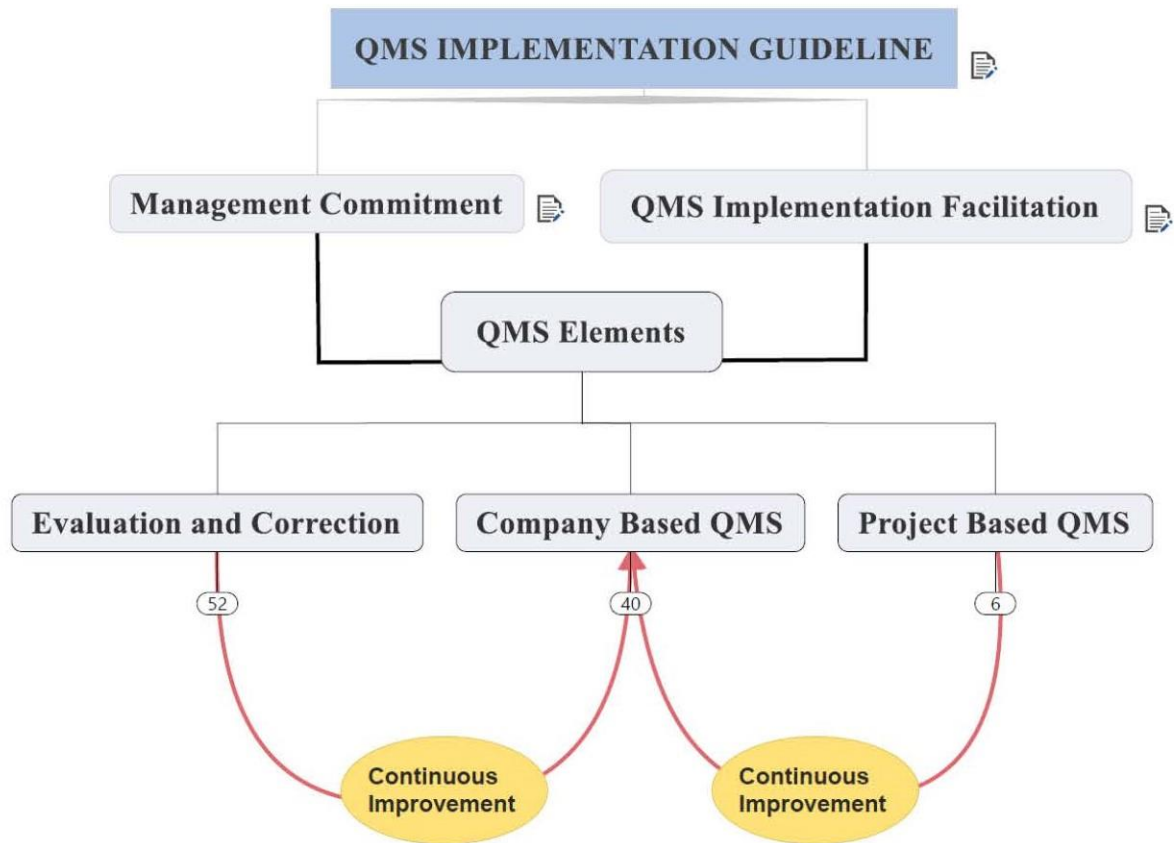
The company-based QMS elements were developed based on ISO 9001:2015 and the case study phase 1. It includes three components from ISO 9001:2015 - management system, documentation, and actions. The management system is a set of interrelated or interacting elements of an organization to establish policies and objectives, and processes to achieve those objectives (BSI-Standards, 2015). The QMS is part of a company's management system (Kuo and Kuo, 2010). For that, the top management should establish the mission, vision, and strategy to achieve their long-term and short-term objectives. The senior management should also set a quality policy that can fit the company's resources and market needs (Pheng and Teo, 2004).

The documentation component includes documents, objective evidence and records (Battikha, 2002; Lari, 2002). The fourth component describes the actions needed for QMS corrections and improvements (Lari, 2002; Lari and Asllani, 2013).

The results of Case Study phase 1 indicate that it is essential for the MMS to have a structure supporting QMS activities, including a separate department for quality management. It could be modified to fit the company resources and the nature of the construction projects. The MMS should develop the Quality assurance and control (QA/QC) processes in such a way as to ensure the involvement of subcontractors, suppliers, materials and submittals (Panuwatwanich and Nguyen, 2017). Similarly, evaluation processes should effectively measure the quality levels of the provided products, services, and related processes to achieve the company's quality objectives. A Quality management plan, which includes setting quality objectives, and specifying necessary operational processes and associated resources to meet the quality objectives, should also be included in the QMS at the company level (Chang and Ishii, 2013; Wu et al., 2011).

4.1.2 Project-based QMS:

The project-based QMS element was also developed based on ISO 9001:2015 and the Case Study phase 1. Construction projects typically have the following constraints: cost, scope, contract and client requirements, available resources, and applicable regulations ([Almahmoud et al., 2012](#)). The MMS needs to understand their customer's requirements/expectations and how the project activities are performed to meet those requirements, which can be done by getting customers' feedback and following their satisfaction in addition to the related codes of conduct and provided services ([Haming et al., 2019](#)). The MMS should also show determination to achieve the required quality levels by performing: continuous monitoring, measurement, inspection, testing, reviewing, and progress evaluation.



QUALITY MANAGEMENT SYSTEM FRAMWROK

Figure – Bambang, 2021

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