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Framework to Integrate Knowledge Management with Total Quality Management to Enhance Construction Project Delivery

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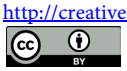

Abstract

The Ghanaian construction industry continues to experience challenges in project delivery, including cost overruns, delays, substandard workmanship, and ineffective knowledge sharing among stakeholders. These challenges highlight the need for a structured approach that integrates knowledge management (KM) processes with total quality management (TQM) principles to enhance project performance. This study develops and validates a framework that combines KM and TQM to improve construction project delivery in Ghana. A mixed-method approach was adopted, beginning with a comprehensive review of relevant theories and existing models, followed by empirical data collection through surveys and focus group discussions with construction professionals. The framework was developed through an iterative process that incorporated theoretical insights and stakeholder feedback to ensure the validity, applicability, and ease of implementation. The proposed framework is structured into three phases: integration of KM processes and TQM principles, the role of the project team and KM/TQM officer, and the conditions, constraints, and strategies for effective implementation. Validation results indicate that the framework is practical, contextually relevant, and capable of improving knowledge flow, quality planning, leadership commitment, and continuous improvement in construction projects. The study contributes a context-specific, actionable model that supports standardized practices, stakeholder collaboration, and performance enhancement within the Ghanaian construction industry.

Keywords

KM, TQM, Integration, Framework, Construction, Project Delivery

1. Introduction

The Ghanaian construction industry has struggled to adequately meet the growing demand for infrastructure. Over the years, the sector has been plagued by issues such as delays, substandard workmanship, and cost overruns, among other challenges (Hammond, 2018). Damoah and Akwei (2017) identified government project failures using six success/failure criteria as an evaluation framework. Their findings revealed that meeting deadlines was the poorest performance criterion, followed by cost, deliverables, and stakeholder satisfaction. The study also emphasized that, although projects fail across all six criteria, failures are most prevalent in the area of project management. Moreover, the performance of Ghana's construction industry remains poor, particularly in terms of cost, quality, and productivity. Most construction projects fail to meet budget targets, leading to significant economic and social consequences (Ofori-Kuragu, 2016). Other challenges facing the construction industry in project delivery include: construction waste, delays, and lack of information sharing among project stakeholders, inefficiencies, mistakes, and poor communications (Adusa-poku & Anokye, 2020). Furthermore, the members of the monitoring team for government projects often lack any background in construction and project management, relying entirely on the District Works Engineer (DWE) for guidance (Ghana Audit Service, 2020). This reliance compromises the integrity of the construction process (PMBOK, 2021). According to Hammond (2018), inadequate planning, incomplete requirements, a lack of resources, inaccurate cost estimates, and a lack of user interaction are some of the causes of poor project performance in Ghana. Meanwhile, project management success is delivering the output within the time schedule, budget, and desired quality performance (Turner & Xue, 2018). The aim of this study is to develop a framework that integrates knowledge management processes with total quality management principles to improve construction project delivery in Ghana. The following is the structure of the paper: the first part reviews literature on related frameworks and models. The next part discusses the methodology, focus group discussion, validation of the framework, discussion, findings from the validation, and conclusion.

2. Literature Review

According to the Project Management Book of Knowledge (PMBOK, 2017), project management is categorized into process groups and knowledge areas. A knowledge area is an identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools and techniques. Knowledge management includes practices and procedures, as well as the people and systems that support a companies' information and knowledge needs (Ozturk & Yitmen, 2019). This includes ways to encourage organizations, firms, and individuals to add value and share knowledge (Rhem, 2017). Currently, research has shown that most entrepreneurs emphasized the integration of intellectual resources through KM processes and carry out basic learn-

ing activities of the organization (Jutidharabongse et al., 2020).

Pemsel et al. (2018) argued that knowledge is one of the most significant sources of competitiveness during the past two decades. They further highlight that it is the most significant resources that ensure efficiency and productivity. This makes teams spend less time searching for answers to fix avoidable mistakes when information is well organized and easy to access. Learning, on the other hand, is the most essential organizational capacity that provides the context required for project performance development and improvement (Ahn, 2015). Therefore in order to ensure that knowledge about project delivery and expertise is recorded and used, KM has proven crucial. Hence, instead of being run as a separate system, it is most effective when integrated into a project organization's daily operations, in view of Calnan et al. (2021). Imran et al. (2018) emphasised that successful project companies consistently invest in learning new skills and expanding their knowledge base to improve performance and protect their competitive advantage. Managing project knowledge, therefore, involves utilizing existing information and generating new knowledge to achieve project goals and promote organizational learning (Pemsel et al., 2018). The key benefits of this process are that prior organizational knowledge is leveraged to improve the project outcomes, and knowledge created by the project is available to support organizational operations and future projects (Yap et al., 2022).

Rhem (2017) indicated that the quality of a project is related to how a project organization makes use of knowledge. The PMBOK guide describes KM as a system enabler for the construction quality system over the course of a project. Each stage of a project's lifetime, from development to execution, produces knowledge about processes and procedures. The capacity of the project team members to freely capture, update, enhance, distribute, and make use of the information is essential to the project's continuous performance improvement. Additionally, it is anticipated that the project delivery would fulfill the objectives of giving clients a superior, cost-effective project completion (Jewell & Flanagan, 2019). To fulfill the expectations of stakeholders and clients, Total Quality Management (TQM) involves methods for incorporating the organization's quality policy about planning, managing, and controlling project and product quality requirements (PMBOK, 2017).

Total Quality Management is a system that encompasses all activities within the broader management function, focusing on defining quality policies, objectives, and responsibilities. It implements these through processes such as quality planning, quality control, quality assurance, and quality improvement within the overall quality system (Howarth & Greenwood, 2018). Project management is accomplished through the appropriate application and integration of quality management processes identified for the project. As a result, TQM is a crucial component of project management, and like any other management approach, it cannot be achieved randomly without a methodical approach. The project must be defined, planned, developed, specified, constructed, and commissioned in accordance with an established set of standards that involve every division of the company, from

top management to every member of the project team, in order to ensure a quality outcome (Lester, 2017). Total quality management has many applications in the construction industry and is implemented either at the company level or during the project delivery process (Oyebisi et al., 2019). The project organization component of the quality management system, according to Calnan et al. (2021), provides details on roles, responsibilities, and accountabilities. It specifically articulates responsibilities for all employees and additional responsibilities of individual management, as well as key technical and quality unit roles in which everyone involved must have the appropriate knowledge necessary for their role. The design and detail of the quality management system facilitate this by providing people with the knowledge related to their roles. Responsibilities and accountability are continuously clarified, improved, and documented following the code and standards of TQM practices (Jewell & Flanagan, 2019; Lukichev & Romanovich, 2016).

Even though literature has increasingly measured project success by Time, Cost, Quality, and Client Satisfaction (Soewin & Chinda, 2018), others define the project references for scope, time, and cost, so that the project execution can be compared to those references to manage performance (PMBOK, 2017; Shenhar & Holzmann, 2017). Some projects end up failing even if they were planned out, carried out on time, on budget, and in accordance with performance objectives. Despite the fact that end users are a crucial component in determining a project's success, such initiatives failed to provide real benefits to them (Hammond, 2018).

According to Calnan et al. (2021), knowledge should be managed appropriately by integrating into how work is conducted, but not as a separate system. Iqbal and Asrar-ul-haq (2017) emphasized that there should be a well-integrated system to review the TQM and its effectiveness in areas of improvement, and appropriate information that leads to adjustments in standards and practices. There are several processes associated with this component of the TQM that contribute to the overall management and utilization of knowledge within the organization to ensure that knowledge gained is incorporated into daily operations in a systematic and sustainable way (Jewell & Flanagan, 2019). Deming (2018) wrote in *The New Economics for Industry, Government and Education*, that best efforts and hard work would not achieve improvement unless they were "guided by knowledge".

Knowledge management at the project site has therefore been important in ensuring that the required information and expertise are captured and utilized (Calnan et al., 2021). It is most effective when embedded into the daily operations of a project organization and successfully integrated into the TQM (Howarth & Greenwood, 2018). An organization may possess extensive knowledge, information, and data relating to processes, including quality management processes. However, such knowledge becomes valuable only when it is readily accessible, effectively shared, and properly utilized (Calnan et al., 2021). A well-designed framework to guide these processes is therefore essential. It is also important to recognize that the suitability of a framework for a particular application may not be immediately evident until the learning curve has stabilized and users have gained adequate ex-

perience through repeated application (Nafe Assafi et al., 2023).

Frameworks can enhance productivity and incur significant memory and performance overhead due to their additional generality and capabilities (Dalkir, 2023). Incorporating the working process into an on-site framework is essential for ensuring effective work progress and meeting specific requirements (Jewell & Flanagan, 2019). Various researchers have proposed frameworks. Among them, Guribie and Tengan (2019) developed the Knowledge Management Implementation Framework (KMIF) to foster a KM culture, establishing KM infrastructure, utilizing KM technology, and conducting periodic measurement and assessment of KM practices. Although the KMIF is user-friendly, it depicts a unidirectional approach to knowledge management implementation. Again, the KMIF model suggests that KM activities and processes are to be performed in a sequence defined by the model. However, KM activities and processes could be conducted simultaneously in parallel with others. Again, the model lacks the specific roles of the project team. The constraints and strategies were not indicated.

Burger and Zulch (2018) developed a construction project management knowledge model involving two NQFs. The model did not include an interrelated knowledge set to engage people, which will encourage construction project managers to take ownership in an attempt to introduce and implement this proposed construction project management knowledge model in their firms.

Moreover, the BAN knowledge management model by Abu Adi et al. (2021), which aims to enhance existing models and inspire future research, did not specify strategies to improve both company performance and work quality processes. The iterative nature of the PDCA cycle allows construction teams to plan their projects meticulously, execute them, assess the outcomes, and make necessary adjustments based on the feedback, but it does not give clear guidelines to the project team members (Deming, 2000). The Knowledge Enabled Quality Excellence (KEQE) theory highlights the idea that organizations can achieve superior quality and excellence through the effective use and management of knowledge and sharing to achieve quality excellence in healthcare. It suggests that healthcare organisations can improve patient outcomes, reduce errors, and enhance overall quality by leveraging knowledge and best practices. It integrates principles of knowledge management and quality management, emphasizing how leveraging knowledge can lead to continuous improvement, innovation, and overall organizational excellence. KEQE theory posits that knowledge is essential in ensuring and enhancing the quality of products, services, and processes. Organizations that effectively manage and apply knowledge are more likely to achieve high-quality outcomes. Though the theory suggests that organizations can reach excellence through continuous improvement facilitated by knowledge sharing and learning there are gaps. The theory did not provide clear evaluation criteria to evaluate its effectiveness; the theory assumes that knowledge can easily be transferred without indicating the other factors that can influence the sharing. and it did not account for external factors and regulatory require-

ments to impact on the effectiveness, moreover, it is limited to the health industry (Ibrahim, 2022). While the knowledge-enabled quality excellence theory provides a valuable framework for achieving quality excellence, it does not account for contextual factors such as organizational culture and the evaluation criteria to assess the effectiveness.

The implementation of these models and frameworks typically involves generic KM tools that do not provide specific technological solutions to support quality management principles, problem-solving, and quality improvement methods. The authors did not indicate the role of the project team and the other stakeholders in the implementation process. The impact of TQM on organizational performance and KM in the construction industry has previously been empirically researched in Ghana. However, no such study was carried out to integrate them to enhance project performance. This study seeks to fill these research gaps by developing a framework to integrate KM with TQM to improve construction project delivery and to improve these models and frameworks in the Ghanaian construction industry.

3. Research Methodology

The study applied both quantitative and qualitative approaches to obtain a new and exciting understanding of how KM is integrated with TQM to improve on construction project delivery in the Ghanaian construction industry. Professionals made up of 156 (design team) and 101 (construction team) were involved. The study targeted three thousand, two hundred and twenty-one (3221) construction professionals in the Ghanaian construction industry. The population comprises registered professionals in good standing, including Architects, quantity surveyors, and engineers.

The number of the target sample is three hundred and forty-six (346) professionals with a minimum of two years of experience. The sample size was determined using Krejcie and Morgan's (1970) table of specifications, which provides the minimum sample size required for different population sizes. The interview, on the other hand, was done to further understand a broad range of concepts to thoroughly understand the subject in detail. Out of the 15 participants interviewed, 5 of them were engineers, five were quantity surveyors, five were architects, and some themes that were identified from the interviews are as follows: Quality planning, leadership commitment, Continuous Improvement, Client focus, Challenges of TQM implementation. Data was collected from March 2024 to August 2024. The privacy and confidentiality of participants were assured. Ten (10) participants were further selected to validate the framework. They comprised construction professionals from the industry, made up of four quantity surveyors, one Engineer (Structural), and three Architects, in good standing, supervising projects.

There were three steps in the framework development process. In order to establish the parameters of the framework, a review of relevant theories was first

carried out. Second, the presentation of the empirical results derived from the data analysis of the survey and interviews made it easier to identify the specific framework items under the various parameters. The final phase of developing the framework involved conducting focus group discussions to validate its specific parameters. These parameters were refined through an iterative process combining theoretical insights and empirical data. The focus group discussions aimed to assess the framework's validity, rigor, dependability, and ease of implementation. Based on the feedback from these discussions, the framework was further adjusted and improved. On the other hand, their views showed that when these two concepts are integrated, it could result in enhanced project performance. Meanwhile, there are constraints that could prevent the implementation. They indicated the conditions and the strategies for the implementation. To ensure effective practice to achieve this outcome, framework to integrate KM with TQM was proposed.

The proposed framework has therefore been developed on the basis of the application of relevant theories, and the principles in the KM and TQM literature are also integrated in this framework. The theories used include: Nonaka and Takeuchi's theory of knowledge creation, Ishikawa's quality circle theory, Davenport and Prusak's Knowledge Markets theory, Crosby's quality theory, and the Deming PDCA Cycle theory. Nonaka and Tacheuchi's theory of knowledge creation highlights the access to a diverse range of knowledge for employees to adapt to changing environments and solve complex problems effectively. By leveraging tools and platforms that facilitate knowledge sharing and integration of data, organizations can empower their workforce to learn from each other and stay agile in the face of challenges. This not only enhances individual capabilities but also fosters a culture of collaboration and innovation within the organization. This theory underpins the idea of KM in the framework (Nonaka & Takeuchi, 1995). Ishikawa's theory of quality is based on the promotion of the "quality circles." The rings introduce a collaborative, open, and inclusive approach to quality inside an organization, which involves planning and leadership commitment. This theory holds the aspect of total quality management in the framework.

The Deming PDCA cycle theory holds the integration of the KM and TQM aspect of the framework. The "Plan, Do, Check, Act (PDCA)" cycle, also known as the Deming Circle in Quality Management, represents the managerial process as a closed-loop system. This cycle functions as a continuous improvement framework, enabling ongoing enhancement of processes and outcomes (Deming, 2000). Davenport and Prusak: Knowledge Markets theory highlights "sellers", "buyers", and "brokers". This theory holds the relationship between the design team, construction team, and the knowledge/total quality management officer in the framework. This implies that the Individuals who seek knowledge to address problems or issues within an organization are referred to as knowledge buyers (Construction team). On the other hand, knowledge salespeople are those who possess a strong reputation within the internal market and have extensive expertise in a

specific procedure, field, or organizational issue (Design team). Knowledge brokers are the individuals who connect knowledge buyers with knowledge sellers (KM/TQM officer) (Davenport & Prusak, 1998). Again, construction firms acquire information from external sources, they compensate consultants and others with monetary payments, which involves the commitment of leadership and a well-regulated construction industry. This is guided by Croby's fundamental ideas of quality theory. He advocates for a top-down approach to quality pursuit within organizations, where senior management assumes the primary responsibility and accountability (Crosby, 1980; Crosby, 1984). In summary, each theory contributes uniquely to the framework: Nonaka and Takeuchi support knowledge creation and sharing; Ishikawa strengthens teamwork and quality participation; Deming guides continuous improvement processes; Davenport and Prusak explain knowledge exchange relationships; and Crosby reinforces leadership commitment and quality governance. These theories provide the theoretical foundation for integrating Knowledge Management and Total Quality Management within the proposed framework (**Table 1**).

Table 1. Mapping of components of the framework and the theories.

Component of the Framework	Theories
Knowledge Management	Knowledge Creation highlights that organizations should provide employees with access to diverse knowledge sources to support learning, adaptability, and effective problem-solving. Through knowledge-sharing tools and collaborative platforms, organizations can enhance innovation and workforce capability (Nonaka & Takeuchi, 1995).
Total Quality Management	Promotion of "quality circles", which introduce a collaborative, open, and inclusive approach to quality management within organizations through planning and leadership commitment, particularly in relation to teamwork, employee involvement, and continuous quality improvement.
Integration of KM and TQM	The "Plan-Do-Check-Act (PDCA)" cycle, also referred to as the Deming Circle in Quality Management, represents management processes as a closed-loop system. The cycle serves as a continuous improvement mechanism that facilitates the ongoing enhancement of organizational processes and outcomes. Consequently (Deming, 2000)
KM/TQM Officer	The interaction between knowledge buyers, sellers, and brokers within an organization. In this framework, the construction team acts as the knowledge buyer, the design team serves as the knowledge seller, and the functions as the knowledge broker who facilitates effective knowledge sharing and application (Davenport & Prusak, 1998).
Leadership Commitment and Quality Governance	Construction firms often acquire knowledge from external consultants and specialists through financial compensation, reflecting the need for leadership commitment and a well-regulated construction environment that advocates a top-down approach to quality management where senior management bears the primary responsibility for ensuring quality standards and organizational commitment (Crosby, 1980; Crosby, 1984).

A preliminary framework was developed to facilitate the integration of KM with TQM to improve practice in the construction industry. This framework aims to enhance project performance in the construction industry during project delivery. The framework's fundamental components are topic areas that are connected to the study's goals. The framework's recommendations and strategies are intended to help the project team enhance the construction project delivery process. The validation aimed to test the suitability of the proposed framework for the integration of KM and TQM in project delivery.

Participants' Assessment of Reliability of Research Findings:

Participants assessed the reliability of the research findings presented to them in Table 2 by confirming whether the findings were consistent with their impressions and with practices during construction project delivery. Table 2 shows a summary of the research findings of the quantitative and qualitative survey results.

Table 2. Summary of research findings of the survey and interview.

Objective	Summary of Findings	Remarks
Explore knowledge management process applications in Ghana's construction project delivery	• There was a significant difference in the views of the design and the construction teams. • When the company creates a report that includes recommendations for practical and workable actions, project performance can be improved. • It also reveals a knowledge gap between the design and the construction teams. • The interview revealed that employees acquire knowledge during the project delivery from themselves. • Since sharing project knowledge is not formally organized, workers do their own thing. • Even though the informal knowledge sharing is good, a formal system will present an opportunity to bridge the gap between their current efforts and a more structured knowledge system.	A clear objective of the organization is on knowledge management practices and applications
Examine total quality management in the delivery of projects in Ghana's construction industry	• There are no quality personnel in most construction sites to champion the quality principles. • The Ghana Building Code, to ensure uniformity of standards for the regulation, is not enforced. • Most construction firms do not provide any proper documentation on quality policy. • Consultants were determined to ensure effective supervision in order to reduce poor-quality work. • The payment system is one of the constraints affecting the quality of construction projects negatively.	Quality standards and processes are all outlined in designs and contract documents, and stakeholders in the construction industry are required to ensure strict adherence to them

Continued

To examine the preconditions for effective integration of KM with TQM management for project delivery	• Lack of training programmes in the Ghanaian construction industry. • The employee does not go through formal training on problem-solving. • Employees should be trained to strengthen their knowledge, which is currently not in place for equipping project team members. • The standardized coefficient is 0.839, suggesting that this path is statistically significant. • This demonstrates that KM practices have a strong and significant effect on TQM.	An active regulated body to regulate the construction industry
To investigate the relationship between KM and TQM and their impact on project performance in Ghana	• An increase in KM usage will positively influence TQM. • There was a strong positive relationship between KM and TQM. An increase in the KM practices potentially improves TQM principles and project performance. • There should be a culture of KM process and TQM Practices for project performance. • The role of quality personnel directly contributes to the overall success of the project. • Detailed quality management practices empower individuals by providing them with a clear understanding of their roles within the project.	Emphasize the practical application of knowledge within organizational processes
To identify the essential factors necessary for the integration of KM and TQM	• KG and KST have strong positive relationships with TQM. • KSH and KAP also have strong positive relationships with TQM. KD has a negative relationship with TQM. • The specific sub-constructs of KMP that significantly influence TQM: KG, KST, KSH, and KAP, have strong positive relationships with TQM sub-constructs like QP, LCOM, and CI.	Identify opportunities for integrating KM processes into existing workflows; Prioritize and allocate dedicated time for KM activities
To identify the key constraints to the integration of KM and TQM	• Lack of awareness of KM with TQM integration. • Lack of time for the integration of KM processes and TQM. • Lack of proper use of KM and TQM integration techniques. • Lack of management support. • Inadequate site communication and information on KM and TQM. • Lack of a system for KM and TQM activities. • Lack of sufficient information on project. • Lack of prediction of the asset's final quality.	Organizations should develop a comprehensive awareness program to highlight the importance of tacit knowledge integration

Source: Author's findings on research. NOTE: Knowledge management processes: knowledge diagnosing (KD), knowledge application (KAP), knowledge generation (KG), knowledge sharing (KSH), knowledge storage (KST). Total quality management principles: continuous improvement (CI), leadership commitment (LCOM), quality plan (QP).

4. Proposed Framework for Integrating Knowledge Management with Total Quality Management to Enhance Project Delivery

The proposed framework consists of three phases (Figure 1). Phase 1 includes the Knowledge Management Processes (KMP) and Total Quality Management Principles (TQMP), both of which are linked to project performance. Phase 2 focuses on the project team, which comprises the design team, construction/production team, and the total quality officer/assistant. Phase 3 encompasses the conditions necessary for knowledge management and total quality management processes, the key constraints for TQM/KM implementation, and the corresponding strategies.

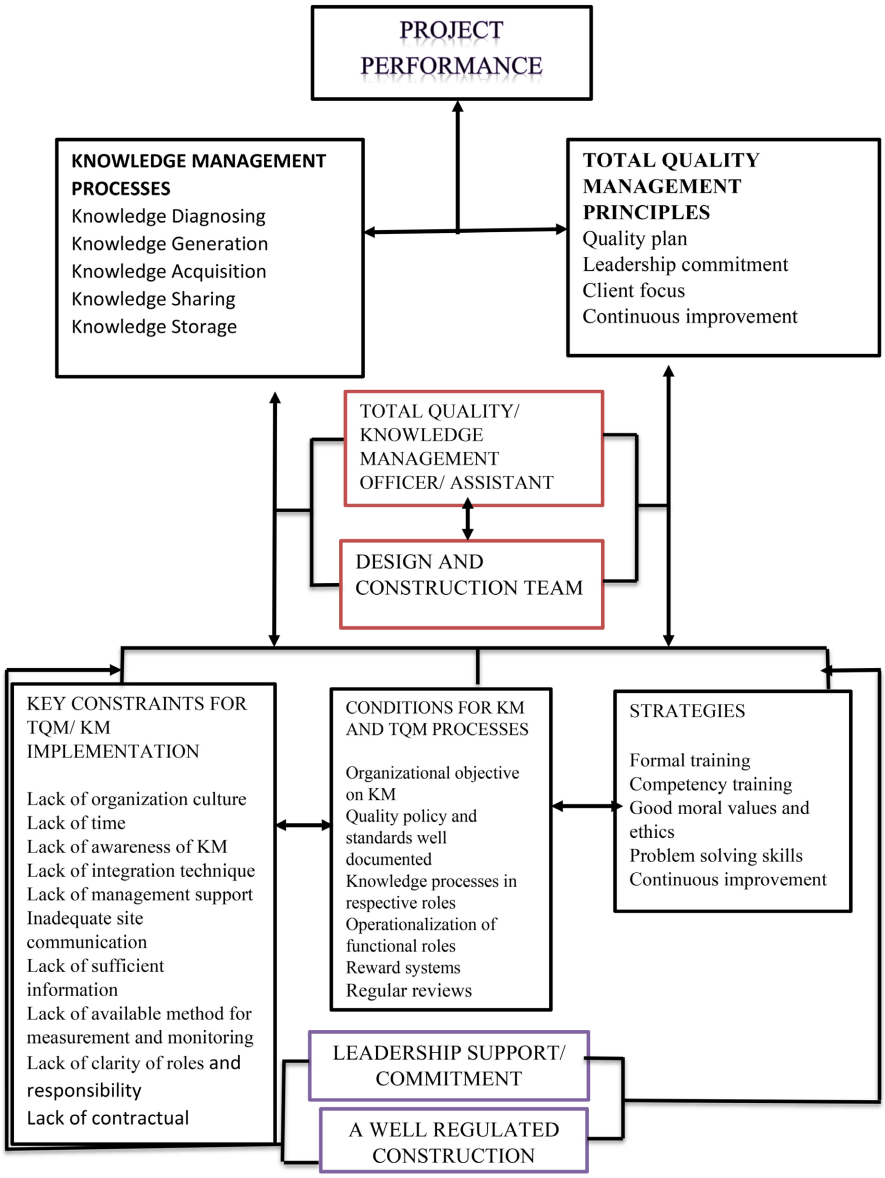

Figure 1. Proposed framework for integrating knowledge management with total quality management to enhance project delivery. Source: author's framework.

Following the validation of the framework, the findings have contributed to its improvement. The section that follows describes the validation procedure, presents the results, and describes how to use the validation results to successfully implement the framework.

4.1. Participants' Assessment of Framework Validity

Participants assessed the applicability and ease of implementation of the framework. Throughout the process, they noted the strengths and weaknesses in the framework as a guide for integrating KM and TQM in project delivery. They also evaluated how clearly the framework presented the guidelines and strategies. Further evaluation was done on the mode of transfer of the knowledge. This feedback was used to improve the framework, ensuring its suitability, applicability, and transferability. Ultimately, participants found the proposed guidelines and strategies understandable and implementable. However, participants also identified certain real-world challenges with regard to the suitability of some of the framework's solutions. They also offered recommendations on how to make it more applicable and simple for us. These concerns and comments have been documented and have been incorporated into the final version of the framework. The framework has been improved by incorporating the feedback provided during the conversations to evaluate its validity. Changes are necessary to achieve the suggested networking approach, based on discussions on the framework's clarity, sufficiency, applicability, and ease of understanding and implementation. These issues are detailed in Table 3.

Table 3. Framework suitability, applicability, and ease of implementation.

Areas of Assessment	Comments on Suitability and Clarity Strength	Weakness
Structure of the design and the construction team	The idea of coming out with such a framework involving the teams is good because things are done differently at different sites. (*Engineer* 2) The aspect of the design and the construction team is appropriate and suitable. (*QS* 1)	The arrows are not well connected to the concept and the teams. (*Engineer* 2) The knowledge flow should be indicated in the framework (*Engineer* 2)
The place of the KM/TQM officer	A TQM/KM officer is appropriate for coordinating between the design and the construction team. (*Engineer* 1) This is suitable since most sites do not have quality personnel to regulate the affairs. (*Engineer* 3) The officer will help to reduce the haphazard nature of organizing activities on site. (*QS* 2)	Should connect the design and the construction team. Should take the centre stage of the whole process. There should be an assistant to support the officer. (*Engineer* 1, 3, *QS* 2)

Continued

Position of the KM/TQM constructs	*The position is okay since their integration brings the result. (QS 1)* *Their connection is bringing the result so that is appropriate. (Architect 1, 2)*	The connection should be clear. (*Architect* 2)
The structure of the various items in the framework	*The improved project performance is the result to be achieved, so at the top is okay. (Architect 2)* *The place of conditions, strategies, and the key constraints is okay. (QS, 1, 2)* *The leadership commitment is appropriate.* *The regulatory bodies will be more suitable than the well-regulated construction industry since they are required to regulate the industry. (Clerk of Works 1, 2)*	There should be a link between project performance, strategies, and key constraints. (*Architect* 2) Using arrows to show the direction of the constructs will improve the quality of the framework (*Clerk of Works* 1) Replace the well-regulated construction industry with regulatory institutions. (*Engineer* 2) The positions of conditions, strategies, and the key constraints should be rearranged.
Assessing the flexibility of the framework	*It is practical but requires commitment and strict implementation. (Engineer 1, 2, 3)* *Such framework is good to ensure effective work progress. (Architect 1, 2, QS 2)* *The regulatory bodies should be well-informed for the framework to work perfectly. (Clerk of Works 1, Engineer 2)* *The idea is good and can help to monitor the progress of the work on site.* *Leadership must support and implement plans to achieve this. (Engineer 3)*	The place of consultants in the framework should be indicated. (*Engineer* 3)
Applicability of framework	*It is very applicable. (Engineer QS 1, 2)* *The place of leadership is appropriate because they have to be responsible for the implementation process. (Clerks of Works 1)*	Consider making it cyclical. The framework has to show what happens beyond improving the work progress. (*Engineer QS* 1, 2)
Area of improvement	*The nature of the knowledge flow should be indicated.* *Knowledge sharing mode is very necessary in KM.* *The Major concern with KM and TQM is determining which communication model is to be adopted that properly suits the recipients. (Engineer 1)*	The communication models should be taken into account. Technological hindrances affect the ease of access and the level of detail required. The feedback period required to assess the effectiveness of the management of the Knowledge should be indicated. The frequency of the details is required. Tailor the knowledge management to suit all stakeholders. (*Engineer* 1)

Source: Author's findings on the outcome of the focus group discussion.

4.2. Validation of the Framework

This section outlines the purpose and objectives of the validation. It describes the validation process and presents the findings, which serve as the foundation for implementing the guidelines and strategies outlined in the framework. The implications of these findings are also discussed.

A framework lacking credibility, transferability, dependability, and conformability cannot be considered reliable or valid (Guba & Lincoln, 1989). To ensure reliability and validity, the framework developed from the data analysis and discussions was validated. The validation process involved collecting qualitative data from construction professionals. At this stage, the primary method used was Focus Group Discussion (FGD) (Krueger & Casey, 2014). This method was chosen specifically for its ability to: Allow the exchange of perspectives, judgments, and responses regarding the sustainability to ensure good practices in the construction industry; Offer guidance on the framework's direction as a policy guideline for use during construction project delivery.

The FGD approach was essential due to its capability to facilitate discussions and interactions among construction professionals who are the primary stakeholders in the implementation of the project management performance framework. The participants in the FGD comprised construction professionals from the industry, made up of four quantity surveyors, one Engineer (Structural), and three Architects, purposively selected from Architectural and Engineering Service Limited (AESL), Building and Road Research Institute (BRRI), and two registered Engineers (Civil) in good standing supervising projects. In all, ten (10) participants were selected to validate the framework, and this is in line with Saunders et al. (2019) assertion that group interviews (focus groups) are between 4 and 12 participants. Participants spared enough time out of their busy schedule to discuss and review the proposed framework.

The data obtained through the focus group interview comprises two forms: an audio recording of participant's discussions and written summaries of the main points from these discussions. It is important to note that, in accordance with research ethics, the audio recording was made with the prior consent of the participants. The FGD focused on issues and themes related to the research objectives. The participants were construction professionals purposively selected. There was a direct visit to the various offices, which involved the professionals at a round table with the printed framework in separate group discussions. Their working experience was between two and twenty years. At Architectural and Engineering Service Limited (AESL), they were: one quantity surveyor, one Engineer (structural), and one Architect. At Building and Road Research Institute (BRRI) they were two Architects and three quantity surveyors. Other two registered engineers (Civil) in good standing supervising projects were also involved to assess:

- The completeness of the framework and the ability of the project team to interpret the framework;
- The suitability of the framework and the ease with which it can be implemented;

- The disposition of the project team to implement the guidelines and strategies in the framework.

4.2.1. Purpose of the Validation

The validation's objective was to determine whether the framework could accomplish the intended objective. According to Wang (2008), validation evaluates the usefulness of a system. The aim of the respondent validation is to seek corroboration or criticism of the researcher's observations and interpretations (Bryman & Bell, 2019). Thus, the validation served as a means to ensure a framework possesses the qualities of transferability and applicability.

4.2.2. Objective of the Validation

The following objectives guided the validation:

- To have discussions about how the framework would accomplish its goal.
- To determine whether the research findings are well-linked in the framework.
- To find suitable ways to make the framework's suggested principles and techniques function in real-world situations.

After discussing each topic, there was an agreement among the professionals and the comments were noted in the notebook. Participants were notified of the modifications through phone calls and emails in response to the focus group discussion's (FGD) comments, which were intended to validate the results and enhance the framework. To enhance the framework, participant responses, feedback, and recommendations from the focus group discussions were taken into consideration. Appendix 1 contains the questions that were considered.

4.2.3. Processing Focus Group Discussion

The data recorded during the focus group discussion were systematically processed and organized by relating the emerging relevant points to the main themes of the discussion, keeping the research objectives in mind. The Audio recordings of the discussions were made alongside manual note-taking of the participants' opinions. These audio recordings were transcribed and reviewed multiple times to facilitate the coding and categorization of information under the primary themes of the research framework.

4.3. The Validated Framework

The framework, as conceptualized in **Figure 1**, comprises six main themes and three basic stages. It also reflects the relevant research objectives. The interrelationship between the framework's themes, stages, and research objectives is detailed in **Table 1**. The three stages involve: the integration of KM and TQM and effective project performance; the project team and the KM/TQM officer; and the conditions, strategies, and constraints for effective project performance. The six main themes involve: the project team, which is made up of the design and construction team, quality/knowledge management officer and assistant, KM processes, and TQM principles, when well implemented during the construction delivery, will ensure effective project performance. The project team should consider

the conditions for KM and TQM processes, strategies for effective implementation, and key constraints for TQM/KM implementation. All these can be effective when there is leadership commitment and active regulatory bodies.

4.3.1. Design and Construction Team

The progress of a construction project in the construction industry depends largely on effective KM and TQM during the project delivery. The construction/production team depends largely on the design team to produce a stable structure and aesthetically good design that could stand the test of time. Also, the design team requires feedback from the construction team during the execution stage of the project. This is to enable the construction team to effectively interpret the design and the project knowledge documented. Again, the design and construction teams made very important corrections to the drawings for difficulties faced on-site. This may include aspects of the drawings that could not be implemented due to the physical conditions of the site. These physical challenges could either be architectural or structural, which requires the two teams to come together and make a decision on it.

From an organizational perspective, knowledge management is about making sure the skills, experience, and expertise of the project team and other stakeholders are used before, during, and after the project. In a project organization, the design team involves the client, who communicates the need for a structure, and employs an architect. The architect designs the kind of structure that meets the client's needs and interacts with the client throughout the project so that the structure stays within the client's requirements and specifications. The architect also communicates with the quantity surveyor, who prices the work, and the structural engineer who designs the load-bearing elements of the structure and ensures that each component is designed to safely withstand the loads that are imposed on the building. Other personnel, such as the resident engineers, report back to the structural engineer and the architect on matters relating to the structure and the load-bearing components that have been designed by the structural engineer. The clerk of works also reports to the architect on the progress of the construction works. Consultants ensure that the work is done according to the contract specifications.

The construction/production team, on the other hand, involves the project manager who facilitates the flow of information between client, architects, and engineers, and other entities involved in the process. The safety officer ensures a safe and healthy working environment for all employees. This includes implementing and maintaining safety protocols, procedures, and policies throughout the organization. The trade's foremen essentially oversee and coordinate the efforts of their trades, ensuring efficiency and adherence to project timelines and quality standards. The role of gang leaders involves overseeing work plans and schedules, while keeping the construction team informed about the latest field advancements. Laborers or construction workers do physical labor on construction sites. The storekeeper possesses sound knowledge of storekeeping operations and is responsible for managing the timely receipt of material/items at stores/stock yard, ensuring

proper storage, issuing and delivery system at construction site along with maintaining inventory system, monitoring and maintaining safe and quality working practices. The trend shows a knowledge flow through the various team members. This indicates that a Production team must be familiar with the design process as a whole. They must understand where problems might arise and work to mitigate those problems as efficiently as possible. The project manager is also responsible for ensuring that each team member has a clear understanding of the project budget and schedule.

4.3.2. Quality/Knowledge Management Officer/Assistant

The quality/knowledge officer and assistant will be in charge of championing the KM processes and TQM principles implementation in terms of effective and efficient processes. The necessity for a total quality/knowledge management officer arises from the importance of ensuring excellence in both quality management and knowledge utilization within an organization. This role involves overseeing and implementing strategies to enhance overall quality standards while also effectively managing knowledge resources to drive organizational growth and competitiveness. The officer will effectively work with the collaboration of both the construction and the design team to foster a culture of continuous improvement, innovation, and organizational learning by integrating quality management principles with effective knowledge management strategies.

4.3.3. Knowledge Management and Total Quality Management

The ability of the project team to diagnose, generate, acquire, share, and store knowledge effectively is very important during the project delivery. In addition to quality planning, leadership commitment, client focus, and continuous improvement within the organization can improve effective project performance. In the framework, KM variables include: knowledge diagnosing, knowledge acquisition, knowledge generation, knowledge sharing, knowledge application, knowledge storing, which are related to TQM variables such as quality plan, leadership commitment, client focus, and continuous improvement. KM is positively associated with TQM, which contributes to enhancing construction project performance. The positive relationships will proactively address potential challenges, ensuring sustained quality improvement in organizational processes (**Figure 2**).

4.3.4. Conditions for KM and TQM Processes

The conditions for the processes involve establishing a clear organizational objective regarding knowledge management practices and their application. This can equip members with the necessary knowledge, especially considering that some employees may not fully grasp these practices. The approach ensures that everyone understands the importance and implementation of knowledge management within the organization. Quality standards and processes should be detailed within designs and contract documents. It is advisable for stakeholders in the construction industry to ensure rigorous compliance with these standards.

It also involves knowledge in respective roles where the project team has the

opportunity for functional role collaboration. Offering opportunities for functional roles can enhance employee engagement, job satisfaction, and overall organizational effectiveness by ensuring that individuals are placed in positions where they can utilize their skills and knowledge to the fullest extent. Moreover, integrating with current KM strategies, such as Communities of Practice (Cop), which is a network of individuals sharing a common interest in a particular field and seeking to develop and enhance their knowledge through community sharing can improve the mode of sharing the use of Building Information Modelling (BIM), a process for creating and managing digital information about a built asset, can be incorporated. This can work effectively with a good reward system.

Selecting an appropriate communication model to suit the recipients of knowledge is crucial. The chosen communication model should consider technological hindrances (ICT type), ease of access, the level of detail required, and the feedback period, as these factors impact the effectiveness of KM. When determining the type and frequency of information needed, it is important to tailor the KM approach to fit the stakeholders' needs as construction becomes more complex with new and modern technologies. This may require establishing a dynamic organizational culture that fosters the open sharing of knowledge and expertise, whether the organization is simple or complex. A system cannot function properly without feedback. Therefore, it is important to measure the success of KM and TQM strategies to ensure continued business support. Consequently, the framework should be periodically evaluated to ensure its effectiveness by setting targets and measuring the success of activities against these targets.

Resource allocation is essential, the necessary resources should be allocated to enable ongoing improvement and prompt action. Stakeholder engagement and commitment are necessary to oversee the progress of the framework.

4.3.5. Strategies for Effective Implementation

Conditions like Organizational objectives on KM/TQM, quality policy and standards well documented, knowledge processes in respective roles, operationalization of functional roles, reward systems, etc., call for effective strategies. The summation of these conditions for KM/TQM processes and strategies would improve the implementation of TQ/K Management. Strategies for ensuring these conditions involve: formal training, capacity building, quality policy, good moral values, and ethics. The construction team should be introduced to problem-solving skills and given consistent on-the-job training programs for continuous improvement.

4.3.6. Key Constraints for KM with TQM Integration

The key constraints that may hinder these strategies include: lack of culture of the importance of quality on projects; high complexity of construction tasks; lack of organizational culture and contractual boundaries; lack of sufficient information; lack of prediction of the asset's final quality; no available methods of measurement and monitoring; lack of clarity on roles and responsibilities; lack of data against which benchmarking can be undertaken could be a barrier for TQM implemen-

tation. Lack of awareness of the importance of tacit knowledge integration; lack of time for implementation of KM processes; lack of proper use of knowledge integration techniques; lack of trust for sharing knowledge; lack of management support; lack of incentives for sharing knowledge; inadequate site communication and information.

4.3.7. Commitment of Leadership and Active Regulatory Institutions

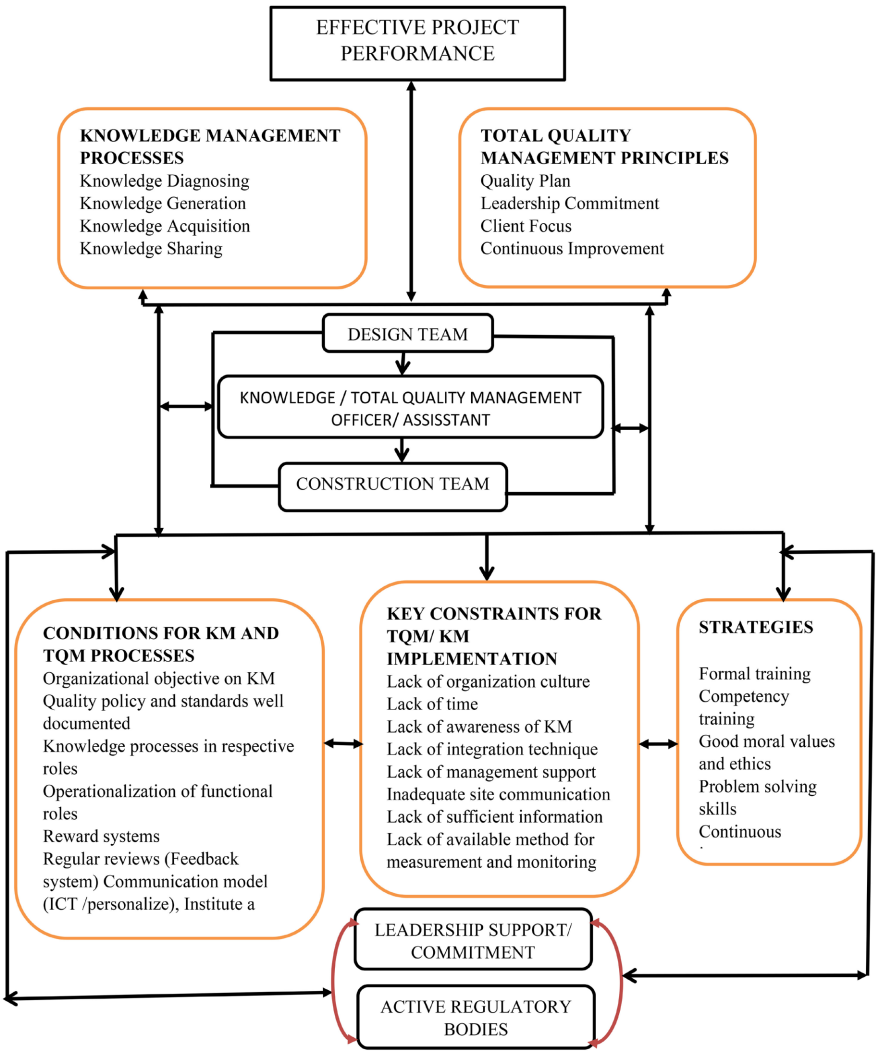

Figure 2. Framework integrating knowledge management and total quality management to enhance project delivery.

An active regulatory institution coupled with committed leadership in identifying key constrains for TQM/KM implementation i.e. lack of organizational culture, lack of time, lack of awareness of KM, lack of integrated techniques, lack of management support, inadequate site communication etc. would lead to an effective implementation of Total Quality/Knowledge Management during the Project delivery The commitment of leadership and support will foster a knowledge-centric organizational culture where employees are encouraged and empowered to con-

tribute their insights, experiences, and expertise. These will work better with a well-regulated construction industry.

5. Discussion of Findings from the Validation

The outcome of the result revealed the procedure to ensure a common practice. This will create awareness of the project team. The KM/TQM officer will coordinate the knowledge flow among the team members since most sites do not have such personnel for the duty. Integrating KM and TQM can really improve practice during project delivery. With leadership in control, they can ensure the effective implementation of the framework. Active regulatory bodies having a fair idea can improve on the framework. The result indicates key aspects like knowledge diagnosing, quality plan, and continuous improvement, ensuring thorough integration of KM and TQM. The practical strategies provide actionable strategies, such as formal training and competency development. Involving stakeholders emphasizes the need for leadership commitment and organizational culture adaptation. The result revealed the appropriateness and suitability of the teams having a common goal to ensure proper knowledge management of quality processes on construction sites.

Framework for Integrating Knowledge Management with Total Quality Management to Enhance Project Delivery:

The framework for integrating KM with TQM was developed and validated to guide construction project delivery. Participants found it practical, though it demands commitment and strict implementation. They also noted that the framework is beneficial for ensuring effective work progress and promoting uniform practices. Participants advocated for effective and well-informed regulatory bodies to oversee the construction project activities in the industry, as these bodies are essential for enforcing correct work practices. Their monitoring will ensure adherence to the framework, allowing it to function optimally. Consequently, leadership must support and initiate plans to achieve this goal.

Participants also highlighted a major concern with KM and TQM: determining the appropriate communication model to adopt. The chosen communication model should suit the recipients of the knowledge and consider factors such as technological hindrances, ease of access, the level of detail required, and the feedback period needed. These factors can impact the effectiveness of KM. It is essential to determine the type and frequency of information needed and tailor the knowledge management approach to suit the stakeholders.

6. Conclusion

This study developed and validated a framework for integrating KM processes with TQM principles to enhance construction project delivery in Ghana. The findings confirm that the persistent challenges of delays, cost overruns, poor communication, and inconsistent quality practices can be addressed through a structured approach that promotes effective knowledge flow, leadership commitment, stake-

holder collaboration, and continuous improvement. The validated framework emphasizes the central role of the design and construction teams, supported by a dedicated KM/TQM officer and assistant, in coordinating knowledge sharing and quality practices throughout the project lifecycle. By aligning KM processes: knowledge diagnosing, acquisition, generation, sharing, application, and storage with TQM principles, including quality planning, client focus, leadership commitment, and continuous improvement. The framework provides a systematic pathway for improving project performance.

Focus group validation demonstrated that the framework is practical and applicable, though the effectiveness depends on strong leadership support, adequate training, and active regulatory oversight. Key constraints such as limited organizational culture for knowledge sharing, inadequate communication systems, and insufficient management commitment must be addressed through targeted strategies, including formal training, capacity building, and the adoption of appropriate communication and technological tools.

Overall, the study contributes a context-specific and implementable framework that enhances standardization, accountability, and performance in construction project delivery. The framework offers practical guidance for industry stakeholders and policymakers seeking to strengthen quality management and knowledge utilization. The framework is limited to the construction industry. Future research is recommended to test the framework across a broader range of projects and other countries, and to quantitatively assess its long-term impact on cost, time, quality, and stakeholder satisfaction.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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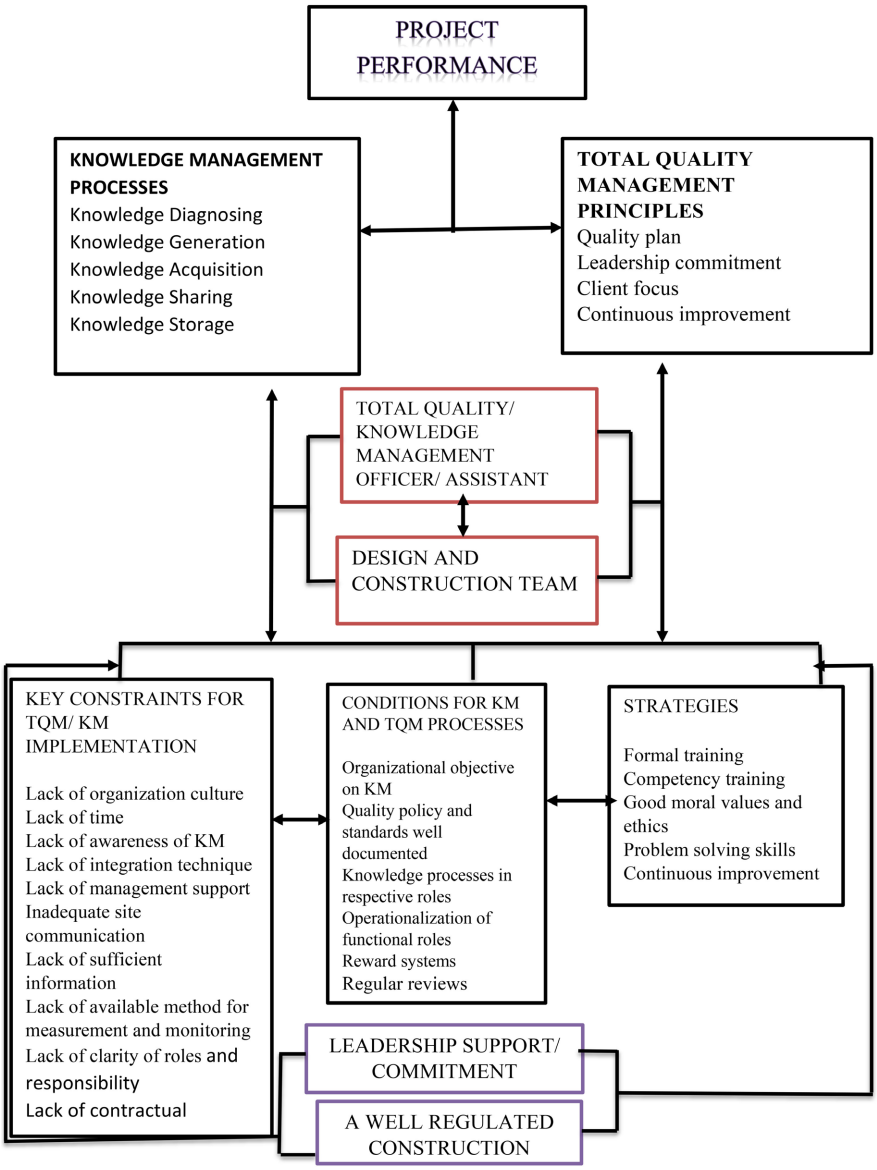
Appendix

Proposed Framework to Integrate KM with TQM

This study aims to test the suitability of the proposed framework (Figure 1) for the integration of KM and TQM in project delivery. Please kindly read through the explanation of the framework and indicate your comments by providing its strengths and weaknesses for implementation.



The Framework

The framework involves the following: quality/knowledge management officer and Assistant, design and construction team, conditions for KM processes and TQM principles, strategies for effective implementation, key constraints for TQM/KM implementation, commitment of leadership, and a well-regulated construction industry.

Design and Construction Team

From an organizational perspective, knowledge management is about making sure the skills, experience, and expertise of the project team and other stakeholders are used before, during, and after the project. A project organization involves the design and production team: the design team involves the client, who communicates the need for a structure, and employs an architect. The architect, designs the kind of structure that meets the client's needs and interacts with the client throughout the project so that the structure stays within the client's requirements and specifications. The architect also communicates with the Quantity Surveyor, who prices the work, and the Structural Engineer, who designs the load-bearing elements of the structure and ensures that each component is designed to safely withstand the loads that are imposed on the building.

The construction/production team, on the other hand, involves the project manager who facilitates the flow of information between the client, architects, and engineers, and other entities involved in the process. Resident Engineers report back to the structural engineer and the architect on matters relating to the structure and the load-bearing components designed by the structural engineer. The clerk of works also reports to the architect on the progress of the construction works. The trend indicates the information flow during the project delivery among the professionals.

The production team must be familiar with the design process as a whole. They must understand where problems might arise and work to mitigate those problems as efficiently as possible. The project manager is also responsible for ensuring that each team member has a clear understanding of the project budget and schedule.

Knowledge Management and Total Quality Management

The framework involves the following information: Knowledge management variables include knowledge diagnosing, knowledge acquisition, knowledge generation, knowledge sharing, knowledge application, knowledge storing, which are related to total quality management variables such as quality plan, leadership commitment, client focus, and continuous improvement. Knowledge diagnosing has a negative correlation with quality planning, but a positive correlation with leadership commitment. It also shows a negative correlation with continuous improvement. Knowledge sharing correlates positively with leadership commitment and continuous improvement, but negatively with quality planning. Knowledge generation demonstrates a positive relationship with quality planning and a strong association with leadership commitment, even though it has a weak connection with continuous improvement. Knowledge storage exhibits a strong positive correlation with quality planning, while having a positive correlation with leadership commitment, but a negative correlation with continuous improvement. Knowledge application shows a strong positive correlation with quality planning, but only a weak correlation with leadership commitment. Knowledge management is positively associated with total quality management, which contributes to enhancing construction project performance. The positive relationships will proactively ad-

dress potential challenges, ensuring sustained quality improvement in organizational processes.

Strategies for Effective Implementation

Strategies for ensuring these conditions involve: formal training, capacity building, quality policy, good moral values, and ethics. Members should be introduced to problem-solving skills and given consistent on-the-job training programs for continuous improvement.

Comments Section

Please provide your comments below regarding the various processes and procedures highlighted in the framework for the integration of KM and TQM to enhance construction project delivery. The feedback will help to improve the framework to be implemented during the construction project delivery.

1) Is the structure of the design and the construction team appropriate?

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2) Does the place of the KM/TQM officer fit the framework?

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3) How suitable and appropriate is the structure of the various items in the framework?

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4) What is your assessment of the flexibility of the framework?

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5) What is your assessment of the applicability of the framework?

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6) Is there any area of improvement?

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7) Will the framework meet its purpose?

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8) Does the framework provide adequate guidelines to improve project performance?

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