

**Developing a quality assessment tool for
the Ghanaian construction industry**

**A Thesis Submitted for the
Degree of Doctor of Philosophy**

By

Hilary Osei-Bonsu

**Department of Civil and Environmental
Engineering, Brunel University London**

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Declaration

I declare that the research presented in this thesis is the original work of the author and is being submitted for the first time to the Post Graduate Research Office at Brunel University London. The study was structured, written, and evaluated by the author within the Department of Civil and Environmental Engineering, College of Engineering, Design and Physical Sciences-CEDPS, Brunel University London, United Kingdom. All information sourced from external works have been properly cited and acknowledged.

Signed: Hilary Osei-Bonsu

Abstract

Globally, there has been an increasing interest and demand in the adoption and implementation of quality management systems in the construction industry, as they provide heightened effectiveness and efficacy for client satisfaction. However, in Ghana, collapses of newly built and on-going building projects have become common place, much of which have been attributed to poor quality works. This situation is engendered by numerous challenges facing the Ghanaian construction industry (GCI), notable of which are lack of appropriate quality standards, resource constraints, and a dynamic regulatory landscape. These underscore the importance of developing a tailored quality management model for the Ghanaian construction setting, which currently has nothing of this sort, as evidenced by the literature. Instigated by this gap, a research study was undertaken to develop a quality management assessment tool (in the form of a maturity model) for improving quality management practices among construction organisations in the GCI.

This research employed a mixed research method by triangulating data obtained through various techniques, namely literature review, questionnaire survey and semi-structured interviews. A pilot study was carried out to evaluate the validity of the questionnaires, which contributed to enhancing the research design and its overall quality. Following the development of a conceptual framework that established the key quality management criteria and standard requirements, relevant primary data was gathered from construction organisations of the GCI and analysed using descriptive and inferential statistical analysis, including Independent sample T-Test, Binary logistic regression, Spearman's correlation and factor analysis. The factor analysis was used to extract components required for the development of the Quality Management Maturity Model (QMMM). Moreso, based on the results and the conceptual model, the structure of the proposed QMMM was designed, which was then validated using feedback acquired from industry experts from the GCI to ascertain the model's usefulness and suitability.

Research findings indicated that the three most significant factors contributing to the successful implementation of QMS are top management commitment, client satisfaction, and the application of legislative instruments. In contrast, the two main challenges affecting the implementation process were found to be inadequate training and education from top management, as well as the belief that engaging in QMS practices is both time-intensive and costly.

The model consists of various structural components, maturity levels and scores, a maturity flowchart and an evaluation sheet. QMMM enables identifying areas of improvement for quality management practices in the GCI.

A key contribution to knowledge of this research includes the new QMMM developed for the GCI, which is innovative and has the potential of improving quality management practice and standards. Additionally, QMMM can be used by industrial professionals and the wider international community through the adoption of the steps developed for its applicability as indicated in Chapter 6.4.3. Using the QMMM will help organisations to be quality conscious to help engender or bring about a change in the culture, as far as quality management is concerned in order to avoid project collapse. Another contribution lies in the fact that the study findings can foster a more robust academic discourse and encourage a collaborative effort among scholars to investigate the use of maturity models in diverse organisations.

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Abbreviations

CIDB	Construction Industry Development Board
CSF	Critical Success Factor
EFQM	European Foundation for Quality Management Model
GCI	Ghanaian Construction Industry
GhIE	Ghana Institution of Engineering
GhIS	Ghana Institution of Surveyors
GIA	Ghana Institute of Architects
ISO	International Organisation of Standardisation
MBNQA	The Malcolm Baldrige National Quality Award Model
MRH	Ministry of Roads and Highways
OHS	Occupational Health and Safety
PPA	Public Procurement Authority
PQP	Project Quality Plans
SPC	Statistical Process Control
QM	Quality Management
QMM	Quality Maturity Model
QMMM	Quality Management Maturity Model
TQM	Total Quality Management

Publications from this Research

1. **Conference Paper**

- Osei-Bonsu H, Braimah N., and Shafique (2023). 'Assessing the knowledge and compliance of Quality Management practice among Ghanaian Construction Organisations'. International Congress on Measurement, Quality and Data Science, MQDS 2023, June 5-7, Bordeaux-France.

2. **Papers (in the pipeline) to be published in reputable journals**

- The adoption of the Quality Management Maturity Model in Ghana's construction industry aimed at improving quality performances (Targeted Journal; Journal of Construction Management and Economics).
- An exploration of the effectiveness and limitations of the Quality Management Maturity Model in fostering quality enhancements within the construction industry (Targeted Journal; International Journal of Project Management).

3. **Internal Brunel University Research Symposia and Conference(s)**

- Osei-Bonsu, H. and Braimah, N. (2022). Developing a Quality Assessment Tool for the Ghanaian Construction Industry. Department Symposium, Brunel University.
- Osei-Bonsu, H. and Braimah, N. (2022). Developing a Quality Assessment Tool for the Ghanaian Construction Industry. Graduate School Poster Conference, Brunel University.

CHAPTER 1: INTRODUCTION

1.0 Introduction

This chapter provides the context for the research thesis, structured as follows: it begins with a comprehensive background of the study, then identifies the research problem and the existing gap in the literature, emphasising the need for the research and/or additional investigations. Secondly, this chapter presents the research aim, objectives, and the questions that the study seeks to address. The chapter then sheds light on the research's scope, methodology and noteworthy contributions. To conclude, this chapter presents a summary of the overall structure of the thesis.

1.1 The Context and Rationale of this Research

1.1.1 The Background

Construction companies around the world encounter numerous challenges and issues, including workmanship defects, project delays, and cost overruns. The rise of globalisation and competition over the last thirty years has further intensified these difficulties (Neyestani and Juanzon, 2016). Consequently, it has become imperative for every construction company to enhance and rectify its operational framework to successfully attain their objectives through the implementation of effective quality management tools.

Quality Management System (QMS) encompasses a set of guidelines that are essential for overseeing quality control, enhancing process improvement, and ensuring the efficacy of quality assurance in a project's implementation (Tramontana, 2023). According to Abd Elhamid and Ghareeb (2011), QMS can be utilised at every level of a project. Therefore, the process of applying these systems is vital for guaranteeing that the requirements of the client are satisfactorily fulfilled during and after the project's duration. Chan (2011) posited that the importance of quality management systems cannot be overstated, given that quality is a fundamental factor influencing the success of projects. According to studies by Low and Peh (1996), the adoption of quality management systems can result in a 15% decrease in overall construction costs by eliminating re-work and waste. Consequently, prioritising this approach is essential for rectifying the challenges faced by the construction sector, as it enhances worker accountability, promotes empowerment, and facilitates continuous monitoring of productivity levels.

Within construction organisations, the effective application of quality management is crucial for improving competitiveness in a market characterised by high demands and challenges. The process of implementing QMS is not a standalone activity; it is generally integrated with various functional and administrative management processes within a construction company.

The focus on quality assurance in projects plays a pivotal role in shaping the decision-making processes of construction organisations (Whang et al., 2019). As such, the execution of QMS may be initiated by the top management of a construction firm or carried out independently at the project level (Okereke et al., 2022).

The Ghanaian construction sector is a thriving industry, which has become a significant force within the country's economy, with a valuation of approximately \$8 billion, and has consistently contributed over 15% to the nation's annual GDP in recent years (Moraes et al., 2023). Moreover, it has significantly contributed to fulfilling the labour requirements of the population, offering job prospects to approximately 420,000 people. Currently, there are approximately 2,500 active building and construction contractors operating within the Ghanaian market (Moraes et al., 2023). There is a notable increase in the demand for construction projects in Ghana. However, the Ghanaian Construction Industry (GCI) suffers from poor project performance, poor job quality, and a lack of creativity or professionalism which often leads to building collapses, injuries, and high construction costs (Adusa-Poku, 2019). According to Gray (2020), in order to avoid issues that could affect a project's end product, an appropriate quality management system is needed to be implemented in construction projects. This process can help to prevent costly repairs and replacements, as well as other problems that could affect the customer's satisfaction.

The subsequent section addresses the research problem and emphasises the necessity of conducting this study.

1.1.2 Problem Statement

Despite the high importance of implementing QMSs, there has been a high incidence of inadequate practices of such systems at construction sites which often results in severe project delays, reworks, and other undesirable risks (Orji, 2019). In developing countries such as Ghana, the construction industry faces a dire deficiency, primarily attributed to a lack of training and a notable absence of commitment from senior management in facilitating the implementation process (Essel, 2020). According to a study by Adusa-Poku (2019), a primary concern for numerous construction companies in Ghana is the efficient application of QMS to fulfill client expectations without incurring supplementary costs by the end of the project lifecycle. This issue is exacerbated by the tendency of certain clients to opt for the least financial outlay, often at the expense of achieving a superior quality product (Damci & Yalcin, 2011). Thus, meeting the needs of clients within the GCI poses a significant challenge for several companies, particularly when faced with intense competition from numerous bidders (Adusa-Poku, 2019). According to Okuntade (2015), this adds to some of the reasons why some companies cut corners at the expense of being more competitive instead of focusing on

ensuring quality on projects. Similarly, bids are sometimes decreased by reducing the profit margins with the belief of securing the remaining open jobs. This demonstrates that construction experts are currently being confronted with multifaceted problems (Ansah, 2018).

Osei-Asibey et al., (2021) established that managing quality on projects is still a major challenge in the GCI, where majority of the construction companies promise to ensure that quality works are implemented but they fail to attain the necessary standards that meet clients' expectations. As supported by Arditi and Gunyadin (2013), construction projects in Ghana consistently struggle with insufficient quality management practices, which has been a persistent challenge for achieving a suitable standard of excellence on projects. The absence of robust quality management practices has been a contributing factor to the occurrence of multiple building collapses in Ghana. Recently, there was a building (three-storey building) collapse at Ofankor, Ghana. An investigation into the collapse of the building encountered some obstacles as the individuals responsible for the building had removed and discarded all the debris from the location (Zurek, 2023).

As reported by Menz (2021), a portion of a 22-storey building that was under construction collapsed in February 2021 at the Airport Residential Area in Accra, Ghana, resulting in injuries to several workers on the site. He went on to assert that the collapsed areas had detrimental effects on the foundation of a nearby school, which resulted in the development of cracks and contributed to environmental pollution experienced by the residents in the vicinity. Reports indicated that the collapse of the structure was due to inept building practices and the contractor was cautioned to stop all building works as it lacked structural integrity (Menz, 2021).



Figure 1.1 A section of a 22-storey building under construction at the Airport Residential Area, near Association International School (Menz, 2021)

Similarly, there was a church building collapse that occurred in October 2020 at Akyem-Batabi in the Eastern Region of Ghana (Frimpong, 2020). This incident occurred while a community church service was being held in the building, which was still under construction. Incident reports indicated that the collapse of the building was due to the use of inferior materials, such as weak concrete which led to the death of 22 persons with others being critically injured, and it was also discovered that the church building was built with expired permit dated in 2000 (Frimpong, 2020). This implies that there was no structure in place to check the quality of works when the building construction was on-going.



Figure 1.2 Building collapse in Akyem-Batabi (Frimpong, 2020)

Not only are structures poorly built, but others are also constructed in great haste (Osei-Asibey, 2021). Sometimes, building extensions are done on the old designs, and some are changed to functions which were not included in the main designs. An architect when interviewed stated that one of the main reasons why building collapses happen is because of the substantial demand for construction buildings (Boateng, 2021). This brings about lots of pressure that results in wrong things being done quickly at a lightning speed. It was also noted that issues such as corruption and political intrusion usually dent the authorities' already under-resourced capability to put things under control. The outcome creates an atmosphere where inappropriate construction practices (including non-adherence of quality management practices and standards) increase in ways that undermine public safety. Additionally, Boateng (2021) argued that Ghana's building safety problem is mainly due to insufficient distribution of public resources for the private gain of a fortunate few.

Research conducted by Adusa-Poku (2014) in Ghana, among construction organisations stressed the limitations of using quality management models and tools as guidelines to manage various projects on site. However, it was further established that quality assurance was identified to be used in Kumasi (Ghana), even though it had not been fully implemented because it required more manpower and delayed project completion time. Only a few QMS were used, with most of the systems ignored while work was on-going (Dansoh, 2005). Therefore, this forms part as an objective for this research to enable critical evaluation of current quality management practices with Ghanaian construction organisations.

Even though the GCI boosts the country's economy, it is presently being faced with diverse uncertainties due to management challenges pertaining to the quality of project works done which tends to affect the economy as well (Boamah, 2019). Despite the industry's significant

economic contribution to Ghana, it is still plagued with some negative practices (Frimpong et al., 2020) and as it was reported that, during tendering of projects, bid appraisal, and contract implementation phases, construction experts are frequently implicated in corrupt activities of which some are ascribed to poor leadership commitment which eventually leads to poor quality implementation of works. Thus, adopting a structured framework to direct all industry stakeholders is the first step towards achieving this goal (Adusa-Poku, 2020). It is considered that paying attention to key quality principles can reduce issues associated with quality management implementation and help to improve quality performance measures in organisations by effectively practicing it (Ansah et al., 2021).

In the United Kingdom's construction industry, QMS is crucial for ensuring project quality, client satisfaction, and regulatory compliance. However, there are notable gaps in the literature regarding their implementation and effectiveness. There are frameworks for total quality management (TQM) that have been established; however, they often fail to consider client-centric strategies, which results in fragmented definitions of project success (Winch et al., 1998). Conversely, Nigeria is facing a severe lack of literature and practices associated with lean and offsite construction, which highlights a growing knowledge disparity relative to the UK (Omotayo & Keraminiyage, 2014). Additionally, while TQM principles underscore the significance of knowledge management as vital for a quality culture, their implementation shows considerable variation across industries, indicating a necessity for tailored strategies in the construction sector (Bukari et al., 2023). In Lagos, Nigeria, traditional quality control practices are prevalent, and there is a critical need for frameworks that utilise modern digital tools to improve quality management and reduce human error (Powell, 2023).

The implementation of QMS in Ghana's construction industry faces significant challenges and reveals notable gaps at both project and organisational levels. Current studies highlight the limited adaptation of innovative procurement practices, such as circular procurement, which could enhance QMS effectiveness by integrating sustainability into project management (Ababio et al., 2023). Additionally, the underutilisation of digital tools for risk management indicates a lack of awareness and training among construction professionals, which hampers the potential benefits of these technologies in improving project outcomes (Mustapha et al., 2024). Furthermore, the selective integration of management systems suggests that organisations may prioritise certain systems over others, leading to inefficiencies and missed opportunities for holistic quality improvement (Chountalas & Tepaskoualos, 2019). Additionally, the reliance on traditional, paper-based quality management processes underscores the need for modern solutions like Building Information Modeling (BIM) to streamline operations and enhance quality control (Nguyen et al., 2018). Collectively, these

findings point to a pressing need for comprehensive strategies that address these gaps and promote effective QMS implementation in Ghana's construction sector.

The above-mentioned studies and reports demonstrate the importance of quality management at construction sites and organisations. Many studies have been undertaken to help make this importance a reality for construction projects in developed countries. However, the research dedicated to addressing the numerous quality management issues within the construction industry in Ghana is quite limited. It is significant to take into consideration that the few studies conducted were all done in one region, namely Kumasi in the Ashanti Region of Ghana, and not adequate to support the proper implementation of quality management in the Ghanaian setting, as the needed models/frameworks are constructed according to cultural, social, and economic characteristics of the region (Jones & Seraphim, 2008). More importantly, recent research conducted by Ansah (2018), Adusa-Poku (2020) and Osei-Asibey (2021) on total quality management usage among Ghanaian construction organisations demonstrate that, there is no validated or an assessment tool in place to monitor the implementation of quality management in the GCI. An important consideration when it comes to dealing with or addressing quality management issues, is the ability to measure the state of quality management practices and knowing the deficiencies or limitations of existing practices among construction organisations. Yet, none of the research available has addressed this issue, neither is there a tool available to help measure quality management performance. Moreso, it is evident that there is little to limited research done on the development and use of a quality assessment tool in construction organisations in Ghana. Therefore, it is against this background that this research seeks to investigate current QMSs being practiced, and their challenges in implementing them, towards developing an appropriate quality assessment tool for enhancing quality management practices within construction organisations in the Ghanaian construction industry.

1.2 Research Aims, Objectives and Questions

1.2.1 Research Aim

This research aims to develop a quality management assessment tool for improving quality management practices among construction organisations in the GCI.

1.2.2 Research Objectives

To achieve the aim, the following objectives are to be pursued:

- To critically review existing literature on the concept of quality management systems, their standards and process improvement tools as applied in the construction industry.
- To investigate current quality management practices in the Ghanaian Construction Industry (GCI).

- To assess the critical success factors and limitations affecting the implementation of QMS in the GCI.
- To develop and validate an appropriate assessment tool for the effective adoption and implementation of quality management practices in the GCI.

1.2.3 Research Questions

To meet the research objectives, the following research questions were developed:

1. What are the existing practices regarding quality management systems in the GCI?
2. What are the limitations in current practice, and the best way to subdue them?
3. How can a suitable tool be formulated to effectively implement quality management practices within the GCI?

1.3 Research Scope

To ensure a focused and directed approach towards meeting the specified aim and objectives, it is imperative to define the scope of this study. This study primarily centers around building projects carried out by construction organisations in Ghana. As a result, this research narrows its scope to the construction industry in Ghana, with a particular emphasis on the construction processes implemented by the Ghanaian construction organisations.

It explores the current practices and challenges being faced to enable the development of the assessment tool which is aimed at supporting the adoption and implementation process of quality management practices within the industry. Most importantly, this research focuses on organisations in Civil and Construction settings to include; Construction Contractors, Project Managers, Site Engineers, Architects, Civil/Structural Engineers, Quantity Surveyors, etc. Many of them operate within the governmental sector, as it is anticipated that directing attention towards the government as a policymaker in the industry will attract the necessary focus required for the tool's successful implementation in the country.

1.4 Overview of the Research Methodology

Research methodology demonstrates how a researcher can analytically and methodically design data collection instruments (e.g. survey, interviews, etc.) to derive reliable and valid results which tend to focus on the set research aims and objectives (Warren, 2020).

This research consists of four stages: the identification of the research problem, the design of the research methodology, the concurrent collection and analysis of data, and ultimately, writing the thesis. In Chapter 1.1.2, the development of the research problem is discussed, highlighting how the researcher identified the issue through a comprehensive literature review and previous research experiences. The emphasis on problem definition at the outset indicated that the construction industry in Ghana suffers from persistent ineffective quality

management practices, which contribute to a high incidence of quality failures in projects. Furthermore, it was discovered that there is less research conducted on the implementation of quality assessment tool within the GCI. Existing studies reveal that there is a lack of a quality assessment tool within the Ghanaian construction sector, which presents a notable research gap that requires attention.

Chapter 4 addressed the research methodology employed for this research, which employed the research onion by Saunders et al., (2019). The overall selected research methodologies are illustrated in Figure 4.10. The researcher adopts a philosophical perspective aimed at addressing a real-world issue by leveraging the experiences and knowledge of practitioners. The ontological stance is interpretivist, and the epistemological approach is subjective, indicating a value-laden axiology. This research is situated within the positivist paradigm, concentrating on the assessment of existing quality management practices and the challenges that construction organisations in Ghana encounter, which is consistent with the deductive research approach utilised in this study.

A pilot study was conducted as an essential component of the research design. This research combines qualitative and quantitative methods, utilising a mixed-method technique. Both qualitative and quantitative methods were integrated in data collection and analysis to enhance the data analysis process by balancing the drawbacks of one type of data with the advantages of the other. Qualitative and quantitative data were collected using an online questionnaire survey and semi-structured interviews. In addition, thematic analysis and statistical analysis software (SPSS) were used for the purpose of data analysis. This research also employs a cross-sectional time horizon as part of its research methodologies.

Prior to conducting further analysis, it was crucial to assess the reliability of the scales employed. It was imperative that the items encompassed within the scale accurately measure the very concept they are intended to evaluate. Internal reliability or consistency is a well-known concept in research methodology. Cronbach's alpha was used as a statistical measure to assess the consistency of items as part of the data analysis process in this research.

In order to validate the assessment model developed for enhancing the effective application of quality management practices within the GCI, a group of experts from the industry were involved in this research. The experts comprised of contractors, consultants, and project managers, who were chosen through a purposive sampling method. The validation process involved conducting interviews with 11 industry experts to gather their feedback and assess the usefulness of the developed model. The insights provided by these industry experts played a crucial role in validating QMMM and ensuring its effectiveness in the GCI.

In summary, Figure 1.3 below depicts all the methodological procedures and processes followed as briefly described in the preceding paragraphs.

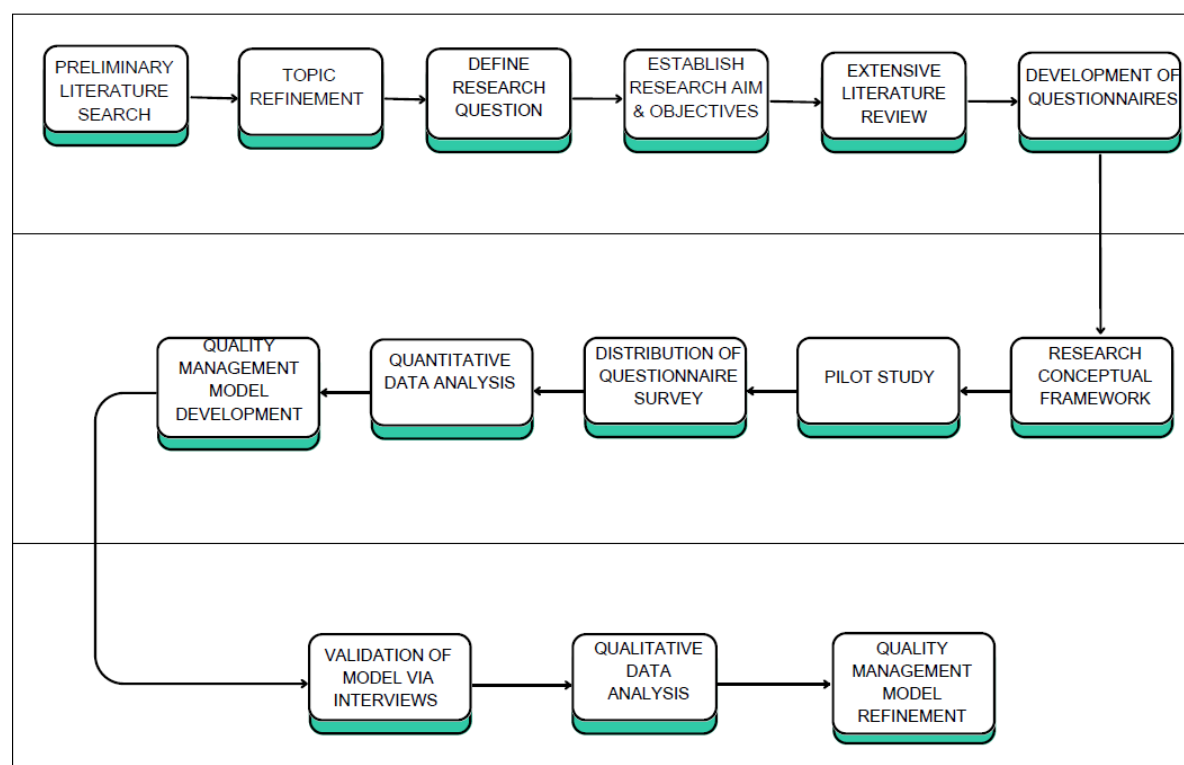


Figure 1.3 Research methodological plan

1.5 Research Contribution to Knowledge

The findings of this research significantly contribute to the current body of knowledge in quality management. It is significant to highlight that this study has developed a novel quality assessment tool (in the form of a maturity model), QMMM, to foster improvements in quality management practices within the GCI. Through comprehensive development of the QMMM, this research provides a meaningful contribution to existing literature, reaching beyond the boundaries of the GCI to effectuate a global significance.

This research significantly contributes to the understanding of QMS within the GCI by integrating established knowledge with empirical data analysis. Through this synthesis, this research provides critical insights that can inform best practices in the construction field.

Additionally, this research serves as a foundational step towards fostering a more robust framework for quality evaluation in Ghana and similar contexts. For instance, in West African countries such as Nigeria which bears similar construction characteristics like Ghana, the developed model can be adapted for use. Moreso, by bridging the research gap, it paves the

way for future investigations that can further elucidate the effectiveness and adaptability of quality assessment tools in diverse environments.

The outcome of this research will also serve as a model for professional bodies within the GCI, to employ to check that its respective organisations are applying the correct QMS procedures in ensuring quality outcomes and safe and/or reliable execution of projects.

Furthermore, the outcomes of this research can be utilised to enhance management practices and to refine work processes associated with the integration of QMS. By leveraging these insights, organisations can better navigate the complexities involved in implementing quality management frameworks, thereby improving their overall operational effectiveness.

Most importantly, incidents such as poor-quality construction works which result in significant damage (through structure failures), project delays, and additional costs to clients (from defects or faults in works) will be reduced and ultimately prevented through the development of this research.

1.6 Structure of the Thesis

1. Chapter 1 provides a detailed overview of the research. It introduces the background relevant to the study and underscores the importance of conducting this research. In addition, this chapter clearly delineates the research aims, objectives, questions, and scope. As a result, it critically examines the research questions that must be answered to validate the specified aims and objectives of the research.
2. In Chapter 2, an extensive examination of existing literature is presented, highlighting both past and current research pertinent to QMS. It offers an overview of quality management standards and discusses the tools and techniques that are prevalent in the construction industry, while also addressing the important aspects related to the GCI.
3. Chapter 3 outlines the research conceptual framework, providing a detailed explanation of its various components.
4. Chapter 4 introduces the Research Onion, which serves as a framework for delineating various research methodologies utilised in this study. Additionally, it elucidates the chosen research method and design, providing a comprehensive explanation for its selection over alternative approaches.
5. Chapter 5 concentrates on the results of this research. Additionally, it provides a comprehensive analysis and in-depth discussion on the outcomes of this research.
6. Chapter 6 demonstrates the development of the finetuned assessment tool (in the form of a maturity model) and its validation.

7. Chapter 7 concludes this research by elaborating on how the research aims and objectives were achieved. It also outlines some recommendations for further work in the future.

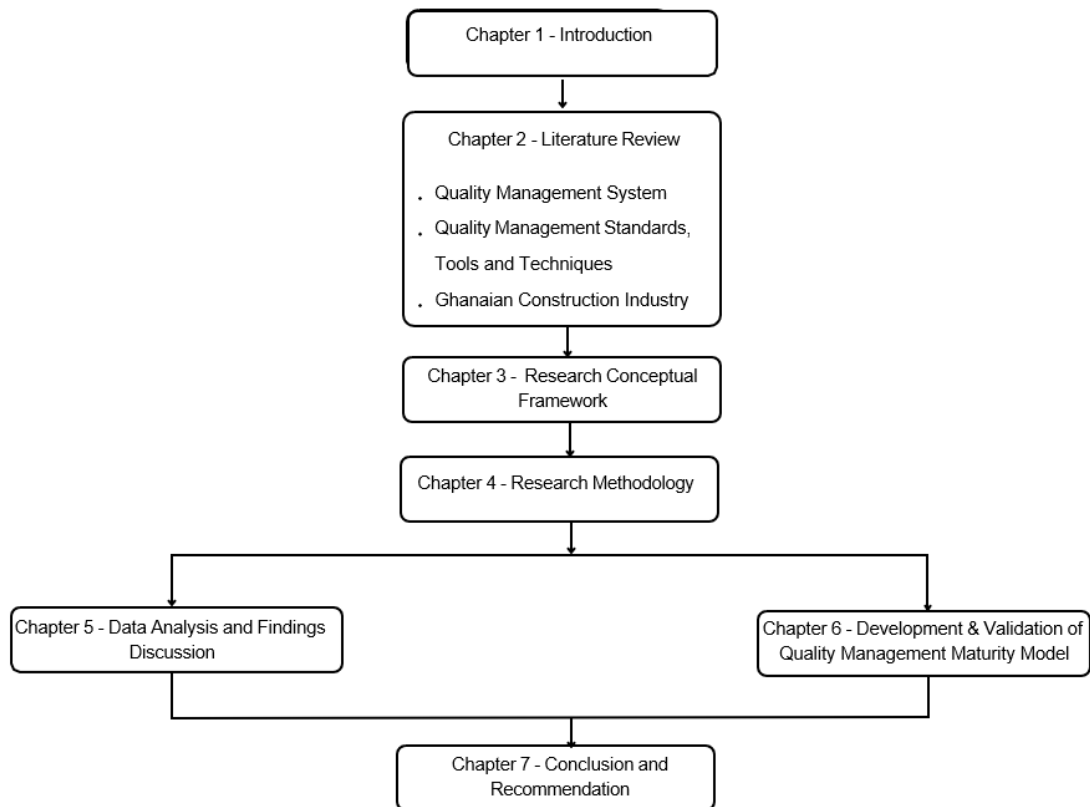


Figure 1.4 Thesis structure

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction- Quality Management System

This chapter offers a comprehensive examination of literature that is relevant to the research. The review is structured into three main sections, each addressing specific areas of interest, as far as the study aim and objectives are concerned. The first section concentrates on Quality and Quality Management System (QMS), examining its principles and practices in industries, including the construction industry. The second explores various tools and techniques employed in quality management. Lastly, the GCI is examined, highlighting its distinct features and challenges. By covering these areas, the review seeks to enhance understanding and knowledge regarding quality management in construction, towards identifying the gaps in research undertaken in this field and also serves as a basis of the research questions explored and evaluated in the subsequent chapters.

2.1 Quality

According to Eng and Yusof (2003), quality can be termed as a concept comprising a set of guiding standards that ensure continuous improvement within an organisation. The achievement of quality is often regarded as one of the most intricate and demanding practices for any entity. Management of quality is an essential aspect of organisational operations, as it ensures that all tasks performed by the organisation are suitable for their intended purpose (Stojmenović & Pavlović, 2019).

The successful completion of a project is contingent upon the project's quality, which serves as the primary foundation (Romeo et al., 2014). Therefore, the significance of quality cannot be undermined in the context of achieving success in construction projects. Hence, it is crucial to implement a suitable and well-structured quality management system to obtain the required benefits essential for project accomplishments (Bhandari, 2022).

By thoroughly understanding how a project aligns with its needs, various factors such as maintenance and operation, construction economy, energy efficiency, and the level of conflict in specifications and drawings can contribute to the overall quality of works produced (Arditi and Gunaydin, 1997).

2.2 Evolution of Quality Management

Over the past few decades, the subject of quality has experienced numerous changes and developments (Broday, 2022). The evolution of quality management is typically divided into four significant stages: Inspection, Quality Control (QC), Quality Assurance (QA), and Total Quality Management (TQM) (Dale et al., 2013). These evolution stages are depicted in Figure 2.1 below:

EVOLUTION OF QUALITY MANAGEMENT



Figure 2.1 Evolution stages of Quality Management (Adapted from Dale, 2013)

2.2.1 Inspection

Costin (1994) identified inspection as a vital process of quality. According to Ingason (2020), the evolution of quality management began after the First World War when an inspection was conducted in mass production in 1930. This was the only process to test the quality of products made by the manufacturer before being sold to the customer or consumer. Due to this, full-time inspectors were appointed to monitor and check that quality was always maintained. According to Dahlaard et al., (2007), quality was checked during the production stage, and therefore quality was identified to be associated with inspection.

A construction site inspection is conducted to verify that the ongoing construction aligns with the project's plans, construction specifications, client's requirements, and code regulations (Schwartz, 2024). Schwartz (2024) further argued that it is important to note that this inspection is not a singular occurrence, but rather a continuous process that involves regular checks of the job site during the project's execution.

Research by Einizinab et al., (2023) identified that currently, the predominant practice for inspecting building work relies on conventional methods, wherein the inspector's physical presence at the construction site is indispensable for overseeing and controlling the inspection of items to maintain quality.

2.2.2 Quality Control (QC)

QC is the second stage in the evolution process of quality management, aimed at maintaining the quality of a product or service and it is mainly linked to defect detection which includes eradicating quality issues to ensure that a client's requirement is duly attained (Luo et al., 2022).

According to Waida (2022), QC involves the process of inspecting, monitoring, and testing deliverables to ensure that they meet project requirements. Buma (2021) recommended conducting regular tests to identify errors and validate products and emphasised the importance of organisations establishing well-defined controls when using quality control as a quality tool. Buma (2021) also highlighted the necessity of QC in reducing various product errors related to quality. Similarly, a study by Ellis and Hogard (2018) demonstrated that effective quality control techniques led to a decrease in defects and errors and contributed to process improvement. Additionally, it was mentioned that QC is not a means of establishing standards, but rather a method of maintaining them through selection, defect identification, and correction of errors in measurements (Ellis and Hogard, 2018).

Waida (2022) stressed the necessity of making decisions at every phase of quality control to attain the highest level of achievable compliance. The implementation of quality control in organisations is critical for fostering appropriate environments for employers and employees to strive for excellence (Chorafas, 2013). As part of creating suitable environments, Tang (2005) highlighted the importance of conducting comprehensive training for employees and establishing benchmarks to ensure product quality as crucial components of effectively implementing quality control in organisations.

2.2.3 Quality Assurance (QA)

The third phase in the evolution of quality management is focused on preventing defects and related incidents (Dale et al., 2013). Quality assurance ensures that products are free of defects and are designed to meet the necessary quality standards (Ellis, 2021). Furthermore, QA serves as a preventive strategy for maintaining quality, contingent upon the existence of appropriate systems that must be followed, thereby ensuring the elimination of defects in performance (Pheng and Teo, 2004).

QA serves as a crucial control mechanism in construction projects, ensuring the evaluation of safety measures from the beginning of the design phase to the completion of the project (Howarth & Greenwood, 2017).

According to Harris et al., (2013), quality assurance comprises of the following:

- The type of materials used: For instance, is it the recommended size, standard or shape?
- Acceptable ways of measuring quality: For instance, what does good look like?
- Equipment: Is it safe to work with and will it function on site?
- Certificate and skills: Do your employees have the right skills for the job?
- Project Management: Agreed budgets, timeframes, bidding processes, etc.

2.2.4 Total Quality Management

The adoption of TQM by numerous organisations can be attributed to their willingness to leverage advanced technology as a means of fulfilling customer expectations (Egwunatum et al., 2021). Consequently, TQM has become an essential method for ensuring the sustainability and long-term survival of organisations, as it requires the active involvement and commitment of every individual within the organisation, regardless of their position (Egwunatum et al., 2021).

Harris et al., (2013) recommended three important principles (listed below), which organisations must meet in order to achieve TQM.

1. Ensure that all requirements are met in a consistent and reliable manner;
2. Aim to add value to the customer by providing services that complement the supply of goods;
3. Provide products or services that are of superior quality compared to all other competitors, excelling in both price and quality.

The implementation of TQM thus calls for organisations to undergo necessary restructuring to improve efficiency and regain competitiveness in the market environments. It is essential for top managers to acknowledge such benefits of integrating TQM principles into their organisations.

Table 2.1: Pros and Cons of TQM

Pros	Cons
Enhances the delivery of top-notch products to clients.	Implementing TQM may necessitate a substantial financial commitment for the conversion process.
It results in decreased expenses at the company level.	TQM often requires a gradual transition which takes place over a prolonged period.
A comprehensive approach is adopted to minimise waste at all levels of the production, promoting sustainable practices and resource conservation.	The possibility of facing resistance to change exists.
Enhances the capacity of a company to be more flexible and adaptable.	It requires the support of the entire organisation to succeed.

(Source: Barone, 2023)

2.3 Construction Quality Management

In the field of construction, quality management can be approached from two distinct levels: the project level and the organisational level. Arditi and Gunaydin (1997) emphasised that, the successful implementation of quality management in the construction sector necessitates adherence to several essential guidelines, including teamwork, commitment and leadership from top management, involvement of suppliers, compliance with codes and standards, consideration of the cost of quality, application of statistical methods, and fulfillment of clients' requirements. Figure 2.2 demonstrates a construction quality model which depicts various elements in a construction project level and organisational level in a construction firm.

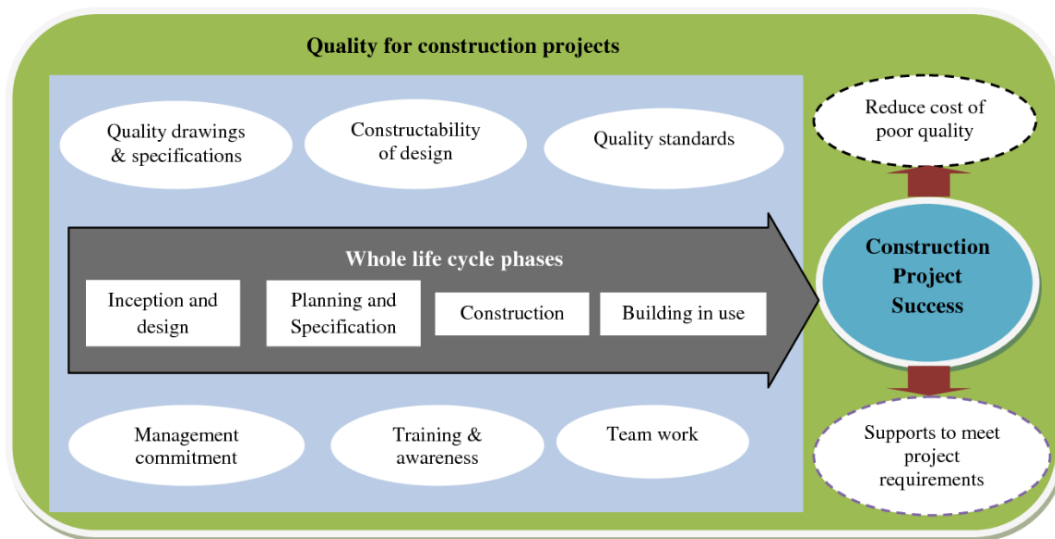


Figure 2.2 Quality management processes in construction (Mallawaarachchi & Senaratne, 2016)

In project construction, the primary essence of QMS is to create a systematic framework that ensures quality is consistently maintained at all phases of the construction project (Egwunatum et al., 2021). This is accomplished when the QMS is applied and executed with appropriate planning and controls in a clear manner. To achieve quality in project construction, the quality of the output is fundamentally dependent on both the quality of the inputs and the responsiveness of the mechanisms in place to address them. Hence, a QMS explains requirements and procedures in well-defined terms, sets policies, monitors work performance, and develops teamwork within an organisation (Dale, 2003).

The construction industry has faced several challenges in integrating sustainable practices into its processes (Zhai et al., 2014). Several organisations have expressed dissatisfaction with their quality improvement strategies, primarily due to their exclusive focus on financial outcomes rather than quality metrics (Shakeel et al., 2017). Extensive research has indicated

that project management is a key factor in securing high-quality results within the construction domain (Ingason, 2020). Consequently, the successful execution of quality management is significantly dependent on the implementation of robust management strategies to address the challenges encountered by organisations.

2.3.1 Quality Control in Construction

Within construction organisations, quality control is fundamentally concerned with ensuring compliance with predetermined standards as specified in the project documentation. Although the primary objective of quality control is to adhere to the existing design choices, certain exceptions to this principle do exist (Zhong, 2015). Gunawardena (2017) noted that unexpected developments, incorrect design decisions, or modifications requested by clients may require a reassessment to ensure alignment with the design choices during the construction phase. The discrepancies in quality may stem from the strategic choices made by senior management. To ensure that the results of their operations align with client expectations, construction companies must minimise the use of substandard materials or products (Wei, 2012).

The quality control methods employed in projects are determined by practical specifications (Oakland & Marosszeky, 2017). Effective implementation of quality control on construction sites allows for the observation of both internal and external controls. Ensuring consistent quality control from the initial stages to the final completion of a construction project is crucial (Auld et al., 2001). This process emphasises the operational strategies and tasks performed by the project team to fulfill quality criteria, including the implementation of quality inspections. Figure 2.3 illustrates a quality control plan for construction projects.



Figure 2.3: Construction Quality Control Plan (Adopted from Zhang, 2018)

2.3.2 Quality Assurance in Construction

Waida (2022) stated that quality assurance pertains to the methods or steps employed to ensure that a project complies with each of its specifications, therefore by tracking compliance and sustaining consistent quality management outcomes over time can be often accomplished through the use of quality assurance. The project board is tasked with the responsibility of project assurance, which starts at the beginning of the project (Thorpe et al., 2004). This function instills confidence in stakeholders regarding the proper and accurate execution of the project. Construction activities commence on the day of commissioning, and due to various considerations, the precision of design details is of utmost importance. As a result, quality assurance involves diligent record-keeping throughout both the design and construction phases (Atkinson, 1974). At construction sites, quality assurance is managed by qualified personnel who ensure that quality control activities are thoroughly implemented and adhered to (Harris et al., 2006).

Ensuring adherence to quality assurance practices is vital for preventing delays and extra costs in projects. This approach not only facilitates the smooth progression of the project as intended but also helps to protect employees on-site from potential accidents or serious injuries (Rumane, 2011).

Table 2.2: Comparison between Quality Assurance and Quality Control

Aspect	Quality Assurance	Quality Control
Focus	Improves processes in order to prevent defects.	Identifies and corrects defects in goods or services.
The extent of applicability	The whole organisation and systems/procedures.	At the level of products and services.
Technique	Preventive	Corrective
Main objective	Maintains regularity, effectiveness, and error reduction.	Identifies and rectifies any defects that may impact on the quality of a product or service's performance.
Function	Preemptive and detail	The strategy is responsive

	oriented.	and result oriented.
Production process timing	Before and amidst the production phase.	Postproduction.
Customer participation	Prioritises the needs of customers and meet their expectations in order to ensure customer satisfaction and loyalty.	It ensures that the products or services meet the expectations of the customers.

Source: (Taylor, 2023)

2.3.3 Review of Quality Management Systems

A thorough review of literature revealed a number of studies devoted to developing and applying construction QMS in various countries.

A study conducted by Kuo and Kuo (2010) in Taiwan construction companies underscored the importance of construction companies adopting the total quality management concept to boost the alignment and integration of leadership, processes, continuous improvement efforts, human resources, and partnering firms, which ultimately results in the delivery of satisfactory products. Their findings were consistent with the prevailing literature, which consistently stresses the crucial influence of TQM on the ongoing competitiveness of construction companies.

According to research by Ali and Rahmat (2010), it was discovered that the primary focus of contractors and clients in Malaysia was on the functionality of products due to defects observed in several high-profile construction projects during the implementation of ISO 9000. As a result, functionality was pinpointed as the most crucial criterion for project performance. On the contrary, time and cost performances were considered less important, despite being recognised as two of the most significant criteria for evaluating construction project performance in various literature. The complexity of construction projects was cited as a reason for the poor time and cost performances, leading to excessive variations in construction when adhering to quality standards. The findings of the study revealed that contractors seldom complete a project without modifying the plans or construction procedures during the process of adopting and implementing ISO 9000 standards (Ali and Rahmat, 2010).

The findings in research conducted by Din et al., (2011) indicate a mutually beneficial relationship between a certified QMS and a project management system within a project-

based organisation, specifically in the construction industry. Construction companies that focus on projects have identified the significance of an ISO 9000 certified QMS in defining and executing essential organisational procedures, with the intent to improve the overall efficiency of a construction firm. It was further highlighted that, insights and knowledge acquired from utilising a project management system can be leveraged to develop and oversee a QMS that is not only efficient and effective but also tailored to specific organisational needs (Din et al., 2011).

According to Leong et al., (2014), their study suggests that the current policy of the Malaysian construction industry should include a focus on workforce and operations, as this has been proven to significantly enhance the quality of project performances. Moreover, it underscored the critical role of QMS in boosting the performance of construction projects, particularly through the provision of services that align with customer expectations for quality.

The challenges associated with implementing lean construction were pinpointed by Ahmed et al., (2020), who emphasised the importance of addressing issues like inadequate management commitment, skills, training, and awareness of lean quality management within the construction sector. They suggested a need to prioritise addressing these challenges to ensure quality on projects.

Souza et al., (2021) underscored the essential significance of quality within TQM, identifying it as the foremost characteristic. It was noted that an emphasis on quality not only fosters the creation of various management strategies and philosophies that prioritise quality but also necessitates the active participation of individuals in the process. Furthermore, their research highlighted the critical nature of TQM, which integrates technology, quality, and human resources within an organisational context.

Rahman et al., (2022) highlighted that construction operations are heavily reliant on manpower and resources, thus inadequate workmanship by any worker can undermine the overall quality of a project. Similarly, variations in material sizes can also impact the overall quality of the work. Moreover, quality assurance was identified as the most influential factor in maintaining quality standards.

The practice of leadership was ranked high by Mohsen Alawag et al., (2023) as one of the essential components of TQM, which demonstrates a substantial effect on project outcomes and serves as a catalyst for employee motivation to drive an organisations development and progress in future.

Table 2.3: Quality Management Systems applied in Other Countries

Author / Country	Adopted System	Performance features & Applications	Methodology / Approach used
Mohsen Alawag et al., (2023) Malaysia	TQM	To check critical success factors impacting industrialised building systems	➤ Interviews ➤ Questionnaire Surveys
Rahman et al., (2022) UAE	QMS-Quality Assurance	To examine the underlying factors and consequences associated with alterations in construction projects	➤ Random sampling ➤ Questionnaire survey
Souza et al., (2021) Brazil	QMS	Exploring new concepts of TQM as a way of adapting to quality management	➤ Content analysis ➤ NVivo ➤ Systematic literature review
Ahmed et al., (2020) / Bangladesh	QMS-Lean	To check the implementation of lean practices and approach in construction	➤ Literature Review ➤ Questionnaire
Leong et al., (2014) / Malaysia	ISO 9000	Project performance	➤ Literature Review
Ali and Rahmat (2010) / Malaysia	TQM	To check performance measurements managed by using ISO certified contractors	➤ Literature Review ➤ Quantitative Survey

T.H. Kuo and Kuo (2010) / Taiwan	TQM ➤ Leadership ➤ Top management cooperation	To evaluate how corporate culture and TQM contribute to the overall outcomes of construction projects	➤ Literature Review ➤ Questionnaire ➤ Semi-structured interviews ➤ Cronbach Alpha for validity test
Din, Abd-Hamid, and Bryde (2011) / Malaysia	ISO 9000	To check ISO 9000 certification and construction project performances including financial management, Project management practices and Project success	➤ Questionnaire ➤ Multiple regression ➤ Cronbach's Alpha measurements

Compiled and adapted from Kuo and Kuo (2010), Ali and Rahmat, 2010

Construction projects are commonly viewed as unpredictable with regards to budget, profitability, delivery time, and expected quality standards (Bashan & Kordova, 2021).

The research conducted by Pheng and Hong (2005) in Singapore delved via administering a survey among construction project managers identified eight factors in ranking order of significance. Notably, total commitment emerged as the top priority, followed by strategic quality management (Pheng and Hong, 2005).

2.3.4 Modern Methods of Construction and how it influences QMS

An essential feature of Modern Methods of Construction (MMC) is an offsite construction approach, which consists of the fabrication of building elements in controlled factory environments. This strategy allows for elevated production quality, as parts are manufactured under stringent supervision, thereby effectively decreasing variations that are typically associated with on-site construction practices (Spišáková et al., 2022; Ofori-Kuragu & Osei-Kyei, 2021). The fundamental aspects of MMC contribute to improved quality control, yielding fewer defects and a higher level of compliance with specified quality benchmarks (Ofori-Kuragu & Osei-Kyei, 2021). Moreover, this transition to factory-centric processes greatly

elevates labour productivity by reducing the complexities and disruptions that are frequently associated with on-site work (Spišáková et al., 2022).

Zou and Feng (2023) indicate that the integration of Building Information Modelling (BIM) with finite element simulations not only optimises costs but also effectively manages quality across the construction lifecycle, especially for large and complex projects. Additionally, the implementation of intelligent information systems can improve quality management by addressing various aspects, including personnel, safety, and environmental management at construction sites (Zhang et al., 2024).

2.4 Importance of QMS

An effective quality management system plays a crucial role in the production of high-quality products that exceeds clients' expectations (Stojmenović & Pavlović, 2019).

Organisations experience notable transformations when they implement quality management systems, leading to heightened satisfaction among both clients and employees (Oakland & Marosszeky, 2017). The adoption of QMS by contractors has resulted in higher levels of client satisfaction, improved adherence to project timelines, and a decrease in the requirement for rework in construction projects (Griffith, 2018).

Previous research has demonstrated that QMS contributes to the success of organisations in their pursuits (Maher Altayeb and Bashir Alhasanat, 2014). Incorporating quality management standards and adhering to their guidelines and requirements are essential for maintaining a company's reputation and promoting financial stability and growth (Low & Teo, 2004).

As noted by Arditi (2012), the adoption of QMS in the construction sector yields a variety of advantages beyond merely enhancing client satisfaction, including the following;

- i. Mitigation of recurring issues at construction sites, thereby promoting ongoing safety.
- ii. Reduction of waste and elimination of the need for rework.
- iii. Fostering positive relationships among management, clients, and employees.
- iv. Establishment of trust among contractors, subcontractors, and suppliers.

2.5 Problems in implementing QMS

The construction sector faces significant challenges in implementing quality management, primarily due to the diverse methods employed and the persistent issues encountered within the industry (Gross, 2021). There is a pressing need for the development of a framework for assessing quality to aid clients in the construction industry in selecting experienced organisations capable of delivering high-quality products, adhering to schedules, and providing goods and services within budget (Idrus and Sodangi, 2010; Dina et al., 2010).

Hossain et al., (2020) highlighted that the management of projects within construction firms requires the execution of diverse administrative responsibilities, such as creating and upkeeping numerous documents. These documents consist of preliminary project blueprints, contractual agreements, logbooks that record insights gained from past projects, inventories of tools and materials, and schedules outlining tasks within varying timeframes (Hossain et al., 2020).

Rowlinson (2004) posited that the challenges associated with the implementation of QMS at construction sites can be attributed to certain contractors who exhibit a lack of commitment to effective quality management. Moreover, on-site workers often view quality management systems as inapplicable, primarily because of the extensive documentation associated with its implementation.

Research by Tang and Kam (1999) pinpointed a critical obstacle in the application of ISO 9001 within Hong Kong's construction sector: the challenge of ensuring that contractors are adequately informed and fully understand the standards, which is compounded by a lack of effective communication and support from upper management. In addition, Balucio and Badoy (2023) reported that numerous concepts associated with ISO 9001 were found to be quite abstract and challenging to understand, according to their survey findings. It was further argued that organisations face difficulties in enhancing their competitiveness and achieving effectiveness merely through the application of ISO 9001.

Harris et al., (2021) highlighted several limitations in the practice of quality management in the United Kingdom. It was identified that the effectiveness of quality management and quality assurance was impeded by a restricted focus on quality management practices, particularly during the construction phase. As a result, there was a notable difference in the commitment to quality management between top management and site workers (Harris et al., 2021).

Research by Nyende-Byakika (2012) revealed that a lack of awareness regarding the benefits of adhering to QMS poses a significant challenge for construction organisations. Furthermore, Neyestani (2016) identified that insufficient training for both employees and employers contributes to the ineffective implementation of these systems within the construction sector. Moreover, research by Karim et al., (2005) indicated that insufficient commitment and lack of support from top management, as well as leadership challenges, are critical reasons for the ineffective application of QMS within Australia's construction sector.

The implementation of quality management systems is frequently hindered by contractors who prioritise the cost of materials over quality when making decisions on site (Akinlabi and Adeniran, 2013), thus the drive to cut initial construction expenses often leads to adverse impacts on the overall project quality.

Unsuitable construction practices such as the deployment of incompetent workers and inferior materials as well as constricted execution of such standards and guidelines have been found to be some of the main causes of building collapses in developing countries (Windapo and Rotimi, 2012). Numerous research studies have consistently shown that factors such as the use of substandard building materials, improper structural designs, deviations from approved building standards, and lack of skilled labour contribute to the compromised safety of buildings in Nigeria (Akinlabi and Adeniran, 2013). Similar obstacles have been identified in Uganda, as well as in various regions across Africa and Asia (Kiryowa, 2021).

2.6 Critical Success Factors for QMS in the Construction Industry

The effective implementation of a QMS necessitates the identification of key factors that are crucial to the implementation process. As noted by Salleh et al., (2018), critical success factors (CSFs) are the key elements that are essential for the effective implementation of QMS within a business unit.

In construction, some of the CSFs required for the implementation of QMS include leadership commitment, effective communication, client satisfaction, and continuous improvement (Gupta, 2018). By focusing on these essential aspects, construction organisations can create strong quality management systems that promote ongoing improvement and excellence in their projects.

2.6.1 Leadership and Top management commitment

The concept of leadership involves the ability to transition an organisation from its existing status to a future position that aligns with the leader's vision. Conversely, the role of top management is to emphasise the importance of quality, client satisfaction, and various quality-related matters (Nasseef, 2010).

The role of effective leadership is paramount in ensuring the successful execution of quality management practices in the construction sector. Various studies have underscored the importance of leadership in achieving elevated quality standards with the application of QMS. For instance, a study by Patel & Solanki (2020) identified leadership and top management commitment as top factors necessary for a successful implementation of TQM. Similarly, an analysis of quality management systems within Egyptian contracting firms highlighted the importance of top management commitment and leadership in ensuring the successful implementation of QMS (Kumar, 2022). The importance of clear and visible support from senior management in overcoming challenges and improving quality performance was stressed in the study conducted by Patel and Solanki (2020). Likewise, empirical studies conducted by Soltani (2005) emphasised the essence of top management commitment as a key factor in implementing quality management systems in projects. Damanik et al., (2023)

argue that leadership enforces an immense significance in facilitating a proactive approach towards maintaining quality assurance on organisational policies.

According to Soltani et al., (2008), the absence of leadership or top management commitment in an organisation leads to poor planning, failure in changing the organisations culture and employee resistance. Therefore, it is imperative that leaders and top management receive proper education and comprehensive training to facilitate the successful implementation of QMS within their organisations (Al-Saffar & Obeidat, 2020). These research findings collectively highlight that the presence of robust leadership commitment is crucial for an effective implementation of quality management initiatives, as they may otherwise encounter substantial challenges and fail to reach the desired outcomes.

2.6.2 Customer Focus

According to Abbas (2020), customer focus is one of the main components of QMS. Mandal (2009) addressed customer focus as a key factor in practicing QMS. Likewise, Dean & Bowen (1994) recognised that customer focus is an important QMS factor that an organisation requires in order to be successful.

The construction industry is committed to completing projects that conform to established standards and fulfil client expectations (Stransky & Matějka, 2019). Designed to integrate business operations with performance objectives, quality management practices focus on elevating customer satisfaction and ensuring the consistent delivery of high-quality products and services (Alotaibi et al., 2013). The increasing influence of customers as advocates for transformation has heightened the demand on the industry to deliver outstanding quality services that align with customer demands and expectations (Boothman et al., 2018).

It is evident that QMS is a strategy focused on the customer, thus enabling companies to recognise their clients as their top-most priority. As a result, the implementation of QMS is considered as a crucial method for enhancing customer satisfaction (Oakland & Marosszeky, 2017).

Internally, customer focus tends to strengthen the pragmatic aspects of QMS. For instance, it was observed by Niu & Fan (2015) that culture, organisational strategies, and policies serve as a support for employee's commitments towards customer satisfaction and continuous improvement of quality. Jung et al., (2009) discovered that achieving quality in a competitive market requires a significant focus on customer satisfaction for organisational excellence.

2.6.3 Education and Training

Education and training play a vital role in ensuring quality management within the construction industry (Farooqui et al., 2008). In addition, education and training have been linked to

improving the quality of work practices and increasing productivity within the construction sector (Manoharan et al., 2022). Research has consistently proven that providing workforce training is very crucial for retaining competent workers in the construction industry when implementing quality (Jadallah et al., 2021). Dale (2003) argued that enhancing the competence of site labourers can enhance construction quality.

The implementation of TQM principles within the construction sector requires an emphasis on enhancing employee motivation, highlighting the critical role of education and training in QMS (Ansah & Tekpe, 2022). Tsang and Antony (2001) assert that employee training is an essential strategy employed by organisations to cultivate particular skills in their workforce, which in turn contributes to an enhanced organisational performance and increased customer satisfaction.

Effective participation among workers can only be achieved when all employees have undergone formal or systematic training in quality management (Galeazzo et al., 2021). Therefore, it is imperative to train all employees in an organisation, as achieving quality in total quality management relies on the participation of individuals at all levels, as highlighted by Sony and Naik (2019).

Previous studies have shown that inadequate education and training are barriers to the effective implementation of QMS practices. As a result, it is essential for employees to engage in quality-focused programmes and training once their organisation's quality objectives are established (Alsawafi et al., 2021). Adequate training in the development and execution of Project Quality Plans (PQP) is crucial for ensuring QMS implementation in construction projects (Shengeza, 2017).

Training initiatives play a significant role in enlightening employees about the advantages of QMS implementation, thereby fostering a culture that prioritises ongoing quality enhancement (Dinas et al., 2019).

2.6.4 Continuous Improvement

Recent research suggests that the continuous improvement process is a key factor in determining the success of a project (Nyakala et al., 2019). By consistently improving processes, procedures, and results, construction firms can enhance the quality of their projects. This iterative approach ensures that standards are not merely met, but exceeded, leading to heightened customer satisfaction and a competitive advantage (Nyakala & Vermeulen, 2021).

The ability to maintain quality while gaining a competitive edge in construction projects is closely tied to continuous improvement. Koh and Low (2010) highlighted the importance of evaluating the performance of competitors, whether through direct or indirect benchmarking,

in order to achieve continuous improvement. Recent research has underscored the importance of various factors such as construction processes, design, development and implementation of quality procedures, benchmarking, and communication in achieving a competitive edge through continuous improvement (Nyakala & Vermeulen, 2021). By consistently improving these factors, construction organisations can boost their overall operational performance and strengthen their competitive edge within the sector. Furthermore, the primary objective of quality management in construction is to ensure that construction projects meet specified standards and client requirements, highlighting the necessity for continual improvement initiatives (Stransky & Matějka, 2019).

The continuous improvement phase is the actual stage where a carried-out quality system is maintained. This phase is crucial for an organisation aiming to enhance its operations to achieve long-lasting advantages from implementing QMS (Nanda, 2005).

In the construction industry, continuous improvement involves pinpointing client needs and reassessing the overall effectiveness of quality systems (Temponi, 2006). This may involve problems associated with the employees and the surrounding environment. A crucial part of continuous improvement is identifying allocated resources and development prospects. Hence, an organisation needs to prioritise its development opportunities (Kanji, 2001).

2.6.5 Communication

Numerous studies have emphasised the crucial role of effective communication in achieving successful quality management practices in construction organisations. For instance, Ahmed et al., (2005) highlighted the significance of open communication and feedback in managing various factors to achieve QMS. Similarly, Shoshan and Çelik (2018) identified communication between the quality department and other departments as a CSF for implementing TQM in the construction industry. In addition, Odiba et al., (2021) highlighted the importance of incorporating quality management practices within managerial roles, underscoring the significance of implementing efficient communication strategies. Furthermore, literature accentuates the pivotal role of communication in quality management, specifically in enhancing safety performance in construction projects (Winge et al., 2019).

Within the realm of quality management systems implementation, communication stands out as a key factor in facilitating collaboration and aligning efforts among project teams, subcontractors, suppliers, other relevant stakeholders engaged in construction projects (Xue et al., 2015). Efficient communication is vital in ensuring that all stakeholders are well-versed in quality requirements, project schedules, and potential risks, allowing for a seamless collaboration towards attaining a high-quality outcome. Furthermore, the establishment of a well-defined framework focused on enhancing the implementation of quality management

system procedures in construction projects underscores the critical role of communication in ensuring the efficacy of quality management practices (Othman et al., 2020).

Communicating the vision of an organisation to all employees is crucial for achieving its goals and improving overall quality. Insufficient communication can lead to a loss of momentum and clarity among top management concerning quality initiatives (Omachonu & Ross, 2004). It is therefore important that the top management regularly communicates with all their employees to explain the organisation's goals and mission. This can be achieved through in-person meetings, rather than relying solely on other communication methods. Feedback after meetings should be enforced in order to implement effective changes to result in attaining quality successful projects (Thiagarajan et al., 2001). Effective communication undoubtedly enhances service quality; when an organisation disseminates precise information throughout its various departments, it guarantees that all employees are informed about its operational procedures (Samat et al., 2006).

2.6.6 Employee Involvement

Employee involvement denotes the active engagement of employees in the decision-making processes and activities that affect their work, as well as the overall quality results of an organisation. In the construction sector, it is essential to utilise the practical knowledge and expertise of employees because of the complex project dynamics and strict quality standards (Alotaibi et al., 2020). Additionally, research by Leong et al., (2014) linked employee engagement to the enhancement of quality management practices within the construction sector.

The involvement of employees in quality initiatives plays a crucial role in enhancing compliance with quality standards and fostering ongoing improvement. Essential strategies for promoting employee engagement while implementing quality includes conducting regular training sessions, implementing feedback mechanisms, and encouraging collaborative problem-solving (Abu-Shanab & Al-Khasawneh, 2021). The significance of employee participation in TQM is well-recognised as an essential element for successfully implementing TQM across various industries. This underscores the pivotal role of employee engagement in spearheading quality improvement initiatives (Das et al., 2011).

According to Xie & Peng (2022), involving employees in Quality Management (QM) results in a deeper understanding and dedication to quality standards and protocols. This unified commitment ensures that all team members follow the highest standards, ultimately enhancing the quality of construction projects. Furthermore, employee empowerment and involvement of employees play a crucial role in improving organisational performance and customer satisfaction, particularly through the implementation of QMS (Zaiter et al., 2021).

2.6.7 Supplier Relationship and Management

The importance of supplier relationship and management cannot be overstated when it comes to the successful execution of quality management within the construction sector. Maintaining effective collaboration with suppliers is paramount in guaranteeing project quality and timely completion (Bemelmans et al., 2015). Empirical studies have demonstrated that the adoption of supplier relationship management as a component of a TQM approach can result in better quality outcomes and heightened customer satisfaction, particularly in competitive market landscapes (Zeng et al., 2018).

Strategies like cultivating long-term partnerships with suppliers and emphasising ongoing cost reductions can greatly enhance the construction industry (Frödel, 2011). Additionally, evaluating supplier quality is crucial for mitigating risks in construction projects (AlMaian et al., 2015).

Alves et al., (2017) underscores the significance of evaluating suppliers and maintaining clear communication to identify nonconformances at an early stage in the procurement process, which helps to avert any quality-related challenges in construction projects.

Bemelmans et al., (2012) emphasise the importance of evaluating the maturity level of buyer-supplier relationship management in construction companies. This evaluation is essential for comprehending and improving the quality of engagements with suppliers. Additionally, Sariola (2018) explores the leveraging of suppliers' innovation potential in construction projects to enhance the contractor-supplier relationship.

2.6.8 Teamwork

Adham and Sukkar (2024) discuss the importance of selecting team members based on specific criteria, qualifications, experience, and interpersonal skills to secure project success within the construction industry. Research conducted by Fabi & Akinseinde (2022) assesses the role of teamwork in enhancing project performance within Nigeria, concluding that effective teamwork contributes to the timely completion of quality projects and increased productivity through the sharing of workloads. Kandaswami & Subbaiyan (2020) point out the insufficient emphasis on onsite teamwork, advocating for the development of high-performing teams through systematic teamwork practices. The critical nature of teamwork and cooperation in managing complex construction projects helps to prevent conflicts and ensure the integration of tasks and teams (Kvalshaugen & Sward, 2024).

The effectiveness of teamwork in construction organisations is contingent upon the harmonious interaction between various functions, the active involvement of employees, and the acknowledgment of individual contributions towards ensuring quality (Aldakhil, 2016).

Given the sequential nature of tasks involved in construction projects, effective teamwork holds significant impact in the construction industry (Tabassi et al., 2014).

Teamwork plays a crucial role in construction quality management by promoting on-time project delivery, enhancing job satisfaction, and influencing organisational culture, all of which contribute to improved service quality and efficiency (Sarok, 2013). Moreover, aligning the various dimensions of teamwork in construction processes can lead to significant advancements in both quality and the safe delivery of projects (Walton et al., 2020). In addition, the constructive impact of teamwork on organisational performance and employee outcomes highlights its significance in achieving quality project success (Sarok, 2013).

2.6.9 Performance Measurement

In the construction industry, performance measurement, particularly concerning quality management, is an essential factor that significantly impacts project outcomes and the success of organisations.

Nyakala and Vermeulen (2021) emphasised that the effective implementation of quality processes can greatly enhance the performance of small and medium-sized construction projects, thus providing a competitive edge. Research conducted by Leong et al., (2014) supports this assertion, demonstrating that construction companies implementing QMS can enhance their project outcomes, thereby fostering greater competitiveness within the marketplace. The ability to evaluate performance against quality indicators allows organisations to identify areas for improvement and to differentiate themselves from their competitors.

The complexity in the construction industry necessitates the adoption of effective QMS to guarantee that projects align with specified standards and meet client expectations. According to Irfan et al., (2020), incorporating quality management into every dimension of construction processes and leveraging advanced measurement systems helps organisations to effectively navigate the complexities inherent in the industry and deliver projects of superior quality that align with client expectations. This requirement is amplified by the competitive dynamics of the industry, compelling firms to consistently refine their quality management practices to preserve their market share and financial viability (Nyakala & Vermeulen, 2021; Stransky & Matějka, 2019).

2.7 QUALITY MANAGEMENT STANDARD, TOOLS AND TECHNIQUES

This section intends to explore the different standards, tools, and techniques that provide a foundation for evaluating the effectiveness of quality management practices across various organisations. These standards, tools, and techniques can also be employed to assess QMS

within construction organisations. This section begins with a detailed overview of the ISO 9001 standard, featuring subsections that outline its different versions. Following this introduction, the discussion progresses to other areas that examine quality management tools and process improvement strategies used to measure quality within organisations.

2.7.1 ISO 9001 Standard

ISO 9001 is a widely accepted standard for quality management on a global scale which supports organisations of different sizes and industries in boosting their performance, satisfying customer demands, and illustrating their commitment to quality (International Organization for Standardization, 2015). Additionally, one of the primary goals of ISO 9001 is to improve organisational efficiency and customer satisfaction (Suhendris & Saroso, 2018). The global adoption of the ISO 9001 standard is evident, as it is implemented by over 1 million organisations in 170 countries (Alvarenga et al., 2018). The adoption of this standard guarantees that organisations do not only fulfil customer needs but also strive for customer satisfaction while consistently enhancing their quality management systems (Sumaedi & Yarmen, 2015).

The construction sector can benefit greatly from obtaining ISO 9001 certification, as it provides advantages such as standardisation, enhanced quality assurance, and heightened competitiveness in the business environment (Shaikh & Sohu, 2020). QMS are critical for construction firms operating in highly competitive and rapidly changing environments, where the adoption of ISO 9001 can promote operational excellence (Hadidi et al., 2017). While the benefits of ISO 9001 certification are significant, the sustainability of its implementation relies on the efficacy of quality management audits (Zeng et al., 2007). It is common for clients in the construction field to demand adherence to ISO 9001 standards from contractors in order to ensure the quality of their projects (Zeng et al., 2005).

The assimilation of ISO 9001 standards in construction firms is becoming increasingly common, particularly within smaller enterprises that strive to enhance their quality management approaches (Akhund et al., 2018). Larger construction firms have recognised the value of obtaining ISO 9001 certification as a means to ensure successful project delivery, prompting widespread adoption of these standards in the field (Neyestani, 2016).

ISO 9001 standards are divided into two fundamental categories, both of which are utilised for the implementation of QMS, and these include ISO 9001:2018 and ISO 9001:2015 (Osei-Bonsu, 2018).

ISO 9001:2015 functions as a quality management guideline that defines the standards for a QMS and its purpose is to support organisations in fulfilling customer and stakeholder

expectations, as well as complying with applicable statutory and regulatory mandates concerning their products or services (Rahim and Asaad, 2018).

A notable difference in ISO 9001:2015 from ISO 9001:2008 is the emphasis on risk-based thinking over solely focusing on continual improvement and customer satisfaction (Melicharova, 2018).

The implementation of ISO 9001:2015 can bring about benefits such as heightened product and service quality, cost efficiency, increased productivity, and an improved corporate image for organisations (Suhendris & Saroso, 2018). It is recommended that companies undergoing the transition to ISO 9001:2015 embrace modern management and quality methodologies to facilitate the adoption of continuous improvement practices (Fonseca & Domingues, 2018). Effective preparation, training programmes, and the development of necessary skills are crucial elements for the successful implementation of ISO 9001:2015 (Domingues et al., 2019).

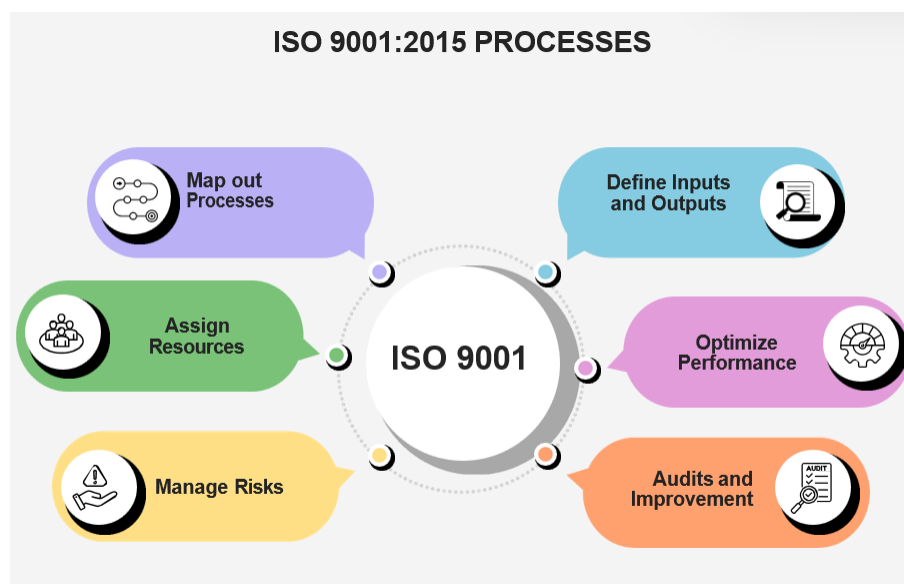


Figure 2.4 ISO 9001:2015 processes (Adapted from Shanker, 2018)

2.7.2 ISO standards used in the Construction Industry

There exist two other types of ISO standards used in the construction industry namely OHSAS 18001 (now ISO 45001) and ISO 14001:2014.

2.7.2.1 Occupational Health and Safety Assessment systems (OHSAS)

OHSAS 18001 was developed to complement ISO 9001:2008, which pertains to quality management, and ISO 14001:2014, a standard focused on environmental management systems (Nsai, 2018). This standard emerged in response to client demands for a recognised

and reliable health and safety management system that could be assessed alongside other management frameworks (Sadiq, 2012).

ISO 45001, when compared to OHSAS 18001, introduces a more refined management system that features clearly articulated terms, responsibilities, and scope. This advancement contributes to its status as a more effective and efficient standard for safeguarding safe and healthy working conditions (Ribeiro & Campanelli, 2021). The standard emphasises the importance of occupational safety and health within the framework of organisational objectives and strategies, encouraging proactive risk management and the establishment of effective occupational safety and health practices (Rodríguez-Martín et al., 2023).

2.7.2.2 OHSAS Implementation in Construction

The construction industry is characterised by significant risks, which underscores the need for effective quality management systems (Animah, 2022). The integration of ISO 45001 into the construction industry is essential for the development of an effective QMS that prioritises occupational health and safety performance (Elkaseh, 2023; Noory, 2024). The standard is aimed at the proactive prevention of injuries and illnesses within the workplace (Abbas, 2023). The framework provides a thorough approach that aids organisations in cultivating a secure and health-conscious workplace for their staff (Abbas, 2023). Consequently, it is imperative for construction firms to implement ISO 45001 to uphold safety, health, and preventive measures on construction sites (Noory, 2024).

An analysis of the management systems employed by various contractors reveals that TQM, which can be successfully integrated via ISO 45001, is essential for enhancing safety and quality within the construction sector (Elghamrawy & Shibayama, 2008).

2.7.2.3 ISO/TC 59 Buildings and Civil Engineering works

ISO/TC 59 encompasses a set of standards aimed at addressing environmental, economic, and social factors in alignment with sustainability concerns associated with developmental processes (ISO/TC 59 - Buildings and Civil Engineering Works, 2021). It serves as a standard that outlines the requirements for developing features which encompass standards for testing tolerance protocols related to sealants (ISO/TC 59 Buildings and civil engineering works - EuroCert, 2021).

2.7.3 Quality Management Models

Recently, a variety of total quality management frameworks and tools have been created and refined. These models function as standardised benchmarks to guarantee the comprehensive application of quality management practices and principles within organisations. Given that this research seeks to establish a quality assessment tool tailored for the Ghanaian

Construction Industry, the subsequent sub-sections will provide a concise overview of several prominent and widely recognised TQM tools and models.

2.7.3.1 The Malcolm Baldrige National Quality Award (MBNQA) Framework

Many organisations worldwide have employed the MBNQA criteria as a framework to boost their competitiveness and evaluate their organisational performance (San & Purba, 2021). The MBNQA is based on seven quality measures as illustrated in Figure 2.5 below.



Figure 2.5: MBNQA Model (Adapted from NIST, 2009)

The implementation of MBNQA within QMS presents a range of benefits and drawbacks. A significant benefit is that the MBNQA offers a comprehensive framework that organisations can utilise to evaluate and improve their quality management practices (Foster et al., 2007). By conforming to the MBNQA standards, organisations can bolster their competitive stance, quantify their performance, and promote a culture of continuous improvement (San & Purba, 2021). The MBNQA model prioritises essential elements such as leadership, strategic planning, and process management, which are vital for attaining organisational excellence

(Asif et al., 2019). Empirical studies indicate that receiving a quality award like the MBNQA often signifies successful implementation of TQM, as it demonstrates a commitment to fundamental TQM principles and values (Saeed et al., 2021).

Notwithstanding the potential benefits of the MBNQA, organisations encounter various challenges and disadvantages during its implementation. Critiques have surfaced despite attempts to integrate MBNQA principles into frameworks like ISO 9000:2000, suggesting that the applicability and effectiveness of the MBNQA criteria may be limited in certain contexts (Akyüz, 2011). The assessments conducted under the MBNQA framework, which aim to establish organisational baselines and highlight areas for improvement, may not always align seamlessly with the complex processes and requirements of the construction industry (Raja et al., 2007). Despite its status as a prestigious quality management award, the MBNQA has been criticised for its practical applicability and effectiveness across various sectors, including the construction industry (San & Purba, 2021).

2.7.3.2 The Deming Prize

The Deming Prize represents a prestigious recognition within the domain of quality management, conferred upon organisations that demonstrate exemplary quality management practices (Agrawal, 2019). This award is grounded in the foundational principles established by W. Edwards Deming who was a key figure in quality management. The evaluation criteria for the Deming Prize are intricately linked to the TQM paradigm, which emphasises continuous improvement and innovation (Alauddin & Yamada, 2022). Organisations honoured with the Deming Prize exhibit notable advancements in their performance, signifying a strong dedication to quality and excellence (Sharma & Mundada, 2019).

One of the primary benefits associated with the Deming Prize lies in its criteria, which are deeply rooted in the principles of TQM that advocate for continuous improvement and innovation. This alignment can significantly elevate quality practices in construction organisations (Alauddin & Yamada, 2022). By prioritising quality improvement processes, the Deming Prize supports construction firms in reaching higher levels of quality output and performance, which in turn improves customer expectations and boosts productivity (Sharma & Mundada, 2019).

The Deming Prize poses specific challenges for the construction industry. A notable drawback is that the rigorous standards associated with the Deming Prize may necessitate considerable resources and effort to achieve, particularly for smaller construction companies that operate with constrained budgets and capabilities (Harrington, 2004). Furthermore, while the emphasis on process enhancement and quality management is advantageous over time, it may initially interfere with established workflows and demand significant organisational

adjustments, which can prove difficult to execute in the rapidly evolving construction environment (Abuazza et al., 2020).

2.7.3.3 The EFQM Model (European Foundation for Quality Management)

According to Watson (2011), EFQM is “the most comprehensive model for organisational excellence”. This model is a tool that identifies processes and manages complex processes effectively.

EFQM has been suggested as an appropriate framework for evaluating ethical performance and organisational quality in construction organisations (Oladinrin & Ho, 2015). However, its suitability for the construction industry has been met with skepticism (Vukomanović et al., 2014). Despite these doubts, various studies have demonstrated that the EFQM model can significantly improve quality management practices in construction companies (Gašparík et al., 2014). Moreso, EFQM has served as a valuable tool for fostering ethical behavior and improving the implementation of ethical codes in construction organisations (Oladinrin & Ho, 2014). Furthermore, the EFQM model has been used in scholarly research to investigate the determinants affecting quality and safety performance within construction firms, underscoring its adaptability and relevance across various sectors (Shanmugapriya & Subramanian, 2015).

As indicated in Figure 2.6, the EFQM model consists of nine (9) components. The enablers pertain to the manner in which an organisation governs itself, oversees its resources and personnel, and formulates its strategic plans. The results provide insight into the organisation's successes, which play a crucial role in fostering satisfaction among its staff and clientele, as well as its influence on the larger community and its performance indicators (Oakland, 2006).

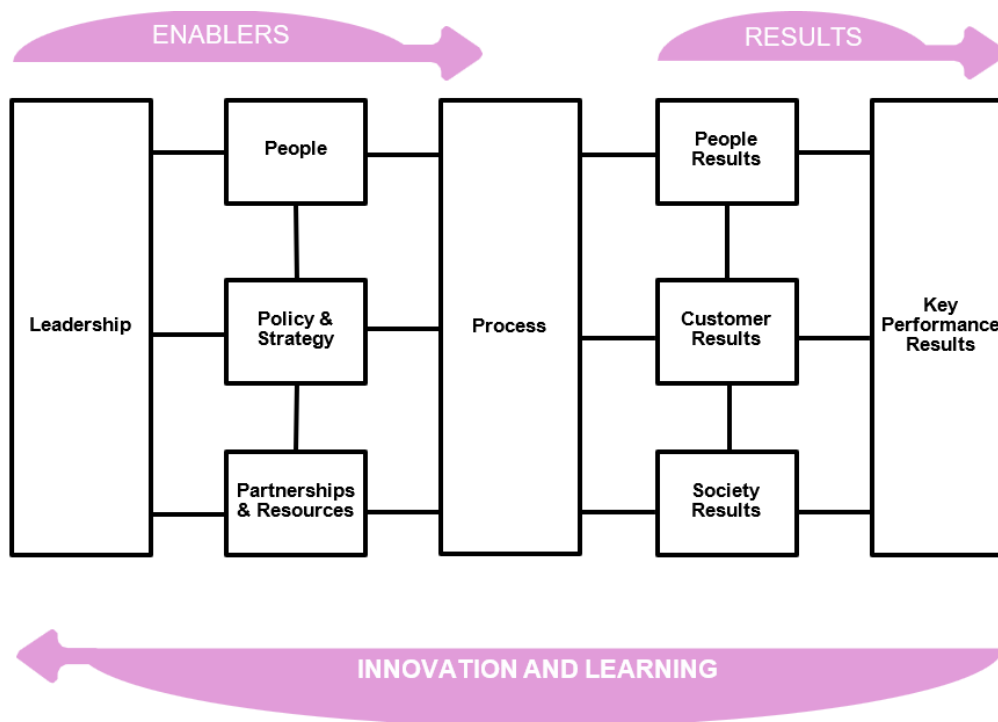


Figure 2.6 The EFQM Model (Adapted from Oakland, 2006)

2.7.4 Quality Improvement Techniques

The construction industry employs diverse quality improvement techniques that seek to improve the overall quality of construction projects. These techniques are typically divided into two fundamental categories: management techniques and statistical techniques. The management techniques involve processes such as QA, QC, and TQM, while the statistical techniques incorporate methods like cost of quality analysis, customer satisfaction evaluation, and the Six Sigma methodology (Tam et al., 2008).

The integration of Six Sigma methodology provides a systematic means of recognising and addressing quality-related problems (Bravo et al., 2020). Additionally, research has examined the implementation of Six Sigma methodology as a means of process enhancement in construction projects (Chaudhari & Wayal, 2020). The focus of Six Sigma tools is on decreasing defects and process variations, which contributes to improved quality and increased efficiency.

Furthermore, the incorporation of lean construction with sustainable construction approaches has been identified as beneficial, resulting in an enhanced corporate image, streamlined processes, and increased satisfaction with customer requirements (Ogunbiyi et al., 2014). The implementation of lean construction methodologies has demonstrated effectiveness in reducing waste, boosting profitability, and enhancing productivity within the industry (Li et al.,

2019). Lean principles have been incorporated into construction projects to optimise processes and improve overall performance in organisations.

A significant aspect of quality improvement techniques within the construction industry is their attention to financial considerations. These practices are intended to resolve financial issues for both employers and contractors by increasing profitability through the reduction of overall costs, the minimisation of project timelines, the decrease of defects, and the enhancement of productivity in construction activities (Awan & Awan, 2015). Furthermore, the fusion of quality improvement and cost-efficiency through industrial enhancement techniques has been underscored as a vital method for elevating quality while preserving financial effectiveness in construction projects (Vink et al., 2016).

A key strategy for improving quality in the construction industry involves the use of the seven fundamental quality control tools, including Ishikawa diagrams and Pareto charts (Abdel-Hamid & Abdelhaleem, 2019). These quality improvement tools facilitate data analysis and enable the prioritisation of improvement initiatives.

In the construction industry, visualisation tools such as Gantt charts play a crucial role in project management by supporting the planning and monitoring of various projects (Marasini et al., 2007). These tools provide a clear representation of project timelines, resource management, and progress evaluation, which ultimately leads to improved decision-making and project success. Furthermore, the implementation of statistical process control (SPC) has been identified as a significant approach for boosting process efficiency in several sectors, including construction (Yunus et al., 2016). SPC facilitates the continuous monitoring of processes, enabling timely corrective actions and enhancements in quality.

2.7.5 QLASSIC

QLASSIC refers to Quality Assessment System in Construction, and it is used to assess and gauge the quality of workmanship in building construction projects and is also founded on the Construction Industry Standard (CIS) 7: 2014 (Sysnovate Solutions, 2021).

A variety of quality assessment systems, including QLASSIC, have been recognised as vital tools for measuring project quality (Habibi et al., 2023). The adoption of QLASSIC and comparable quality assessment frameworks seeks to establish benchmark standards for construction quality, thereby improving customer satisfaction in projects (Sulaiman et al., 2019). QLASSIC was developed to tackle the challenges associated with quality assessment in construction projects (Seman et al., 2021). Additionally, QLASSIC provides a chance for both contractors and developers to prove their commitment to quality.

2.7.5.1 Objectives of QLASSIC

- To determine a quality standard assessment system for quality of workmanship for construction works
- To gather data for statistical analysis.
- To evaluate the standards of construction methodologies within the building sector.
- To be used as a criterion for evaluating contractors' performance by assessing the quality of their workmanship.

Table 2.4 Types of buildings assessed using QLASSIC

Types of Building	Assessed Building Types
Type A (Landed Building)	Terrace and Cluster buildings
Type B (Stratified Building)	Flats, Serviced Accommodations, Town houses, etc.
Type C (Commercial/Industrial/Public buildings without centralised cooling systems)	Factories, warehouses, Universities, Office buildings, etc.
Type D (Commercial buildings with centralised cooling systems)	Stadiums, Community halls, Small Office Virtual Office (SOVO), Colleges, etc

Source: Adapted from QLASSIC standard QLASSIC (CIS 7:2014), (2022)

2.7.5.2 QLASSIC Scope

The quality of craftsmanship of a construction work is evaluated in accordance with the requirements of the standard. Marks are awarded if the craftsmanship fulfills the established criteria outlined in the Construction Industry Standard (CIS 7:2006). The marks are subsequently summed to calculate the QLASSIC Score (%) for a construction project. QLASSIC evaluations take place on-site and follow the principles of initial inspections. Construction work that is corrected following an evaluation will not be re-assessed. The aim of this concept is to encourage the contractor to consistently "Do Things Right the First Time and at Every Time" (Azir et al., 2018).

Aside QLASSIC, there are a few quality assessment tools being used in other developed countries. O'Connor & Koo (2021) designed a 'Quality Leading Indicator Tool' to enable practitioners assess project design quality and to aid in preventing undesirable risks in construction in Texas. Similarly, Mahachi (2021) developed a construction quality assessment tool based on CONQUAS model, which is used for assessing the quality of building projects. Most importantly, CONQUAS functions as a benchmarking tool, and has been introduced in

Singapore, and also applied in other developed countries like United Kingdom (Mahachi, 2021).

2.7.6 Ghana National Quality Award: Ghana Standards Authority

Every organisation is constantly seeking for new approaches to meet their customers' expectations and achieve their goals in a more effective and efficient manner. The Ghana Standards Authority (GSA) and the Association of Ghanaian Industries (AGI) established the National Quality Awards (NQA) in 2017, and which has since evolved to be one of the most prominent and well-known awards in the nation (GSA, 2017). The awards scheme, which recognises excellence and the adoption of internationally recognised quality standards by locally owned Ghanaian organisations in the fields of manufacturing and service delivery, has raised public awareness about the importance of standardisation.

The national quality awards are conferred on organisations classified into various categories as indicated in Figure 2.7.



Figure 2.7: The assessment process of National Quality Awards by Ghana Standards Authority (Adapted from Ghana Standards Authority, 2017).

As shown in Table 2.5, the National Quality Awards assessment process involves several key stages (Ghana Standards Authority, 2017). Depending on how firmly the assessment rules are applied, organisations can select the appropriate level at which they desire to compete. The degrees of participation are as follows:

Table 2.5: Levels of participation and its assessment criteria(s)/ Awards

Level of Participation	Assessment Criteria	Award	Maximum winning score
1	9	Bronze	1000
2	18	Silver	2000
3	27	Gold	3000
4	40	Diamond	4000

Source: (Adapted from Ghana Standards Authority, 2017)

2.7.7 Review of Maturity Models

Maturity models are now fundamental tools for organisations that seek to evaluate and improve their processes in various areas, such as healthcare, manufacturing, information systems, construction sectors, etc. Maturity models are generally composed of a series of distinct levels that depict an organisation's journey from initial to advanced stages of process effectiveness. They facilitate organisations in evaluating their current processes against established benchmarks and in identifying areas for enhancement through a structured framework. Research by Tarhan et al., (2020) underscores the effectiveness of maturity models in encouraging incremental improvements in organisational processes by providing clear developmental pathways. This evaluation is crucial, as it allows organisations to identify their strengths and weaknesses in current processes, facilitating targeted improvement initiatives. In a similar vein, Pereira and Serrano (2020) remarked that maturity models have become indispensable tools for improving organisational capabilities by defining not only the present state but also a pathway for improvement that showcases the best practices essential for increasing process effectiveness and efficiency. Thus, maturity models encourage informed decision-making, ensuring that interventions are based on empirical assessments rather than mere assumptions. Moreover, various models, such as the Capability Maturity Model (CMM), present structured steps for implementation, which considerably mitigate the complexities associated with process improvement (Versendaal et al., 2013).

Multiple maturity models focus on digital transformation depicting an ever more vital area in construction as firms endeavour to exploit digital technologies for enhanced productivity. Han et al., (2024) formulated a comprehensive digital transformation maturity model that integrates key domains such as digital infrastructure and management digitisation, addressing shortcomings observed in other industries.

A notable criticism of maturity models is their inconsistent quality as their numbers increase. Chen et al., (2021) argue that while there has been a significant rise in the number of developed maturity models, the methodological rigour involved in their development is often questionable, leading to models that may not effectively meet their intended goals. This concern is echoed by Lee et al., (2019) who points out issues regarding the validity of these models across various application sectors, suggesting that many lack the robust foundation necessary for practical application. The increase in publications often conceals the inherent problems within these models, resulting in a proliferation of inadequately tested or poorly designed frameworks (Das et al., 2023).

2.8 THE GHANAIAN CONSTRUCTION INDUSTRY (GCI)

This section aims to offer an in-depth review of the GCI. The infrastructural sector of this industry will be discussed into detail. Also, the significant challenges or limitations faced by the GCI, as well as the industry's impact on the Ghanaian economy will be discussed in this chapter.

2.8.1 Overview of the GCI

The Ghanaian construction industry (GCI) has a complex nature, which represents different and numerous kinds of stakeholders (Dadzie et al., 2021). Over the past few years, the industry has exhibited steady growth as there has been an increase in the development of infrastructures including affordable housing projects in the country. Ghana is known to be one of the “attractive” countries for investments and tourism due to its political stability (Osei-Asibey, 2021).

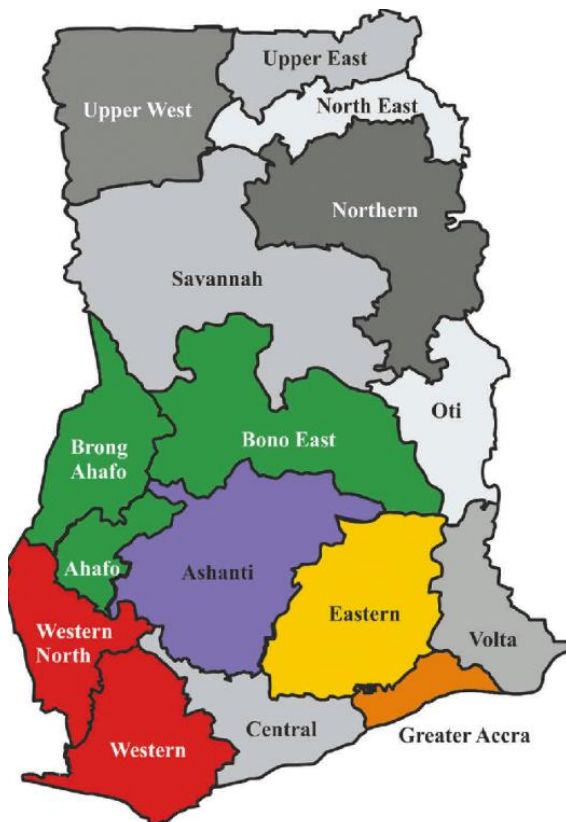


Figure 2.8 Map of Ghana (Adapted from Andoh et al., 2020)

The Chamber of Construction Industry Ghana oversees the governing and regulation of various activities in this industry, from advocacy to assisting in the identification of overseas suppliers. The Ministry of Works and Housing is responsible for overseeing building infrastructure and construction throughout the country (Frimpong and Kwasi, 2013).

Ghana's construction industry is made up of a large number of unskilled labour, which constitutes about 67.2%, and 24.8% of it being made up of skilled labour, with the remaining 8% made up of extremely skilled labour (Ghana Investment Promotion Council, 2006). The industry mainly depends on the labour force like several developing countries (GSS, 2020). It is estimated that there are about 2,500 active contractors involved in the building and construction industry (Quansah, 2022). The participants include a variety of entities, from small indigenous micro-enterprises and distinctive contractors to large international civil engineering and construction firms (Ghana - Construction and Infrastructure, 2022).

Several governmental institutions are pivotal to the operations of the GCI. The Ministry of Works and Housing directs housing projects while the Ministry of Roads and Highways (MRH) is responsible for roads infrastructural projects. According to Osei-Asibey et al., (2021), four main distinct clients can be identified in Ghana: The Government (the largest client), Real Estate Developers, Corporate Institutions (private and public), and Home Builders (see Figure 2.9).

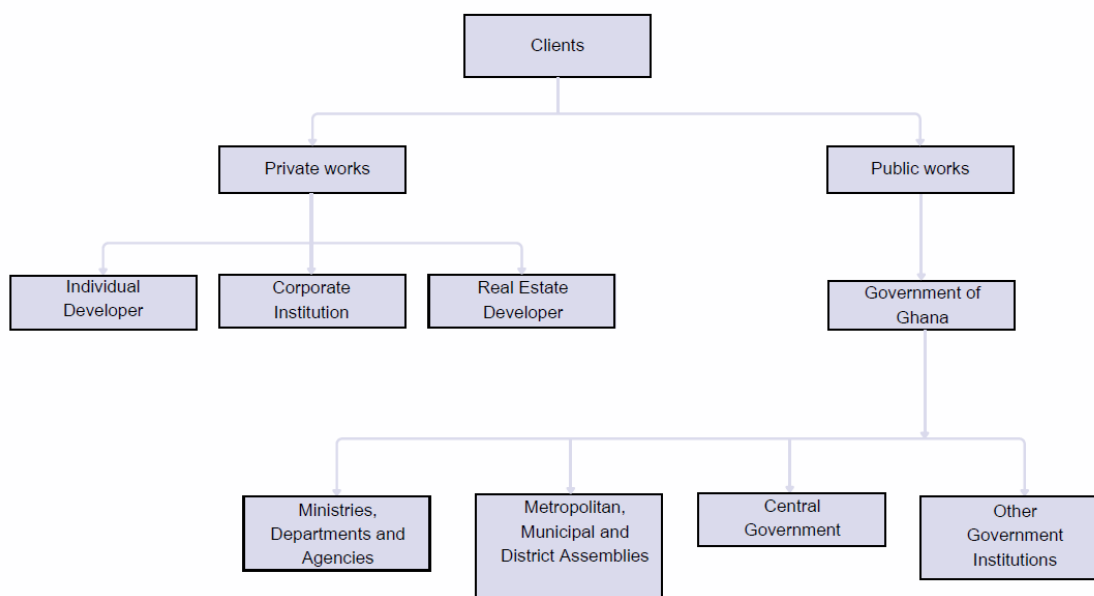


Figure 2.9 Clients within the GCI (Adapted from Osei-Asibey et al., 2021)

The GCI also comprises of building project consultants, architects, construction contractors, quantity surveyors, and skilled artisans. Architects, Engineers and Quantity Surveyors (QS) are professionals or consultants who are frequently involved in construction projects. The professional organisations that regulate consultants' practices in the GCI include the Ghana Institute of Architects (GIA), the Ghana Institution of Surveyors (GhIS), the Ghana Institute of

Construction, and the Ghana Institution of Engineering (GhIE) (Osei-Asibey et al., 2021). All professional consultants are expected to display strong professional ethics when providing services to clients. Likewise, Donkoh and Aboagye-Nimo (2016) noted that the stakeholders associated with the GCI consist of contractors, professional consultants, suppliers, clients, statutory authorities, and traditional authorities. The term "client" may also denote the employer, or the agency engaged in public infrastructure, along with private entities and entrepreneurs who generally manage the procurement of services between consultants and contractors for designated projects (Donkoh and Aboagye-Nimo, 2016).

The GCI is characterised by several key subsectors that are vital for its growth. These include: 1) Construction of commercial, residential, and municipal buildings; 2) Infrastructure, focusing on water and sanitation systems; and 3) Transportation infrastructure, which includes the establishment of airports, roads and harbours (Ghana - Construction and Infrastructure, 2022).

The GCI seems to be thriving, making a substantial contribution to both GDP and employment. Cement demand, which serves as a crucial metric for assessing construction activity, was projected to increase consistently from 8.8 million metric tonnes in 2017 to 12.5 million metric tonnes by 2021 (Ghana - Construction and Infrastructure, 2022). In recent years, Ghana's construction sector, valued at \$8 billion, has contributed over 15% to the nation's annual GDP, employing around 420,000 individuals within the industry (Ghana - Construction and Infrastructure, 2022). According to WIRE (2022), in the first half of 2021, Ghana's construction industry grew by 8.2 percent year on year (YoY). Research conducted by Fitch Solutions, a division of ratings agency Fitch, stated that Ghana's construction sector is placed sixth in Sub-Saharan Africa (Yeboah, 2021), as depicted in Table 2.6. Considering its risk profile, the nation is also the sixth most alluring market in Africa.

Table 2.6 Industry ranks and values for some African Countries

Country	Construction Industry Value (US\$)	Industry Risk Score (Position)
Ghana	9bn	6 th
South Africa	24bn	2 nd
Nigeria	55bn	9 th
Kenya	10bn	5 th
Ethiopia	26bn	13 th
Ivory Coast	5bn	11 th
Uganda	5bn	11 th

Source: (Adapted from Yeboah, 2021)

Though the construction industry yields Ghana's economy and serves as a means of employment for its citizens, the industry is characterised by unethical practices (Asamoah and Decardi-Nelson, 2014). The industry experiences challenges due to poor planning practices, which involve the improper use of water and energy, over utilisation of construction materials, a failure to address the needs of consumers and tenants, and a disjointed approach to stakeholder collaboration (Twumasi-Ampofo et al., 2013).

2.8.2 Quality Management practices in the GCI

The research conducted by Osei Mensah et al., (2012) brought to light the extensive integration of QMS in construction sites. The study indicated that various QMS are utilised across various construction sites in Ghana, with a prominent focus on quality control as the leading approach to maintaining quality in these environments.

Inspections are typically regarded as a fundamental practice employed to oversee and identify defects in materials or equipment in GCI (Ayertey Nubuor et al., 2017). In addition to other quality control methods, benchmarking is occasionally utilised to evaluate the performance metrics of a construction organisation in relation to another competing entity, thereby determining the most effective quality measures that can be adopted in accordance with the organisation's principles (Dansoh, 2005). The findings of a survey by Adusa-Poku (2014) revealed that the employed sample population achieved better quality outcomes by implementing inspection methods. It was highlighted by Adusa-Poku (2014) that supervisors implement this procedure to deliver site instructions to labourers, which serves to address and correct any issues that may arise during work on-site.

In Ghana, the implementation of the ISO 9001:2008 guidelines help construction organisations to ensure that their activities are conducted according to the highest quality standards. Through the International Standards Organisation's (ISO) code, construction firms and companies provide their employees with the necessary skills and knowledge to perform their duties efficiently and effectively (Sarpong, 2013). This includes training in the various aspects of the work environment. The training also helps them develop a process approach that will improve their efficiency and effectiveness.

Quality assurance helps the construction organisations to understand their clients' expectations and provide them with the necessary services to meet their needs. It also helps them keep their clients satisfied. For instance, if a construction firm provides high-quality buildings, they can in turn expect to get additional contracts from their clients (Sarpong, 2013).

2.8.3 Challenges faced by the GCI

The GCI is gradually failing to adequately meet up with the high demands for infrastructural needs. This industry has been affected by poor quality of work, project delays, cost overruns,

and many others. Deficit in the proper regulation of systems has also been known as a culprit (Adusa-Poku, 2020).

A study by Adusa-Poku (2014) indicated that quality is an essential factor in ensuring effective project completion. The study further concluded that one of the main aims of QMS, customer service, was not considered as a significant factor in ensuring quality of projects. On top of this, in Ghana, the principles of QMS are not implemented in construction and this results in poor quality works, low client satisfaction and high costs in construction (Osei-Asibey, 2021). Consequently, a significant obstacle lies in achieving high quality standards within the construction industry. According to Ofori (2012), contractors and consultants both confirmed that low productivity, inadequate trained workers, mediocre workmanship contribute to some of the problems faced by the GCI. Unfortunately, many construction firms in Ghana do not have the necessary staff members to implement and manage the quality management system (Sarpong, 2013).

Construction firms are being faced with several issues related to management such as effective communication, planning, customer satisfaction, health and safety awareness, availability of materials and equipment, lack of teamwork, low level of skilled personnel, poor organisation and scheduling and controlling techniques (Fugar & Agyarkwa-Baah, 2010; Amoah et al., 2011; Ofori, 2012). Imbeah (2012) also confirmed that QMS has not been successfully executed in Ghana because there is no structure in place for the practical application of these standards. The problems raised, all points to the need for quality management application in the GCI to improve performance, decrease waste and rework and enhance customer satisfaction (Harrington et al., 2012).

Ankomah and Boakye (2010) indicated that prominent players in the industry typically do not prioritise health and safety matters. Investigations into the challenges facing sustainable construction in Ghana have shown that, although there are advantages, there is a notable absence of strategic frameworks to facilitate sustainable practices, a deficiency in public understanding, and a lack of governmental advocacy, among other challenges (Djokoto and Dadzie, 2013).

The Construction industry in Ghana barely pays attention to construction site waste management (Ofori, 2013). Studies by Opintan-Baah et al., (2011) attributed these challenges to lack of proper implementation of regulations associated with these problems. The lack of proper enforcement of regulations and poor monitoring of construction activities has exacerbated the rate of environmental degradation while exposing several people, including both construction workers and non-construction workers, to serious health risks (Ofori et al., 2014). Clearly, such negligence cannot continue for an infinite period because with each

passing year, significant impacts are occurring, thus increasing the risk of harm to the environment and humans at large.

Two of the key challenges contractors face are finance and design related issues, according to Laryea (2010), which results in poor quality of works are briefly explained below:

Finance: The contractors stated that the main challenge to contracts was payment. Delay in payments establishes that a contractor cannot foresee a cash flow. The problem in foreseeing cash flows means that banks views contractors as a greater risk, hence, the benefit on money to construction firms is greater. As a result, contractors face significant costs when obtaining capital.

Design: The contractors revealed that most designs are sometimes insufficient and poorly conveyed to allow contractors to plainly comprehend what to build without numerous meetings with designers. Sometimes, drawings do not have adequate details. Other times, the client's requirements are not depicted in the tender documents. For this reason, modifications exist in the construction phase, and this also leads to a huge impact on workflow, cashflow and the scheduled project plan.

2.8.4 Legislative measure for the GCI

There are a number of legal obligations and/or enforcement systems presently in place in the GCI; the construction sector in Ghana operates within a multifaceted legal framework that encompasses a range of obligations and enforcement mechanisms designed to oversee critical elements of construction activities.

The adherence to occupational health and safety (OHS) standards represents a vital legal requirement within the GCI. However, the current OHS regulations face significant criticism due to their ineffectiveness and the lack of rigorous enforcement mechanisms. Research has shown that the public institutions tasked with the enforcement of OHS regulations in Ghana suffer from considerable inefficiencies, which in turn results in inadequate compliance by construction companies (Boadu et al., 2021; Eyiah et al., 2019). The situation is further complicated by the absence of a specialised regulatory authority responsible for monitoring OHS compliance, as there is no centralised organisation to guarantee the implementation of health and safety measures during the execution of contracts (Hagan et al., 2021; Boadu et al., 2020).

The procurement processes in the construction industry of Ghana are also governed by legal frameworks that seek to uphold transparency and fairness. Notwithstanding the implementation of these measures, corruption continues to pose a substantial challenge,

especially during the phases of tendering and contract evaluation. Evidence from research indicates that unethical practices, such as favouritism and conflicts of interest, are frequently observed among public officials involved in procurement (Agyekum et al., 2021; Ameyaw et al., 2017; Osei-Tutu et al., 2010). These corrupt practices not only diminish the integrity of the procurement process but also lead to delays in project completion and budget overruns, which represent major challenges within the industry (Asiedu & Adaku, 2019; Famiyeh et al., 2017). Additionally, the disjointed structure of the construction industry, which is largely dominated by informal practices and family-run enterprises, exacerbates the challenges in enforcing legal obligations (Anzagira et al., 2021).

The construction sector in Ghana encounters considerable difficulties concerning workmanship and quality, which are intensified by a lack of compliance with regulations and insufficient enforcement of current legislation. A major concern is the failure to follow standard specifications throughout the design and construction processes, resulting in numerous defects within the built environment (Famiyeh et al., 2017). Notably, there is a widespread occurrence of discrepancies between the approved plans and their actual execution, which further undermines the overall quality of construction in Ghana (Agyefi-Mensah et al., 2020). In order to tackle these issues, it is crucial to establish comprehensive legislative frameworks that mandate compliance with building standards and elevate the quality of construction practices. This necessitates the empowerment of regulatory agencies to perform routine inspections and impose sanctions for violations, as noted by Anku-Tsedde and Deffor (2014), who underscore the significance of regulatory oversight in maintaining quality compliance. Furthermore, improving the training and certification processes for construction personnel can greatly enhance the quality of workmanship, as evidenced by numerous studies that correlate skilled labour with superior construction results (Salleh et al., 2022; Hedidor & Bondinuba, 2017).

2.8.4.1 Ghana Public Procurement Authority Act

The Public Procurement Act of 2003 (Act 663) defines the process of acquiring works, goods, and services at the most advantageous cost of ownership, ensuring that the right quantity and quality are obtained at the appropriate time and place for the direct benefit of governments, corporations, or individuals, generally through a contractual agreement (Ameyaw, Mensah and Osei-tutu, 2012). Alternatively, it can be viewed as the mechanism through which organisations procure works, goods, and services using public financial resources. As stated by Ayitey (2012), PPA is a comprehensive process that incorporates an all-inclusive process from effective procurement planning and budget allocation to inviting and evaluating bids, awarding contracts, managing contracts, measuring performance, auditing, and reporting. The Public Procurement Law, 2003 (Act 663), according to Aidoo (2017), is an all-encompassing

piece of legislation crafted to rectify the inadequacies and institutional weaknesses that plague the public procurement systems in Ghana.

According to PPA Ghana (2023), the role of the PPA includes:

- Establishes regulations for procedures and appeals from tenderers.
- Details the offenses along with their corresponding penalties.
- Specifies thresholds in the Schedules of the Act.
- Grants the authority to issue Regulations that are enforceable under the Act.

Construction activities in Ghana (government projects) are organised mainly as a tripartite arrangement between the client, professional consultants, and the contractor, in accordance with procurement rules (Boadu, 2021). The procurement process in Ghana is illustrated in Table 2.7 below.

Table 2.7 Project procurement process in Ghana

Stakeholder	First Action	Second Action	Third Action	Fourth Action	Fifth Action
Client	Conceptualise	Initialise	* * * * *	* * * * *	Use the product
Practitioners (consultants)	* * * * *	Design client's concepts	Manage the project	Manage the project	* * * * *
Contractor	* * * * *	* * * * *	Execute the project	Complete the project	* * * * *

Source: (Adopted from Gyadu-Asiedu, 2009)

Traditional procurement processes are often applied for public works in which the Ministry of Works and Housing provide mandatory registration and grading for suppliers and contractors. The contractors recognised by the Ministry of Works and Housing largely consisted of traditional and outdated entities, and there were frequent inconsistencies in their registration standards, which encompassed the contractors' list and financial thresholds, as noted by the World Bank (1996) and Eyiah and Cook (2003). The Ministry of Finance has been developing a National Procurement Code since 1999, drawing on successful procurement practices from the Ministry of Health to primarily regulate procurement through the issuance of circulars (Boadu, 2021). This amounted to a set of processes which were derived from conventions which are linked to procurement control by the Ministry.

Most of the beneficiaries are foreign construction companies mainly because of their good and expensive machinery or equipment, amongst other resources, which leads to the transfer of huge sums of money into their home accounts. Meanwhile, the native Ghanaian construction companies, lose their bids for a several number of contracts, which has continuously been recognised as a huge blow to their mission to successfully compete for such profitable contracts (Asibey-Mensah, 2009).

2.8.4.2 Standard Tender Document

A public procurement manual is issued by the PPA as listed in Schedule 4 of the Act. They include a standard invitation and contract document for procurement at all value levels. It offers practical guidance and detailed procedures for carrying out procurement in compliance with the Act (Ppa.gov.gh, 2022).

In the GCI, there are various ways through which infrastructure projects are tendered and these are either by:

1. Selective tendering
2. Competitive tendering
3. Sole-source tendering

Most times, before a government project commences, it is publicly advertised on the relevant Ministry's website or newspapers, then later, bidding documents are finally evaluated based on quality of services and cost/budgets of the tenders received.

2.8.5 Ghana Building Code for Building and Construction

The Ghana Building Code (GhBC) specifies minimum building criteria through prescriptive and performance-based rules (Etefe, 2023). It was predicated on broad concepts that allow for the utilisation of novel materials and architectural designs.

The objective of the code is to ensure consistency in the regulation and adherence of stakeholders within the GCI, focusing on aspects such as public health, overall safety, fire safety, structural efficiency and integrity, as well as environmental integrity and sustainability. Furthermore, the code intends to strengthen compliance among stakeholders by delineating their roles and responsibilities in ensuring safety standards are upheld at construction sites (Osei-Asibey et al., 2021).

The adherence to the Ghana Building Code is profoundly influenced by the quality of construction materials and methodologies employed. The use of low-quality materials, often stemming from contractors' cost-reduction strategies, has been correlated with a significant number of building collapses in Ghana (Kidido et al., 2021). The Ghana Standards Authority

has identified the necessity of ensuring that locally produced materials adhere to recognised standards to mitigate the risk of structural failures (Biney, 2024). Additionally, the informal construction sector, which frequently operates without sufficient oversight, plays a role in perpetuating inadequate workmanship and non-adherence to safety regulations (Hedidor & Bondinuba, 2017).

It is crucial to integrate sustainable practices into building codes to improve quality management in the construction field. Ghana has made considerable strides in the adoption of green building codes and regulations that aim to advance sustainability in the construction sector (Hess, 2021). However, the adoption of these green initiatives is obstructed by a general lack of awareness and understanding among stakeholders, as well as insufficient incentives for compliance (Agyekum et al., 2020). Studies suggest that increasing public awareness regarding the advantages of sustainable construction can significantly enhance compliance rates and facilitate the adoption of green building practices (Ahiabu et al., 2023).

The Ghana Building Code supports practices that minimise resource consumption and enhance energy efficiency, aligning with global sustainability targets (Darko & Chan, 2018; Anzagira et al., 2019). In addition, the promotion of green building practices and sustainability efforts can be aligned with the principles of the Ghana Building Code, as these initiatives enhance building quality while simultaneously fostering environmental sustainability (Anzagira et al., 2022). However, barriers such as limited awareness and financial challenges have been identified, highlighting the need for further efforts to improve compliance and advance sustainable practices within the construction industry (Guribie et al., 2021; Darko et al., 2018).

To conclude, the Ghana Building Code offers a solid foundation for managing quality in construction; however, its effectiveness is undermined by factors such as non-compliance, weak enforcement mechanisms, and a deficiency in stakeholder awareness. It is imperative to address these challenges by implementing better training, conducting awareness campaigns, and enforcing regulations more stringently to elevate the standards of construction quality in Ghana.

2.8.5.1 Inspections

Mandatory inspections must be performed by the Head of Works, or the Head of Works must have the ability to accept inspection reports from designated agencies or individuals. Inspection reports are required to be written and signed by either a responsible officer of the approved agency or the designated individual in charge. Subject to the permission of the appointing authority, the Head of Works is authorised to seek expert advice as judged appropriate to report on unexpected technical challenges that occur (GSA, 2018).

Materials, equipment, and tools that have been approved by the Head of Works must be used in their construction. Materials that are to be reused must satisfy the criteria established in this Code for new materials. The reuse of used equipment and devices is prohibited unless the Head of Works provides explicit permission. The Head of Works is also authorised to inspect the buildings, structures, and sites for which an application has been submitted prior to the issuance of any permissions (GSA, 2018).

The efficacy of inspections is frequently undermined by the qualifications and training of the inspectors involved. Research indicates that numerous building inspectors in Ghana encounter difficulties stemming from insufficient training and a limited comprehension of the legal standards that they are tasked with (Asante & Sasu, 2018). This deficiency in knowledge can result in failures to detect construction defects or issues of non-compliance, thereby exacerbating the incidence of building collapses in urban settings (Kidido et al., 2021). Furthermore, the reliance on unskilled contractors and builders complicates the situation, as these individuals may fail to meet the standards established by the Ghana Building Code (Kidido et al., 2021). Therefore, establishing a culture of accountability for developers and contractors by imposing stricter penalties for non-compliance might effectively deter poor construction practices (Offei et al., 2018).

2.9 Summary of Chapter Two

This chapter identified that quality management is widely adhered to in developed countries. Additionally, several fundamental factors that are crucial for the successful implementation of QMS were identified; these factors include top management commitment, customer focus, continuous improvement, teamwork, employee involvement, communication, performance measurement, supplier relationship management and education and training. This chapter further delineates the barriers to QMS, particularly focusing on the unique challenges encountered in developing countries such as Ghana, while also highlighting the importance of QMS implementation.

In addition, the findings from literature review such as, critical success factors, QMS barriers, quality management practices, etc. fed into the development of various key aspects in this research to include; the development of the research conceptual framework and the design of the questionnaire. Furthermore, the analysis of the questionnaire together with literature review facilitated the development of the QMMM (Chapter 6) for the GCI.

This chapter explored some of the predominant quality management models which are widely adopted by organisations, such as the Deming Prize Model, MBNQA model, and EFQM. This chapter also presented a thorough overview of the GCI. It was discovered that the GCI is gradually failing to adequately meet up with the high demands for infrastructural needs. This

is because the industry has been affected by poor quality of works, project delays, cost overruns, and many others. Similarly, a deficit in the proper regulation of systems has also been known as a culprit in the industry. From literature, inspection is known to be one of the most common practices of ensuring quality in Ghana. Furthermore, it was highlighted that the purpose of the Ghana Building code is to maintain consistency in the regulation and compliance of stakeholders in the building construction sector in terms of public health, fire protection, structural integrity, etc. while improving quality buildings and sustainability.

CHAPTER 3: RESEARCH CONCEPTUAL FRAMEWORK

3.1 Introduction

An important step necessary in the development of a quality assessment tool is the need to conceptualise the key issues and parameters needed for its development. Thus, there was a need to have a theory upon which this study will be developed on. This was based on the general theory of how quality management is used, their characteristics, etc. and all of these were gleaned from the literature review as the basis of its development. Moreso, the conceptual framework was based on quality management theories. Therefore, it was used as the underpinning theory of this thesis.

This chapter has two parts: the first part highlights the significance of the framework, while the second specifically highlights the design of the framework including a brief description of its various components.

3.2 Conceptual Framework and Its Importance

The formulation of a conceptual framework starts with the logical assumption that a problem exists, and the use of processes, procedures, practical approaches, tools, or theories may be utilised to solve the problem (Zackoff et al., 2019). The conceptual framework articulates the significance and relevance of a study, detailing how the research design, which includes data collection and analytical techniques, appropriately and accurately addresses the research questions (Ravitch & Rigan, 2017). Shikalepo (2020) stated that a conceptual framework unifies the important concepts in a study in order to establish the study's focus and purpose. The framework elaborates the most important aspects that must be studied, either in narrative or graphical form, and includes its main factors, variables, or constructs, as well as the assumed relationship between them (Miles and Huberman, 1994a). These components were identified through a meticulous literature review, and the constructed framework elucidates the interplay between research questions, primary methodologies, data collection strategies, and analytical methods, thereby providing a basis for the integrity of the research in its application. It is possible to examine how the conceptual framework has been depicted and how the illustration has been interpreted in the context of the specific study, hence, it enables a reader to have a better understanding of the research's direction (Shikalepo, 2020).

According to Ravitch & Carl (2021), the following points signify the essence of conceptual frameworks:

- Helps a researcher to design, modify, and limit research questions properly.
- Assists in the establishment of a suitable framework for data collection and framework development.

- Serves as a framework for recognising the importance and relevance of existing research theories and literature, as well as for engaging with and integrating them.
- Provides the general framework within which a researcher can specify and investigate the study objectives and its targeted readers.
- Assists a researcher determine their methodological approach and technique.

3.3 The Conceptual framework for this research

As noted in the previous section, developing a conceptual framework is an important step in achieving the study's research objectives. This framework was designed based on relevant concepts identified in literature review, most importantly the key findings from literature as well as the researcher's understanding and knowledge of the phenomenon being understudied. Therefore, information obtained from literature review, pilot study and survey questionnaires were used to develop this framework. This framework forms the basis for the development of a quality improvement model in the form of a maturity model. The framework was validated through experts in the industry to ascertain its applicability and suitability in the industry.

This framework seeks to serve two objectives, with the first being to depict knowledge and understanding of quality management, upon which the framework will be refined based on the feedback received from the survey respondents during the development of this research. The second objective is to demonstrate how the developed framework can serve as a tool to improve quality management practices adopted for projects in the GCI.

The framework (illustrated in Figure 3.1) represents a complete understanding and intent of the research. It focuses on the following vital components for its development:

- a) Quality Management Drivers
- b) QMS Barriers
- c) Quality Management Improvement Processes
- d) Quality Management Performance Measures
- e) Source of information
- f) Quality Management Practices
- g) Quality Management outcomes
- h) QMS controls

This framework presents a broad perspective of the eight components integrated into a model while considering QMS implementation constraints within an organisation. The main QMS framework aspects are shown in Figure 3.1, illustrating the ways in which they are interconnected. The components identified in Figure 3.1 were derived from general QMS which has been adopted for the construction industry.

The adoption of QMS in organisations is not without challenges. As a result, the framework highlights that constraints may emerge during the adoption of QMS. Additionally, the framework argues that QMS deployment can result in continuous improvement of processes which can enhance the overall performance of organisations.

This framework has been designed to embody the required needs of the GCI. It has also been developed in a way that will serve as a guide using the eight (8) key factors when applying QMS.

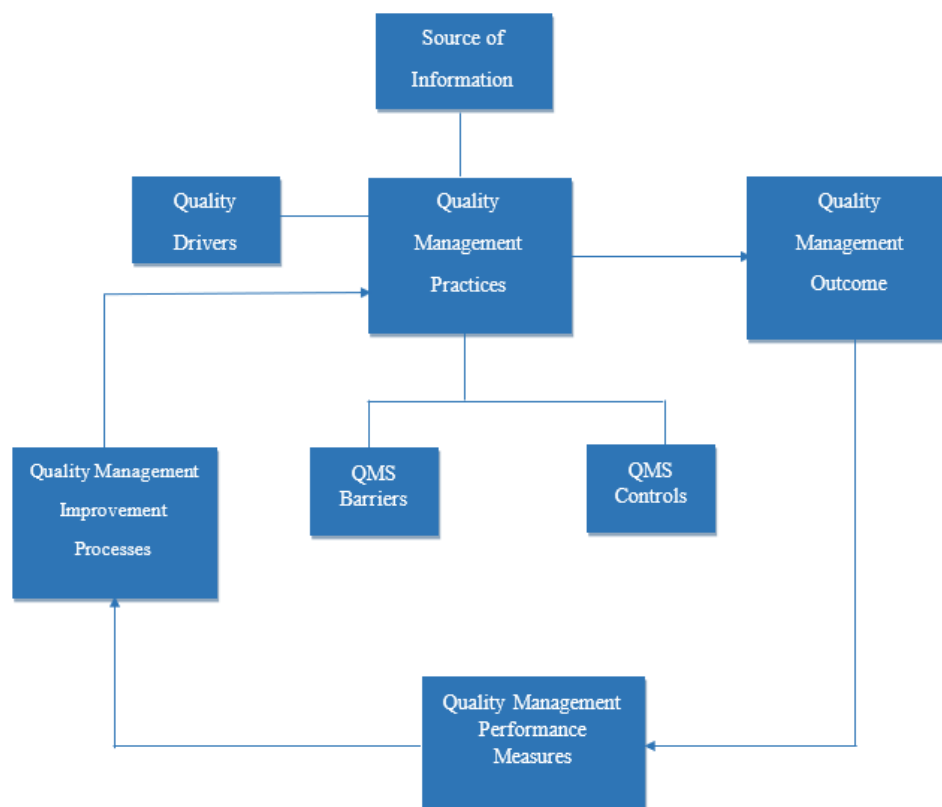


Figure 3.1 Research conceptual framework

3.3.1 Quality Management Drivers

The quality management drivers can be simply deduced from the definition of QMS. The objective of QMS is to fulfil and satisfy the needs of customers, making customer focus an essential component of the system. Several organisations have a Quality objective, Vision, or Mission, in order to work towards their company goals. To accomplish this purpose, the organisation must create processes and policies for each department to follow to ensure that quality is always monitored (Hoare, 2023). Resources need to be allocated to ensure that

these processes can be effectively implemented. Hence, these afore-mentioned elements (depicted in Figure 3.2) act as a catalyst, known as quality drivers, to achieve quality management implementation in organisations. Due to these reasons, quality management drivers form the first part of this framework design

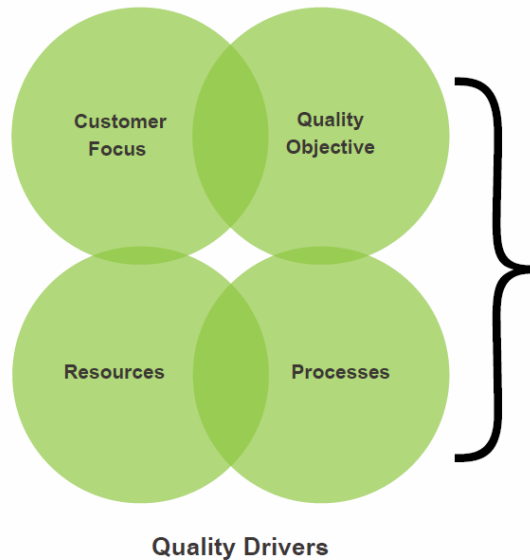


Figure 3.2 Elements of Quality Drivers (Adapted from Hoare, 2023)

3.3.2 QMS Barriers

As discussed in Chapter 2.5, implementing quality in an organisation comes with its shortcomings.

The intricacies of quality management in the construction sector are exacerbated by systemic issues associated with management practices. Numerous organisations do not implement a methodical approach to quality management, which frequently results in improvised methods that fail to conform to recognised standards such as TQM (Tiong et al., 2014; Joubert et al., 2012). The lack of an integrated quality management system can lead to inconsistent quality outcomes, poor documentation practices, and a lack of accountability in projects (Odiba et al., 2021; Kareem & Ulutagay, 2022). Therefore, the framework seeks to include quality barriers as one of its components in order to derive answers from respondents in the construction industry as to what constitutes the limitations they face while implementing quality on projects.

3.3.3 Quality Management Improvement Processes

Chapter 2.7 discussed some quality improvement models which are being used by several organisations globally. Quality management improvement processes were selected as part of the framework components because of their importance in ensuring effective application of QMS. Quality management processes, including benchmarking, enable construction organisations to pinpoint potential areas for improvement and in adopting successful practices

from their industry peers (Tiong et al., 2014; Kiew et al., 2016). The application of benchmarking allows organisations to strengthen their QMS and TQM initiatives, ultimately resulting in better project results and increased client satisfaction (Abubakar et al., 2023). Thus, various improvement processes or standards applied by the Ghanaian construction industry would be identified via survey and this will be used to complete the developed framework to ensure quality in organisations.

3.3.4 Quality Management Performance Measures

Performance measurement is done in most organisations, much so in construction firms to ensure that quality thrives in their projects. Research findings indicate that the successful execution of construction projects is often characterised by their ability to fulfill key performance indicators (KPIs), which are integral to the overall success of the project (Tunji-Olayeni et al., 2016). In Chapter 2.6, some key success factors required for quality implementation were discussed with performance measurement being one of the key factors. Hence, it is imperative that performance measures are checked when monitoring quality, thus, the reason for its inclusion as a part of the designed conceptual framework.

3.3.5 Source of information

The degree to which data satisfies client's expectations or requirements for excellence is demonstrated by data quality. Planning, reporting, decision-making, and carrying out operational tasks can all be done with ease by processing and interpreting high-quality data. Data quality dimensions (see Figure 3.3) also enable tracking of how the quality of data kept in different systems and/or across departments evolves over time (Ahmad, 2019). These characteristics form part of the pillars of every data quality strategy. Hence, it is vital for feedback to be derived to know the periodic checks of quality information over time during construction projects. This provides reason for the inclusion of information or data sources checks as a component of this framework to help enhance quality on various projects.



Figure 3.3 Dimensions of data quality management (Adapted from Ahmad, 2019)

3.3.6 Quality Management Practices

In order to make the framework relevant and useful for application, it is imperative to include this in the framework components. The implementation of quality management practices in the construction sector is critical for achieving successful project outcomes, enhancing client satisfaction, and improving overall organisational effectiveness. The increasing acknowledgment of TQM principles as a key strategy serves to address the risks posed by substandard quality, which can lead to serious problems such as building collapses and failures in project execution (Adeosun et al., 2020). Likewise, Muhwezi et al., (2021) indicated that the construction sector has encountered criticism regarding the subpar quality of its project outcomes, recommending the establishment of stringent quality management practices to effectively address client needs.

3.3.7 Quality Management Outcomes

The construction sector has progressively acknowledged the significance of adopting comprehensive quality management frameworks to enhance project outcomes. A robust quality management framework in the construction industry is crucial for guaranteeing that projects conform to recognised standards and fulfill stakeholder expectations, while reducing waste and enhancing efficiency (Muhwezi et al., 2021). The quality framework outcome represents the end-result of its use or application. Similarly, the benefits that will be derived from using this framework will be demonstrated under the quality management outcomes to ensure its applicability at all times.

3.3.8 QMS Controls

QMS controls are a fundamental component of QMS in the construction industry, as it is vital for ensuring that projects align with predetermined standards and meet client expectations (Odiba et al., 2021). A robust QMS not only elevates the quality of construction results but also fosters greater project efficiency and enhances the satisfaction of stakeholders involved. Due to its importance, it was factored as a component in the development of this framework. This component was included to enable feedback derived from the respondents to be examined to allow the completion and effective use of this framework.

3.4 Summary of Chapter Three

This chapter presented a brief discussion on what a conceptual framework entailed, and its significance. The various components that the framework encompassed were itemised and briefly discussed with its reasons for inclusion in the framework development.

The literature review served as the foundation for developing the research conceptual framework. Eight key factors which were deemed to be vital in QMS implementation were derived from reviewed literature, which enabled the development of the research conceptual

framework, as indicated in Figure 3.1. These key factors include: QMS barriers, quality management performance measures, quality drivers, source of information, quality management outcomes, quality management improvement processes, quality management practices and QMS controls.

To conclude, the conceptual framework has demonstrated the key/core considerations or elements that are necessary for assessing quality management practices, and these contributed to the development of QMMM in Chapter 6.

CHAPTER 4: RESEARCH METHODOLOGY

4.0 Introduction

This chapter outlines the research methodology that serves as the foundation for this study. It aims to elucidate and analyse the methodological choices that have informed the methods and approaches employed in this research. This chapter additionally explores the different philosophical perspectives that were evaluated for this study, along with the rationale behind selecting each perspective, including the research approach, strategy, techniques and time horizon employed for data collection and analysis.

4.1 Research Methodology Overview

Kumar (2019) defined research methodology as a set of steps or methods used to discover, select, assemble, and analyse data variables on a specific topic. According to Fellows & Liu (2009), research methodology demonstrates the principles and processes of a logical approach which is applied in scientific research. In essence, research methodology represents a cohesive strategy rooted in philosophical assumptions that informs the chosen research design, enabling the successful realisation of the research aims and objectives. To identify the most appropriate research method, it is vital to understand and clarify the core purpose of the study. A comprehensive analysis of the research aims, objectives, and questions is necessary to ensure alignment with the overall research (Neuman, 2009).

Dainty (2008) stated that research methodology does not only comprise of research methods but also comprises of philosophical principles which validate the research being understudied; these principles influence the existing research methods which have been employed to obtain data to solve a problem. To adequately address the proposed research questions, it is crucial to identify and select specific components, including research philosophy, research approach, research choice, research strategy, research time horizon, and research techniques (Goddard and Melville, 2011). As noted by Ketchen and Bergh (2007), research philosophy encompasses the worldview of the researcher. Since research is inherently based on assumptions, the selected research philosophy influences the perceptions and beliefs that guide the development and analysis of a given phenomenon. According to Saunders et al., (2009), a research approach can be classified as inductive, deductive, or abductive. Researchers have the option to employ a range of strategies, such as experiments, surveys, case studies, action research, grounded theory, or ethnography, depending on the nature of the research. Moreover, the choice between mixed methods and mono methods allows for the exploration of various techniques and procedures necessary to meet the research objectives, ultimately leading to answers for the research questions based on the data collected and analysed (Saunders et al., 2009).

4.2 Types of Research

There are three major types of research, and they are descriptive, explanatory, and exploratory (Saunders et al., 2019). The type of research conducted is often influenced by the established aims and objectives, as this framework provides the researcher with a clearer perspective on the research methodology and the assumptions that underpin their investigation. Given that theory is more than just a list of factors, characteristics, or concepts, it must also discuss how and why these variables fit together, in addition to the connections, relationships, and timeframes between events and occurrences (Sutton & Staw, 1995), these types of research are not mutually inclusive. A descriptive study, for example, might be a continuation of explanatory or exploratory research (Saunders et al., 2009).

Exploratory research design seeks to examine the research issue in various depths rather than providing definitive and conclusive answers to research questions. It has been suggested that "exploratory research is the preliminary investigation that lays the groundwork for more conclusive research". It can even assist in defining the study strategy, sample approach, and data gathering method (Toraman, 2022). Exploratory research "tends to address fresh challenges with little or no prior research" (Saliya, 2016).

This research approach can encompass conducting interviews with specialists in the relevant field and executing a comprehensive review of existing literature (Saunders et al., 2019). The participants' quality and volume of information will be used to make the decision. Moreover, this form of research might explain, as well as providing a thorough comprehension of a current scenario in order to identify shortcomings and open the door to more accurate future studies.

Saunders et al., (2009) outlined seven distinct research strategies (archival research, case study, experiment, grounded theory, survey, etc), and argued that more than one can be employed for exploratory research. However, they suggested that the decision should also be based on the researcher's personal philosophical stance. Furthermore, several authors have claimed that the quality of a management study may be significantly impacted by an understanding of a person's beliefs and worldview (Saunders et al., 2009). In greater depth, knowing one's philosophical perspective is critical since it may assist researchers in enhancing their research design by considering not just the sort of evidence needed to answer their research questions, but also how this data should be obtained and understood (Easterby-Smith et al., 2002).

Descriptive research, as noted by Chapman and McNeil (2005), seeks to address inquiries related to what, who, and how many. It provides a comprehensive depiction of a particular situation or a set of conditions. This type of research produces a detailed description of

individuals, situations, or events. The research is to communicate on the state of a wide variety of social indicators, as well as to raise questions that may demand further investigation into the reason why problems occur (Saunders et al., 2012). Although qualitative research may sometimes be used for descriptive purposes, descriptive research is typically characterised as a sort of quantitative study (McCombes, 2022). To guarantee that the results are valid and accurate, the study design should be properly constructed.

The following qualities characterise descriptive studies, according to Descriptive Research - Research-Methodology (2022):

1. A descriptive research design can employ an extensive array of research techniques to explore one or several variables.
2. Descriptive studies, while closely connected to observational studies, extend beyond just methods of data collection through observation. Case studies and questionnaires are other common data gathering tools in descriptive research.
3. The results of descriptive studies create opportunities for further research. When a descriptive study responds to the question "What?" it is possible to do additional research to discover an answer to the question "Why?".

Explanatory research is a study approach that investigates why something happens when there is minimal information available and it can help you get a better understanding of a subject, determine how or why a certain phenomenon occurs, and forecast future phenomena (George, 2022). Explanatory study may alternatively be defined as a 'cause and effect' paradigm, in which patterns and trends in existing data that have not been explored before are investigated.

Based on the type of knowledge discovered, this study is characterised as both descriptive and explorative research. This research comes under descriptive research since it aims to understand practical issues first, even though it began with a theoretical viewpoint through the development of a conceptual framework. As a result, this study revealed the realities in terms of current issues as discussed in Chapter 1.1.2. In contrast, it is explorative in this research context due to the fact that it adapts and examines the existing quality management practices at project levels to develop a suitable quality assessment tool to enhance its implementation process in the GCI and beyond. Nevertheless, the most important purpose of this study is to provide a systematic yet innovative approach for checking quality management practices to manage construction projects in organisations in order to improve existing practices. Consequently, this research is inherently exploratory.

4.3 Research Design

When conducting a research project, it is crucial to select the appropriate methodology to ensure that specific research questions, aims and or objectives can be met and thus, the findings can be validated. This refers to the kind of knowledge to be uncovered, such as descriptive, explanatory, or exploratory (Robson, 2011; Fellows and Liu, 2008).

A research design provides a comprehensive framework outlining the methodology for conducting a study. It specifies the types of data to be collected, identifies the sources from which this data will be obtained, details the methods of data collection, and describes the expected approaches for analysing the collected data (Saunders et al., 2019). The design is thought to give logical arguments that enable a researcher to draw conclusions about the variables under investigation.

Numerous factors influence the formulation of a research design, often referred to as the research strategy. Key considerations encompass the objectives of the research, the existing level of knowledge regarding the subject matter, the philosophical foundations guiding the inquiry, the resources available to the researchers, and the timeline allocated for the research process (Saunders et al., 2019).

According to Saunders et al., (2019), the Research Onion serves as a systematic approach for classifying research methods, which ranges from overarching research philosophies to detailed research methods and techniques. It consists of a series of layers or phases which describes a specific research activity from which several research methods for data collection can be understood (See Figure 4.1). Similarly, this model provides distinct guidelines to adapt with, to achieve specific research aims and objectives. The adoption of the Research Onion makes it easy to be applied as each stage is well-defined. Consequently, this chapter adopts the research onion model by Saunders et al., (2019) to achieve the research aim and objectives.

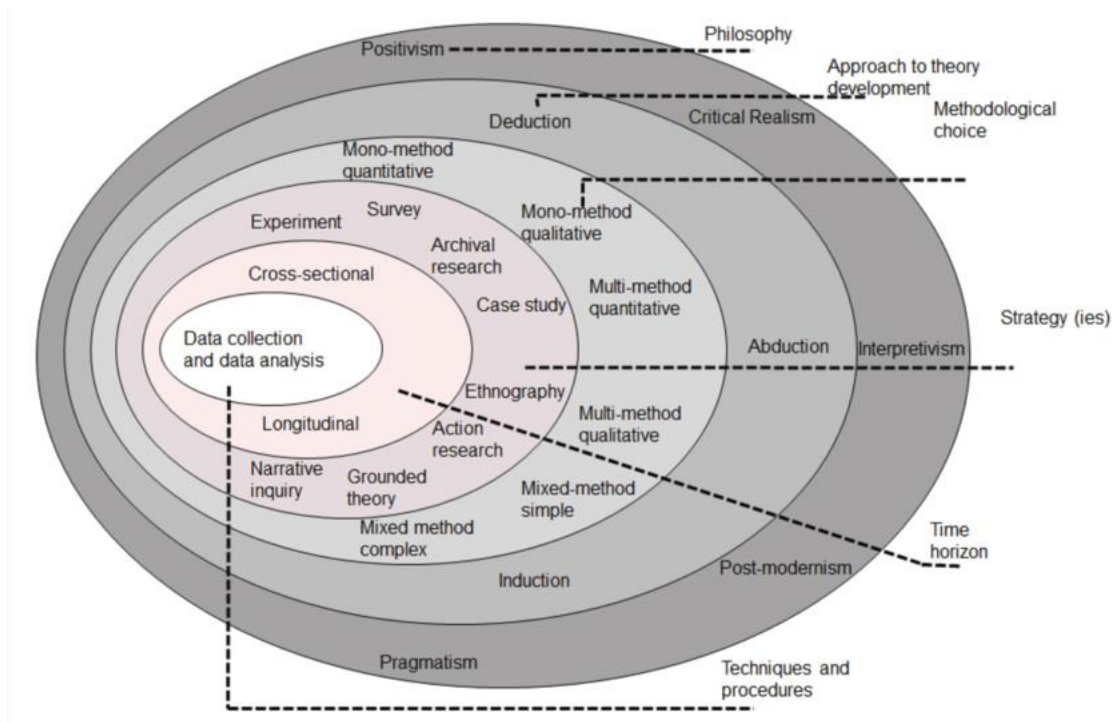


Figure 4.1: The Research Onion model (Saunders et al., 2019)

4.4 Research Philosophy

Research philosophy is a crucial component of research methodology, as it pertains to how things are understood or interpreted (Osei-Bonsu, 2018). These viewpoints focus on the research strategy and the methods chosen as part of the strategy (Saunders et al., 2019). The adopted philosophy can be affected by practical factors. Nonetheless, the overall result is undoubtedly one's specific perception of the connection between knowledge and the procedure by which it was created. Furthermore, a research philosophy outlines key presumptions about how a specific researcher views the world, and these presumptions serve as the basis for both the research strategy and the methods a researcher chooses to implement that plan (Saunders et al., 2019). It is crucial to evaluate these presumptions because they will influence how the investigation will proceed.

Three key factors were emphasised by Easterby-Smith (2012) as being important for comprehending problems with research philosophy. First, they emphasised how it might inspire researchers to make their research designs clearer. Secondly, an understanding of philosophical principles can guide the researcher in selecting the most effective design from those proposed. Thirdly, a background in philosophy can empower the researcher to explore or formulate designs that surpass their previous areas of expertise.

In every phase of research, the researcher makes different kinds of assumptions being either conscious of it or not (Burrell and Morgan, 2017). These assumptions consist of theories

concerning human knowledge (epistemological assumptions), about the concepts of realities (ontological assumptions) and the assumptions concerning values and ethics (axiological assumptions). These assumptions certainly influence the research questions, the chosen methods to be applied and how the findings are comprehended (Crotty, 1998). Saunders et al., (2019) classified axiology, epistemology, and ontology as the three major types of research philosophy. These philosophies are briefly explained below with a justification on why it was selected for its application in this research.

4.4.1 Ontological Assumptions

Bryman (2008) established the theory of 'social ontology' which he described as a philosophical study in research which affects the state of social things or entities and what is common between them.

Ontology consists of objectivism, subjectivism, and pragmatism (Phillimore and Goodson, 2004). Bryman and Bell (2011) described objectivism as "an ontological position which claims that social phenomena and their values possess an existence which is independent of social actors". Subjectivism, in contrast, posits that social phenomena emerge from the viewpoints and subsequent behaviours of social agents who have been influenced by their experiences (Saunders et al., 2019). Pragmatism asserts that knowledge is developed through interactions and experiences, supporting the notion that research should focus on addressing practical issues in the real world (Lefley, 2006; Modu et al., 2022; Morgan, 2014). This viewpoint is particularly pertinent in the fields of social sciences and management research, where the complexity and ever-changing nature of human behaviour demands methodologies that are both flexible and adaptable.

In summary, table 4.1 presents the difference between objectivism and subjectivism.

Table 4.1: Differences between Objectivism and Subjectivism

Ontology	Objectivism	Subjectivism
Truth	There exists a singular truth	Multiple truths are acknowledged
Fact	Facts are objective and can be articulated	Facts are contingent upon the observer's perspective.

Source: (Adapted from Easterby-Smith et al., 2012)

Since this research intends to develop a quality assessment tool for the successful execution of quality management practices in the GCI, it involves gathering participants' perceptions based on their understanding of the challenges encountered in the industry, as well as examining their views on the advantages of implementing QMS within the GCI. Hence, this

research is expected to consist of social activities with its focus being on the relationship between the phenomenon, the practice, and the user to comprehend the problem. As a result, this research takes a blended approach that incorporates both objectivism and subjectivism.

4.4.2 Epistemology

Epistemology encompasses three primary perspectives: positivism, interpretivism and pragmatism (Voordijk, 2009). Positivism develops hypotheses created from theories and these hypotheses are tested and backed by data analysis. The positivist method leans to distinguish and investigate by explaining the phenomenon which is under study. Links between the various variables are established and linked to a particular theory after the explanation (Neville, 2007). Positive thinkers contend that reality is subject to observation, study, and even modelling. On the other hand, the interpretivist school of thought places particular emphasis on how human actors perceive the topic being studied in relation to how well they comprehend it. In this way, theories that define new knowledge in accordance with an interpretation of reality can be proposed (Saunders et al., 2016). According to interpretivism, humans are more likely to have an impact on circumstances and behave inexplicably (Neville, 2007).

Saunders et al., (2019) elucidate that researchers adhering to positivist philosophy prioritise empirical facts over abstract ideas. They contend that a fundamental principle of this philosophy is the necessity for investigations to be conducted as thoroughly as possible while maintaining a value-neutral stance. Furthermore, Easterby-Smith et al., (2012) emphasise that the core tenet of positivism posits that the social world exists independently, necessitating that its characteristics be assessed through objective methodologies rather than relying on subjective intuitions or perceptions. Bryman (2004) argues that Interpretivism is predicated on the premise that a research strategy must acknowledge the distinctions between human beings and the objects studied in the natural sciences, necessitating that social scientists grasp the subjective meanings associated with social actions. Myers (2013) further asserts that interpretive researchers believe that the only means of comprehending reality is through social constructs, which encompass language and shared significances. While positivist research typically seeks to test a theory to enhance the predictive understanding of a phenomenon, interpretive research focuses on comprehending the phenomenon through the values that individuals ascribe to it (Creswell, 1994; Myers, 2013).

Pragmatism is an epistemological paradigm which is associated with scientific inquiry (Creswell, 2007). Creswell (2007) argued that researchers who have worldviews believe that positivism and pure interpretivism may not wholly support the objectives of their study, but he emphasised that the involvement of worldviews must consist of an action plan for improvement which can transform the livelihood of the participants. Robinson (2011) asserted that

pragmatism mixes elements of several methods from philosophical paradigms. Researchers can use the strengths of both methods to gain a comprehensive insight into the social phenomenon (Kasim, 2012). Research grounded in the philosophy of pragmatism illustrates the utilisation of various research methodologies, including action research, as well as qualitative and quantitative approaches. This versatility renders pragmatism more applicable compared to other research philosophies (Osei-Bonsu, 2018).

This research seeks to obtain knowledge on the adopted quality management practices and challenges faced by the GCI during quality implementation to develop an assessment tool based on their perceptions and responses obtained from data analysis. Consequently, the researcher focuses on organisational behavior, particularly within the construction industry, where top managers tend to manage relationships in a more personal manner compared to large corporate organisations (Bolton, 1971). It can be argued that epistemological views lean more to interpretivism rather than positivism. Therefore, the epistemological perspective of this research is grounded in a pragmatist position.

4.4.3 Axiology

Axiology is a value that, according to Creswell (2014), is established by objective standards or by human ideas, interests, and experience. A person's background, experiences, and ideas about what the truth should be all contribute to the diversity of their viewpoints. To determine if axiological philosophy is significant and skewed or value-free and impartial, it is necessary to make an assumption (Collis & Hussey, 2003).

Although Saunders et al., (2009) assert that such perspectives are prevalent in the natural sciences, they argue that a distinct scenario arises within the social sciences, which often focuses on the perceptions and behaviors of individuals. Instead, interpretivists hold that the researcher's values affect how facts are found, how they are interpreted, and how they are approached when trying to learn something new.

Table 4.2: Differences between Research Philosophies

Research Philosophy	Research Approach	Ontology	Axiology	Research Strategy
Positivism	Deductive	Objective	Value-free	Quantitative
Interpretivism	Inductive	Subjective	Biased	Qualitative
Pragmatism	Deductive or Inductive	Objective or Subjective	Value-free or Biased	Qualitative and/or Quantitative

Source: Adapted from Osei-Bonsu (2018)

4.4.4 Conclusion of this study's philosophical perspective

Based on the previous subsections that discussed the philosophical stance, it can be concluded that this research is grounded in a pragmatist philosophy. This perspective straddles both objective and subjective paradigms in terms of ontological assumptions, while it also finds itself between the interpretivist and positivist paradigms regarding epistemological assumptions. This is explained using a combination of methods in the research to create the quality assessment tool. As a result, the research strategically combines its capabilities with both quantitative and qualitative methodologies. This perspective makes it possible to recognise research approaches with awareness, which makes it easier to adopt research procedures that are beneficial to achieving the aims and objectives of the research.

The positivist paradigm is associated with research Objectives 2 and 3, which concentrate on assessing quality management practices and the challenges of implementation within GCI. This aligns with Deming's (1993) assertion that effective management is contingent upon the ability to measure outcomes. Conversely, Saunders et al., (2019) argued that the interpretivist perspective is particularly well-suited for management research contexts, a notion that is equally relevant to the field of construction management. Additionally, interpretivism is present in this study's Objective 4 (validation of the model). Furthermore, just as pragmatism is a real-world practice, so is this research to some extent.

4.5 Research Approach

The research approach is a systematic process and strategy that transitions from broad assumptions to detailed methods for collecting, analysing, and interpreting data (Bhandari, 2022). Consequently, the choice of research approach is influenced by the specific research problem being examined.

The three types of research approach are deductive, inductive and abductive (Osei-Bonsu, 2018).

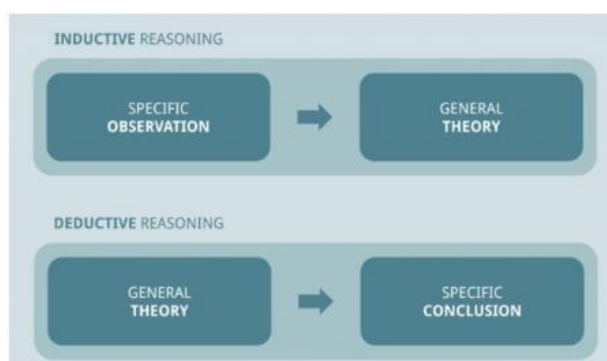


Figure 4.2 Inductive and Deductive research approach (Ajitesh, 2022)

4.5.1 Deductive Research Approach

As noted by Saunders et al., (2016), the deductive method is predominantly informed by theoretical considerations and utilises hypothesis testing as a means to corroborate or advance existing theories.

As noted by Collis and Hussey (2003, referenced in Saunders et al., 2016), the deductive research approach is regarded as the leading method within the natural sciences. This methodology is grounded in laws that facilitate explanations, enabling the anticipation of phenomena, the prediction of their occurrences, and the ability to exert control over them. This research approach is objectivist from an ontological standpoint, and positivist from an epistemological standpoint, according to positivist epistemological philosophy. Thus, Robson (2011) outlined a structured process for executing deductive research, which includes the formulation of a hypothesis grounded in theory, the practical application of this hypothesis, the testing of the operational hypothesis, the examination of the investigation's results, and, if necessary, the adjustment of the theoretical constructs. Similarly, based on a review by Dudovskiy (2019), it was observed that the stages that are often followed by research that employ a deductive method include:

1. Generating a theory from a hypothesis.
2. Putting a hypothesis into operational language and putting forward links between two particular variables.
3. Applying the appropriate procedure while testing a hypothesis. These consist of quantitative methods such as regression, correlation analysis, and measures like mean, median, mode and among others.
4. Checking the test results to see if the theory was supported or disproven. When analysing test results, it's crucial to contrast study findings with those of the literature review.
5. Changing the theory in cases where the hypothesis is not supported.

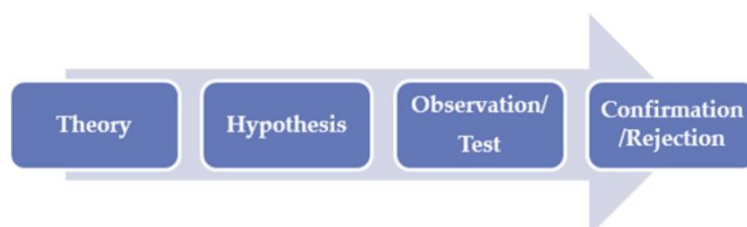


Figure 4.3: Deductive Approach (Dudovskiy, 2019)

4.5.2 Inductive Research Approach

The inductive research approach is a method that draws conclusions by transitioning from specific observations to broader generalisations (Bhandari, 2022). Gladwell (2010)

characterises the inductive approach as a process of theory development that initiates with specific instances, aiming to formulate a comprehensive understanding of the phenomenon being studied. This research methodology facilitates the collection of data, and the formulation of theories derived from the findings obtained through surveys. This methodology commences with the identification of research aims, objectives, and questions that must be addressed. It highlights the potential for uncovering gaps in existing literature that warrant further exploration, particularly within the realm of qualitative research. The inductive research approach aims to extract meanings from collected data to identify relevant patterns that can inform the development of a theory. Importantly, this approach does not preclude the researcher from utilising existing theories to articulate the research question under examination (Saunders et al., 2012).

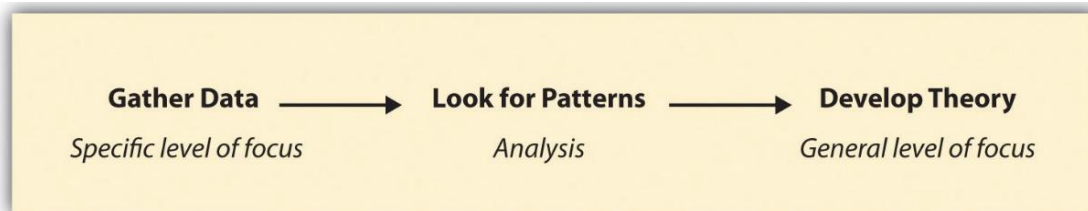


Figure 4.4 Inductive research (DeCarlo, 2022)

According to Wong (2022), the following are some of the advantages of inductive research approach:

- By observing things, it aids the researcher in reaching a conclusion.
- The main advantage of inductive reasoning is that it enables you to form a range of conclusions.
- It makes it easier to analyse patterns and develop new theories.

4.5.3 Abductive Research Approach

Suddaby (2006) highlights that an abductive approach involves a back-and-forth process that skillfully combines both deduction and induction, rather than following the linear progression from theory to data (as seen in deduction) or from data to theory (as in induction). It may be challenging to distinguish between deductive and inductive methods in most research situations. The combination of these two methods within a single study is not only possible but is often beneficial (Saunders et al., 2016).

A summary of the differences between the three research approaches are highlighted in Table 4.3 below.

Table 4.3 Differences between Deduction, Induction and Abduction research approach

Deduction	Induction	Abduction
If the premises hold true, it follows that the conclusion must also be true. Transitioning from general principles to specific instances.	Untested conclusions are derived from established premises. Transitioning from particular instances to broader concepts.	Established premises serve as the foundation for deriving testable conclusions. Generalising from specific-to-general interactions.
Data collection is utilised to evaluate hypotheses related to an established theory.	The objective of data collection is to investigate a phenomenon, identify patterns, and establish a conceptual framework.	Data collection is utilised to investigate a phenomenon, discern significant themes, contextualise them within a theoretical framework, and corroborate the findings through additional data gathering.
The rejection of a theory versus the affirmation of a theory.	Theory development and construction.	The development or alteration of theoretical frameworks involves the creation of a novel theory or the refinement of an existing one when deemed necessary.

Source: (Saunders et al., 2016)

4.5.4 Chosen Research Approach for This Research

This research employs a combination of both inductive and deductive research approaches. A theory was formulated about what quality management components make up a good quality management practice (inductive). Data was collected and deduced to specify the important factors required (deductive). Then the theory was tested (deductive) to ascertain its validity. However, the research approach used for this research largely leans towards a deductive approach.

This study commenced with the identification of a significant issue: the GCI exhibits a deficiency in quality awareness and suffers from inadequate quality management practices. This shortcoming has led to numerous quality failures in construction projects. Furthermore, it was found that there is an absence of a quality assessment tool that the GCI can use and implement, highlighting a critical research gap to be focused on.

4.6 Research Strategy

The research strategy outlines the overall trajectory of the investigation (Walia, 2022). Research strategy includes various components, one of which involves the systematic process of carrying out research. This is influenced by various factors, including philosophical viewpoints, the nature of the research questions, aims/objectives, available resources, time constraints, and the level of existing knowledge relevant to the topic being investigated (Saunders et al., 2016).

Numerous research strategies are employed in the field of social science research, including surveys, experimental designs, analysis of archival data, case studies, action research, grounded theory, ethnographic studies, and historical analysis (Ali, 2018).



Figure 4.5: Forms of Research Strategies (Ali, 2018)

Yin (2014) asserts that the experimental strategy is largely implemented within controlled laboratory conditions, which facilitates the abstraction of the phenomenon from its unique context. This methodology usually encompasses the identification of variable associations and the execution of hypothesis tests. The survey strategy, on the other hand, is carried out under open conditions where participants can freely express their opinions. Similarly, the survey approach is typically connected to the deductive method (Saunders et al., 2016). As a result, one important approach for gathering significant amounts of data is by employing a questionnaire. More details on the strategies, including their features, are enumerated in Table 4.4.

Table 4.4 Types of research strategies and their features

RESEARCH STRATEGIES	FEATURES
SURVEY	Applied in the context of descriptive and exploratory research studies

EXPERIMENT	Better aligned with controlled experimental settings than with natural settings
CASE STUDY	This is appropriate for researchers who aim to derive a deep insight of a phenomenon Exhibits considerable proficiency in elucidating the questions of 'why', 'what', and 'how' Unsuitable for the collection of data aimed at broader applicability
ARCHIVAL RESEARCH	Uses administrative documents and records as its primary source of data
ACTION RESEARCH	Creates a thorough understanding of a certain phenomenon, but literature recommends that it is in educational settings.
ETHNOGRAPHY	This can be applied in study groups
GROUNDING THEORY	This method has been applied by several academia's, especially in the built environment field The process has faced significant criticism for its complexity and the considerable amount of time needed to complete it Data collection process requires many site visits
NARRATIVE INQUIRY	This approach is particularly appropriate for relatively small targets This strategy is rigorous and time-consuming
MIXED METHOD(S)	This approach is employed to investigate and elucidate a particular phenomenon Facilitates a range of perspectives to enhance understanding Provides answers to queries about what, how, and why

	Enables study to be generalised or ranked based on importance.
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Source: (Saunders et al., 2016)

The above-mentioned strategies in Table 4.4 can be either applied alone or combined by using a mixed method. Although each research strategy can be employed to answer a particular question from a different philosophical stance, each one of the strategies can be biased therefore using a mixed research strategy can help to decrease the partialities of the various methods (Creswell, 2014). The type of research question plays a major role in this decision-making, as demonstrated in Table 4.5. For instance, Saunders et al., (2012) described surveys as a commonly employed methodology in the fields of management and business research, primarily aimed at exploring inquiries related to "what," "who," "where," "how much," and "how many". In addition, it is employed in exploratory and descriptive research. This approach is excellent for studies with limited time and funding because it allows the researcher to provide findings that are typical of the population without having to collect data from the entire population. Both Saunders et al., (2012) and Yin (2014) argue that, while several research strategies exist, there can be large overlaps, therefore, it is important to consider a strategy which has more advantage over the other when investigating a study.

Table 4.5 Aspects of Research Strategies

Research Strategy	Forms of Research Question	Requires control of Behavioural Events	Focuses on Contemporary Events
Experiment	How, Why?	Yes	Yes
Survey	Who, What, Where, How many, How much?	No	Yes
Archival Analysis	Who, What, Where, How many, How much?	No	Yes/No
History	How, Why?	No	No
Case Study	How, Why?	No	Yes

Source: (Yin, 2014)

In general, the literature has revealed that four types of scales are used in various study contexts: nominal, ordinal, interval, and ratio (Yin, 2014). Every scale has its own set of characteristics, requirements, assumptions, and limits. The five-point Likert scale was selected for this study to prevent the issues of limited response options linked to a small scale and the ambiguity that can arise from using a larger scale. In addition, a five-point Likert-type scale was utilised due to its effectiveness in evaluating all pertinent choices along a continuum.

This approach enables participants to articulate their opinions clearly while also providing a robust mechanism for distinguishing between varying levels of agreement or disagreement.

4.6.1 Chosen Research Strategy

The research questions in this study began with “what” and “how”. Based on the attributes of research strategies described by Yin (2014) in Table 4.5, survey strategy was adopted, as it was more suitable to be applied to this research in order to successfully attain the research objectives. The paragraph below explains why this research strategy was selected and its purpose for this research.

Survey strategy was chosen for this research. Survey methods such as questionnaires were developed and employed for the purpose of this research. Questionnaires can be classified into two main types: quantitative and qualitative, depending on the specific research questions being investigated (Saunders et al., 2019). In this study, most of the survey questions were subjected to quantitative analysis. The insights derived from open-ended questions were analysed using qualitative techniques, allowing for a discussion and critical evaluation of the data without reliance on statistical measures. The inclusion of open-ended questions enhanced the uniqueness and relevance of the research. Additionally, dichotomous questions were utilised in this survey, enabling participants to provide responses in a simple yes or no format, which is recognised as one of the most straightforward methods for eliciting answers from respondents in questionnaire-based research (Arora, 2017). Questionnaire surveys were carried out to collect data from various organisations within the GCI, aiming to identify current practices and challenges. This information will assist in developing an assessment tool to evaluate quality and improve its application in the industry. The survey strategy, as noted by Saunders et al., (2009), is related to a deductive research method and can be utilised for exploratory and descriptive research.

4.7 Research Choice

The selection of a research method is a critical aspect of the research process, as it determines how data will be collected for subsequent analysis (Osei-Bonsu, 2018). Researchers can typically adopt the two primary methodological options: quantitative and qualitative approaches, or a combination of both (Saunders et al., 2016).

Saunders et al., (2016) posited that the selection of quantitative research is primarily concerned with numerical or statistical data, whereas qualitative research focuses on gathering information from various sources, including journals, participant observations, opinions, and more. Although qualitative data may incorporate some numerical elements, it predominantly consists of narrative or textual information. Consequently, qualitative methodologies are employed to depict reality through the observation of individuals in their

natural environments (McCombes, 2022). Unlike quantitative approaches, qualitative methods do not commence with the testing of a hypothesis, model, or concept. Instead, they represent a systematic exploration of the unknown, necessitating an unbiased perspective from the researcher to effectively comprehend human behaviour in previously unexamined contexts (Jonker, 2009). Qualitative research fundamentally relies on open-ended questions. Nevertheless, the decision-making process is not limited to a binary choice, as there exists an alternative strategy termed mixed methods. In selecting a suitable research methodology, a researcher may decide to employ a single data collection technique accompanied by its respective analytical procedures, which is termed a mono-method. Alternatively, the researcher may choose to utilise a range of data collection techniques and corresponding analytical procedures, referred to as multiple methods (Saunders et al., 2019).

To correlate the data, a mixing phase such as triangulation is required. When a researcher operates within competing paradigms, it presents a notable epistemological concern. Furthermore, there is a likelihood of discrepancy between the data from both periods. A distinct mixed methods approach is characterised by its sequential structure, wherein either the quantitative or qualitative component is executed and meticulously examined. After this initial analysis, the subsequent phase is formulated and implemented to mitigate the risk of insufficient corroboration. As a result, one phase predominates in a sequential mixed methods approach (Saunders et al., 2016).

The integration of mixed methods represents a significant source of evidence that can be derived from research, thereby enriching the findings and rendering the study more comprehensive (Saunders et al., 2016). One of the key benefits of mixed methods is the enhanced ability to demonstrate knowledge concerning the research problem, surpassing the insights gained from a singular methodological approach. Additionally, the use of mixed methods reduces the likelihood of bias in data collection methods (Sekaran and Bougie, 2009). The combination of qualitative and quantitative research methodologies can bolster the credibility of the data obtained (Osei-Bonsu, 2018). It has been argued that by merging both quantitative and qualitative approaches, researchers can fill in data gaps, as the limitations of one method can be offset by the advantages of the other (Bergman, 2010).

4.7.1 Chosen Research Choice

The purpose of this research is to develop a quality assessment tool (in the form of a maturity model) that will facilitate the improvement of quality management practices in the GCI. As such, it is vital to adopt an effective data collection and analysis methodology that is consistent with the objectives of this study. This research adopts a mixed method as an appropriate research choice which consists of an online survey technique with the implementation of both

quantitative and qualitative research data analysis. Employing the use of a qualitative method can provide a clear picture of the current practices of QMS in the GCI. This was selected due to the fundamental philosophical perspective that people's experiences and behaviours play an essential role in this research. Similarly, the qualitative phase was employed to validate the developed tool, while the quantitative phase was employed to evaluate the preliminary outcomes. The selection of mixed methods for this research is primarily justified by the diverse array of research strategies it encompasses in its implementation.

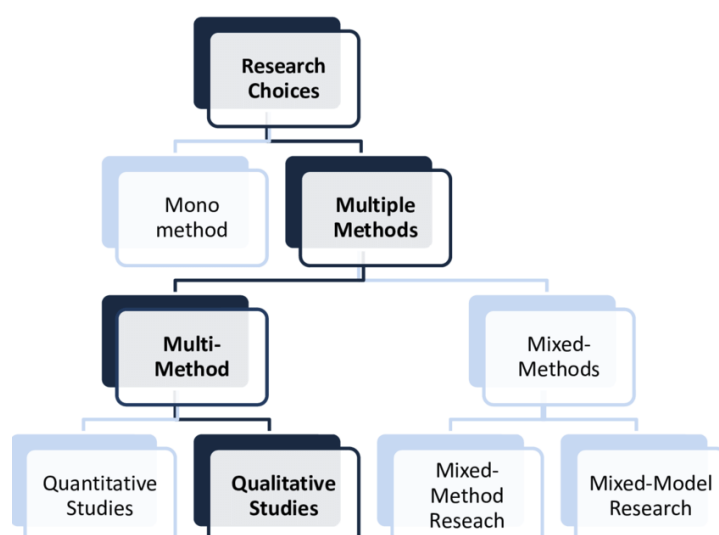


Figure 4.6: Research choices (Adapted from Saunders et al., 2008)

4.8 Research Time Horizon

The research methodologies pertaining to time horizons can be categorised into two primary types: cross-sectional and longitudinal (Osei-Bonsu, 2018). Cross-sectional studies involve the collection of data at a single point in time, typically over a span of days, weeks, or months, to address specific research inquiries. In contrast, longitudinal studies entail multiple analyses conducted over various time intervals, allowing for a more comprehensive examination of research questions across different periods (Saunders et al., 2016). It is important to note that longitudinal research is generally more resource-intensive, requiring greater time, effort, and financial investment compared to cross-sectional studies (Kothari, 2004). Cross-sectional studies are typically low in cost and require minimal time for execution, often relying on survey methods (Saunders et al., 2019). Due to restricted time limit, this research has selected a cross-sectional time horizon to investigate the current practices of QMS and to identify the challenges encountered at a specific time. Furthermore, the data was gathered through surveys conducted over several days, thereby making the cross-sectional horizon suitable for data collection and analysis processes.

4.9 Research Data Collection Techniques

The collection of relevant data is crucial for fulfilling the aims and objectives of the research (Fellows & Liu, 2009). In this study, the purpose of data collection is to obtain reliable and valid information from participants to effectively address the research objectives.

The methods employed for data collection enable the researcher to determine the most suitable research techniques and the analytical approaches necessary for deriving answers to the research inquiries (Pratt and Loizos, 2003). The selection of methods and techniques during this phase must align with the chosen research philosophy, strategy, options, and timeframes within which the findings will be evaluated (Jackson, 2011).

There are two categories of data that can be obtained through Primary and Secondary sources (Dudovskiy, 2018). Primary data signifies data that is created through the researcher's own investigation, while secondary data consists of information that has been collected by other researchers in the past. This secondary data can provide essential insights for new researchers (Dudovskiy, 2018).

For this research, primary data was collected using online questionnaire surveys while secondary data was obtained from literature reviewed on the subject matter using journals, articles, and books by previous researchers. The validity of the developed tool was done using interviews to collect feedback from experts in the construction field. These sources were used to reduce researcher or respondents bias while improving the reliability and validity of the research.

4.9.1 Primary source of data

Primary data refers to the firsthand data collected by the researcher at the expense of finding a possible solution to a phenomenon (Sekaran, 2013), thus primary data depicts the researcher's original findings. When there is no sufficient secondary data, a researcher can obtain primary data to answer the proposed research questions (Dudovskiy, 2018). Primary data can be obtained using different methods such as observations, interviews, and questionnaires (Collis & Hussey, 2003 and Saunders et al., 2019).

Primary data is usually unique, original and limited to the researcher undertaking the study to provide a realistic account of the problem being accessed. The approaches to collecting primary data can be related to both qualitative and quantitative research strategies; however, the choice of method is determined by the specific aims and objectives of the research, the resources at the researcher's disposal, and the researcher's level of expertise. For this study, the primary data collection method utilised was an online questionnaire survey.

After ethical approval was granted, a questionnaire survey was distributed to some construction organisations in the GCI. The purpose of the questionnaire survey was to explore the understanding of quality management and its practices within the GCI in order to provide solutions on how to manage quality successfully on projects. Interviews were used to validate the developed tool by seeking assistance from some building construction experts within the industry. Excel and IBM SPSS 26 (Statistical Package for Social Scientists 26) were used to generate descriptive and inferential statistics for this research.

4.9.2 Secondary Data collection method

Secondary data collection refers to acquiring information that is already available. Saunders et al., (2019) explained that secondary data is mostly collected to gain some understanding on the problem being understudied and it is mainly derived from the reviewed literature of a study. Secondary data sources for this research include journals, articles, books, conference papers, internet, previously published and unpublished PhD theses, online databases such as Science Direct, International Journal of Project Management, Emerald-Library, and a few others to mention.

As part of the review, which included reading for the research methodology, a wide range of field-based concepts, such as QMS and quality management models were examined. The secondary data enhances the researcher's understanding of the research issues while aiding in the development and comprehension of the research topic. Additionally, it provides a strong basis for carrying out further investigation and this aids in choosing the best techniques for the study subject (McCombes, 2022). Moreover, secondary data can offer a tool for efficiently interpreting and comprehending the source of data.

For this research, a thorough review of existing literature was done throughout the research process. This systematic approach was crucial for laying solid theoretical groundwork for the area of study, enabling the resolution of issues and the achievement of research aims. The focus of the literature review was on quality management practices in the construction sector. The research question, aim, and objectives were formulated based on a preliminary literature review. The literature review for this research was broken down into three main sections. The first provided a general overview and presented information on quality management systems, the second part discussed quality management standards, tools and techniques, and the last section in Chapter 2, discussed the GCI. Literature review was also used to provide a general overview of a research conceptual framework. This introduced the research conceptual framework which was finetuned after data collection.

4.9.3 Questionnaire

A questionnaire is a form designed and utilised in a survey through which respondents complete a mailed form and submit it back to the researcher (Creswell, 2018). He further explained that the respondents select answers to the set questions and provide basic or demographic information's to the researcher (Creswell, 2018).

The administration of questionnaires can take two primary forms: they can be completed independently by participants or overseen by researchers. According to Bhandari (2022), this choice of administration method plays a crucial role in shaping the research outcomes and the overall effectiveness of the survey process. Bhandari (2022) argued that self-administered questionnaires are far more popular because they are simple to conduct and inexpensive, whereas researcher-administered questionnaires provide valuable insights to the researcher. Gray (2014) stated that employing the use of questionnaires has several benefits which includes reduced cost and time, and it can be delivered to numerous participants without incurring a high cost. Similarly, participants' responses are received within a short period of time, and they can respond to the questionnaires at their own convenient time (Greener, 2008).

Saunders et al., (2018) highlighted that the term "questionnaire" is widely used to describe a data collection method wherein researchers pose identical questions in a systematic format to a selected sample, aiming to gather responses from a large number of participants. This method encompasses structured interviews, telephone surveys, and online questionnaires. Questionnaires can be administered through various channels, including telephones, mails, etc. However, it is crucial to design an effective questionnaire to facilitate the collection of comprehensive responses from participants, thereby fulfilling the research aims and objectives (Collis and Hussey, 2003).

Saunders et al., (2018) stated that questionnaires can be used to obtain standardised data, hence it is quite easier to make some comparisons. This questionnaire was selected to purposely focus on the right people within the construction industry to derive the right answers in order to accurately develop a quality assessment tool. According to Sekaran (2003) and Bryman (2004), these points make a questionnaire the best option to choose:

- It is the most efficient method to use to collect primary data
- It provides a straightforward approach to study a phenomena
- It does not require more skills like interviews
- It can be administered to many people, and it is cost effective
- It is less time-consuming

Emailed questionnaires, which are a self-administered type of survey, were used to obtain responses for data collection. This form of questionnaire allows the accuracy of data collected, which then implies that the data is reliable without any bias from the researcher (Saunders et al., 2018).

4.9.3.1 Questionnaire Design

Creswell (2009) stated that the limitation of using a questionnaire is usually not clear until data analysis begins. Therefore, it is of great importance that questionnaires are well designed for the best data collection to provide more concise solutions to achieve the research aims and objectives of the research. In creating the questionnaire for this research, aspects from literature review were used. The research aim, objectives and questions were also adopted to recreate some questions to obtain participants perception about the implementation of quality management practices and any challenges faced. Some past questionnaires used in construction management were studied and used as a guide in designing this research. The draft questionnaires were modified after suggestions made by the principal supervisor before it was submitted as part of required documents for ethical approval (copy of the questionnaire is at Appendix A).

The most important step in establishing and constructing a questionnaire is examining the study objectives, as a good research questionnaire is one that achieves its goals (Sekaran, 2003). Ahaotu (2018) suggests that when developing a questionnaire, researchers should consider three key attributes: it should be centered on the research topic, the questions must be concise to effectively communicate their meaning, and they should be clear and easy to understand. Additionally, Bourque and Fielder (1995) advised that the questions must be clear and or, precise, that abstract phrases and jargons must not be included, and that the questionnaires must start with simpler questions and further advance to more sophisticated ones, presenting questions in a reasonable manner.

The questionnaire used had three (3) main sections with other sections having sub-sections of other questions (see Appendix A). The questionnaire survey commenced with a brief explanation of its objectives and a definition of any important terms used. Following that, the first section asked questions about the characteristics of the survey participants and their respective organisations, including their demographic data such as the job roles, professional disciplines, work experiences, academic qualifications, and the types of projects conducted by their organisation. The second section included four (4) sub-parts which sought to identify the perception of QMS, the importance of QMS, explored its critical success factors, and the barriers affecting its implementation process. Lastly, the third (3) main section also had 4 sub-sections or parts which asked evidence-based questions to generate answers on QMS

documentations, QMS effectiveness, the current applied tools and techniques and focused on QMS measures for ensuring project success. The survey instrument consisted of a blend of open-ended and closed questions, specifically crafted to assess respondents' comprehension of the QMS utilised by the GCI. It also aimed to identify the obstacles these organisations encounter, which would aid in the development of an assessment tool to enhance the implementation of QMS.

The questionnaire survey was administered online and targeted towards people at the organisational level such as Project Managers, Site Engineers, Contractors, Civil/Structural Engineers, Quality Engineers, etc. The questionnaire consists of various aspects relating to QMS and its practices in the GCI. To measure significant factors or indicators, a Likert scale was used to gain different feedback from the respondents. The significance of employing a Likert scale in the development of questionnaires aimed at gauging the degree of agreement or disagreement with specific statements has been underscored by Saunders et al., (2016). This methodological approach is essential for accurately evaluating the underlying dimensions of various factors. A Likert scale can consist of multiple points, including configurations with an even number of options that lack a neutral point, thereby compelling respondents to choose a definitive stance. However, a five-point Likert scale is considered suitable for evaluating the intensity of opinions, as it incorporates a neutral option that can significantly affect the respondent's expressed viewpoint. The Likert scale was also utilised in Parts 2 and 3 of the designed questionnaires.

4.9.4 Interviews

Interviews represent a method of data collection commonly employed in social research, characterised by the exchange of information between two or more individuals through a structured series of questions and responses (Bhandari, 2022). A researcher creates interview questions to obtain information from respondents regarding a particular topic or topics. Similarly, Ahaotu (2018) described an interview as a structured exchange between two or more people in which the interviewer asks questions and the interviewees willingly respond. An interview has a significant advantage because it produces a large amount of data rapidly, however, it also has some drawbacks and flaws (Yin, 2014). For instance, the interviewees might not want to or feel comfortable discussing everything even though the interviewer wants to find out some other vital information.

Numerous researchers, such as Saunders et al., (2018) characterised interview methods into three categories such as: structured, semi-structured, and unstructured. Furthermore, interviews enable respondents to express themselves freely and without limitation, resulting in a wealth of data (Saunders et al., 2016). Alternatively, semi-structured interviews are

facilitated through the use of question guides, allowing for flexibility in the order of questions posed during the interview process. In this type of interview, respondents are free to answer questions however they see fit, and the emphasis is on the respondent rather than the researcher (Greener, 2008). The process facilitates the establishment of trust between the interviewer and the participants, encouraging them to provide candid and sincere answers. This dynamic significantly contributes to the credibility of the research findings (Gray, 2014). Also, it gives the researcher the freedom to ask follow-up questions to explain certain issues.

Saunders et al., (2016) asserted that semi-structured interviews are particularly useful for gaining insights into a specific context and for uncovering the dynamics at play in exploratory research, as well as for elucidating the motivations behind participants' perspectives. Moreover, Bryman (2016) asserted that this method of gathering data is particularly suitable when the researcher possesses a thorough understanding of the topic at hand and when the research is aimed at a specific setting.

This research used interviews to achieve objective 4, which aimed to develop and validate an appropriate tool for the effective adoption and implementation of QMS and practices. This was attained via zoom video communications with the support of industrial experts from some construction companies in Ghana to check its suitability and applicability in the industry. Through this, qualitative data analysis was achieved in order to refine the developed assessment tool for its usage.

4.9.5 Sampling of the study participants and its Techniques

When undertaking a study, it is often quite challenging to connect with every individual for interviews or the dissemination of questionnaires. The effort to reach all potential participants can be both time-consuming and financially burdensome, potentially resulting in the inefficient use of resources, particularly when some individuals may not be well-informed about the relevant issues. Thus, it is imperative to utilise a sampling approach in research, as this method provides substantial advantages for both the researcher and the validity of the research results (Naoum, 2007).

Sampling is a strategy for choosing specific individuals or a subgroup of the population in order to draw statistical conclusions from them and assess the features of the entire population (Fleetwood, 2018). Similarly, a sample, according to Collis and Hussey (2009), is a group of people who can reflect the complete population of people who participated in a study.

Sampling procedures, on the other hand, relate to the many ways used to pick individuals for a sample from a wider population. Sampling techniques offer a variety of ways that allow a researcher to reduce the amount of data required by taking into account those from a certain sub-group (Saunders et al., 2018). Sampling techniques often require a population and its

sample size to be identified. Moreover, the demand for sampling arises when budget and time restraints inhibit the researcher from studying a greater populace, and when it is impractical to carry out a survey in the entire populace (Saunders et al., 2012).

Sampling methods are generally classified into two main types: probability sampling and non-probability sampling (McCombes, 2022). Probability sampling includes techniques such as systematic random sampling, simple random sampling, cluster random sampling, and stratified random sampling (Saunders et al., 2016). In contrast, non-probability sampling encompasses methods like quota sampling, snowball sampling, convenience or purposive sampling, and self-selection sampling (Saunders et al., 2016). Figure 4.7 below depicts some examples of sampling techniques based on each category.

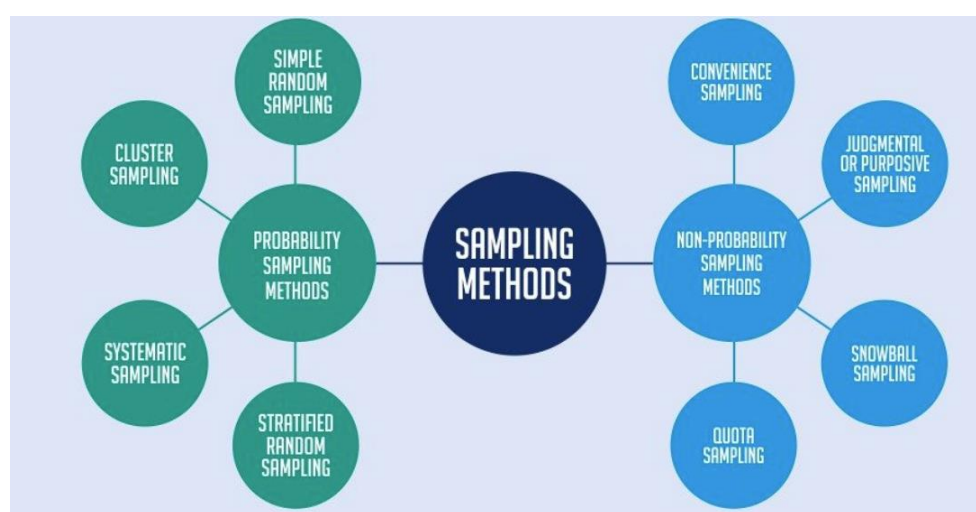


Figure 4.7 Types of Sampling techniques and their methods (Adopted from Fleetwood, 2023)

Probability sampling technique is applied in quantitative research when the probability of each member involved has been identified (Teddle and Yu, 2007). Random sampling is a key component of probability sampling, which enables a researcher to draw robust statistical conclusions about an entire group which enables the likelihood of selection bias to be reduced (McCombes, 2022). With random sampling, each person in the populace has an even possibility or chance to be chosen while with non-probability sampling, the technique is applied when the probability of including each person or member in the entire population is unknown, therefore this often happens in the case of qualitative research approach (Gary, 2014).

For this research, a non-probability sampling type such as purposive sampling was used as the sampling technique. Purposive sampling represents a qualitative research strategy that permits researchers to select participants based on particular traits or criteria that align with the study's goals. This technique is particularly useful for exploring specialised topics or populations where participants have unique knowledge or skills related to the phenomenon

being studied (Palinkas et al., 2013; Straffon, 2024). Similarly, Baah et al., (2022) highlights that purposive sampling plays a vital role in contexts where researchers intend to gather cases that contain substantial information related to particular topics or phenomena within the construction sector. Construction professionals from various firms in Greater Accra, which is the capital of Ghana were sampled to answer the set questionnaires as well as some industry experts being who were purposely sampled for interview purposes for qualitative data analysis. The sampled construction firms included professionals from Architectural firms, Project Management firms, Consulting firms and Civil engineering firms, of which 142 responses were generated with 65% response rate towards the development of this research outcome which is QMMM.

4.9.5.1 Chosen Sampling Technique

As this research aims to develop a quality assessment tool to enhance quality management practices in the GCI, it is essential to derive sufficient data from the participants. To accomplish this, it is important to conduct a targeted sampling of qualified respondents capable of offering essential insights into the research questions.

The selected experts who responded to the questionnaire were chosen using a purposive sampling technique, aimed at including construction professionals such as architects, quantity surveyors, site engineers, project managers, etc. with work experiences in the GCI to provide answers which can help to re-define and validate the developed quality assessment tool. The purposeful technique was consciously employed to choose experts according to their qualifications and areas of expertise. The interview session was held and recorded online via zoom video communications. The interview was carried out in English to facilitate straightforward transcription and analysis. For data security, the recording was saved and secured with a password-protected computer and backed on a one-drive.

4.9.6 Pilot Study

A good research study with an appropriate experimental design and precise performance is required to obtain high-quality results. As a result, a pilot study is an important preparatory step before conducting the real interview and questionnaire. A pilot study represents the preliminary stage of the research process, typically conducted on a smaller scale, which helps in refining the design and making necessary adjustments for the main study (Thabane et al., 2010). Simkus (2022) established that a pilot study, often known as a "feasibility study," is a small-scale exploratory study carried out before any large-scale quantitative research in order to assess the likelihood of a future, full-scale project. As noted by Sekaran (2003), the fundamental purpose of conducting a pilot study is to examine the clarity and comprehensibility

of the questions included in interviews or questionnaires for the participants. It also aims to provide significant information that will support the successful completion of the study. Evaluating its viability prior to conducting the major study (also known as large-scale main trial) can be quite significant regarding its purpose. A pilot study offers essential information that aids in determining sample size and evaluating other components of the main study, helping to reduce unnecessary efforts from both researchers and participants, as well as minimising the waste of research resources (In, 2017). Before initiating the pilot study, it is essential to clearly define the factors involved and ensure they are well-established, as this will allow the pilot study to fulfill its intended purpose.

The pilot study can be conducted either as an internal pilot study that is part of the main study's research design or as an external pilot study that functions independently from the primary investigation (Simkus, 2022). One of the fundamental reasons for conducting pilot research is to obtain primary data for calculating a sample size for its key outcomes. This allows researchers to forecast an acceptable sample size, budget appropriately, and refine the study design before embarking on a full-scale project (Simkus, 2022). Creswell and Clark (2007) stated that the main aim of carrying out a pilot study includes creating and testing the suitability of research methods as well as conducting preliminary data collection.

For this research, a pilot study was undertaken to evaluate the validity of the questionnaires, which allowed the researcher to adjust their methodologies to improve and finalise the designed questionnaires. The pilot study for this research was done in two stages. The researcher's supervisor conducted the first phase of the pilot study; as a result, the initial draft set of questions was altered to improve their validity. The second phase was conducted by distributing the set of questionnaires to a small sample group of experts (11) with expertise in the construction field in Ghana. After the pilot study was completed, the questions were revised based on the feedback and viewpoints of the participants. Participants' remarks were deemed extremely valuable and taken into consideration. The questions were altered to make them more understandable and simpler by omitting questions that were not too relevant for the study by rephrasing and amending the questionnaire and the language used.

4.9.7 Data Analysis

Data analysis is the process of summarising acquired data and this entails interpreting data acquired using logical and analytical reasoning in order to identify patterns, correlations, or trends (Bhat, 2019). As outlined by Saunders et al., (2019), the concluding phase after the collection of data is termed the data analysis stage. This stage focuses on the evaluation of raw data to extract the essential findings needed to respond to the research questions. The process of data analysis encompasses the assessment, classification, testing, calculation, and

integration of both quantitative and qualitative data to elucidate the outcomes derived from the data collection techniques (Yin, 2014). To ensure coherence with the research questions, it is crucial to develop a data analysis strategy from the beginning (Yin, 2014).

The obtained data from the survey are in an ordinal form as a Likert scale was used to derive most of the answers from the respondents. It was deemed important to analyse the data sets using descriptive statistical analysis. For the open-ended questions which included the characteristics of the participants in the survey, the descriptive statistical analysis was employed, and the data was represented in percentages to describe the obtained data.

4.9.7.1 Qualitative Analysis

In qualitative research, non-numerical data (such as text, video, or audio) are obtained and analysed to fully understand ideas, beliefs, or experiences (Bhandari, 2022). She further added that qualitative data analysis can be applied to get a comprehensive understanding of a situation or introduce innovative research concepts. This method focuses on text rather than numbers, as this has been acknowledged as a key characteristic of qualitative analysis. According to the findings of Saunders et al., (2018), no established method has been found for the analysis of qualitative data. Qualitative data is typically characterised as non-numerical.

According to Saunders et al., (2016), there are five distinct approaches to the analysis of qualitative data, which are detailed as follows:

1. Thematic Analysis: This method involves a high range of inductive approach where ideas are formed from data obtained from the respondents and are not enacted by the researcher.
2. Content Analysis: This refers to a systematic approach which is used to ascertain the existence of certain themes, words or ideas within qualitative data.
3. Grounded Analysis: This method uses coding and classification of obtained data to generate theories.
4. Discourse Analysis: This refers to the analysis of both written and spoken language in a social context. Alternatively, it depicts how a language can be assessed beyond a sentence to develop an understanding of how it functions.
5. Comparative Analysis: This method is linked to thematic analysis and involves the analysis of multiple phenomena in complex cases.

The data collected from interviews were analysed manually using thematic analysis.

4.9.7.2 Quantitative Data Analysis

This type of data analysis technique is associated with numeric data. Quantitative data analysis can be used to detect averages and patterns, predict results, and produce test casual

relationships, and deduce results for larger populations (Bhandari, 2022). Quantitative data analysis comprises the calculations of events of a variable quantity and the variations between the variables (Saunders et al., 2018). Employing quantitative data analysis enables a researcher to convert raw data into significant data sets through critical thinking. Various techniques employed in quantitative data were Chi-square test, T-test, and variance analysis. Moreso, advanced software packages for data management and statistical analysis are of great importance for the application of these methods, for instance, SPSS, NVivo, SAS, Minitab and Stat view (Saunders et al., 2019).

Quantitative data analysis relies on the aims and objectives of a research, where the aim of the study requires obtaining information about the phenomena of the study. Inferential and descriptive statistical analysis are the two forms of statistical data analysis (Glen, 2023). Inferential statistics accentuates the “statistically significant” variations between two or more data sets while Descriptive statistics allows a researcher to draw conclusions from the obtained data as a whole (Glen, 2023). The essence of descriptive statistical analysis is to ensure that the data obtained is more understandable by using tables, graphs, and calculations of different methods such as mean, median, standard deviations and range (Sekaran, 2003).

The descriptive analysis in this research includes visual representation which included graphical approaches, percentage tables, and, most notably, average mean scores. Standard deviations and other metrics of variability and dispersion were also collected. The structure of the descriptive statistical analysis is designed to correspond with the layout of the questionnaire survey, which consists of three main sections, each featuring multiple subsections of follow-up inquiries. The initial section incorporated pie charts as part of the descriptive analysis, whereas the latter two sections incorporated additional descriptive techniques, including means and standard deviations, to effectively represent the trends observed in the responses gathered from the Likert scale. The technique used to ascertain the column measurements for the Likert scoring system encompassed a scoring spectrum from 1, denoting the minimum score, to 5, signifying the maximum score. Consequently, this established a total range of 4, derived from the calculation of 5 minus 1. Given that there are five columns, the range divided by this figure produces a cell length of 0.8 ($5/4$). Therefore, the length of the first cell is computed as $1 + 0.8$, resulting in a value of 1.8, which is presented in Table 4.6. Although the means is frequently employed as a key indicator of central tendency, it falls short in providing a comprehensive understanding of the data (Sozen, 2019). To illustrate the variability within the dataset, a measure of dispersion is required, and for this research, the standard deviation has been identified as the most fitting metric.

Table 4.6 Interpretation of Likert Scale

Point Scale	Qualitative Interpretation	Mean / Range Values	Level of Agreement
1	Strongly disagree	1.00-1.80	Very Low
2	Disagree	1.81-2.60	Low
3	Neither disagree nor agree	2.61-3.40	Moderate
4	Agree	3.41-4.20	High
5	Strongly Agree	4.21-5.00	Very High

Adopted from Sözen, 2019

Also, Relative Importance Index was used in this study under the data analysis and discussion chapter (Chapter 5). This was done to calculate for the weighted value based on the opinions of the respondents regarding the barriers that affect the implementation of QMS and the importance of QMS practices within their organisations.

Relative Importance Index (RII) holds significant relevance in this research, as the index's value delineates the hierarchical level of importance. It is particularly beneficial for surveys that utilise a Likert scale (Tholibon et al., 2021).

Below indicates the RII formula which was used to calculate the average weights which was used in ranking the indicators:

$$\text{Relative Importance Index (RII)} = \frac{\sum W}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N} \dots\dots\dots (1)$$

In this context, "W" denotes the weight assigned by respondents to each factor, with a scale from 1 to 5. Specifically, "n1" indicates the count of respondents who selected "Strongly Disagree," "n2" corresponds to those who chose "Disagree," "n3" reflects the number of respondents who are "Uncertain," "n4" signifies the respondents who indicated "Agree," and "n5" represents those who selected "Strongly Agree." Consequently, the aggregate number of respondents is denoted as N. The Relative Importance Index is quantified on a scale from 0 to 1 (Tholibon et al., 2021).

Following that, the data was subjected to inferential statistics. Inferential statistics utilise statistical measures to create generalisations about a population based on the results obtained from a sample. This is accomplished by analysing the numerical data for relationships, trends, and discrepancies. The application of inference analysis is instrumental in evaluating the robustness of relationships present within a sample. This analytical approach allows for the assessment of how independent variables affect the results. Techniques such as ANOVA,

Chi-Square Statistic, and Regression are categorised as forms of inferential analysis. Chi-square tests are utilised to uncover significant differences in the data by assessing the fit between observed data and expected values. ANOVA is a statistical procedure that splits observed variance data into distinct components for use in additional tests and when there is no actual difference between the groups, the F-ratio of the ANOVA should be in close proximity to 1 (Kenton, 2022).

Correlation refers to the bivariate analysis that assesses the relationship or degree of association between multiple data sets (Bhandari, 2022). The correlation coefficient's value falls between the ranges of -1 and +1. Perfect correlation would be indicated by a coefficient of either -1 or +1. However, in data analysis, this rarely happens. A correlation of zero signifies the absence of a linear relationship between the two variables (Bhandari, 2022). The coefficient's plus or minus sign must be the first thing to be considered during analysis.

It was crucial to analyse the relationships between the primary variables/factors in order to fulfil the study's objectives. This involved identifying the connections between the barriers to quality management system adoption and the key elements needed for its success. On the other hand, it was also necessary to examine the connection between the key quality management components and the potential advantages of accomplishing these quality management practices being implemented. There are two main types of correlation: Spearman and Pearson (McLeod, 2019). The key difference between these two correlation types lies in their suitability for different types of data; Spearman is particularly well-suited for data derived from ordinal scales, such as the Likert scale or ranked scales, while Pearson is more fitting for data obtained from interval scales (McLeod, 2019).

Furthermore, the data analysis processes were primarily carried out using the Excel and SPSS software programmes (please see Chapter 5).

4.9.8 Chosen Research Techniques

The researcher used a mixed-method approach to gather data, including questionnaires and interviews to create background knowledge before developing a conceptual framework. The justification for employing a mixed methods approach, which integrates both qualitative and quantitative techniques for data collection and analysis, lies in its potential to enhance the overall data analysis process. This approach allows for the mitigation of the limitations inherent in one type of data by leveraging the strengths present in the other. This was then applied to real world scenarios (practice-based) in order to explore, obtain significant information, and comprehend the perceptions and values of applying quality management for building project performance. This suggests that a combination of qualitative and quantitative methods was utilised in the processes of data collection and analysis. Moreover, interviews with some

selected experts were conducted as part of an expert opinion poll to provide qualitative data, which were analysed using thematic data analysis. Experts from the GCI were selected based on their relevant experience and active engagement in construction projects. This approach allowed the researcher to address the second objective of the study. On the other hand, quantitative data were obtained through a questionnaire survey.

In summary, the following are the statistical analyses that were carried out:

- Reliability test to check consistency in the data sets
- Descriptive analysis of data sets to include mean, standard deviation, and percentages
- The internal consistency of the reduced data variables was evaluated using Cronbach's Alpha.
- Inferential statistics to draw conclusions about the relations between variables. These inferential statistics include Independent sample T-Test, Chi-square, Binary logistic regression, Spearman's correlation and,
- Factor analysis to minimise data set to aid in the development of the tool.

Table 4.7 presents a summary of the methodologies used to address the research objectives.

Table 4.7 Adopted Research methodologies to achieve the targeted objectives of this research

Stage	Research Objectives	Research Methods: Data Collection	Research Method: Data Analysis	Expected Outcome
1	To critically review existing literature on the concept of quality management systems, their standards and process improvement tools as applied in the construction industry	Literature Review	Critical Analysis	Questionnaire & Conceptual Framework

2	To investigate current quality management practices in the GCI	Literature Review & Questionnaire Survey	SPSS	Questionnaire & Conceptual Framework
3	To assess the critical success factors and limitations affecting the implementation of QMS in the GCI	Literature Review & Questionnaire Survey	SPSS	Refined Quality Assessment Tool
4	To develop and validate an appropriate assessment tool for the effective adoption and implementation of quality management practices in the GCI	Questionnaire Survey & Interviews	Qualitative	Refined Quality Assessment Tool (QMMM)

4.10 Triangulation

In the context of research, triangulation involves the integration of multiple datasets, methodologies, theoretical frameworks, and/or investigative approaches to effectively solve a research question (Bhandari, 2022). Triangulation is a methodology for analysing the findings of the same study utilising diverse data collection methods, such as demonstrated in Figure 4.8. It is used for three major purposes: to improve validity, to build a more detailed image of a research subject, and to investigate various approaches to understanding a research

problem (Nightingale, 2020). Creswell (2014) asserted that using a triangulation method adds more depth to research findings and also strengthens the validity of the research. Similarly, Noble (2019) demonstrated that triangulation in research helps to strengthen the credibility and validity of research findings.

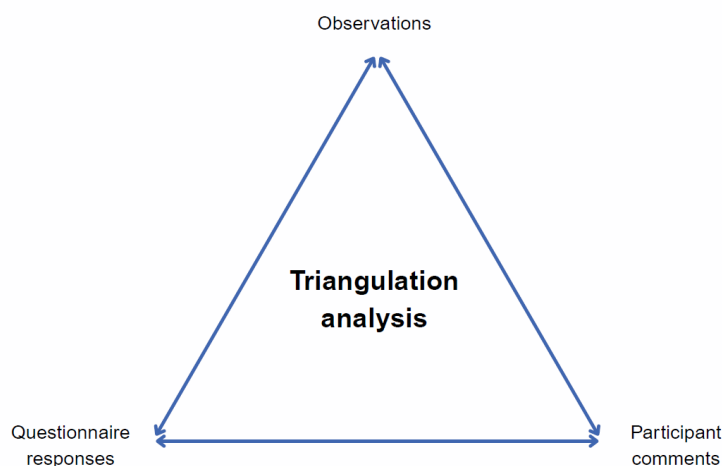


Figure 4.8 Triangulation analysis (Adapted from Barnum, 2021)

Furthermore, according to Bhandari (2022), researchers frequently use triangulation in their studies to document their thorough review and analysis of the data. This strategy improves the validity of their research by checking for mistakes in interpretation or measurement using numerous approaches and perspectives. Triangulation mixes quantitative methods with qualitative methods such that a group of respondents can be interviewed, and the other groups acts in response to a questionnaire (Gary, 2014). Yin (2014) acknowledged the importance of employing different methods and several sources of evidence; this enables a researcher to address a wide range of both behavioural and historical issues.

This study employed triangulation techniques utilising a mixed-method sequential exploratory design. The initial phase involves the collection and analysis of quantitative data, followed by the subsequent gathering and analysis of qualitative data. Survey results obtained from quantitative data complemented the interview results obtained from qualitative data which was attained from some construction professionals in the GCI. This enabled the development of the QMMM which is the outcome of this study.

4.11 Research Reliability and Validity

Reliability and validity are key measures for evaluating the quality of research (Middleton, 2022). They express how effectively a method, methodology, or test is viable. The reliability of a measure pertains to its consistency, while its accuracy is termed validity (Middleton, 2022). To diminish the risk of acquiring inaccurate outcomes while simultaneously bolstering

the credibility of the findings, greater emphasis should be placed on ensuring the validity and reliability of the used research techniques (Saunders et al., 2016).

4.11.1 Research Reliability

According to Middleton (2022), reliability is characterised by the extent to which a method consistently measures a specific construct. Problems related to reliability are sometimes tied to bias, suggesting that the use of a subjective approach by a researcher can undermine the reliability of the research findings (Bergman, 2002). While reliability is an important factor, it cannot be considered in isolation; thus, a test must be both valid and reliable to be effective (Oliver, 2010). By reducing biases, pilot studies aid in determining the dependability of research instruments.

Various techniques exist for assessing the reliability of data obtained from questionnaire surveys; nonetheless, Cronbach's Alpha stands out as the predominant method for evaluating inter-item reliability and internal consistency within such surveys (Pallant, 2020). Consequently, Cronbach's Alpha is commonly employed to ascertain the validity of scales constructed from multiple Likert-type questions in surveys or questionnaires. To evaluate the internal consistency and reliability of the questionnaire used in this research, the Cronbach's alpha coefficient was employed, given its relevance to Likert scale measurements, as indicated in Table 4.6. Figure 4.9 illustrates Cronbach's Alpha's values and its associated interpretations as seen below.

Cronbach's Alpha	Interpretation
$\alpha > 0.9$	Excellent
$\alpha > 0.8$	Good
$\alpha > 0.7$	Acceptable
$\alpha > 0.6$	Questionable
$\alpha > 0.5$	Poor

Figure 4.9 Interpretation of Cronbach's Alpha values (Elham et al., 2023)

4.11.2 Research Validity

Validity describes how correctly a method can measure what it is envisioned for (Fleetwood, 2022). The concept of validity is associated with the reliability of the research results, indicating that the findings must genuinely represent the subjects they are intended to address (Saunders et al., 2009). Survey research validity pertains to how well the survey captures the necessary variables; hence, validity is the ability of an instrument to measure what it was designed to measure (Dudovskiy, 2019).

The following steps were considered to ensure the validity of this research:

1. A suitable method of measurement was used, which was the questionnaire survey. Some of the questions were based on previous studies' findings and the others were based on some established theories in quality management.
2. A pilot study was carried out prior to the distribution of the main questionnaires.
3. Industry experts from the GCI and the researcher's main supervisor assisted during the pilot study process and the participants' opinions were deemed quite useful and were incorporated to finalise the questionnaire.
4. The targeted sample population used for the survey were some distinguished architectural/consulting firms, Project management firms and civil engineering firm as and associations under the GCI.

4.12 Ethical Consideration

Ethics encompasses the values and standards that aid in distinguishing between acceptable and unacceptable elements of research activities (Osei-Bonsu, 2018). It is imperative for researchers to adhere to ethical guidelines to maintain confidentiality and accountability throughout the research process. To effectively address ethical concerns in research, specific procedures must be implemented to guarantee thorough ethical evaluation.

4.12.1 Human Ethics

This research ensured that complete consent was acquired from each participant. Participant information sheets were disseminated to clarify the study's aims and the significance of their contributions. Informed consent forms accompanied these sheets, enabling participants to provide their consent for engaging in the online survey. To uphold confidentiality in data analysis, total anonymity was guaranteed. The research did not present any substantial risks, thereby safeguarding participants from any potential harm. These were done to attain an ethics approval from Brunel University for primary data to be effectively collected. Consequently, the researcher sought ethical approval following the application guidelines outlined by the Ethics Committee of Brunel University, which subsequently granted the approval (refer to the Appendix for details of the application).

4.13 Summary of Chapter Four

This chapter discussed the research methods and methodology that was used to accomplish the research aims and objectives; the first phase of this chapter involved a comprehensive review of the philosophical paradigms that served as the foundation for this research, as well as an exploration of the research approach and strategy. After a critical evaluation of various research approaches, pragmatism was selected as the philosophical framework guiding this study. The deductive approach was deemed the most appropriate research approach, and a

mixed-methods strategy, integrating both quantitative and qualitative elements, was employed. An evaluation of the strengths and weaknesses intrinsic to these approaches was conducted. The latter part of this chapter describes the four distinct stages of the research study: the creation of the questionnaire, the sampling methods employed, the data collection processes, and the analysis of the gathered data. Outcomes from this chapter enabled the development of the online questionnaire survey which was later analysed and interpreted as discussed in Chapter 5. This in turn, enabled the development of the QMMM in Chapter 6 through extractions from factor analysis supported with literature review. A summary of the chosen methods are highlighted in blue as shown in Figure 4.10 below.

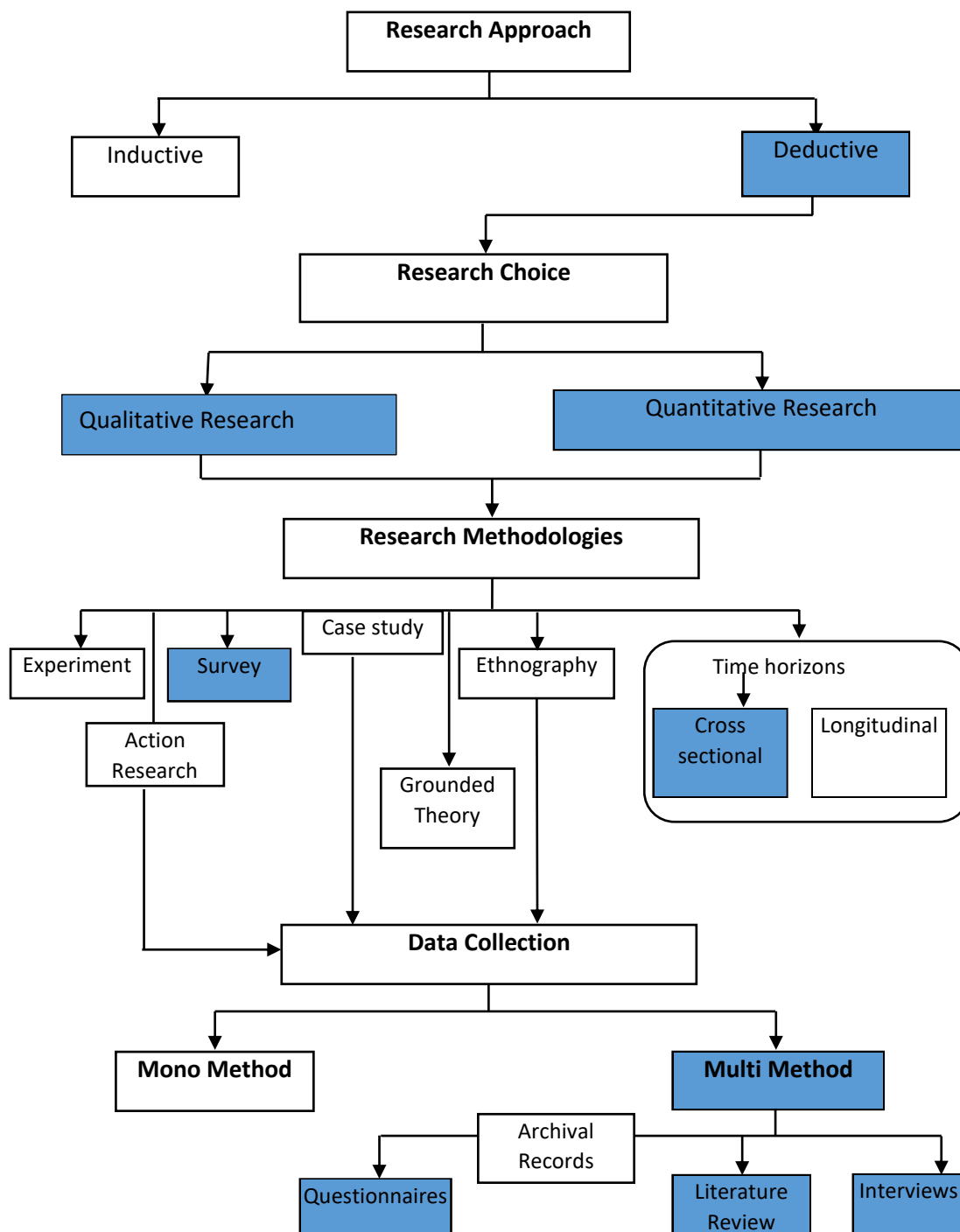


Figure 4.10 An overview of chosen research methods (Adapted from Osei-Bonsu, 2018)

CHAPTER 5: DATA ANALYSIS AND FINDINGS DISCUSSION

5.1 Introduction

This chapter provides an overview of the data gathered from an online distributed questionnaire survey. The questionnaire was completed by 142 personnels which included top managers, middle, and junior staff, and other employees within the Ghanaian construction organisations. Purposive sampling technique was used to sample construction professionals for this study. The principal findings contributed significantly to meeting the study's main goal of developing an assessment tool (in the form of a QMMM) for the implementation of quality management practices in the Ghanaian Construction Industry.

This chapter also provides a comprehensive discussion on the research findings and shows how it correlates with the literature review. In order to gather the relevant information required for the development of this tool, the following research questions were formulated and addressed by the survey questionnaire.

1. What are the existing practices regarding quality management systems in the GCI?
2. What are the limitations in current practice, and the best way to subdue them?
3. How can a suitable tool be formulated to effectively implement quality management practices within the GCI?

The primary data collected was first analysed using SPSS to find among other things, trends, various participating firms, and to identify factors influencing QMS compliance.

This chapter is divided into three main parts: the first focuses on descriptive data analysis, the second on inferential data analysis, and the third on a chapter summary.

5.2 Descriptive Data Analysis

The questionnaire was used to gather primary data amendable to the descriptive statistical analysis and was presented under three major sections. Section One (1) investigates the survey respondents' characteristics, including their respective organisations. Section Two (2) is divided into four major sub-sections that aims to identify the perception of QMS, investigate its importance, critical success factors, and barriers affecting its implementation process. Section Three (3) endeavours to generate responses on QMS documentation, effectiveness, and applicable tools and techniques.

5.3 Characteristics of Survey Respondents (Section 1)

This section uses tables and graphs to demonstrate the main characteristics of the respondents.

5.3.1 The Educational Level

The results from the descriptive statistics showed a total of 142 participants. For the educational level, Figure 5.1 illustrates the number of respondents based on the type of educational background and or level they possess. Figure 5.1 depicts that about 69 respondents (48.59%) have Master's/PhD, 68 respondents (47.89%) have Bachelor's degree and the remaining 5 respondents (3.52%) have Diploma/HND. Even though employees possessing Diplomas or Technical training backgrounds accounted for 3.52%, all representatives or respondents were incorporated into the analysis, as construction work is inherently technical and necessitates a higher level of skills and training.

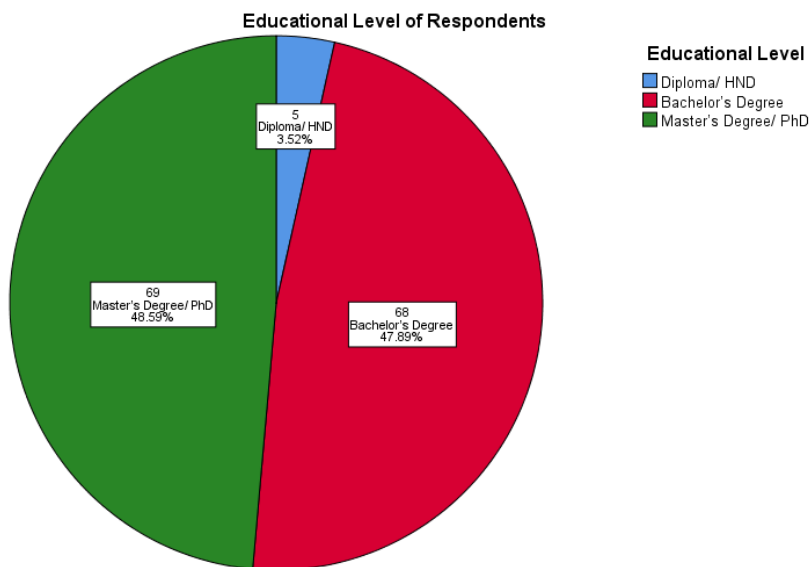


Figure 5.1 Educational Level of respondents

Figure 5.1 also depicts that percentage wise, the respondents with either Bachelor's Degree and, or Master's/PhD Degree are highly educated with 47.89% and 48.59% respectively, which is recommended in order to obtain all the necessary information's required in their respective fields and the construction industry as a whole. In addition, the educational level of the respondents suggest that these respondents are highly educated, that is; they have high knowledge about the construction industry, and have the relevant experience needed to assist in the continuity of this research. According to Valero (2021), it is critical to have educated and skilled employees as it helps with the effective development of quality management practices within organisations due to their knowledge and expertise. Furthermore, the competitive employment market in the construction sector, which rewards applicants with advanced degrees, also complements this survey findings; a larger proportion of Master's/PhD holders might signify a pool of individuals with advanced expertise in areas such as project management, quality control, or specific construction-related disciplines. This diversity in skills and knowledge can positively influence the implementation and refinement of QMS practices.

It is widely known that implementing QMS requires that all levels of employees must be educated, highly trained, and very capable of analysing information and solving various problems in their various organisations (Windapo & Umeokafor, 2022). As a result, one of the most significant indicators of having a successful implementation of quality management is the level and or, degree of education an employee possesses.

Several studies have highlighted the significance of educational qualification, more specifically in attaining higher education levels among employees within an organisation (Karimi & Taghaddos, 2019). Higher levels of education and technical skills are essential for building and managing projects due to their increasing complexity, driven by factors such as advancements in technology and sustainability regulations. This may account for the increased response rate observed among participants possessing higher academic qualifications. Additionally, the increasing focus on lifelong learning and professional growth in the construction sector can be one of the factors which influences people to pursue postgraduate degrees.

5.3.2 Type of Respondent's Organisation

Table 5.1: Participating Firms

Organisation	Frequency(N)	Percent (%)
Architectural Firm	21	14.8
Civil engineering / Consulting Firm	38	26.8
Construction Firm	40	28.2
Project Management Firm	43	30.3
Total	142	100.0

The respondents who participated in responding to the questionnaire survey came from different organisations. These organisations are: Architectural Firms, Civil/Consulting firms, Construction firms and Project Management firms. Based on the survey, 21 respondents participated from Architectural firms/organisations while 38 respondents also participated from Civil/Consulting firms in GCI. Similarly, 40 of the respondents were from Construction firms and the remaining 43 of the respondents were from Project Management firms. The data collected from the participating firms demonstrates that relevant industry-based personnels that possess knowledge in their various respective fields of work were selected to obtain vital information's needed for the continuity of this research, with the highest percentage of participants coming from Project Management firms (30.3%).

5.3.3 Size of respondents' organisation

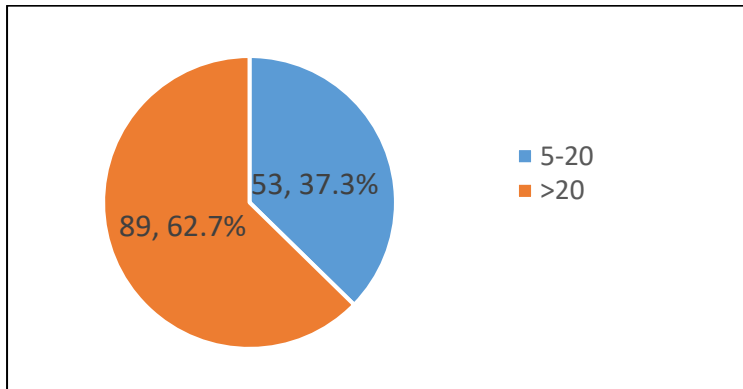


Figure 5.2: Size of respondents' organisation

The size of the respondents' organisation is illustrated in Figure 5.2, where approximately 63% of the respondents work in organisations with more than 20 employees whereas approximately 37% of the respondents are from organisations that have close to 20 employees as their organisation size.

Research by Dubey et al., (2018) argues that organisational size plays an important role in the effectiveness of QMS and not just leadership commitment. Research suggests that larger organisations tend to have more resources and capacity to implement comprehensive QMS practices (Oakland, 2014). These organisations may benefit from dedicated quality teams, sophisticated quality control processes, and more extensive documentation of quality procedures (Aksorn & Hadikusumo, 2008). A higher percentage of respondents from larger organisations could indicate greater emphasis on quality management infrastructure. Murmura and Bravi (2017) highlighted that, in comparing larger firms and smaller firms, smaller firms have fewer human resources and a small managerial capacity, even though their motives for achieving ISO 9001 certification may be centered on a better corporate image. Smaller organisations, on the other hand, may tend to face resource constraints that can impact the implementation of robust QMS practices. Their limited budgets and human resources might hinder their ability to invest in advanced quality control measures (Chen et al., 2022). However, smaller organisations often display flexibility and adaptability, which could lead to innovative and streamlined QMS approaches (Chin et al., 2004), as the insights gained from these studies are crucial in understanding the challenges and opportunities associated with the implementation of effective QMS practices.

5.3.4 The Role/Positions of the Participants

The questionnaire survey was distributed to participants who occupy various roles in construction organisations such as Architects, Civil/Structural Engineers, Contract Managers,

Project Managers, Quantity Surveyors, and Site Engineers. The respondents occupied mid-level to senior level positions in the organisations. In Figure 5.3, Architects, Site Engineers and Project Managers were each represented by 23 individuals (16.2%) respectively of the sample size. There were 31 Civil/Structural Engineers representing 21.8%, 22 Contract Managers representing 15.5%, 19 Quantity Surveyors representing 13.4%, and only 1 site Foreman/Supervisor representing 0.7% of the study population. Based on the respective roles and/ or positions they occupy within their organisations; they were deemed qualified to provide pertinent information regarding quality management systems in the Ghanaian construction industry.

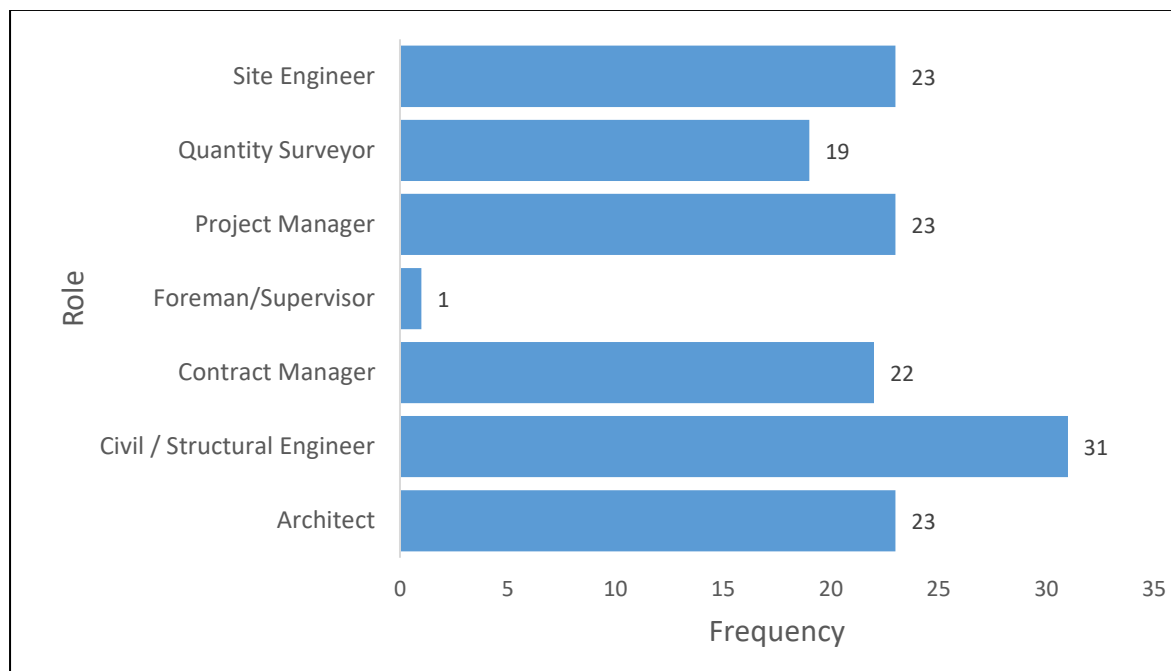


Figure 5.3: Participants' roles in organisation

Having different varied positions within an organisation helps in defining roles and responsibilities which is one of the critical success factors that affects the implementation of quality management systems. Literature supports the idea that a multi-stakeholder approach to quality management in construction is essential for comprehensive insights (Andrewis et al., 2018a). The varied respondents' roles and organisations represented in this study align with the perspective, ensuring a comprehensive exploration of quality management systems and practices in the GCI. Additionally, prior research highlights the significance of leadership and management roles in shaping organisational quality culture (Ansah, 2018), further justifying the importance of inclusion of mid-to-senior-level professionals in the study.

Overall, in assessing the characteristics of the survey respondents, it can be demonstrated that the respondents are highly experienced and knowledgeable, of which most are from relevant construction organisations, hence making them suitable for this research.

5.4 Respondents understanding and perceptions of key issues related to QMS (Section 2)

Four major questions were put forth for the participants to respond to, using Likert scales to indicate their level of agreement to statements formulated on vital issues of QMS. The issues included: “their perception of QMS”, “Importance of QMS”, “Critical success factors that influence QMS” and “Barriers that affect the implementation of QMS”.

The primary rationale for investigating QMS awareness and knowledge is because it offers a representation of respondents’ level of perception and understanding concerning issues associated with quality management in construction. According to Sallam (2018), knowledge is one of the most important intellectual assets that an organisation and or an industry needs to possess, and the construction industry is no different. As this industry is a project-based sector, it has a responsibility to manage project knowledge, as this influences an organisation’s performance (Sallam, 2018). It is therefore essential to critically evaluate QMS understanding, particularly amongst top managers and mid-level managers including supervisors, to determine their level of understanding and perceptions of QMS.

The analysed data of the responses to the questions with their mean and standard deviation scores are presented in the following sections.

5.4.1 Perception about Quality Management Systems

This section focused on how participants from various construction organisations view and understand the objective of QMS and its practices. Participants were requested to consider and rate their understanding of QMS (as expressed by 5 statements in Table 5.2) using a scale from 1 (strongly disagree) to 5 (strongly agree). Table 5.2 also presents descriptive statistics from the responses which include the mean (average) scores, and their corresponding standard deviations. The descriptive statistics intend to offer clearer understanding of the various responses provided by the respondents based on each indicator regarding QMS perception.

Table 5.2: Descriptive statistics on QMS Perception

Item	Indicators	Mean	Std. Deviation
P1	QMS can improve client satisfaction	4.44	0.525
P2	QMS provides the right guidelines which always ensures quality	4.44	0.539
P3	QMS reduces re-works on projects	4.55	0.540
P4	QMS focuses on continuous improvement	4.41	0.535
P5	Practicing QMS provides high profits for organisations	4.54	0.554
	OVERALL	4.48	0.539

The findings presented in Table 5.2 indicate that there were varying perceptions that existed over what constitutes quality. It is also evident from Table 5.2 that the mean values ranged from 4.41 to 4.55, which demonstrates that most of the respondents 'agree' to each of the indicators presented, regarding their views on QMS. The high mean scores align with literature suggesting that effective QMS implementation leads to enhanced client satisfaction, reduced re-works, continuous improvement, and improved profitability (Ahaotu, 2018). The consistently low standard deviations across the various indicators reflect a significant consensus among participants about the advantageous influence of QMS practices.

Taken together the responses on perception about Quality Management Systems, "QMS reduces re-works on projects" had the highest average score (mean = 4.55; SD =0.540) while the least item score came from "QMS focuses on continuous improvement" with a mean of 4.41 and SD of 0.535. All the indicators on QMS perception had an average score higher than 4.0 which exceeded the median of 3. This signifies that averagely; respondents agree that quality management systems present some benefits indicating a positive perception by the respondents.

The study findings, as reported in Table 5.2, highlight the reduction of re-works as highly ranked by the respondents. However, other studies by Aletaiby (2018) have a contrary point which suggested that client satisfaction was highly considered as how quality was perceived by interviewed respondents. Research conducted by Love et al., (2023) established that rework is one of the most common consequences of inferior quality in construction, which

validates the perception that implementing QMS can help to reduce or prevent its occurrence on a project or other works.

The positive perception of QMS practices also indicates a favourable organisational culture and a commitment to quality excellence. This perception can significantly influence employee motivation, engagement, and commitment to quality initiatives. However, while the high mean scores are encouraging, it is essential to ensure that these perceptions align with actual organisational practices and outcomes. Continuous assessment and improvement of QMS practices based on both perceptions and empirical data are crucial for sustained success. The overwhelmingly positive perception of QMS practices among respondents reflects a belief in its effectiveness in enhancing quality and ensuring continuous improvement.

Overall, it can be concluded that because majority of the respondents are highly educated as illustrated in Figure 5.1, most of them have the right perception about QMS within their various organisations.

5.4.2 Importance of QMS

There are several benefits of implementing QMS as highlighted in the literature review (see Chapter 2.4). This section presents the individual results regarding the importance of QMS. The respondents were asked to rank their experts' opinions by using a 5-point Likert scale to indicate their extent of agreement from 'strongly disagree (1)', 'disagree (2)', 'neither disagree nor agree (3)', 'agree (4)', and 'strongly agree (5)' in relation to key indicators of QMS importance, as listed in Table 5.3. For analysis purposes, a Relative Importance Index (RII) was used to calculate the weighted average/value in order to rank them based on their level of importance agreed by the respondents.

Table 5.3: Relative Importance of QMS importance

Indicators	Levels of Agreement using Likert scale					Mean	RII	Rank
	S.A	A	N	D	S.D			
Defines Roles and responsibilities	53	83	5	0	0	4.34	0.872	7
Results in less rework	90	51	1	0	0	4.63	0.925	5
Improves productivity	81	60	0	0	0	4.57	0.913	6
Provides high client satisfaction	105	36	0	0	0	4.74	0.953	1
Provides increased market share/profits	104	38	0	0	0	4.73	0.946	2
Less incidents (increased safety precautions)	91	51	0	0	0	4.64	0.928	4
Provides increased competitive advantage	96	45	1	0	0	4.67	0.934	3

In Table 5.3, the factor with the highest weight of Relative Importance Index (RII) denotes 'QMS provides high client satisfaction' whilst the lowest ranked RII represents the statement 'Defines Roles and Responsibilities'.

In terms of the awareness and understanding of the significance of QMS, the respondents ranked Client satisfaction as the most crucial factor when considering the significance of QMS within their companies, as indicated in Table 5.3. Neyestani (2016) examined the role of QMS in construction projects and concluded that the most critical elements for achieving project success are customer satisfaction, viewed as a key business objective, along with the iron triangle of cost, time, and quality. Similarly, Ahaotu (2018) reported high Customer satisfaction ranking with regards to QMS importance.

In this study, increased market shares/profits and increased competitive advantage were ranked 2nd and 3rd respectively by the respondents regarding QMS importance. These results are consistent with those reported in literature by Marafa Ribah & Singh (2023) and Delgado-Hernández & Palacios-Navarro (2023), as these scholars demonstrated that the above-mentioned factors ranked highest as the significance of implementing QMS in works. Similarly, Sweis & Jaradat (2021) also asserted that the application of QMS and ISO 9001 standards have an impact on companies by increasing their profits and giving them a competitive edge over other companies, provided that its being appropriately adhered to as required. The least ranked item by the respondents was the statement that says 'QMS defines roles and

responsibilities. However, in literature (Uche-uwadia, 2023), it has been reported that one of the effective practices of quality management is having a team with a well-defined roles and responsibilities for the benefit of the organisation.

5.4.3 Critical Success Factors affecting the implementation of QMS

This section presents descriptive statistics on critical success factors that impact the implementation of QMS. Respondents were requested to consider and rate their level of familiarity of key factors associated with QMS (as expressed by 10 statements in Table 5.4) employing a Likert scale that ranges from 1 (strongly disagree) to 5 (strongly agree). Table 5.4 also presents descriptive statistics from the responses which include the mean (average) scores, and their corresponding standard deviations.

The results in Table 5.4 suggest that the respondents have a comprehensive understanding of the critical success factors that drive QMS processes. Hence, it is evident that the extensive familiarity can be attributed to the utilisation of Quality Management Systems (QMS) by most Ghanaian construction organisations, as highlighted in Table 5.6.

Table 5.4: Descriptive statistics on Critical Success Factors

Item	Critical Success Factors	Mean	Std. Deviation
CF1	Quality Education	4.46	0.514
CF2	Employees' Involvement	4.33	0.530
CF3	Organisational culture	4.45	0.527
CF4	Top management commitment and leadership	4.71	0.455
CF5	Subcontractors and suppliers' assessment procedures	3.84	0.554
CF6	Long-term relationships with subcontractors and suppliers	3.96	0.504
CF7	Legislative instrument in operation	4.59	0.535
CF8	Client satisfaction	4.68	0.499
CF9	Communication between Top Managers and employees	4.57	0.511
CF10	Teamwork	4.54	0.514

Overall, the mean scores for all critical success factors were above 4, indicating that they are all considered to be important for successful QMS implementation. However, there is some variation in the scores with "Top management commitment and leadership" having the highest mean score (4.71) and "Subcontractors and suppliers' assessment procedures" having the lowest mean score (3.84). This indicates that although all factors hold significance, certain ones may necessitate greater focus than others.

The top three critical success factors based on mean scores were Top management commitment and leadership (CF4), Client satisfaction (CF8), and Legislative instrument in operation (CF7). This demonstrates that strong leadership, focus on client satisfaction, and a supportive regulatory environment are essential for successful QMS implementation in construction. Additionally, this suggests that these factors are particularly critical for successful QMS implementation in the construction industry. It is important to ensure that top management is committed to QMS and that there is a strong focus on client satisfaction.

The majority of the proposed key QMS factors agreed by respondents, such as the Top management and leadership commitment, Legislative instrument in operation, Client satisfaction, Communication between top management and employees, and Teamwork comply with the requirements of the ISO 9001 standard. These results are comparable to those of Khatatbeh (2022), which concluded that critical success factors such as teamwork, employee involvement, etc. highlight the importance of construction engineering in the process of achieving ISO 9001 standards in an organisation.

Furthermore, these findings correlate with other studies that examine critical success factors in the construction industry. Kareem & Ulutagay (2022) reported that critical success factors for QMS in the construction industry include leadership, top management commitment and involvement, and the identification of crucial elements impacting QMS application.

It is interesting to note that the mean scores for "Subcontractors and suppliers' assessment procedures" and "Long-term relationships with subcontractors and suppliers" were low. This indicates that these factors could highlight potential areas for enhancement in the construction industry. It is important to develop effective procedures for assessing subcontractors and suppliers, and to build strong long-term relationships with them.

Generally, these results suggest a clear hierarchy of perceived critical success factors for QMS in the construction industry, emphasising the paramount importance of top management commitment, client satisfaction, and compliance with legislative requirements.

Communication, organisational culture, and employee involvement also play significant roles, while subcontractor/supplier relationships and teamwork were viewed with slightly lower importance or varying degrees of significance among respondents.

5.4.4 QMS Barriers

There are several barriers that impede the successful implementation of QMS as discussed in the literature review (see Chapter 2.5). This section presents individual responses regarding the barriers of QMS. The respondents were asked to rank their choices or opinions by using the Likert scale to either 'strongly disagree (SD)', 'disagree (D)', 'neither disagree nor agree (N)', 'agree (A)', and 'strongly agree (SA)' to the various statements (indicators) that were provided.

Table 5.5: Relative Importance Index (RII) results on barriers affecting QMS implementation

Indicators	Levels of Agreement using Likert scale					Mean	RII	Rank
	S.A	A	N	D	S.D			
Inadequate training & education	102	40	0	0	0	4.72	0.944	1
Low bid on sub-contractor selection	25	91	25	0	0	4.00	0.799	8
Lack of employees' involvement	77	62	1	0	0	4.54	0.904	7
Ineffective communication between top managers and employees	94	47	0	0	0	4.67	0.931	5
Financial constraints & insufficient resources	95	42	2	0	0	4.67	0.927	6
The notion that practicing QMS is time consuming & costly	100	41	0	0	0	4.71	0.939	2
Various requests from documentations on requirements	96	45	1	0	0	4.67	0.934	4
Lack of enforcement of legislative measures	98	43	1	0	0	4.68	0.937	3

Research by De Silva et al., (2023) states that the most important barriers to the implementation of quality management practices in the construction industry include lack of capabilities of staff, higher cost of training, lack of project compliance monitoring, and

assessment of technical competence of subcontractors. However, as indicated in Table 5.5, this study identified eight significant barriers through a Likert scale survey, with "Inadequate training & education" emerging as the most prominent concern (mean score = 4.72, Relative Importance Index = 0.944). This finding aligns with previous research highlighting the critical role of training and education in equipping construction personnel with the necessary knowledge and skills in order to effectively implement QMS procedures (Kareem & Ulutagay, 2022). The lack of awareness and understanding of QMS principles and practices can lead to misinterpretation, inefficient application, and compromised project quality. According to Chiarini (2017), quality managers asserted that the absence of sufficient training leads to poor quality products, services, and client displeasure. Several writers have pointed out the critical role of human resources and the significance of training, which are deemed vital for the successful integration of quality management practices and the enhancement of business performance (Oakland & Morris, 2013). Experts in the field of quality assert that training is a fundamental aspect of quality implementation and requires a commitment of financial resources (Aburas, 2020).

Interestingly, this study also revealed that the "Notion that practicing QMS is time-consuming & costly" ranked second (mean score = 4.71, RII = 0.939). This perception, while not as widely documented in literature as inadequate training, resonates with concerns raised by some authors regarding the perceived resource burden associated with QMS implementation (Rashed & Othman, 2015a).

Furthermore, the study identified "Lack of enforcement of legislative measures" as the third most significant barrier (mean score = 4.68, RII = 0.937). This finding suggests that the effectiveness of QMS implementation can be hampered by inadequate regulatory frameworks and enforcement mechanisms. Research supports this notion, emphasising the importance of robust regulatory environments in promoting and ensuring compliance with QMS standards within the construction industry (Mokwena, 2020).

Other notable barriers identified in the study include "Ineffective communication between top managers and employees," "Financial constraints & insufficient resources," "Lack of employees' involvement," and "Various requests from documentations on requirements". These findings highlight the importance of holistic approaches to QMS implementation that address communication gaps, resource limitations, employee engagement, and documentation clarity.

5.5 QMS Compliance and Practices of Standards (Section 3)

This section presents visual representations in both graphical and tabular forms illustrating the responses generated for QMS Compliance and practice standards.

Table 5.6: QMS Compliance among Participants

Response	Frequency (N=142)	Percentage (100%)
Does your organisation have an adopted QMS in practice?		
No	7	4.9
Yes	130	91.5
Maybe	5	3.5
Does your organisation have an approved quality strategy/plan designed by the top management?		
*Yes	140	98.6
Maybe	1	0.7
Is your organisation's QMS certified in accordance with ISO 9001 international standard or any other standard?		
No	23	16.2
Yes	93	65.5
Maybe	26	18.3
Is your organisation's QMS certificate still valid?		
No	31	21.8
Yes	69	48.6
Maybe	42	29.6
Overall Compliance score		
Non-Compliant	50	35.2
Compliant	92	64.8

The survey reveals a positive trend with 91.5% of respondents indicating that their organisations have adopted QMS in practice. This strong presence suggests a growing recognition of the value that QMS provides in managing construction projects effectively. Additionally, the majority of respondents (98.6%) reported having a top management designed quality strategy, further emphasising their commitment to quality within their organisations. Only 65.5% of the various organisations have their QMS certified against ISO 9001 or other

standards. This indicates that there is a potential gap between implementing QMS principles and formally verifying their effectiveness through external audits (Abd Ghani, 2021). Furthermore, 21.8% of organisations have QMS certificates that are no longer valid, raising concerns about ongoing maintenance and commitment to continuous improvement. Despite the positive aspects, 35.2% of participants were categorised as non-compliant based on their responses even though 64.8% of the participants were categorised as compliant. This highlights the need for further efforts to bridge the gap between having an adopted QMS and actively adhering to its principles or practices. Specific areas for improvement might include enhancing employee engagement, strengthening internal audits, and ensuring resources are adequately allocated for effective QMS implementation.

Following the assessment of compliance, practice of standards amongst the respondents were also evaluated by posing certain relevant questions as follows:

Question: Does your organisation have an assessment tool in place to check quality?

From Figure 5.4, it depicts that 93% of the respondents indicated that their organisations do not have a quality assessment tool in place to check quality whilst 7% of the respondents established a certainty that the organisation uses an assessment tool to implement quality. This necessitates the need for a development of an assessment tool as it is of great importance for improving quality management practices in an organisation.

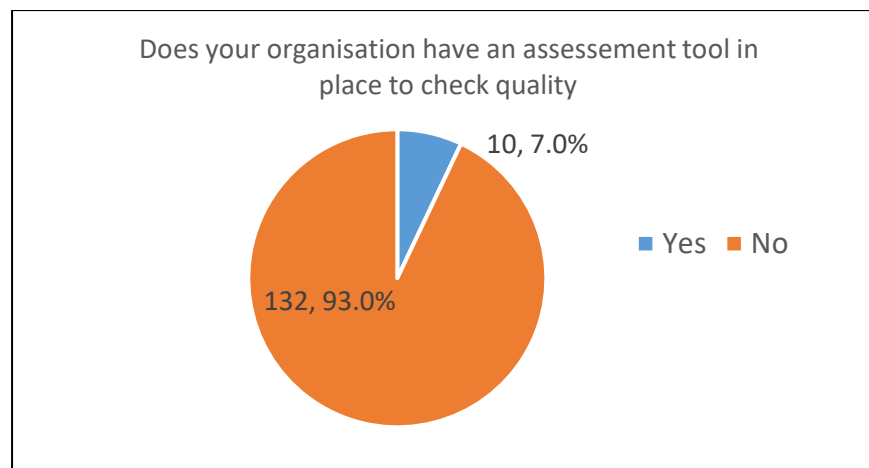


Figure 5.4: Respondents feedback on possession of a quality assessment tool

Question: Is project review done after the close-out of the project?

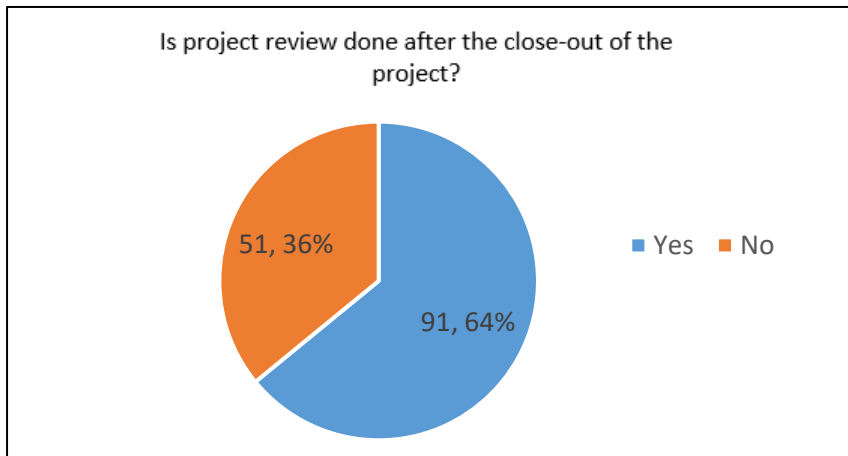


Figure 5.5: Respondents' views on project review

According to the findings, 64% of the respondents affirmed that project reviews take place after the completion of projects, in contrast to 36% who claimed that project reviews are not conducted following a successful project closure.

Question: Does your organisation gather data to assess performance of operations or works?

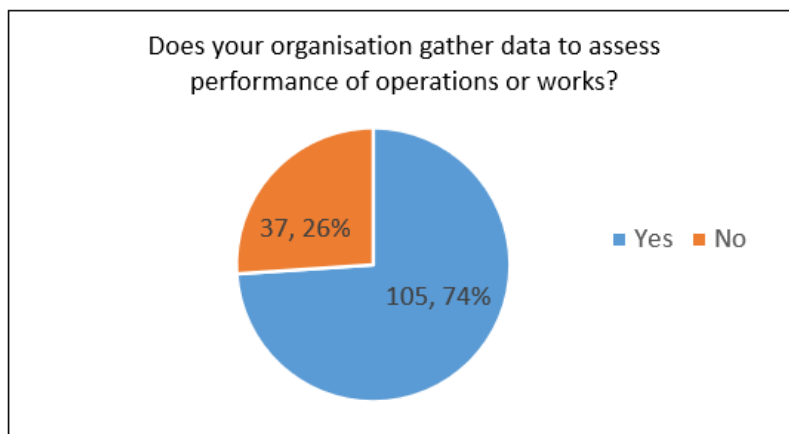


Figure 5.6: Response on the use of data to assess works

Figure 5.6 reveals that the majority of respondents, accounting for 74%, responded affirmatively to the question of whether their organisations collect data to evaluate the performance of ongoing and completed work. In contrast, 26% of the respondents reported that they do not collect data to assess the performance of their operations or completed projects.

Question: If 'Yes', please select the form of data acquisition procedure that is carried out in your organisation

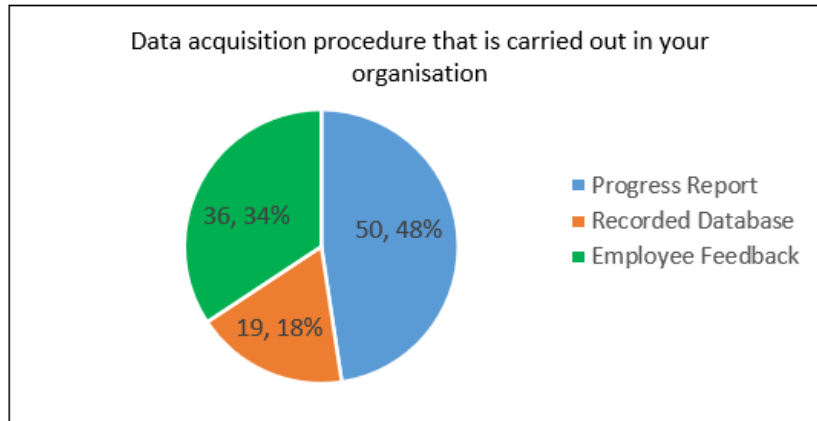


Figure 5.7: Response on data acquisition procedure

In reference to the 105 respondents who answered 'Yes' in Figure 5.6, Figure 5.7 reveals that 48% of them consider progress reports to be the primary avenue for obtaining project-related data. In addition, 34% and 18% of the respondents cited employee feedback and recorded databases, respectively, as significant sources of data acquisition within their organisations, as indicated in Figure 5.7.

Implementing QMS practice standards in the construction industry requires best practices. These encompass performing business analysis, engaging in preliminary planning, enhancing awareness, providing specialised training, managing documentation, implementing measurement and control systems, conducting audits, and fostering continuous improvement (Vishe, 2023). Regular compliance, inspections and auditing appeared as important factors in a study by Elsokhn & Ezeldin (2023) in the facilitation of quality management practices. Additionally, careful selection of materials, production techniques, and quality control measures are necessary to ensure compliance with standards and specifications in infrastructural projects (Akkaya & Taşdemir, 2023).

5.5.1 QMS Effectiveness

This section focuses on indicators that demonstrate the effectiveness of QMS implemented in various construction organisations. The results presented in Table 5.7 identified key indicators of QMS effectiveness with its corresponding mean scores and standard deviations.

Table 5.7: Descriptive statistics on QMS effectiveness (Evidence of QMS effectiveness)

Item	Indicators	Mean	Std. Deviation
QE1	Your organisation has an effective	4.57	0.525
	quality reporting structure		
QE2	The adopted QMS method is	4.59	0.548
	implemented effectively		
QE3	Organisation has a process for effectively managing quality documents	4.67	0.487
QE4	Your organisation keeps records of previous work	4.73	0.479
	OVERALL	4.64	0.509

The findings from the survey underscore a positive result. With an average mean score exceeding 4.5 for all four indicators, respondents expressed confidence in their organisation's quality reporting structure (4.57), QMS implementation (4.59), quality document management (4.67), and record-keeping of previous work (4.73). Nevertheless, it is important to transcend basic averages and analyse the variations inherent in these indicators. The effectiveness of the quality reporting structure hinges on its ability to accurately capture data, analyse trends, and inform decision-making. Clear communication and easy access to reports are crucial for cultivating a culture of quality enhancement. Similarly, an implemented QMS method's effectiveness depends on its suitability in reference to the specific needs and context of the construction organisation. A one-size-fits-all approach rarely works, and tailoring a QMS to address unique challenges is key to maximising its effectiveness (Adatsi, 2024).

Examining these indicators through a comparative lens reveals interesting parallels with existing research. Some authors highlight the importance of communication, training, and top-management commitment for effective QMS implementation, resonating with the emphasis on having proper documentation reporting structures and tailored methods (Neyestani, 2016).

Aburas (2020) underscores the need for robust documentation and record-keeping which aligns with the survey findings on quality document management and past project records. A well-defined system for creating, storing, and updating documents ensures consistency, prevents errors, and readily equips personnel with the necessary information to perform their tasks. Finally, the practice of keeping records of previous work serves as a valuable repository

of knowledge. Analysing past projects, identifying successes and failures, and applying those learnings to future endeavours forms the bedrock of continuous improvement.

5.5.2 QMS Tools and Techniques

This section presents the individual responses regarding the use of QMS tools and techniques as indicated in Table 5.8. The respondents were asked to rank their choices or opinions by using the Likert scale with options such as 'Always', 'Often', 'Sometimes', 'Seldom/Rare', and 'Never' to the various tools and techniques provided.

Table 5.8: Descriptive statistics on QMS Tools and Techniques

Tools	Mean	Std. Deviation
Benchmarking	4.53	0.529
Six Sigma	1.63	0.849
Lean	1.51	0.628
Flow chart	3.39	0.866
European Foundation for Quality Management (EFQM)	4.29	0.900
Kaizen	1.70	0.797
Cause and Effect Diagram	2.25	1.135
Histogram	1.39	0.753
Pareto Analysis	1.05	0.301
Total Quality Management	4.37	0.689

The survey reveals a clear preference for holistic approaches to quality management with benchmarking (mean score = 4.53) taking the top. This aligns with findings from previous studies, which emphasises the importance of comparing performance against established benchmarks to identify areas for improvement (Androwis et al., 2018). Additionally, Total Quality Management (TQM) (mean score = 4.37) receives significant adoption, reflecting a commitment to continuous improvement and employee involvement, as advocated by Aburas (2020).

However, the low scores for specific tools like Six Sigma (mean score = 1.63), Lean (mean score = 1.51), and Cause and Effect Diagram (mean score = 2.25) suggest a potential gap between theoretical understanding and practical implementation. While these tools offer

structured methodologies for problem-solving and process optimisation, their application within the dynamic and often resource-constrained environment of construction projects might require further adaptation and training.

Furthermore, the survey highlights the importance of simple visual tools like flow charts (mean score = 3.39) and the EFQM model (mean score = 4.29). These findings align with research by Saeed et al., (2021) which demonstrates that applying QMS tools enables the effective application of quality management practices in construction organisations.

5.5.3 Measures for QMS success

This section focuses on measures that ensure QMS success in various construction organisations. This study's focus on QMS success measures reveals valuable insights into what defines QMS effectiveness within the construction sector according to respondents, as indicated in Table 5.9.

Table 5.9: Descriptive statistics on QMS success measures

Item	Indicators	Mean	Std. Deviation
QS1	Projects must meet the acceptable standards	4.73	0.448
QS2	Projects delivered within acceptable timeframe, budget and quality standards	4.79	0.410
QS3	Projects delivered within acceptable sustainability standards	4.75	0.434
QS4	Field Supervisors to check that materials being used are of approved quality and standards	4.66	0.504
:	OVERALL	4.73	0.449

The data reveals a clear consensus among respondents: Projects delivered within an acceptable timeframe, budget and quality standards sit atop the hierarchy of success measures, with a mean score of 4.79 on a 5-point Likert scale. This finding highlights the industry's recognition of the delicate balance between timely completion, resource allocation, and achieving exceptional standards. Notably, achieving projects of high sustainability closely follows with a mean score of 4.75, highlighting the growing emphasis on environmentally sustainable construction practices. Additionally, adherence to acceptable standards had a

mean score of 4.73. This underscores the fundamental role of meeting established benchmarks as a cornerstone of quality construction.

While these top-ranking indicators paint a promising picture, the data also reveals a potential area for improvement. Ensuring that field supervisors consistently inspect the quality of materials used recorded the lowest mean score of 4.66. This suggests that, while the importance of high-quality materials is acknowledged, consistent on-site inspection might require further attention. This finding aligns with previous studies which emphasised the crucial role of site supervision in maintaining QMS effectiveness as a measure of ensuring success in its implementation process (Rashed & Othman, 2015).

5.6 Inferential Statistics

This section presents the application of inferential statistics to analyse the relationships between various variables in this study.

This analysis seeks to extract meaningful insights from a valid sample of the study, which can then be applied to a larger population.

5.6.1 Comparison of Knowledge on QMS among type of organisation and organisation size

The Independent Sample T-Test was conducted to determine whether the difference in level of knowledge between subgroups was significant. Following the outcome, it can be concluded from the p-values computed (**P-value <0.05**) that there was statistically significant difference in knowledge score between the subcategories under organisation size ($P=0.031$), thus respondents who belong to organisations with size greater than 20 members demonstrated sufficient knowledge about QMS compared to respondents in organisations with membership less than 20.

Also, in comparing the knowledge level amongst organisations, P-value computed (**P-value =0.039**) suggests, there is a statistically significant difference in the knowledge level between construction firms and project management firms. This implies that respondents who belong to project management firms demonstrate sufficient knowledge about QMS compared to respondents in construction firms. The remaining comparison among firms did not show any statistically significance difference in knowledge level (**P- value>0.05**).

Table 5.10: Comparison of Knowledge level among various sub-categories

		Knowledge		Independent	Sample
				Test	
		Insufficient	Sufficient	t	P-value
Organisation size	5-20	19	34	-2.181	0.031
	>20	22	67		
Organisation	Architectural firm	7	14	-0.206	0.838
	Civil Engineering firm	13	25		
	Architectural firm	7	14	0.322	0.749
	Construction firm	15	25		
	Architectural firm	7	14	-1.432	0.157
	Project Management firm	6	37		
	Civil Engineering firm	13	25	0.652	0.517
	Construction firm	15	25		
	Civil Engineering firm	13	25	-1.500	0.138
	Project Management firm	6	37		
	Construction firm	15	25	-2.099	0.039
	Project Management firm	6	37		

5.6.2 Comparison of QMS Compliance among type of organisation and organisation size

The Independent Sample T-Test was conducted to check whether the difference in level of compliance between sub-groups was significant. Following the outcome, it can be concluded from the P-values computed (P-value >0.05) that there was no statistically significant difference in compliance between the various sub-categories under organisation size and organisation type.

Table 5.11: Comparison of compliance level among various sub-categories

		Compliance		Independent Sample Test	
		Non-Compliant	Compliant	t	P-value
Organisation size	5-20	20	33	-1.189	0.236
	>20	30	59		
Organisation	Architectural firm	6	15	0.498	0.621
	Civil Engineering firm	13	25		
	Architectural firm	6	15	1.021	0.312
	Construction firm	18	22		
	Architectural firm	6	15	0.271	0.787
	Project Management firm	13	30		
	Civil Engineering firm	13	25	0.719	0.474
	Construction firm	18	22		
	Civil Engineering firm	13	25	-0.287	0.775
	Project Management firm	13	30		
Organisation	Construction firm	18	22	-1.005	0.318
	Project Management firm	13	30		

5.6.3 Chi square test on respondents' compliance to QMS

A chi square test was conducted to ascertain the respondent's compliance to QMS. A null hypothesis (H_0) was established, positing that no relationship exists between the paired categorical variables. Conversely, the alternative hypothesis (H_a) asserts that a relationship does exist between these variables. When the computed p-values are less than or equal to the alpha level of 0.05, the null hypothesis is rejected, leading to the conclusion that a significant relationship is present between the paired parameters under investigation. In contrast, p-values exceeding the alpha threshold of 0.05 indicate acceptance of the null

hypothesis, suggesting that the relationship between the paired parameters is not significant. In Table 5.12, it is evident that none of the demographic features has a significant relationship with compliance to QMS standards, thus, whether an organisation is compliant or not, is independent of these features.

Table 5.12: Pearson Chi Square Test

Demographics		Value
Educational Level	Chi-square	3.480
	df	2
	P- value	0.176
Respondents Organisations	Chi-square	2.570
	df	3
	P- value	0.463
Organisation Size	Chi-square	0.236
	df	1
	P- value	0.627

5.6.4 Spearman's Test

The spearman's rank correlation coefficient was employed to analyse the ordinal data sets derived from the survey. From Appendix A, it is evident that there is a significant relationship between Perception (Awareness of QMS) and Barriers, as it shows Sig. (2-tailed) = .000 and a correlation coefficient value of **0.369** depicting a low positive correlation between the two variables. Similarly, for the purpose of the tool development, the relationship between Critical Success Factors and barriers affecting QMS implementation was checked. It was identified that a moderate positive correlation exists between the two variables (correlation coefficient value of **.0421**) and thus, there is a significant relationship between Critical Success Factors and Barriers (Sig. 2-tailed) = .000). Additionally, it is illustrated in Appendix A that, there is a significant relationship between Perception and Critical Success Factors, as it demonstrates a Sig. (2-tailed) = .000 and a coefficient value of **.380** depicting a low positive correlation between them. Additionally, a weak positive correlation (rho **.330**) exists between Critical Success Factors and Evidence of QMS Effectiveness which also shows a significant relationship between the two variables (Sig. (2-tailed) = .000).

5.6.5 Binary Logistic Regression

Logistic regression serves as a crucial function in classification and the construction of models. In many business environments, it is often challenging for individuals to evaluate responses in a definitive manner (Demuyakor and Geng, 2022). Thus, there arises a necessity to embed a concept of likelihood or probability within the framework. Logistic regression is instrumental in this scenario, particularly when the dependent variable is categorical, potentially involving two or more categories. To address the situation of a dependent variable with two categories

(whether there is an indication of QMS compliance or not), a binomial logistic regression technique was adopted.

5.6.5.1 Classification for Likelihood of Compliant or Non-compliant

This research employs a binary logistic regression model to assess the probability of respondents adhering to or deviating from QMS standards. The results of the model's classification indicate a prediction regarding the likelihood of compliance, which is illustrated in Figure 5.8 below.

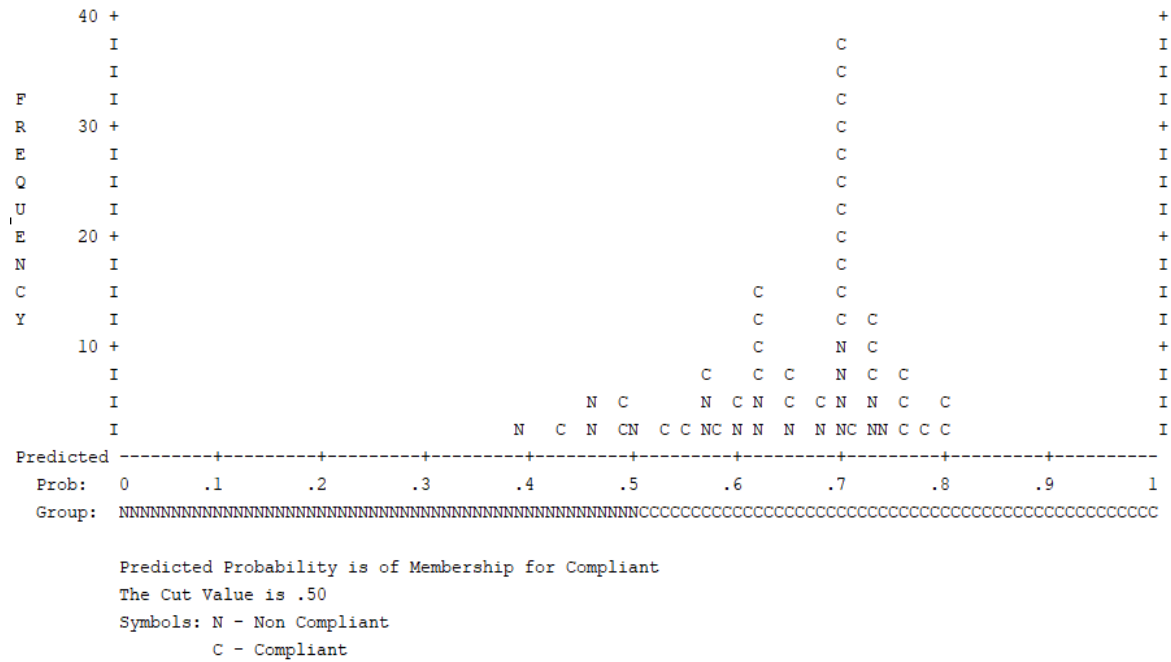


Figure 5.8 Likelihood of compliance or non-compliance using binary regression model

Therefore the generalised model equation is given as:

$$\text{Logit (compliant)} = \ln(1-p) = a + \beta_1 * \text{importance score} + \beta_2 * \text{effectiveness score} + \beta_3 * \text{knowledge score}$$

There is the need to figure out all the regression coefficients and predict whether a typical case is likely to be compliant. The summary of the logistic regression is shown in Table 5.14 as follows:

Table 5.13: Hosmer and Lemeshow Test

Step	Chi-square	df	P-value
1	14.458	8	0.071

The P- value of 0.071 (>0.05) indicates that the theoretical model fits the data, rejecting the null hypothesis that the model does not fit the data.

Table 5.14: Model Accuracy

Observed		Predicted		
		Compliance Category		Percentage
		Non-	Compliant	Correct
		Compliant		
Compliance Category	Non-Compliant	9	41	18.0
	Compliant	10	82	89.1
Overall Percentage				64.1

The cut value is .500

It can be seen from the above table that, the model accuracy of 64.1% can be deemed satisfactory.

Model Equation Summary

The model equation incorporates all categorical independent variables and presents essential parameters as outlined below:

B (Unstandardised Beta): These coefficients represent the parameters of the regression equation.

S.E.: The standard error indicates the precision of the sample mean in relation to the actual population mean. An increase in the standard error suggests a greater dispersion of the means, thereby increasing the likelihood that any specific mean may not accurately reflect the true population mean.

P-value: This value is employed to evaluate the statistical relevance of a specific attribute in the study. P-values that are greater than 0.05 suggest that the independent variable of interest has an insignificant effect on the dependent variable. On the other hand, P-values that fall below 0.05 indicate a significant effect of the independent variable on the dependent variable.

Exp (B): This term refers to the odds ratio, which measures the strength of the relationship between two events, A and B. An Exp (B) value greater than 1.0 indicates a higher likelihood of occurrence, while an Exp (B) value less than 1.0 suggests a lower likelihood.

Table 5.15: Illustration of independent variables for model equation

Independent variables	B	S.E.	df	P- value	Exp(B)
Importance score	-0.004	0.679	1	0.996	0.996
Effectiveness score	-0.553	0.557	1	0.321	0.575
Knowledge score	0.356	0.148	1	0.016	1.428
Constant	-3.512	3.455	1	0.309	0.030

The final Model Equation is given as:

$$\text{Logit (Compliant)} = \ln(p/1-p) = - 3.512 - 0.004 \cdot \text{Importance score} - 0.553 \cdot \text{Effectiveness score} + 0.356 \cdot \text{knowledge score}$$

Interpretation

Importance score: Considering the independent variable “QMS importance score”, the calculated odds ratio ($\text{Exp}(B) < 1.0$) suggests that the importance of QMS is less likely to lead to QMS compliance.

Effectiveness score: Considering the independent variable “Effectiveness of QMS”, the calculated odds ratio ($\text{Exp}(B) < 1.0$) suggest the effectiveness of QMS practice in firms is less likely to lead to QMS compliance.

Knowledge score: Considering the independent variable “knowledge about QMS” the calculated odds ratio ($\text{Exp}(B) > 1.0$) suggests that Knowledge about QMS is more likely to lead to QMS compliance. The Beta value ($B=0.356$) suggests a positive correlation between knowledge about QMS practice and compliance with QMS standards. The outcome of the table suggests that knowledge scores significantly influence the compliance of QMS amongst the respondents. (P value=0.016).

5.7 Factor Analysis

Before factor analysis was done, a reliability test was performed for each of the factors to identify which factors were reliable. To justify this, for an acceptable reliability test, a Cronbach Alpha should be more than 0.7 for 10 or more items and Cronbach Alpha > 0.5 for less than 10 items (see Chapter 4.11). This was done as a benchmark to specify the number of components to be used for factor analysis. As a result, 6 components were found reliable for this purpose. For this section, a KMO and Bartlett Test, Total Variance of the 6 components and a Pattern matrix will be presented with the outcome of the analysed data.

Table 5.16: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.707
Bartlett's Test of Sphericity	Approx. Chi-Square	805.599
	df	171
	Sig.	0.000

The first step in factor analysis is to establish whether the data has the necessary properties. Variables that show weak or non-existent relationships are deemed inappropriate for factor analysis. Therefore, the subsequent tests were carried out to ascertain the adequacy of the data for factor analysis: the KMO statistic and Bartlett's test for each individual variable. The KMO and Bartlett tests take into account all relevant data. Wicklin (2022) established that a KMO score greater than 0.5 and a significance threshold for the Bartlett's test less than 0.05 indicate that there is strong correlation in the data, hence, Table 5.16 shows a KMO value of **0.707** which signifies a good level of acceptance. The Bartlett's test produced a significance level of 0.000 ($p < .001$), indicating that the correlation between variables was statistically significant for a principal components analysis for the development of a tool.

Total Variance Explained

Table 5.17 presents the six (6) factors used for the factor analysis. The cumulative variance derived for the components that were analysed was 64.23%. According to Akhtar (2020), when the variance explained is 35%, it indicates that the data is not significant and that the measures, as well as the data collection procedure, may need to be revisited. Therefore, since the cumulative variance explained is more than 60%, it is deemed appropriate for a model development.

Table 5.17: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.436	23.348	23.348	4.436	23.348	23.348	3.164
2	2.025	10.656	34.004	2.025	10.656	34.004	2.014
3	1.633	8.594	42.598	1.633	8.594	42.598	2.337
4	1.575	8.291	50.889	1.575	8.291	50.889	2.318
5	1.327	6.983	57.872	1.327	6.983	57.872	2.921
6	1.209	6.363	64.234	1.209	6.363	64.234	1.315

Extraction Method: Principal Component Analysis.

a. When components show correlation, the sums of squared loadings cannot be combined to calculate a total variance.

Table 5.18: Pattern Matrix

	Component					
	1	2	3	4	5	6
QMS perception: QMS provides the right guidelines which always ensures quality						0.535
QMS perception: QMS focuses on continuous improvement						.754
QMS importance: Results in less Rework				.658		
QMS importance: Less incidents on site (increased safety precautions)				.757		
QMS importance: Increased competitive advantage				.778		
Barriers affecting QMS implementation: Low bid sub-contractors' selection			.612			
Barriers affecting QMS implementation: Lack of employees' involvement			.776			

Barriers affecting QMS implementation: Ineffective communication between top managers and employees			.758			
Barriers affecting QMS implementation: Financial constraints and Insufficient resources			.528			
QMS practice standards: Does your organisation have an adopted QMS in practice?		.571				
QMS practice standards: Is your organisation's QMS certified in accordance with ISO 9001 international standard or any other standard?		.900				
QMS practice standards: Is your organisation's QMS certificate still valid?		.857				
Measures for QMS success: Projects must meet the acceptable standards					.811	
Measures for QMS success: Delivering projects within a specified timeframe and budget while ensuring high quality standard					.891	
Measures for QMS success: Achieving projects of high sustainability					.741	
QMS effectiveness: Your organisation has an effective quality reporting structure	.597					
QMS effectiveness: The adopted QMS method is implemented effectively	.726					
QMS effectiveness: Organisation has a process for effectively managing quality documents	.799					
QMS effectiveness: Your organisation keeps records of previous work	.748					

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalisation.
a. Rotation converged in 10 iterations.

The pattern matrix displays the distinctive contribution of a variable to a factor and is often easier to interpret.

Table 5.19 Extracted Components and their significant variables

Component	Factor	Significant Variables
1	Effectiveness	• Organisation has an effective quality reporting structure. • The adopted QMS method is implemented effectively. • Organisation has a process for effectively managing quality documents. • Your organisation keeps records of previous works.
2	QMS practices	• Does your organisation have an adopted QMS in practices? • Is your organisation's QMS certified in accordance with ISO 9001 standard/ any other standard? • Is your organisation's QMS certificate still valid?
3	Barriers	• Low bid of subcontractor's selection • Lack of employees' involvement • Ineffective communication between top managers and employees. • Financial constraints and insufficient resources
4	Importance	• Results in less rework • Less incidents on site • Increased competitive advantage
5	QMS measures	• Projects must meet acceptable standards • Delivering projects within a specified timeframe & budget while ensuring high quality standards • Achieving projects of high sustainability
6	Perception	• QMS provides the right guidelines which always ensures quality • QMS focuses on continuous improvement

5.8 Reliability Test

The collected data was subjected to a reliability test as part of the initial step in the study. The reliability of the questionnaire was assessed using Cronbach's Alpha. Cronbach's Alpha is the most employed method for assessing the inter-item reliability and internal consistency of a survey questionnaire (Pallant, 2020). Consequently, Cronbach's Alpha is commonly used to ascertain the validity of scales constructed from multiple Likert-type questions in surveys or

questionnaires. According to Nadaf (2021), the generally acknowledged rule is that a value of “0.6 to 0.7” denotes an acceptable degree of reliability whilst a value of “0.8 or higher” denotes a very good level. It is worth mentioning that reliability test results are valid for factors with items between 3 and 10 items. Therefore, Cronbach alpha was not computed for QMS perception which had only 2 extracted items. The results of the reliability test are illustrated in Figure 5.20 below.

Table 5.20 Reliability Test

Extracted Factors	N of Items	Cronbach's Alpha
QMS Effectiveness	4	0.765
QMS practices	3	0.700
QMS Barriers	4	0.660
QMS Importance	3	0.628
QMS success measures	3	0.799

It can be concluded that the internal consistency of the measures used in this analysis is acceptable for the development of a maturity model for effective implementation of quality management practices in the GCI.

5.9 Summary of Chapter Five

This chapter reported the findings from an online questionnaire survey which was generated from construction industry experts in Ghanaian construction organisations. Additionally, each of the findings were discussed with inference to literature.

The study's empirical findings were presented through the application of both descriptive and inferential statistical analyses, based on primary data sourced from an online questionnaire. This was divided into three main sections. Quantitative data analysis produced several noteworthy findings that can be discussed and be used to draw conclusions based on the results. The primary characteristics of the respondents were determined by illustrating statistical data using visual representations such as graphics and tables. The responses to the survey questions were based on a five-point Likert scale, which the respondents used to rank indicators based on their opinions about statements that were posited to them. Most of the responses were presented based on the mean, standard deviation, and percentages utilised in the questionnaire. For all inferential tests employed in this chapter, the significance of the results was assessed using an alpha level (P-value >0.05) as the threshold.

The second main section concentrated on the essential components regarding a range of issues affecting QMS implementation. The results discussed in this chapter revealed that there were varying **perceptions** that existed over what constitutes quality. The high mean scores and low standard deviations across indicators suggest a strong consensus among respondents regarding the positive impact of QMS practices. In terms of the awareness and understanding of the **significance** of QMS, the descriptive statistics provided in section 5.4.2 indicate that the respondents ranked Client satisfaction as the most crucial factor when considering the significance of QMS application within their companies. Overall, the mean scores for all **critical success factors** were above 4, indicating that they are all considered to be important for successful QMS implementation. The top three critical success factors based on mean scores were Top management commitment and leadership (CF4), Client satisfaction (CF8), and Legislative instrument in operation (CF7). From the results, there was uniformity in the responses obtained from the respondents as the participants agreed to the proposed indicators associated with the barriers affecting the successful implementation of QMS in their respective organisations. About 35% of them are non-compliant based on all the items that were assessed for QMS practices. Factor analysis done in this chapter helped to determine the design of the parameters required to form part of the structure of the QMMM. Therefore, the survey outcomes analysed in this chapter aided with the development of the QMMM as indicated in Chapter 6.

CHAPTER 6: DEVELOPMENT AND VALIDATION OF QUALITY MANAGEMENT MATURITY MODEL

6.1 Introduction

In the specific context of the GCI, where infrastructural development is accelerating, the need for quality management model for aiding satisfactory delivery of projects is evident. Existing global quality management tools and models (see Chapter 2.7) may not fully capture the nuances of the local industry thus, necessitating the need to develop a tailored model. Challenges such as varying standards, resource constraints, and a dynamic regulatory landscape underscore the importance of developing such a tailored model for the Ghanaian construction setting, which currently has nothing of this sort. This model will serve as a tool and a roadmap for the industry's companies to enhance their quality management practices systematically.

In this study, even though the respondents demonstrated a positive perception of quality management practice which is translated into a higher level of knowledge and understanding rating, about 35% of them are not compliant based on all the items that were assessed for QMS practices. More so, it is significant to note that 93% of the respondents indicated that their organisations do not have a quality assessment tool in place to check quality.

On account of these outcomes and based on the gaps identified from the study survey, it is evident that the appropriate form of tool required for an effective and successful implementation of QMS practices for the industry will be a Quality Management Maturity Model (QMMM).

6.2 Key features of a Quality Management Maturity Model

Maturity models have served as a useful framework for organisations seeking to enhance and systematically improve their quality-related processes. These models enable organisations to gain insights into their existing quality management capabilities and pinpoint specific areas that require improvement (Hoare, 2023).

In developing an assessment tool or model, the systematic incorporation of QA and QC practices can profoundly enhance the credibility and operational effectiveness of assessment tools, ensuring their compliance with industry standards and best practices (Mahachi, 2021).

The application of maturity models goes beyond simple evaluation; they act as mechanisms for fostering continuous improvement and achieving quality assurance (Hoare, 2023). Maturity models are structured into multiple levels, which range from ad-hoc processes to optimised practices, characterised by quality control and continuous improvement. Thus, organisations can apply these levels to compare their quality management practices with established

industry benchmarks for improvement (Barker, 2023). In addition, maturity models are essential in enhancing improvement processes, these models can serve as a basis for quality assessment and the development of improvement plans (Hoare, 2023).

To ensure successful development of the QMMM, the key background features of the model are first presented. These features relate to the definitions and scope of: Quality dimensions, Quality levels, Quality assessment, and Quality improvement as identified from the literature review.

6.2.1 Quality dimensions

A key feature of a quality maturity model is the identification of the distinct dimensions that organisations need to evaluate in order to ascertain their maturity level (Peng et al., 2015). According to Duncan et al., (2022), a fundamental element in establishing quality dimensions within maturity models is the acknowledgment that these dimensions should be both comprehensive and pertinent to the unique context of the organisation. Therefore, it is crucial to select the quality dimensions that align with the business strategies, objectives, and values. This comprises of various dimensions that encompass the expectations and necessities of both customers or clients and stakeholders.

6.2.2 Quality levels

One of the critical components of a robust maturity model is the specification of quality levels that represent the distinct phases of quality status across various dimensions. The articulation of quality levels within maturity models plays a pivotal role in enabling organisations to grasp their present capabilities while also providing a structured framework for progression (Adekunle et al., 2022). These quality levels serve as the criteria for evaluating and comparing the current and desired quality status, as well as for recognising the gaps and strategies for improvement. Thus, according to Abdellatif et al., (2019), it is essential that quality levels are clearly outlined, uniformed, and quantifiable.

6.2.3 Quality assessment

A quality maturity model also requires a structured approach for conducting a quality assessment. A fundamental element of quality assessment in a QMM involves the identification of maturity levels, which generally span from initial or disorganised phases to optimised or highly proficient phases (Ramadan & Arafeh, 2016). This assessment plays a crucial role in determining the existing level of quality maturity across different dimensions, facilitating a comparison with the desired level. A quality assessment process represents a systematic methodology that involves the establishment of quality criteria, the acquisition and evaluation of data, and the dissemination of results (Lucander & Christersson, 2020). This process is fundamental for ensuring that products, services, and processes conform to

established criteria and for facilitating continuous improvement. Thus, it is imperative to conduct quality assessments periodically and consistently.

6.2.4 Quality improvement

A pivotal component of a quality maturity model is the creation and execution of a quality improvement plan, which is instrumental in addressing gaps and achieving the intended quality maturity level across all dimensions. This plan is a detailed document that articulates the objectives, resources, responsibilities, timelines, and metrics necessary for the enhancement of quality maturity and performance (Tran et al., 2021). The quality improvement plan should be based on the results and recommendations of the quality assessment, and it should be monitored and evaluated for progress and outcomes.

6.3 Developing QMMM for Ghanaian Construction Industry

The insights and interpretations from the online questionnaire survey detailed in Chapter Five, supported by a comprehensive review of the literature, have contributed significantly to the establishment of the QMMM for the GCI.

6.3.1 Components and Structure of QMMM

The structure of the proposed model is as shown in Figure 6.1, which displays 7 components, 6 of which were extracted from the data analysis (Chapter 5), and the remaining 1 (critical success factors) obtained from literature as cited in most studies and assessed by respondents in this study. Moreso, based on the results and the conceptual model, the structure of the proposed QMMM was designed. This structure is informed by the aim to capture the relationships between the components in the context of the effective implementation of quality management practices in the GCI.

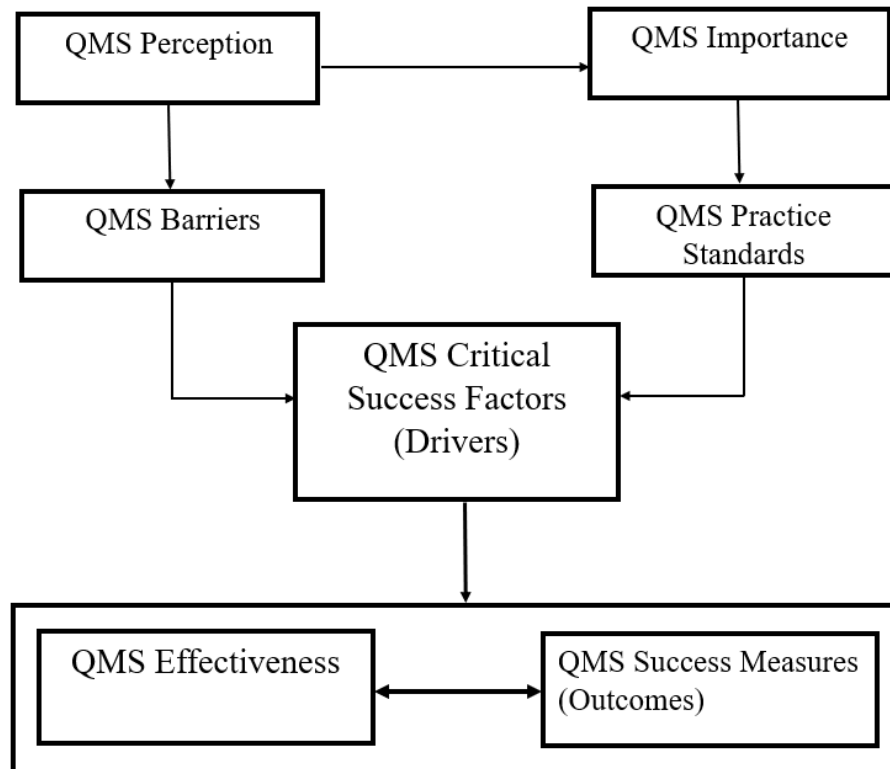


Figure 6.1: Structure of the model for GCI

QMS Perception directly influences QMS Importance. The arrow signifies that how quality management is perceived may affect its perceived importance. Both QMS Perception and QMS Importance contribute to the understanding of QMS Barriers. For instance, negative perceptions or low importance might contribute to perceived barriers. QMS Importance directly influences adherence to QMS Practice Standards. The connection implies that the perceived importance of quality management may influence the level of adherence to established standards. QMS Practice Standards and QMS Critical Success Factors (Drivers) are connected; indicating that the adherence to practice standards may be correlated with the critical success factors. QMS Critical Success Factors (Drivers) influence QMS Implementation Effectiveness which results in measured success (outcomes). This implies that certain factors perceived as critical to success are vital for the effective implementation of quality management practices.

6.3.2 Detailed description of the model components and their constituents

Table 6.1 displays the factors that define (or are embodied in) each of the 7 fundamental components of the QMMM. The aspects of the survey that helped with identifying the right factors are called factor analysis. The essence of the factor analysis was to pinpoint the key dimensions required for the development of the QMMM. Thus, by capturing the relationships between these factors, the analysis yielded important insights into the correlation between the key elements of the QMMM. The factors were also determined based on the average values of ratings from respondents' degree of agreement of them as being embodiments of the components.

Table 6.1: Extracted Components and their respective factors

Component 1: QMS Effectiveness	
1	Effective quality reporting structure
2	Effective implementation of adopted QMS method
3	Effective management of quality documents
4	Proper records of previous works
Component 2: QMS Practice Standards	
1	Adopted QMS in practice
2	Organisation's QMS certified in accordance with ISO 9001 standard/ any other standard
3	QMS certificate still valid
Component 3: QMS Barriers	
1	Contractor selection based on low bid criterion
2	Lack of employees' involvement
3	Ineffective communication between top managers and employees
4	Financial constraints and insufficient resources
Component 4: QMS Importance	
1	Results in less rework
2	Less incidents on site
3	Increased competitive advantage
Component 5: QMS Success Measures (Outcomes)	
1	Projects must meet acceptable standards
2	Projects delivered within acceptable timeframe, budget and quality standards
3	Projects delivered within acceptable sustainability standards
Component 6: QMS Perception	
1	QMS provides the right guidelines which always ensures quality
2	QMS focuses on continuous improvement
Component 7: QMS Critical Success Factors (Drivers)	
1	Top management and leadership commitment
2	Legislative instrument in operation
3	Client satisfaction
4	Communication between top management and employees
5	Teamwork

6.3.2.1 QMS Effectiveness

➤ **Effective Quality Reporting Structure**

A robust reporting structure is essential for maintaining quality effectiveness in projects, as it promotes transparent communication, accountability, and informed decision-making. Additionally, it serves as a basis for documenting quality metrics, which aid in continuous improvement and ensures the consistent application of quality standards throughout the project lifecycle. The continuous enhancement of reporting quality, as highlighted by Taniguchi and Onosato (2018), is vital for the success of projects, enabling the identification of areas requiring improvement and implementation of necessary corrective measures.

➤ **Effective Implementation of Adopted QMS Method**

The success of a QMS is intrinsically linked to the proper implementation of the chosen methodology. This indicator delves into the execution of the defined quality management processes and procedures. Effective implementation involves aligning organisational activities with the principles and objectives of the adopted QMS. Neyestani (2016) asserts that the adoption of an effective QMS does not only help in the development of quality procedures but also guarantees that each phase of a construction project meets the requirements set by clients. This alignment is particularly significant in the construction industry, where the multifaceted nature of projects necessitates a comprehensive grasp of quality management methods to successfully navigate potential challenges.

➤ **Effective Management of Quality Documents**

Documentation lies at the heart of any QMS, and its effective management is fundamental to ensuring the system's efficacy. The establishment of a robust quality management system is contingent upon the development of well-defined documentation protocols that align with the strategic objectives of an organisation and adhere to regulatory requirements. Mo (2014) asserts that such a system (QMS) must be customised to reflect the unique circumstances of each institution, which entails the maintenance of succinct documentation that promotes operational efficiency and effectiveness. Likewise, Migda (2023) points out that ensuring the accuracy of documents, maintaining version control, and providing accessibility are critical aspects of a quality management system.

➤ **Proper Records of Previous Works**

The ability to maintain accurate and comprehensive records of previous work is a crucial facet of QMS effectiveness. This indicator assesses an organisation's commitment to documenting and archiving information related to past projects, inspections, and quality assessments. Aburas (2020) underscores the need for robust documentation and record-keeping which aligns with the survey findings on quality document management and previous project records. Proper record keeping serves as a valuable resource for continuous improvement initiatives, historical analysis, and evidence of compliance with industry standards. It also contributes to the organisation's knowledge base, enabling informed decision-making and promoting a culture of learning from past experiences.

6.3.2.2 QMS Practice Standards

➤ **Adopted QMS in Practice**

The adoption of QMS within organisational practices represents a pivotal aspect of ensuring consistent product and service quality. This factor evaluates how well a company has incorporated QMS into its day-to-day operations. Therefore, it is crucial to adopt and implement a suitable and well-structured quality management system in order to obtain the required benefits essential for project accomplishments (Neyestani, 2017). Practicing quality management is an essential aspect of organisational operations, as it ensures that all tasks performed by the organisation are suitable for their intended purpose (Stojmenović & Pavlović, 2019). Thus, it plays a pivotal role in enhancing an organisation's overall performance.

➤ **Organisation's QMS Certified in Accordance with ISO 9001 Standard/Any Other Standard**

ISO 9001 is an internationally acknowledged standard for quality management, with the primary goal of improving organisational efficiency and customer satisfaction (Suhendris & Saroso, 2018). Certification to established international standards, like ISO 9001, signifies a commitment to achieving and maintaining high-quality standards. This subset assesses whether the organisation has undergone a formal certification process in line with established quality standards. QMSs are critical for construction firms operating in highly competitive and rapidly changing environments, where the adoption of ISO 9001 can promote operational excellence (Hadidi et al., 2017). Additionally, the construction sector can benefit greatly from obtaining ISO 9001 certification, as it provides advantages such as standardisation, enhanced quality assurance, and heightened competitiveness in the business environment (Shaikh & Sohu, 2020).

➤ **QMS Certificate Still Valid**

Maintaining the validity of the QMS certification is paramount for ensuring an ongoing commitment to quality excellence. Organisations that hold valid QMS certifications can effectively differentiate themselves in a competitive market environment. A significant number of clients tend to favour certified suppliers, viewing such certification as an indicator of quality and dependability (Feng et al., 2017). The attainment of a valid QMS certification confirms that an organisation systematically implements established processes and procedures. Such systematic implementation contributes to the reliability of product and service quality, thereby promoting customer satisfaction (ISO, 2015).

6.3.2.3 QMS Barriers

➤ **Contractor selection based on low bid criterion**

Choosing contractors according to the criterion of the lowest bid imposes substantial challenges to the implementation of effective quality management systems (QMS) within construction projects. Research findings indicate that relying on the lowest bid as the primary criterion for contractor selection can lead to a lack of critical skills and a neglect of proper planning and quality management practices (Waheeb & Andersen, 2021). Also, this approach often prioritises cost over quality, leading to compromises in workmanship, materials, or adherence to standards. Consequently, this barrier undermines the overarching goal of delivering high-quality construction projects.

➤ **Lack of Employees' Involvement**

A crucial aspect of successful QMS implementation is the active involvement and engagement of employees at all levels within construction companies. According to Liu (2021), involving employees in the decision-making process significantly boosts their enthusiasm and facilitates better communication within the organisation, ultimately contributing to enhanced quality performance. In contrast, a lack of employee engagement can create a gap between the quality objectives established by management and the execution of those objectives by employees, which may lead to inferior quality results. In addition, when employees feel disconnected or disengaged from quality-related processes, it creates a barrier to effective QMS.

➤ **Ineffective Communication Between Top Managers and Employees**

Effective communication forms the backbone of a robust QMS. When there is a lack of, or ineffective communication channels between top management and employees on quality-related matters, it becomes a substantial barrier. Insufficient communication may result in employee resistance, as employees might perceive themselves as uninformed or undervalued

in the decision-making process (Basera et al., 2020). Furthermore, Shimizu (2016) identified a significant communication disconnect, suggesting that senior management often overestimates the clarity and effectiveness of their interactions with employees. Consequently, this cognitive bias can intensify the difficulties encountered during the implementation of QMS, as employees may not fully comprehend the intended goals or their individual contributions to the process.

➤ **Financial Constraints and Insufficient Resources**

Financial constraints and insufficient resources pose formidable barriers to the successful implementation of QMS in construction organisations. Othman et al., (2020) asserts that a lack of sufficient resources directly undermines the implementation of quality management systems, culminating in inefficiencies and inadequate project delivery. Kareem and Ulutagay (2022) also asserted that the practical challenges in establishing quality standards are frequently attributed to insufficient financial resources, which impede organisations from adequately training their workforce and acquiring the requisite tools for quality management.

6.3.2.4 Importance

➤ **Results in Less Rework**

An effective QMS is crucial for reducing rework in construction projects. A well-established QMS ensures that quality standards are clearly defined, communicated, and adhered to, throughout the project lifecycle (Kareem and Ulutagay, 2022). This leads to better clarity regarding project requirements, reducing errors and deviations from initial specifications. Consequently, the occurrence of rework due to misunderstandings or misinterpretations diminishes significantly, thereby contributing to cost savings and improved project timelines.

➤ **Reduces Incidents on Site**

A fundamental aspect of QMS in the construction sector is the establishment of comprehensive safety measures. According to Tiong et al., (2014), the implementation of QMS is vital for ensuring quality and includes procedures that does not only ensure compliance with regulatory standards, but also creates a culture of safety consciousness among the workforces. The standardisation of processes facilitated by QMS is instrumental in decreasing variability and errors that could potentially result in accidents. Furthermore, Kiew et al., (2016) underscore that the effective integration of QMS can enhance project management capabilities, which are critical for maintaining safety standards on construction sites. This is especially pertinent given the intricate nature of construction projects, where effective coordination and control are crucial to preventing incidents.

➤ **Enhances Competitive Advantage**

A well-implemented and effectively managed QMS provides construction companies with a distinct competitive edge. The implementation of QMS within the construction sector is gaining acknowledgment as an essential approach to bolster competitive advantage. This is particularly significant in an industry that features complex projects, a wide range of stakeholders, and strict regulatory demands. By incorporating QMS frameworks, organisations can enhance the quality of their construction deliverables while simultaneously promoting operational efficiencies that are vital for sustaining a competitive position (Sheoran, 2023; Tiong et al., 2014).

6.3.2.5 QMS Success Measures (Outcomes)

➤ **Projects Must Meet Acceptable Standards**

Ensuring that projects meet acceptable standards is a foundational criterion for the success of any QMS. This involves a meticulous adherence to predefined quality benchmarks, industry standards, and regulatory requirements (Neyestani, 2017). Assessing the success of quality management in projects requires a comprehensive strategy that integrates essential success factors, strategic management principles, and the continual review of quality management practices (Shankar, 2017). QMS should establish clear and measurable criteria against which the outcomes of projects can be evaluated. Regular audits and inspections are integral components that involve ensuring that projects align with the defined quality standards.

➤ **Projects delivered within acceptable timeframe, budget and quality standards**

One of the primary indicators of QMS success lies in the efficient delivery of projects within the controls of time and budget without compromising on quality. This necessitates a well-defined project management framework within the QMS, incorporating scheduling, cost control, and risk management. Efficient management of time and costs can significantly diminish the chances of disputes and claims, which often stem from delays and cost overruns (Kumar & Kumar, 2018). Timely completion and adherence to budgetary allocations underscore organisational efficiency and the effectiveness of the QMS. Concurrently, the emphasis on maintaining high-quality standards throughout the project lifecycle ensures that quality services are delivered on time to exceed the client's expectations (Zhang et al., 2019).

➤ **Projects delivered within acceptable sustainability standards**

In the contemporary business environment, the success of a QMS is increasingly linked to the incorporation of sustainable practices within project execution. Embedding sustainability into construction projects plays a crucial role in enhancing project quality and ensuring stakeholder satisfaction, both of which are fundamental indicators that measure the success of projects

(Yu et al., 2018). Sustainable projects consider environmental, social, and economic aspects, aiming for longevity, minimal environmental impact, and positive social contributions (Ali et al., 2019). Successful QMS implementation should be synonymous with a commitment to sustainable development, reflecting an organisation's responsibility towards future generations and the broader community.

6.3.2.6 Quality Management System: Perception

➤ **QMS Provides the Right Guidelines Ensuring Consistent Quality**

In the evaluation of the perception about QMS, the first sub-factor delves into the perception of stakeholders regarding the effectiveness of QMS guidelines. This encompasses the extent to which the established guidelines consistently contribute to the delivery of high-quality products or services. A positive perception in this regard suggests that QMS is viewed as a reliable framework, providing clear and appropriate directives that facilitate the maintenance and improvement of quality standards. This perception may manifest in enhanced organisational efficiency, reduced errors, and increased customer satisfaction (Gremyr, 2021).

➤ **QMS Focuses on Continuous Improvement**

Recent research suggests that continuous improvement process is a key factor in determining project quality (Nyakala et al., 2019). This sub-factor assesses stakeholders' awareness and acknowledgment of the QMS's role in fostering a culture of ongoing enhancement. Organisations with a positive perception in this domain are likely to view their QMS not merely as a static set of guidelines but also as a dynamic system that encourages learning, adaptation, and evolution. This perception aligns with contemporary quality management philosophies, emphasising the importance of continuous improvement to stay competitive, thus responding to changing market dynamics, and meeting evolving customer expectations.

6.3.2.7 QMS Critical Success Factors (Drivers)

➤ **Top management and leadership commitment**

One of the key factors that determines the effectiveness of efforts to implement quality management in an organisation is the commitment of the upper levels of management, which is the top management (Krajcsák, 2019). Effective implementation of quality management is largely contingent upon the influence of top management or leadership, as highlighted by most quality models. Top management commitment facilitates QMS by allowing for better decision making (Ahmed et al., 2019). Top management, who make crucial decisions for their organisations, play a significant role in the development of culture and management, as well as how culture is cooperatively expressed, valued, and practiced.

➤ **Legislative Instrument in Operation**

Compliance with legislative instruments and regulatory frameworks is fundamental in the QMS context. Legislative instruments establish essential guidelines and standards that construction companies are required to follow, thereby impacting the overall quality performance of their projects (Shehu, 2023). In the Ghanaian construction industry, adherence to legal requirements and industry standards is essential for ensuring quality, safety, and environmental sustainability. Not only does this factor involve understanding the regulations but it also involves implementing and monitoring them effectively throughout the entire project lifecycle.

➤ **Client Satisfaction**

Client satisfaction serves as a crucial indicator of QMS effectiveness. The implementation of QMS is considered as an important method for enhancing client satisfaction (Oakland & Marosszeky, 2017). Meeting or exceeding client expectations not only validates the quality of construction projects but also contributes to building reputations and future business opportunities. Understanding client needs, ensuring transparent communication, and delivering high-quality outputs are pivotal for sustained client satisfaction.

➤ **Communication Between Top Management and Employees**

Effective communication channels between top management and employees form the backbone of a robust QMS. The establishment of a well-defined framework focused on enhancing the implementation of quality management system procedures in construction projects underscores the critical role of communication between top management and employees in ensuring the efficacy of quality management practices (Othman et al., 2020). Clear, transparent, and regular communication fosters a shared understanding of quality goals, expectations, and strategies. It encourages employee engagement, alignment with organisational objectives, and the dissemination of crucial information regarding quality policies and procedures.

➤ **Teamwork**

Collaboration and teamwork among employees at all levels are essential for the successful execution of QMS within construction companies. Encouraging teamwork promotes a culture of shared responsibility, knowledge exchange, and continuous improvement, ultimately contributing to the overall quality of construction projects. The critical nature of teamwork and cooperation in managing complex construction projects helps to prevent conflicts and ensure the integration of tasks and teams (Kvalshaugen & Sward, 2024).

6.4 Maturity Levels and their descriptions

There are five (5) maturity levels embodied in this model, namely: Initial, Elementary, Developed, Improved and Optimised. Each maturity level and their descriptions are presented as follows:

1. **Initial:**

- Organisations at this level have a limited understanding of Quality Management System (QMS) concepts.
- There is little awareness or recognition of the importance of QMS.
- Barriers to QMS implementation are not identified or addressed.
- QMS practices are not standardised, and critical success factors are not recognised.

2. **Elementary:**

- Basic QMS awareness exists, but perceptions vary across the organisations.
- Some recognition of the importance of QMS, but not consistently applied.
- Identified and documented barriers to QMS implementation.
- Basic QMS practices are in place, but they are not yet standardised.
- Some critical success factors are recognised but not consistently addressed.

3. **Developed:**

- Consistent positive perceptions of QMS across the organisation.
- Clear recognition of the importance of QMS, and efforts are made to prioritise it.
- Barriers to QMS implementation are actively addressed and mitigated.
- QMS practices are standardised.
- Critical success factors are identified and integrated into QMS practices.

4. **Improved:**

- Positive perceptions and understanding of QMS are embedded in the organisation's culture.
- Recognised and consistently applied importance of QMS throughout projects.

- Proactive identification and continuous improvement of QMS barriers.
- QMS practices are well-defined, consistently applied, and monitored.
- Critical success factors are actively managed and integrated into all processes.

5. Optimised:

- QMS is fully embraced and integrated into all aspects of the organisation.
- Recognised importance of QMS is a core value that helps to drive decision-making processes.
- Barriers to QMS implementation are continuously monitored and proactively addressed.
- QMS practices are highly standardised, with continuous improvement processes in place.
- Critical success factors are deeply established in all organisational processes.

6.4.1 Maturity Level Scores:

A score range using a Likert scale as indicated in Chapter 4 (Table 4.6) was adopted to create the maturity level scores. Based on the need for equal scoring for the different levels, the scales chosen for the different levels are as follows:

1. **Initial (1.00-1.80):** Limited or no systematic quality management practices.
2. **Elementary (1.81-2.60):** Some basic awareness and sporadic implementation.
3. **Developed (2.61-3.40):** Established quality management practices with documented processes.
4. **Improved (3.41-4.20):** Proactive management and continuous improvement.
5. **Optimised (4.21-5.00):** Fully integrated, leading-edge quality management practices.

6.4.2 Components and Criteria:

The seven components are defined with its associated scores as follows:

1. QMS Effectiveness:

- **Score 1.00-1.80:** Ineffective or non-existent implementation.
- **Score 1.81-2.60:** Limited effectiveness, sporadic successes.
- **Score 2.61-3.40:** Effective implementation in specific areas.
- **Score 3.41-4.20:** Broadly/Largely effective implementation with continuous improvement.

- **Score 4.21-5.00:** Fully effective implementation, continuous optimisation.

2. QMS Practice Standards:

- **Score 1.00-1.80:** No established standards or guidelines.
- **Score 1.81-2.60:** Basic standards and not consistently applied.
- **Score 2.61-3.40:** Documented standards, periodic reviews.
- **Score 3.41-4.20:** Established standards, regular updates.
- **Score 4.21-5.00:** Best practices, continuous refinement.

3. QMS Barriers:

- **Score 1.00-1.80:** Numerous barriers hindering QMS implementation.
- **Score 1.81-2.60:** Major barriers, limited efforts to overcome.
- **Score 2.61-3.40:** Identified barriers with some mitigation strategies.
- **Score 3.41-4.20:** Few barriers, actively managed.
- **Score 4.21-5.00:** Minimal barriers with a continuous improvement culture.

4. QMS Importance:

- **Score 1.00-1.80:** Not considered important.
- **Score 1.81-2.60:** Limited importance, minimal impact on decisions.
- **Score 2.61-3.40:** Recognised importance, considered in key decisions.
- **Score 3.41-4.20:** Integral to decision-making processes.
- **Score 4.21-5.00:** Strategic importance, central to organisational goals.

5. QMS Success Measures (Outcomes)

- **Score 1.00-1.80:** Not implemented any formal measures.
- **Score 1.81-2.60:** Defined some measures, but not yet fully implemented or integrated.
- **Score 2.61-3.40:** Implements and manages some QMS measures.
- **Score 3.41-4.20:** Analyses its QMS measures and uses the data to identify and implement process improvements.

- **Score 4.21-5.00:** Continuously improved QMS measures with optimised success.

6. QMS Perception:

- **Score 1.00-1.80:** Lack of awareness or negative perception.
- **Score 1.81-2.60:** Limited awareness, inconsistent understanding.
- **Score 2.61-3.40:** Positive perception, awareness among key stakeholders.
- **Score 3.41-4.20:** Clear positive perception and recognised importance.
- **Score 4.21-5.00:** Deep understanding and appreciation across the organisation.

7. QMS Critical Success Factors (Drivers):

- **Score 1.00-1.80:** Lack of identification or focus on critical success factors.
- **Score 1.81-2.60:** Limited understanding and emphasis on success factors.
- **Score 2.61-3.40:** Identified critical success factors with occasional emphasis.
- **Score 3.41-4.20:** Consistent focus on critical success factors.
- **Score 4.21-5.00:** Proactive management and optimisation of success factors.

6.4.3 The Applicability of the Maturity score flow chart

The maturity score flow chart presented in Figure 6.2 can be effectively used together with the evaluation sheet provided in Appendix B. The processes and steps employed in the use of the maturity score flow chart are described below as follows:

1. Identify key components (factors) that are required to be assessed. Once these factors are established, the criteria and specific items associated with each factor are carefully considered. This step helps to set a foundation for evaluating each component comprehensively, ensuring that all relevant aspects are considered.
2. Each item related to the identified factors is examined in detail. A rank or score is assigned according to how effectively each item fulfills the criteria. This process of examination and ranking helps to capture the performance of each item within its respective component, providing a clear sense of how it contributes to the factor's maturity.

3. After scoring individual items, the next step is to calculate the average score for each component. By adding together, the scores of each item and dividing the total by the number of items, an average that reflects the maturity level of the component can be derived. This calculated average offers an initial insight into the maturity level of each individual component.
4. With average scores being determined for each component, the maturity levels for each identified components can be assigned; these levels serve as indicators of where each component stands in the maturity spectrum, highlighting strengths and areas that may need attention.
5. Following this, an overall maturity score is generated by averaging the scores of all components. This overall score provides a comprehensive view of the system's maturity, representing the cumulative performance across all evaluated factors.
6. The final step is interpretation and improvement. The overall maturity score is examined to identify patterns, strengths, and areas for growth. This analysis allows for targeted improvements, guiding actions to enhance maturity across the assessed factors.

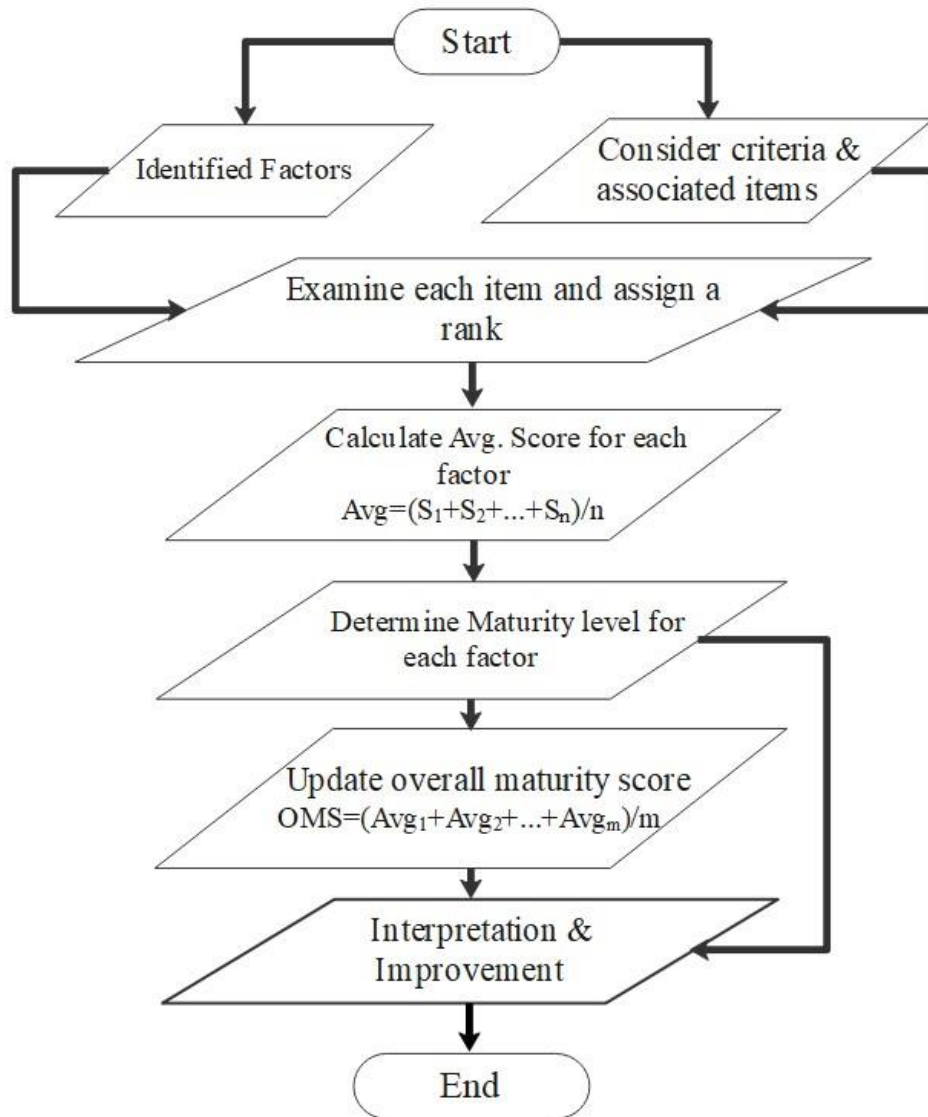


Figure 6.2 Maturity score flowchart

6.5 Validation of the QMMM

As with any model developed for use in industry, this research carried out a validation of the QMMM to ascertain its applicability or use as a quality management assessment model for construction organisations in the Ghanaian construction industry. The validation involved carrying out in-depth interviews with relevant industry expertise working with Ghanaian construction organisations. A purposive sampling technique was employed to choose the experts for this validation process (Campbell et al., 2020) instead of randomly selecting them in order to obtain and yield relevant feedback to validate the developed model. The experts (respondents) selected for this were 11 in number, who were initially contacted to confirm their consent to participate in the validation process. The validation team included some of the respondents who completed the main questionnaire survey of the study.

An interview was conducted for this validation process where the QMMM was presented to the experts for them to express their views as to the model's suitability and usefulness in assessing construction quality management practice. Before the main interview session, most respondents participated in an online session to clarify any queries or concerns. Semi-structured interviews were then conducted via phone at the respondents' convenient time wherein respondents were urged to provide adequate detailed responses to the following validation questions asked:

- Is the quality management maturity model simple and clear enough to understand?
- Do you think the model is useful enough to be implemented within construction organisations?
- Is the model well-detailed?
- Do you agree that regular review and assessments are required when implementing the model to keep quality in check?
- Could you recommend any improvements for the developed model which has been presented?
- Do you have any other suggestions?

6.5.1 Analysis and Discussion of validation responses

Characteristics of respondents

The industry experts who were involved in the model validation process are described in Table 6.2. They include Project Managers, Civil/Structural Engineers, Architects, Contract Managers and a Quantity Surveyor with 12 years' experience and above in their respective fields.

Table 6.2 Characteristics of validation team

Participating Firms	Job Role	Number of respondents	Number of years' experience
Project Management Firms	Project Managers	3	>25 years
Civil/Structural Engineering Firms	Civil/Structural Engineers	3	>20 years
Architectural Firms	Architects	2	>20 years
Consulting Firms	Quantity Surveyor	1	12 years
Construction Firms	Contract Managers	2	>15 years
		Total Respondents=11	

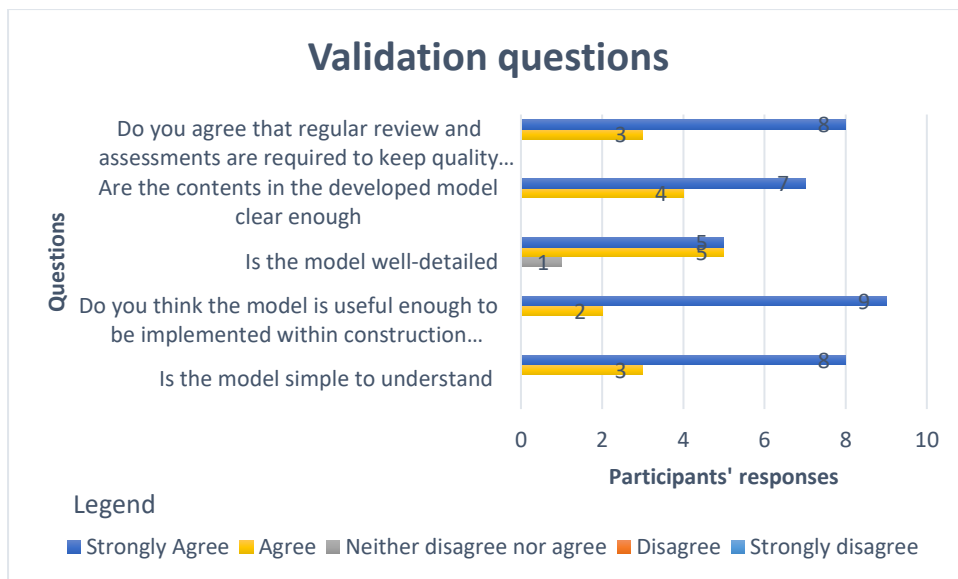


Figure 6.3 Validation responses based on Likert scale

Discussion on analysed responses

Based on the results illustrated in Figure 6.3, most of the responses ranged between “agree” to “strongly agree” regarding the posed questions. 8 respondents “strongly agreed” whereas 3 respondents “agreed” that regular reviews and assessments are required while using QMMM. Regarding whether the contents in the model are clear enough, 7 respondents “strongly agreed” to the question whilst 4 others “agreed” to it being clear enough to comprehend. Also, even though 1 respondent “neither disagreed nor agreed” to the question whether the model is well-detailed, 5 respondents “strongly agreed” whilst the remaining 5 respondents “agreed” that the model is well-detailed. Furthermore, in ascertaining the model’s usefulness, 9 respondents “strongly agreed” whilst the remaining 2 respondents “agreed” that its suitable to be implemented in their respective organisations. Lastly, 8 respondents “strongly agreed” to the question whilst 3 others “agreed” to it being clear enough to comprehend.

The first question was aimed at obtaining the respondents’ opinions on how simple and easy it was to comprehend the developed QMMM. Collectively, the respondents unanimously agreed that the quality maturity model was deemed acceptable in terms of its comprehensibility. Similarly, the usefulness of the model was acknowledged through positive responses from the respondents. A senior architect stated that *“this model is very good, and I believe it will help our organisations to improve on our quality management practices as it was developed in the context of our country”*. Another respondent also added that, *“the barriers indicates that more awareness needs to be made on enforcing quality so as to reduce the limitations it comes with”*. In addition, respondents concluded that quality needs to be focused more on, than cost reduction when working on projects.

There were some key suggestions put forth in the quest to include a sample that shows the integration of the flow chart, if possible. In this regard, one of the respondents also highlighted that, *“this approach would facilitate a more straightforward and effortless understanding of the developed quality model, thereby guaranteeing its effective application”*.

Another respondent proposed the development of a checklist to complement the model, stating that: *“The purpose of the checklist would be to facilitate the applicability of the quality model”*. This respondent argues that construction organisations could greatly benefit from implementing and improving the quality of their work. The respondent further mentioned that *“by using the checklist, organisations would have access to guidelines that would help them adhere to standards and make the required necessary improvements”*.

To summarise, the following three (3) recommendations were suggested to enhance the overall effectiveness and usability of the quality model:

1. Creating a sample flowchart to enhance practicality and ease of application.
2. Designing a checklist or evaluation sheet to assist in the smooth facilitation of the model.
3. Adjusting the title of the model to align with the research objective.

Also, it was suggested to the experts that periodic assessment is essential; thus, quarterly implementation of the model was suggested and agreed on.

An evaluation sheet which embodies a compressed and refined version of the maturity score flowchart, and a sample is illustrated in Appendix B, as requested by the industry experts for internal use within their various organisations.

6.6 Summary of Chapter Six

In light of the outcomes and the shortcomings revealed by the study's survey, it was apparent that the GCI required a robust framework to enhance the implementation of QMS practices; therefore, the analysis and interpretation of the results from the online questionnaire survey in Chapter Five, supported with reviewed literature, were utilised in the development of the QMMM for the GCI. Moreso, based on the results and the conceptual model, the structure of the proposed QMMM was designed.

Accordingly, this chapter presented the development of a Quality Management Maturity Model (QMMM), which was identified as the appropriate instrument to achieve the purpose of this research. The model was developed to serve as a tool and a roadmap for the industry's companies to enhance their quality management practices systematically.

The developed model has different components which includes the structure of the model (Figure 6.1), maturity levels and scores (Chapter 6.4), maturity score flowchart (Figure 6.2), and a sample evaluation sheet (see Appendix B). Extracted components from factor analysis were used to identify the key dimensions that were required for the development of the QMMM. The factor analysis helped to capture the relationships between the components, and the analysis also provided valuable insights into the correlation between the key elements of the QMMM. Table 6.1 illustrates the factors that defined each of the 7 fundamental components of the QMMM. The maturity score flow chart (Figure 6.2) can be used in conjunction with the evaluation sheet (Appendix B) as described in Chapter 6.4.3.

Additionally, the QMMM was validated using 11 industry experts to ascertain the model's applicability and usefulness. Analysed responses from the industry experts were outlined in section 6.5.1.

To conclude, the following chapters of this thesis actualised and or, fed into the development of the QMMM, which includes Chapter 1(research aims and objectives), Chapter 2 (literature review of past and present research on QMS), Chapter 3 (the development of the research conceptual model), Chapter 4 (research methodology; the development of the online questionnaire survey), and Chapter 5 (analysis and interpretation of survey outcomes). Thus, this research can be further concluded in Chapter 7 after the development of the QMMM, with further recommendations for future studies.

Chapter 7: CONCLUSION AND RECOMMENDATION

7.1 Introduction

This chapter presents a summary of the research findings related to the research aims and objectives, as well as the conclusions drawn from those findings. Additionally, this chapter underscores the principal findings in theory and practice, in addition to its contributions to the overall body of knowledge. Finally, recommendations for the model adoption and additional research needs are presented alongside the study's limitations.

This research aims to develop a quality assessment tool (in the form of quality management maturity model) for improving quality management practices adopted in the Ghanaian Construction Industry. It is anticipated that the developed maturity model will enhance an effective assessment of quality management practices at both organisational and project levels, thereby enabling high-quality project delivery in construction organisations within the Ghanaian construction industry.

7.2 Summary of Findings and Conclusions

In this section, the objectives will be reviewed based on the research findings.

7.2.1 Conclusions on Objective 1

To critically review existing literature on the concept of quality management systems, their standards and process improvement tools as applied in the construction industry.

In order to accomplish the initial objective of this research, it is essential to possess a comprehensive understanding of QMS. To achieve this, the researcher conducted a critical evaluation of existing literature. This involved an extensive review of a wide range of sources including books, articles, academic papers, and professional websites, with the aim of gaining insights that would assist in determining the main parameters for assessing this study. Additionally, the literature review sought to explore themes relevant to QMS in the construction sector, with particular attention given to the context of construction organisations, which serve as the primary focus of this study.

The review in Chapter 2.2 traced the historical development of QMS, detailing the integral components of Inspection, QA, QC, and TQM. Similarly, Chapter 2.7 was used to achieve objective 1 by reviewing quality management standards, and process improvement tools as applied in the construction industry. Regarding the standards, ISO 9001:2015 was also reviewed. Some of the tools being employed in construction organisations include EFQM, MBNQA, QCLASSIC, etc.

Quality management tools play an important role in enhancing organisational performance by providing structured approaches to manage and effectively improve quality management practices in order to deliver high quality services. Majority of the reviewed papers mentioned a number of quality management dimensions such as performance measurement, customer satisfaction, leadership commitment, continuous improvement and amongst others. The identified dimensions bring to light significant factors that are crucial for consideration when conducting a quality assessment on a project. A conceptual framework was constructed, informed by a review of literature on quality management tools and the essential success factors that influence their implementation process. Most importantly, this led to the achievement of objective 4.

7.2.2 Conclusions on Objective 2

To investigate current quality management practices in the Ghanaian Construction Industry.

To accomplish this objective, an online questionnaire survey was used to collect data on the existing quality management practices amongst Ghanaian construction organisations. The survey findings revealed that the respondents' perceptions of QMS varied. The findings reveal that most respondents demonstrated an understanding of the concept and identified its benefits. Therefore, it can be concluded that the respondents have a well-defined awareness of the role, influence, and advantages of integrating quality initiatives into their organisational practices (see Section 5.4 in Chapter 5). It was discovered that about 65% of respondents showed compliance with QMS standards/ requirements while 35% showed non-compliance. The respondents acknowledged having an adopted QMS in place, which is practiced in their respective organisations. Currently, within the GCI, three main quality tools and techniques are employed, namely: Benchmarking, EFQM, and Total Quality Management. In addition, the survey revealed that checks are done in order to ensure that projects meet the right standards and are delivered within the agreed timeframe and budget to ensure client satisfaction. Furthermore, other practices done to ensure QMS effectiveness include having a reporting structure and record keeping of past and present works (see Section 5.5.1). Some organisations confirmed that project reviews were usually conducted after a project closure.

It is well established that quality control serves as a fundamental aspect of quality management practices that are rigorously followed in the GCI. Within building construction environments, inspections are generally viewed as critical activities aimed at overseeing and detecting any faults in materials or equipment (Ayertey Nubuor et al., 2017). Even though QMS is practiced in some construction organisations, it is evident that there is a deficit in proper regulation of systems as well as other issues like project delays and poor quality of works. From literature findings, it is also known that the GCI lacks a quality management

assessment tool and there is no organised tool in place to enhance quality management practices. As a result of the nature of the problem at hand, there's a need for an appropriate form of tool required for an effective and successful implementation of QMS practices for the industry, which is the developed Quality Management Maturity Model (QMMM).

7.2.3 Conclusions on Objective 3

To assess the critical success factors and limitations affecting the implementation of QMS in the GCI.

The **critical success factors** that contribute to the successful implementation of QMS in the GCI were assessed through the questionnaire survey (findings presented in Section 5.4.3). The results of the questionnaire revealed ten key factors of QMS that were examined to gain a comprehensive understanding of the respondents' opinions. It was observed that there were diverse responses in relation to each of the proposed key factors. Overall, the findings indicated a clear hierarchy of perceived critical success factors for QMS within Ghanaian construction organisations. The results emphasised the utmost importance of top management, client satisfaction and compliance with legislative requirements. These elements have been recognised as essential for the effective execution of QMS within construction firms in Ghana.

The results of the literature review indicated that specific limitations impede the effective implementation of QMS. These limitations encompass project delays, inadequate training, cost overruns, among others. Upon assessing the efficacy of these from the questionnaire survey, it was revealed that the three main barriers to practicing quality management within construction organisations in Ghana are: "inadequate training and education", "time constraints and costs" and "lack of enforcement on legislative measures", as these were ranked 1st, 2nd, and 3rd respectively; hindering the practices (see Chapter 5.4.4).

Both the critical success factors, also known as the quality drivers and barriers/limitations informed the design of the conceptual framework and the QMMM. Although through literature findings, it was ascertained that CSF drives the successful implementation of QMS, it was also argued that organisations face some barriers while implementing it. Also, components associated with both CSF and barriers were extracted for the development of QMMM.

7.2.4 Conclusions on Objective 4

To develop and validate an appropriate assessment tool for the effective adoption and implementation of quality management practices in the GCI.

The primary aim of this research is to develop a tool for assessing quality management practices. The effective implementation of quality management practices in the GCI is to be enhanced by the application of a quality maturity model which was developed in two distinct

stages. The initial stage included a thorough examination of pertinent literature, while the subsequent phase concentrated on analysing data gathered from a questionnaire survey to uncover important findings (see Chapter 5).

Following the completion of the evaluation process, the model was validated and refined based on interviews with experts from the construction industry, who offered valuable feedback and suggestions. Consequently, the final validated model (presented in Chapter 6) was rendered suitable and an essential tool for enhancing Quality Management Systems (QMS) implementations in the construction industry of Ghana. This QMMM will enable any organisation to know how developed their quality management system is, and what they need to do, in order to be able to move to the next level or improve on their quality management practices (in the form of their maturity levels).

The successful accomplishment of the research objectives signifies the attainment of the study's aim. Through meticulous evaluation and refinement, the quality management maturity model has been effectively developed, enabling an effective facilitation of quality management practices being implemented within construction organisations in Ghana.

7.3 Key Contributions of the Research

This study has made noteworthy contributions to the existing body of knowledge and practical applications. The subsequent sections delineate these contributions, categorised into theoretical and practical aspects:

7.3.1 Theoretical Contributions

- 1) As part of the outcome of this research, an essential and novel quality management tool has been developed for use within the GCI to improve the assessment of quality management practices (in the form of their maturity levels). This is a novel and innovative tool in the field of quality management as the GCI lacks such tools, besides the fact that the tool was designed, developed and tested based on current quality management practices of the GCI. The tool can be applied beyond Ghana, particularly in construction industries with similar characteristics (for example in their labour demographics, industry know-how and culture) as those of the GCI, especially in Sub-Saharan African countries and globally.
- 2) This research endeavour makes a valuable contribution by bridging the gap identified from paucity of empirical studies on quality assessment tools in developing countries such as Ghana and other neighbouring countries that bears similar construction characteristics. Extant literature has decried the little attention that quality management research has received in the GCI, particularly on the assessment of

quality and how this can be improved. It is anticipated that the research results will also be used for future research publications.

- 3) The outcome of this current research is anticipated to serve as a catalyst and an inspiration for other researchers and scholars to undertake subsequent research on quality, specifically within the field of QMS, as it is increasingly becoming a vital aspect in the corporate sphere.

7.3.2 Practical contributions

- 1) The primary contribution of this thesis is the development of a quality management maturity model (QMMM) based on thorough literature review and empirical findings. This model plays a vital role in identifying the key factors necessary for the effective implementation of QMS within the GCI. The use of QMMM will help organisations to be quality conscious and contribute to engendering (or bringing about) a change in culture, as far as quality management is concerned. The model can thus help to improve quality management practices which in turn will prevent disasters such as building and structure collapse. Through the development of this model, the government can also monitor to see the extent to which organisations adhere to it.
- 2) Another key contribution of this thesis is the development of a structure that is based on a thorough investigation of the existing body of literature and empirical evidence. By means of this structure, crucial barriers to the effective integration of QMS within Ghana's construction sector are recognised. Therefore, this research yields valuable insights and recommendations for enhancing the implementation of QMS in the Ghanaian construction sector as well as other neighbouring countries who have similar construction industry characteristics like Nigeria.
- 3) Empirical data presented in this research serves as valuable evidence, shedding light on the noteworthy function of QMS practices as a vital philosophical approach. Implementing these practices can greatly assist the construction industry in enhancing its overall performance.
- 4) The insights gained from this research can be instrumental in fostering the implementation of QMS across multiple sectors, not only in the construction industry but also across different sectors. Moreover, these insights can be leveraged to support management efforts and to refine work practices and objectives in the context of QMS adoption and implementation.

7.4 Research Limitations

It is important to acknowledge the limitations of any study, as they can significantly impact the conclusions that can be drawn. Notwithstanding the researcher's diligent efforts to address the study limitations, the following issues remain noteworthy. Time and financial constraints

are common challenges faced by researchers, and this study was no exception. A sample size which is a representative from the GCI was obtained, but due to the time and resource constraints, it was reasonable to sample 142 responses from the participants which was used to represent the GCI's behaviour and practices. The primary limitation lies in the paucity of literature on quality management models and practices in the GCI. As a result of this, most of the literature relied on were materials from research carried out in other countries (both developed and developing countries). Hence, the conclusions and outputs from the study's literature review, which formed the basis of, among others the study's conceptual framework and subsequent maturity model developed, were not necessarily congruent with the GCI settings, but were more or less generally applicable or compliant to its context.

Some potential challenges in the adoption of the model may stem from cost implications, that is, in terms of the cost of gathering the necessary data and inputting it into the model. Another challenge is lack of data from most construction organisations. Also, there is resistance to change which depicts that, it may be difficult to implement, and this may require some cultural change in the attitude in the practice of quality management. Therefore, its implementation will require enforcement of Ghanaian regulations when it comes to adhering to quality management related activities.

7.5 Recommendations for further research

As the research progressed, multiple areas were identified as fruitful subjects for exploration. The recommendations presented in this section are specifically tailored to address research and methodological issues that were not encompassed within the parameters of this study. It is recommended that future research endeavours should address the following areas:

- 1) Although the study findings are gathered from the GCI, they have the potential to be applied or reproduced by researchers in various public or private sectors in Ghana, including the education and health sectors, among others. These sectors can utilise the research to examine the phenomenon of QMS from their unique perspectives and propose potential enhancements. Furthermore, this research offers an opportunity for comparative analysis, enabling a comprehensive understanding of the subject matter.
- 2) It would be beneficial to conduct a comprehensive investigation in future regarding the adoption of the developed quality maturity model in Ghana, and examine the outcomes observed by organisations that have implemented the model. The results would allow for a comparison between the outcomes achieved by those organisations that have embraced the model as an assessment tool and those that have not been influenced by its utilisation.

- 3) An investigation into how top management can enforce a high implementation rate of quality improvement standards as part of defining roles and responsibilities within organisations is highly recommended.
- 4) The significance of culture in ensuring the successful implementation of quality management standards and tools cannot be overstated. Therefore, it is strongly advised that additional research is conducted in this field to, amongst others, examine culture imperatives within organisations and their influence on quality management practices.
- 5) Future studies exploring or investigating quality management practices in Ghana using a much larger sample size is recommended for future studies. This can produce a more in-depth or profound understanding of all the issues this study investigated.
- 6) It is also recommended that training must be provided on the application/use of QMMM.

7.6 Concluding Remarks

The literature review and questionnaire survey conducted in this study have yielded significant findings. It has been observed that the implementation of QMS has been extensively researched and adopted by construction organisations worldwide. However, in the specific context of Ghana, there is a lack of appreciable research on QMS usage, and the implementation of quality assessment tools within the GCI.

Consequently, this study has successfully addressed this knowledge gap by first focusing on exploring the level of QMS implementation and the utilisation of quality assessment model in the GCI. The study then produced a conceptual model on quality management, followed by developing a quality maturity model to serve as a tool for enhancing QMS practices in the GCI. This model is based on the conceptual framework, key factors derived from both the existing literature and the responses obtained from the questionnaire survey, and validation of the model through interviews with relevant experts. It can be inferred that the model will be instrumental in promoting the adoption of QMS practices within Ghanaian construction companies. As a result, these organisations are likely to see advantageous outcomes regarding their overall performance.

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Appendix A: Spearman's correlation of variables

		QMS perception	QMS importance	Critical Success Factors	Barriers	QMS Effectiveness	QMS Measures
QMS_perception	Correlation Coefficient	1.000	0.382**	0.380**	0.369**	0.405**	0.219**
	Sig. (2-tailed)	.	0.000	0.000	0.000	0.000	0.009
	N	142	142	142	142	142	142
QMS_importance	Correlation Coefficient	0.382**	1.000	0.429**	0.275**	0.264**	0.231**
	Sig. (2-tailed)	0.000	.	0.000	0.001	0.002	0.006
	N	142	142	142	142	142	142
Critical Success Factors	Correlation Coefficient	0.380**	0.429**	1.000	0.421**	0.330**	0.222**
	Sig. (2-tailed)	0.000	0.000	.	0.000	0.000	0.008
	N	142	142	142	142	142	142
Barriers	Correlation Coefficient	0.369**	0.275**	0.421**	1.000	0.437**	0.293**
	Sig. (2-tailed)	0.000	0.001	0.000	.	0.000	0.000
	N	142	142	142	142	142	142
QMS_Effectiveness	Correlation Coefficient	0.405**	0.264**	0.330**	0.437**	1.000	0.395**
	Sig. (2-tailed)	0.000	0.002	0.000	0.000	.	0.000
	N	142	142	142	142	142	142
QMS_Measures	Correlation Coefficient	0.219**	0.231**	0.222**	0.293**	0.395**	1.000
	Sig. (2-tailed)	0.009	0.006	0.008	0.000	0.000	.
	N	142	142	142	142	142	142

**.

Correlation is significant at the 0.01 level (2-tailed)

Appendix B: Evaluation sheet

Model Components		Rank					Avg. Score		Component Maturity level		Overall Maturity Levels		
Component 1: QMS Effectiveness		SD=1	D=2	N=3	A=4	SA=5	QE=	Determine Maturity level for each component based on Avg. Score	Update overall maturity score	$M = \frac{QE + QPS + QB + QI + QM}{7}$	☐ Initial (1.00-1.80): Limited or no systematic quality management practices		
1	Effective quality reporting structure						(QE ₁ +QE ₂ +QE ₃ +QE ₄)/4					☐ Score 1.00-1.80: Ineffective or non-existent implementation. ☐ Score 1.81-2.60: Limited effectiveness, sporadic successes. ☐ Score 2.61-3.40: Effective implementation in specific areas. ☐ Score 3.41-4.20: Broadly effective implementation with continuous improvement. ☐ Score 4.21- 5.00: Fully effective implementation, continuous optimisation	
2	Effective implementation of adopted QMS method											☐ Score 1.00-1.80: No established standards or guidelines. ☐ Score 1.81-2.60: Basic standards, inconsistently applied. ☐ Score 2.61-3.40: Documented standards, periodic reviews. ☐ Score 3.41-4.20: Established standards, regular updates. ☐ Score 4.21-5.00: Best practices, continuous refinement	
3	Effective management of quality documents												
4	Proper records of previous works												
Component 2: QMS Practice Standards		SD=1	D=2	N=3	A=4	SA=5	QPS=						☐ Score 1.00-1.80: Numerous barriers hindering QMS implementation. ☐ Score 1.81-2.60: Major barriers, limited efforts to overcome. ☐ Score 2.61-3.60: Identified barriers with some mitigation strategies. ☐ Score 3.41-4.20: Few barriers, actively managed. ☐ Score 4.21-5.00: Minimal barriers, continuous improvement culture
1	Adopted QMS in practices						(QPS ₁ +QPS ₂ +QPS ₃)/3						
2	Organisation's QMS certified in accordance with ISO 9001 standard/ any other standard								☐ Score 1.00-1.80: Not considered important. ☐ Score 1.81-2.60: Limited importance, minimal impact on decisions. ☐ Score 2.61-3.40: Recognised importance, considered in key decisions. ☐ Score 3.41-4.20: Integral to decision-making processes. ☐ Score 4.21-5.00: Strategic importance, central to organisational goals				
3	QMS certificate still valid												
Component 3: QMS Barriers		SD=1	D=2	N=3	A=4	SA=5	QB=	Determine Maturity level for each component based on Avg. Score	Update overall maturity score	$M = \frac{QE + QPS + QB + QI + QM}{7}$	☐ Elementary (1.81-2.60): Some basic awareness and sporadic implementation		
1	Contractor selection based on low bid criterion						(QE ₁ +QE ₂ +QE ₃ +QE ₄)/4						
2	Lack of employees' involvement												
3	Ineffective communication between top managers and employees												
4	Financial constraints and insufficient resources												
Component 4: QMS Importance		SD=1	D=2	N=3	A=4	SA=5	QI=						☐ Score 1.00-1.80: Not implemented any formal measures ☐ Score 1.81-2.60: Defined some measures, but not yet fully implemented or integrated. ☐ Score 2.61-3.40: Implemented and manages some QMS measures ☐ Score 3.41-4.20: Analyses its QMS measures and uses the data to identify and implement process improvements ☐ Score 4.21-5.00: Continuously improved QMS measures with optimised success
1	Results in less rework						(QI ₁ +QI ₂ +QI ₃)/3						
2	Less incidents on site												
3	Increased competitive advantage												
Component 5: QMS Success Measures		SD=1	D=2	N=3	A=4	SA=5	QM=	Determine Maturity level for each component based on Avg. Score	Update overall maturity score	$M = \frac{QE + QPS + QB + QI + QM}{7}$	☐ Managed (3.41-4.20): Proactive management and continuous improvement		
1	Projects must meet acceptable standards						(QM ₁ +QM ₂ +QM ₃)/3						
2	Projects delivered within acceptable timeframe, budget and quality standards												
3	Projects delivered within acceptable sustainability standards												
Component 6: QMS Perception		SD=1	D=2	N=3	A=4	SA=5	QP=						☐ Score 1.00-1.80: Lack of awareness or negative perception. ☐ Score 1.81-2.60: Limited awareness, inconsistent understanding. ☐ Score 2.61-3.40: Positive perception, awareness among key stakeholders. ☐ Score 3.41-4.20: Clear positive perception, recognized importance. ☐ Score 4.21-5.00: Deep understanding and appreciation across the organization
1	QMS provides the right guidelines which always ensures quality						(QP ₁ +QP ₂)/2						
2	QMS focuses on continuous improvement												
Component 7: QMS Critical Success Factors		SD=1	D=2	N=3	A=4	SA=5	QC=	Determine Maturity level for each component based on Avg. Score	Update overall maturity score	$M = \frac{QE + QPS + QB + QI + QM}{7}$	☐ Optimised (4.21-5.00): Fully integrated, leading-edge quality management practices		
1	Top management and leadership commitment						(QC ₁ +QC ₂ +QC ₃ +QC ₄ +QC ₅)/5						
2	Legislative instrument in operation												
3	Client satisfaction												
4	Communication between top management and employees												
5	Teamwork												

Rank: SD= Strongly Disagree D= Disagree N= Neutral A= Agree SA= Strongly Agree

Component Labels: QE= QMS Effectiveness QPS= QMS Practice Standards QB= QMS Barriers QI= QMS Importance QM= QMS Success Measures QP= QMS Perception QC= QMS Critical success factors

Model Components		Rank					Avg. Score	Component Maturity level		Update overall maturity score	Overall Maturity Levels	
Component 1: QMS Effectiveness		SD=1	D=2	N=3	A=4	SA=5	QE= 3	[] Score 1-1.80: Ineffective or non-existent implementation. [] Score 1.81-2.60: Limited effectiveness, sporadic successes. [X] Score 2.61-3.40: Effective implementation in specific areas. [] Score 3.41-4.20: Broadly effective implementation with continuous improvement. [] Score 4.21-5: Fully effective implementation, continuous optimization			[] Initial (1.00-1.80): Limited or no systematic quality management practices	
1	Effective quality reporting structure	X					(1+4+5+2)/4					
2	Effective implementation of adopted QMS method				X							
3	Effective management of quality documents					X						
4	Proper records of previous works		X									
Component 2: QMS Practice Standards		SD=1	D=2	N=3	A=4	SA=5	QPS= 4	[] Score 1-1.80: No established standards or guidelines. [] Score 1.81-2.60: Basic standards, inconsistently applied. [] Score 2.61-3.40: Documented standards, periodic reviews. [X] Score 3.41-4.20: Established standards, regular updates. [] Score 4.21-5: Best practices, continuous refinement			[] Elementary (1.81-2.60): Some basic awareness and sporadic implementation	
1	Adopted QMS in practices				X		(4+4+4)/3					
2	Organisation's QMS certified in accordance with ISO 9001 standard/ any other standard				X							
3	QMS certificate still valid				X							
Component 3: QMS Barriers		SD=1	D=2	N=3	A=4	SA=5	QB=2.75	[] Score 1-1.80: Numerous barriers hindering QMS implementation. [] Score 1.81-2.60: Major barriers, limited efforts to overcome. [X] Score 2.61-3.40: Identified barriers with some mitigation strategies. [] Score 3.61-4.20: Few barriers, actively managed. [] Score 4.21-5: Minimal barriers, continuous improvement culture		[X] Developed (2.61-3.40): Established quality management practices with documented processes.		
1	Contractor selection based on low bid criterion	X				X	(1+5+1+4)/4					
2	Lack of employees' involvement					X						
3	Ineffective communication between top managers and employees	X										
4	Financial constraints and insufficient resources				X							
Component 4: QMS Importance		SD=1	D=2	N=3	A=4	SA=5	QI= 3.67	[] Score 1-1.80: Not considered important. [] Score 1.81-2.60: Limited importance, minimal impact on decisions. [X] Score 2.61-3.40: Recognised importance, considered in key decisions. [] Score 3.61-4.20: Integral to decision-making processes. [] Score 4.21-5: Strategic importance, central to organizational goals				
1	Results in less rework				X		(4+4+3)/3					
2	Less incidents on site				X							
3	Increased competitive advantage			X								
Component 5: QMS Success Measures		SD=1	D=2	N=3	A=4	SA=5	QM= 2.33	[] Score 1-1.80: Not implemented any formal measures [X] Score 1.81-2.60: Defined some measures, but not yet fully implemented or integrated. [] Score 2.61-3.40: Implemented and is managing QMS measures [] Score 3.61-4.20: Analyses its QMS measures and uses the data to identify and implement process improvements [] Score 4.21-5: Continuously improve QMS and its measures of success		[] Improved (3.41-4.20): Proactive management and continuous improvement		
1	Projects must meet acceptable standards	X					(1+2+4)/3					
2	Projects delivered within acceptable timeframe, budget and quality standards		X									
3	Projects delivered within acceptable sustainability standards				X							
Component 6: QMS Perception		SD=1	D=2	N=3	A=4	SA=5	QP= 3	[] Score 1-1.80: Lack of awareness or negative perception. [] Score 1.81-2.60: Limited awareness, inconsistent understanding. [X] Score 2.61-3.40: Positive perception, awareness among key stakeholders. [] Score 3.41-4.20: Broad positive perception, recognized importance. [] Score 4.21-5: Deep understanding and appreciation across the organization		[] Optimised (4.21-5.00): Fully integrated, leading-edge quality management practices		
1	QMS provides the right guidelines which always ensures quality		X				(2+4)/2					
2	QMS focuses on continuous improvement				X							
Component 7: QMS Critical Success Factors		SD=1	D=2	N=3	A=4	SA=5	QC= 3	[] Score 1-1.80: Lack of identification or focus on critical success factors. [] Score 1.81-2.60: Limited understanding and emphasis on success factors. [X] Score 2.61-3.40: Identified critical success factors with occasional emphasis. [] Score 3.41-4.20: Consistent focus on critical success factors. [] Score 4.21-5: Proactive management and optimization of success factors				
1	Top management and leadership commitment		X		X		(4+2+3+1+5)/5					
2	Legislative instrument in operation				X							
3	Client satisfaction			X								
4	Communication between top management and employees	X										
5	Teamwork					X						
Rank: SD= Strongly Disagree D= Disagree N= Neutral A= Agree SA= Strongly Agree		Examine each item and assign a rank					Calculate Avg. Score for each component		Determine Maturity level for each component based on Avg. Score		M= $\frac{3+4+2.75+3.67+2.33+3+3}{7} = 3.11$	
Component Labels: QE= QMS Effectiveness QPS= QMS Practice Standards QB= QMS Barriers QI= QMS Importance QM= QMS Success Measures QP= QMS Perception QC= QMS Critical success factors												

Appendix C: Participant Information Sheet

PARTICIPANT INFORMATION SHEET

Study title: Developing a Quality Assessment Tool for the Ghanaian Construction

Industry

Invitation Paragraph

Dear Sir/Madam,

I am Hilary Osei-Bonsu, a doctoral researcher in the Civil Engineering department of Brunel University.

As part of data collection for my PhD study, you are kindly invited to participate in this study by providing information that will be valuable for my study. My research is titled: **Developing a Quality Assessment Tool for The Ghanaian Construction Industry**. The research aims to develop a quality assessment tool to enhance the adoption of quality management practices in the Ghanaian Construction Industry.

Therefore, I am requesting your kind cooperation in giving your knowledge, expertise, and time by responding to the questionnaire(s) that will be sent to you. Your full cooperation is very vital as this research outcome will be beneficial to Ghana and the academia.

What is the purpose of the study?

The aim of this research is to develop a quality assessment tool to enhance quality management practices in the Ghanaian construction industry. This research has the following objectives:

- To critically review extant literature on the concept of quality management systems, its standards and process improvement tools as applied in the construction industry.
- To evaluate QMS currently being used on project construction sites in Ghana.
- To assess the critical success factors of projects and the barriers of implementing quality management systems in the Ghanaian construction industry.
- To develop an appropriate quality assessment tool for enhancing quality management practice.
- To validate the developed tool for the effective adoption and implementation of quality management system in the Ghanaian construction industry.

Why have I been invited to participate?

You have been invited to participate in this research so that you can contribute your immense knowledge on the adoption of quality management practices, its challenges and implementation process in the construction industry. Your response to these questionnaires will be beneficial to the Ghanaian construction industry as an assessment tool will be developed, which is the first of its kind in Ghana.

Do I have to take part?

Participation is completely voluntary, and you may withdraw at any time. It is not mandatory.

What will happen to me if I take part?

Information provided by participants will be used for this research and will be kept securely for the duration of this research. All data collected will be kept and solely accessed by the researcher and will not be made available to other parties or the public. Any information provided before withdrawal shall immediately be destroyed.

Are there any lifestyle restrictions?

No, there are no lifestyle restrictions for the purpose of this research.

What are the possible disadvantages and risks of taking part?

Taking part in answering the questionnaires does not impose any risks neither does it include any disadvantages.

What are the possible benefits of taking part?

The objective of this study is to develop a quality assessment tool which will be used to improve quality management practices in the Ghanaian Construction Industry. This research will also be beneficial to the academia as other researchers will be able to adopt this tool for further research purposes.

What if something goes wrong?

If you have any concerns about any aspect of the study, you can speak to the researcher who will answer your questions. If you are not satisfied with their response, you may wish to forward a complaint directly by contacting their main supervisor, who is nuhu.braimah@brunel.ac.uk.

Will my taking part in this study be kept confidential?

Yes, participation in this research is totally confidential and respondents will be anonymous.

Will I be recorded, and how will the recording be used?

No, you will not be recorded

What will happen to the results of the research study?

The findings will be published in the form of a report, which will be included in a thesis that forms part of the PhD degree. Furthermore, it is also likely that the researcher will write academic papers based on the findings of this study, and that these papers will be published in professional journals or presented at conferences.

Who is organising and funding the research?

This research is led by Hilary Osei-Bonsu, a PhD student at Brunel University. This research is Self-Funded and is supervised by Dr. Nuhu Braimah.

What are the indemnity arrangements?

Brunel University London provides appropriate insurance cover for research which has received ethical approval. For queries and complaints, you may contact Professor Simon Taylor who is the Chair of the CEDPS Research Ethics Committee via email: simon.taylor@brunel.ac.uk

Who has reviewed the study?

The researcher's supervisors and the Brunel University's Ethics Committee have reviewed all aspects of this study.

Research Integrity

Brunel University London is committed to compliance with the Universities UK [Research Integrity Concordat](#). You are entitled to expect the highest level of integrity from the researchers during the course of this research

Contact for further information and complaints

Researcher name and details:

Hilary Osei-Bonsu

Doctoral Researcher (1841815)

1841815@brunel.ac.uk

(If relevant) Supervisor name and details:

Dr. Nuhu Braimah

Nuhu.braimah@brunel.ac.uk

For complaints, Chair of the Research Ethics Committee:

Professor Simon Taylor

simon.taylor@brunel.ac.uk



Online Consent Form

STUDY TITLE: DEVELOPING A QUALITY ASSESSMENT TOOL FOR THE GHANAIAN CONSTRUCTION INDUSTRY

NAME OF PRINCIPAL INVESTIGATOR: HILARY OSEI-BONSU

Please confirm the following:

	Yes	No
I have read the Participant Information Sheet included with this questionnaire		
I am over the age of 18		
I understand that no personal identifying data is collected in this study, therefore I know that once I have submitted my answers I am unable to withdraw my data from the study		
I agree that my data can be anonymised, stored and used in future research in line with Brunel University's data retention policies		
I agree to take part in this study		

QUESTIONNAIRE

PROJECT TITLE: DEVELOPING A QUALITY ASSESSMENT TOOL FOR THE GHANAIAN CONSTRUCTION INDUSTRY

Objective of this questionnaire is to explore quality management practices adopted on construction project sites to develop a quality assessment tool to enhance quality management practices in the Ghanaian Construction Industry.

Guidelines

The survey is divided into three primary sections. The first section provides a summary of the organisations represented by the respondents and their respective project locations. The second section focuses on Quality Management Systems (QMS) and ISO Standards. The third section aims to investigate the significance of QMS, identify its key success factors, and examine the obstacles that may hinder its implementation. Please review the questions carefully and provide your honest feedback by selecting the appropriate options and/or adding comments where necessary. This will facilitate thorough data analysis for the research. All information will remain confidential, with the exception of the names of the organisations and project sites, ensuring the highest level of anonymity.

PART 1

1. Which of the following best describes your Qualification/Educational Background?
 - a) GCE / O'Level / West African Senior School Certification (WASSCE)
 - b) Diploma/ HND
 - c) Bachelor's Degree
 - d) Master's Degree/ PhD
 - e) Other(s), please specify:

2. Which of the following best describes the role you play in your organisation?
 - a) Project Manager
 - b) Site Engineer
 - c) Contract Manager
 - d) Architect
 - e) Civil / Structural Engineer

- f) Quantity Surveyor
- g) Other(s), please specify:

2b) Which of the following organisations do you work for?

- a) Construction Firm
- b) Civil engineering / Consulting Firm
- c) Architectural Firm
- d) Project Management Firm
- e) Other(s), please specify:

3. Which of the following indicates the size of people in your organisation?

- a) 1-5
- b) 5-20
- c) 20-100
- d) More than 100

PART 2

These set of questions seeks your opinion on a range of issues related to your understanding of QMS within your organisation. To answer the questions below, you can **circle** either one or more options to answer each question.

1. Which of the following best describes your perception about the benefits of quality?
 - a) Continuous improvement
 - b) Customer satisfaction
 - c) Increased profit
 - d) Elimination of defects
 - e) Corrective actions and Inspections
 - f) Reduction of Cost & Rework
 - g) Other (s)

2. Which of the following quality management principles do your organisation practice?
 - a) Leadership Commitment
 - b) Involvement of people
 - c) Customer focus
 - d) Continual improvement
 - e) Process approach
 - f) Factual approach to decision making
 - g) System approach to management
 - h) Mutually beneficial supplier relationships

3. Which of the following factors does your organisation take into consideration when ensuring quality during the project lifecycle?
 - a) Customer satisfaction
 - b) Profit
 - c) Quality Occupational health and safety
 - d) Timely completion of the project
 - e) Environment

f) Other(s)

4. To what extent are QMS used in your organisations?

- a) Always
- b) Often
- c) Sometimes
- d) Rarely
- e) Never

5. How frequent does your organisation make use of each of the quality management tools and techniques? Please indicate your response to each by ticking/circling suitable number on the scale of 1 to 5, where 1 is 'Never' and 5 is 'Always'

- a) Pareto analysis
- b) Histogram
- c) Cause and effect diagram
- d) Flow chart
- e) Benchmarking
- f) Plan-Do-Check-Act
- g) Kaizen
- h) Six Sigma
- i) Control charts
- j) Other(s)

6. Does your organisation have an ISO certification?

Yes / No

6b. If Yes, what specific type of ISO 9001 standard is implemented within your organisation?

7. Please rank each of the following clauses in ISO 9001:2015 on their level of relative importance of (10 being 'highest importance' and 1 the lowest)
- a) Scope
 - b) Normative Reference
 - c) Terms and Definitions
 - d) Context of Organisation
 - e) Leadership
 - f) Planning
 - g) Support
 - h) Operation
 - i) Improvement
 - j) Performance Evaluation
8. Which of the following best describes the extend of increase (in any) of customer satisfaction following the implementation of ISO/QMS?
- a) No difference
 - b) 0 – 5% than before
 - c) 5 -10% than before
 - d) 10 – 15% than before
 - e) 15 – 20% than before
 - f) More than 20%
9. What quality improvement approach is utilised within your organisation? Please indicate your response to each by ticking/circling suitable number on the scale of 1 to 5, where 1 is 'Never' and 5 is 'Always'.
- a) Inspection
 - b) Quality Control
 - c) Quality Assurance
 - d) Total Quality Management
10. Is the adherence to quality standards or guidelines in projects regulated within your organisation?
- Yes / No

10b. If Yes, is it checked regularly?

- a) Before the start of the project
- b) After each design phase
- c) During the construction stage

PART 3

The following set of questions intend to find out your perception on a range of issues interconnected with QMS practices within your company. Therefore, please tick(✓) the best option(s) from the table based on how you agree nor disagree with the statements below.

a) Importance of Quality Management Systems

	Strongly Agree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Defined Roles and Responsibilities					
Results in less Rework					
Improved Productivity					
Produce high client satisfaction					
Increased market shares/ profits					
Less incidents on site (increased safety precautions)					
Increased competitive advantage					

b) Critical Success Factors which affect QMS practices at Construction Project Sites

	Strongly Agree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Quality Education					
Teamwork					
Employees' involvement					
Communication between top managers and employees					
Organisational culture					
Client satisfaction					
Top management commitment and leadership					
Subcontractors and suppliers assessment procedures					
Long-term relationships with subcontractors and suppliers					

c) Barriers affecting QMS Implementation

	Strongly Agree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Inadequate training and education					
Low bid sub-contractors' selection (low bid mindset)					
Lack of employees' involvement					
Ineffective communication between top managers and employees					
Financial constraints and Insufficient resources					
The notion that QMS is time consuming and costly					
Various requests from documentations					

on requirements					
Inadequate commitment from top management					

Thank you.

Appendix E: Ethical Approval



College of Engineering, Design and Physical Sciences Research
Ethics Committee
Brunel University London
Kingston Lane
Uxbridge
UB8 3PH
United Kingdom
www.brunel.ac.uk

24 January 2022

LETTER OF APPROVAL

APPROVAL HAS BEEN GRANTED FOR THIS STUDY TO BE CARRIED OUT BETWEEN
07/02/2022 AND 29/04/2022

Applicant (s): Miss Hilary Osei-Bonsu

Project Title: Developing a Quality Assessment Tool for the Ghanaian Construction Industry

Reference: 35414-LR-Jan/2022- 37440-2

Dear Miss Hilary Osei-Bonsu

The Research Ethics Committee has considered the above application recently submitted by you.

The Chair, acting under delegated authority has agreed that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that the conditions of approval set out below are followed:

- **Approval is given for remote (online/telephone) research activity only. Face-to-face activity and/or travel will require approval by way of an amendment.**
- **The agreed protocol must be followed. Any changes to the protocol will require prior approval from the Committee by way of an application for an amendment.**

In addition to the above, please ensure that you monitor and adhere to all up-to-date local and national Government health advice for the duration of your project.

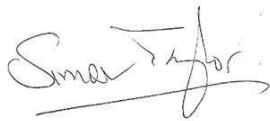
Please note that:

- Research Participant Information Sheets and (where relevant) flyers, posters, and consent forms should include a clear statement that research ethics approval has been obtained from the relevant Research Ethics Committee.
- The Research Participant Information Sheets should include a clear statement that queries should be directed, in the first instance, to the Supervisor
- (where relevant), or the researcher. Complaints, on the other hand, should be directed, in the first instance, to the Chair of the relevant Research Ethics Committee.

Approval to proceed with the study is granted subject to receipt by the Committee of satisfactory responses to any conditions that may appear above, in addition to any subsequent changes to the protocol.

The Research Ethics Committee reserves the right to sample and review documentation, including raw data, relevant to the study.

You may not undertake any research activity if you are not a registered student of Brunel University or if you cease to become registered, including abeyance or temporary withdrawal. As a deregistered student you would not be insured to undertake research activity. Research activity includes the recruitment of participants, undertaking consent procedures and collection of data. Breach of this requirement constitutes research misconduct and is a disciplinary offence.



Professor Simon Taylor Chair of the College of
Engineering, Design and Physical Sciences Research
Ethics Committee Brunel University London