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The Influence of Knowledge Management, Total Quality Management, and Worker Competencies on Construction Project Performance in Rwanda

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ABSTRACT: This study aimed to examine the influence of Knowledge Management (KM), Total Quality Management (TQM), and Worker Competencies on Construction Project Performance in Rwanda. It explored the relationships between these management practices and project outcomes, assessing their predictive power in enhancing efficiency, quality, and sustainability. A total of 290 respondents were selected using stratified random sampling from various construction firms in Rwanda.

The study employed quantitative descriptive research design utilizing descriptive statistics and structural equation modeling. The results indicated that respondents exhibited high engagement in Knowledge Management *(Mean = 3.36, SD = 0.753)*, Total Quality Management *(Mean = 3.32, SD = 0.735),* and Worker Competencies *(Mean = 3.30, SD = 0.722).* Despite minor gaps in continuous improvement practices and stakeholder conflict resolution, there was a high level of construction project performance *(Mean = 3.30, SD = 0.722).*

The study found that Worker Competencies had a strong positive correlation with Construction Project Performance *($\beta = 0.572$, $p < 0.001$),* signifying that skilled labor directly enhances project outcomes. Total Quality Management also exhibited a significant positive correlation with Construction Project Performance *($\beta = 0.319$, $p < 0.001$),* underscoring the importance of structured processes, stakeholder relationships, and evidence-based decision-making. Conversely, Knowledge Management did not show a statistically significant direct relationship with Construction Project Performance *($\beta = 0.019$, $p = 0.371$),* suggesting that its impact may be mediated through other management processes.

The findings suggest that enhancing Worker Competencies and Total Quality Management can significantly improve construction project performance in Rwanda. Worker Competencies emerged as the most significant predictor of project success, highlighting the need for technical training, leadership development, and conflict resolution mechanisms. Based on these findings, it is recommended that construction firms invest in workforce development programs, implement robust quality control measures, and integrate systematic knowledge management practices to optimize project efficiency and sustainability. Future research should explore digital transformation strategies and advanced construction technologies to further enhance industry best practices.

KEYWORDS: Consumption Tax, Corporate Tax, Economic Growth, FMOLS, Panel Data, Tax policy reforms

CHAPTER 1. INTRODUCTION

Background of the Study

At the international level, the construction industry plays a central role in driving economic development; nonetheless, it tends to be burdened

with all sorts of issues, such as low productivity, cost overruns, and poor project delivery (Ibrahim et al., 2024). The need for enhancing project performance has generated growing interest in the application of management approaches like Knowledge Management (KM), Total Quality Management (TQM), and measurement of labor productivity. Used in combination effectively with one another, these practices have been reported to possess a tremendous potential to improve construction performance through efficiency optimization, error minimization, and improved project quality (Gupta & Khitoliya, 2020).

Despite their potential, construction companies around the world still face barriers that hinder the full implementation of these methods, due to barriers such as change resistance, process fragmentation, and uneven application criteria (Demirdöğen, 2023; Yepes & López, 2021).

In the African environment, the construction sector has emerged as a central driver of economic growth, particularly in areas undergoing high rates of urbanization and growing infrastructural needs. Despite this, the sector remains plagued by inefficiencies and project failure, which are mainly due to ineffective knowledge sharing, poor quality control, and the challenges of quantifying and enhancing labor productivity effectively (Aigbavboa et al., 2023; Demirdöğen, 2023). Research has established that the implementation of knowledge management (KM) practices can facilitate effective collaboration and flexibility among stakeholders, while total quality management (TQM) has been associated with improved operational effectiveness and client satisfaction (Gupta & Khitoliya, 2020). Equally, effective measures of labor productivity can inform the prudent deployment of resources, hence ensuring projects are delivered on budget and on schedule ("Labour Productivity in Construction SMEs: Perspectives From South Africa," 2023). Notwithstanding these observations, Africa's construction industries, including Rwanda's, have trailed the global standard of best practices, a factor worsened by the scarcity of research into how such management strategies can be effectively customized to suit local conditions (Misnan et al., 2024).

Rwanda, which is witnessing unprecedented change and development, has placed infrastructure development at the top of its Vision 2050 strategy. Nevertheless, Rwanda's construction industry is still facing different challenges, such as low labor productivity, delay in projects, and quality (Demirdöğen, 2023). The absence of a systematic framework for the coordination of knowledge management (KM), total quality management (TQM), and measures of labor productivity has limited the sector's capacity to maximize its growth prospects. Moreover, though international and African studies provide informative data on the benefits of such management practices, there is a wide knowledge gap in context-related studies relevant to Rwanda. Rwanda's unique social, economic, and regulatory landscape necessitates a specific examination of how KM, TQM, and measures of labor productivity impact the performance of construction projects (Misnan et al., 2024; "Labour Productivity in Construction SMEs: Perspectives From South Africa," 2023).

This study aims to bridge this gap by analyzing the impact of Knowledge Management, Total Quality Management, and Employee Competencies on the performance of construction projects in Rwanda. Through the solution of local problems and the adoption of these management strategies to the Rwandan context, the study will promote more effective strategies for improving construction outcomes. The findings of this study will not only benefit the Rwandan construction industry but will also provide insights that could be transferable to other developing countries that are facing similar issues in the construction sector.

Objectives of Study

The main objective of this study is to examine the influence of Knowledge Management (KM), Total Quality Management (TQM), and Worker Competencies on the performance of construction projects in Rwanda. Specifically, this study aims to:

1. To determine the level of understanding about knowledge management Process in terms of:
    1.1. Knowledge Identification,
    1.2. Knowledge Acquisition,
    1.3. Knowledge Sharing,
    1.4. Knowledge Application and
    1.5. Knowledge Evaluation.
2. Assess the Total Quality Management practices of construction companies in Rwanda in terms of
    2.1. Customer Focus
    2.2. Leadership
    2.3. Involvement of People
    2.4. Process Approach
    2.5. Continuous Improvement
    2.6. Evidence Based decision Making and
    2.7. Relationship Management.
3. Evaluate the construction project performance as perceived by the respondents.
4. Examine the relationship of Knowledge management, Total Quality management, and Worker's Competencies on the Construction project performance.
5. Develop a strategic framework based on the findings of the study

Parameters and Limitations of the Study

The objective of this research is to assess the contribution of Knowledge Management (KM), Total Quality Management (TQM), and

employees' skills to the performance of construction projects in the construction industry in Rwanda. The study will focus on the expected effects of these management practices on the project results, such as efficiency, quality, and on-time delivery, and adjusting for the effects of demographic factors such as age, gender, marital status, and education.

The research will be geographically limited to some construction companies in Rwanda within the five regions of the nation. By restricting the companies and geographical locations, the research will strive to offer solutions to the problems of KM, TQM, and Workers' competencies in the Rwandan construction sector. The findings will offer useful insights that can be applied in other comparable construction companies and projects in Rwanda and possibly other African nations experiencing the same management problems.

The primary stakeholders of this research will be project managers, site managers, and capable workers of the chosen firms. For collecting large data, the study will take up both offline and online survey techniques. The techniques will be selected to acquire quantitative data, thereby enabling detailed analysis of the correlation between knowledge management, total quality management, worker competence, and construction project performance.

However, the study will face various limitations. The first anticipated limitation is the limitation of time. Even though sufficient time was set aside for the collection of data, some participants might still find themselves lacking enough time to answer the questionnaires due to their tight schedules and day-to-day activities in the construction sites. This limitation in time could result in late submission or inferior data since some of the participants would rush through completing the questionnaires.

The researcher will be most likely to encounter new methodology and protocol challenges on data collection. These will include document preparation and submission for approval by the Ethics Review Board (ERB) and gaining permissions from the selected organizations. Managing these bureaucratic procedures will add extra complexity and time delays to the study.

Despite these limitations, the researcher will nevertheless guarantee the integrity and credibility of the data collected. The information gained from this research is expected to significantly contribute to the knowledge of drivers of construction project performance in Rwanda, thus enabling the development of more effective management practices and improving the overall quality and effectiveness of construction activities in such environments.

Significance of the Study

This study has significant contributions to different constituencies like the construction industry, policy makers, academia, schools, and Rwanda's overall economic development agenda. The importance of this study is summed up in the following.

Construction industry experts: The purpose of this research is to provide insightful remarks on how the integration of Knowledge Management (KM), Total Quality Management (TQM), and labor productivity measures can further improve the performance of construction projects in Rwanda's construction sector. With knowledge of the key drivers to success in these areas, construction professionals can adopt better strategies to reduce inefficiencies, accelerate project timelines, and improve the quality of construction projects overall.

Policymakers: The research will empower policymakers with evidence-informed policy recommendations on the application of management practices that will improve the performance of the Rwandan construction industry. It will also guide the formulation of policies to enable the application of KM, TQM, and labor productivity models, hence meeting Rwanda's Vision 2050 infrastructure objectives.

Scholars and Practitioners: The research seeks to develop a critical empirical foundation for future research on the connection between management styles and the performance of construction projects, and particularly in developing nations like Rwanda. The findings will add to the growing literature in construction project management, and provide new evidence to the degree to which knowledge management, total quality management, and measurement of productivity are applicable in local contexts.

Academic Institutions: The current study is intended to offer students, lecturers, and researchers pursuing construction management, operations management, and civil engineering studies a complete knowledge of drivers of project success in Rwanda. Additionally, it can serve as a guide to curriculum development and a case study for future studies.

Economic Development Stakeholders: Economic performance of the construction projects is expected to be improved through analyzing the effect of Knowledge Management, Total Quality Management, and labor productivity measures. This is expected to improve the efficiency, quality, and sustainability of the construction activities in Rwanda. Through enhanced project management practices, the study seeks to empower the country to achieve its ambitions in infrastructure development, drive economic growth, and enhance the competitiveness of the construction industry in Rwanda at the international level.

Definition of Terms

To enable a more accurate comprehension of this research, the following study framework operational definitions of terms were created.

Knowledge Management (KM) refers to the systematic process of creating, distributing, applying, and maintaining knowledge and information in an organization, particularly for construction works. This study will focus on KM with specific emphasis on how knowledge is obtained, shared, and utilized to improve the performance of construction works in Rwanda.

Total Quality Management (TQM) is an ongoing managerial activity intended to improve the quality of products and processes by involving all organizational members. In this study, TQM is the application of quality improvement practices intended to enhance construction outcomes, such as efficiency, customer satisfaction, and adherence to project schedules.

Worker competencies are the combination of skills, knowledge, experience, and attitudes that people have and apply to perform their duties effectively in construction operations. Technical competence, problem-solving capacity, communication skills, and adaptability of workers are some of the areas that this study will focus on in particular since all these are important in enhancing the performance of construction projects in Rwanda.

Construction Project Performance: Describes the general performance of a construction project in meeting its targets, such as cost-effectiveness, timely completion, levels of quality, and stakeholder satisfaction. In this research, it will include the role of KM, TQM, and measures of labor productivity in meeting these levels of performance in the construction industry of Rwanda.

Influence: It refers to the effect or the impact that one variable exerts on another. Influence in this research will demonstrate how Knowledge Management, Total Quality Management, and measures of labor productivity affect building project performance, and how moderating variables influence these relationships.

CHAPTER II. LITERATURE REVIEW

This chapter gives a detailed review of the literature, including relevant studies, concepts, and paradigms that are the building blocks for this research project.

Knowledge Management Practices

Knowledge Management (KM) is an important aspect of optimizing construction project performance by boosting efficiency, decision-making, and innovation. Effective KM practices guarantee that knowledge is recognized, captured, shared, utilized, and assessed in an organization. In the construction sector, where teamwork and expertise are crucial to success, well-designed KM systems improve cost control, project quality, and risk management. This review of the literature examines the most important KM dimensions (Knowledge Identification, Knowledge Acquisition, Knowledge Sharing, Knowledge Application, and Knowledge Evaluation) with respect to their influence on construction project performance in global, African, and Rwandan environments. This review also points to the research gap in Rwanda's construction sector with a focus on the necessity of additional studies for the maximization of KM practices to enhance project performance.

Knowledge Identification

Knowledge identification is important in improving construction project performance through ensuring that useful expertise and insights are identified, disseminated, and applied effectively. In international, African, and Rwandan contexts, efficient knowledge management practices, especially knowledge identification, play an important role in efficiency, cost savings, and innovation in construction projects. Yet, despite its importance, the application and effect of knowledge identification in Rwanda are not well studied, and thus more research is needed to fill this gap.

Internationally, identification of knowledge is identified as an essential element of knowledge management that has a direct impact on the efficiency and success of projects. Research shows that human capital, such as employees' abilities and knowledge, contributes to up to 79.5% of employee performance, which plays a critical role in project implementation (Yani & Suyarti, 2023). Additionally, relational and structural capital, including organizational networks and infrastructure, enable better communication and cooperation, thus leading to better project outcomes (Singla et al., 2020).

Tacit knowledge sharing is also critical in international construction industries. Efficient mechanisms for knowledge identification and sharing among workers drive innovation, minimize errors, and optimize project implementation (Boamah et al., 2022). Nevertheless, cultural obstacles and organizational resistance may hinder knowledge identification processes, requiring adaptive strategies specific to various regional environments.

In the context of Africa, knowledge identification is now emerging as a key determinant of construction project performance. Tacit knowledge sharing is extremely important in sub- Saharan Africa, where on-the-job learning and experiential knowledge transfer are essential forces behind value generation (Boamah et al., 2022). Nevertheless, knowledge identification is commonly subject to difficulties such as poor documentation systems, poor institutional frameworks, and constrained access to sophisticated knowledge management tools.

Additionally, the success of knowledge identification differs across organizational culture, with some companies being more committed to knowledge-sharing practices than others. Studies point out that combining knowledge identification with employees' competencies can improve project efficiency and quality, but uneven implementation is a hindrance to achieving its full potential across the African construction sector.

In Rwanda, identification of knowledge directly and quantitatively affects performance in construction projects, especially the control of cost and motivation of employees. Success in knowledge identification is highly correlated with project success, explaining 81.1% of outcomes variability (Baributsa & PhD, 2023). Employees' work experience and knowledge, if moderated by employee motivation, meaningfully enhance quality and execution in projects (Yani & Suyarti, 2023).

In spite of these favorable associations, cultural diversity, lack of adequate knowledge- sharing mechanisms, and differences in the level of motivation are some of the challenges affecting the efficacy of knowledge identification within Rwandan construction projects. Lack of systematic knowledge management frameworks as well as sporadic documentation methods also restrict the scope of application of knowledge identification towards project success

Although global and African literature emphasizes the importance of knowledge identification in the performance of construction projects, few studies directly examine this aspect in the Rwandan context. The available studies mainly concentrate on general elements of knowledge management, without attention to the specific contribution of knowledge identification in enhancing project efficiency and quality.

Knowledge Acquisition

Knowledge acquisition is one of the building blocks of knowledge management that directly affects the performance of construction projects through communication, decision- making, and optimal utilization of resources. In global, African, and Rwandan perspectives, the employees' capability to acquire and implement knowledge directly reflects on efficiency, cost minimization, and the success of a project. Knowledge acquisition, in spite of being acknowledged, is not thoroughly studied in the Rwandan construction industry, emphasizing further research.

Internationally, knowledge acquisition has been seen as a principal factor in the success of projects. Workers who continuously gain knowledge are more able to utilize gained skills and information, resulting in better project performance (Abdul-Rahman & Radzi, 2014). Knowledge acquisition allows for the adoption of new construction methods, boosts problem- solving capacity, and increases efficiency in carrying out projects.

Sharing tacit knowledge, a critical function of knowledge procurement, promotes coordination and innovation among construction projects. Nevertheless, threats like inadequate communication, project complication, and structural obstacles frequently restrain the application of knowledge, triggering systematic knowledge management systems (Korkmaz & Bahidrah, 2018). Critical measures to circumvent these hurdles include using virtual knowledge bases and promoting knowledge-culture in construction companies.

Knowledge acquisition is also an important function in the African construction industry and plays a decisive role in the performance of the project. Nonetheless, cultural variations, absence of standardized training sessions, and technological resource constraints impact the level of knowledge acquisition by workers. Literature shows that sharing tacit knowledge is necessary for promoting teamwork and innovation, but cultural differences and hierarchical work structures tend to hamper successful knowledge sharing (Boamah et al., 2022).

Organizations in Africa are urged to invest in ongoing training programs and establish systems that enable knowledge acquisition and utilization. Enhancing labor force capabilities by using knowledge transfer mechanisms has proven to enhance productivity, quality, and project longevity.

In Rwanda, learning has a close relationship with the performance of construction projects. Research emphasizes that knowledge drives successful project cost control, which in turn plays an important role in the timely and quality delivery of projects (Baributsa & PhD, 2023). Those employees who keep learning and using knowledge can successfully handle project resources, foresee problems, and use solutions to improve overall performance.

In spite of these advantages, the Rwandan construction industry faces challenges. The limited availability of knowledge management tools, poor training programs, and differences in employee motivation limit the achievement of full benefits from knowledge acquisition. Leadership style and organizational culture also significantly influence the manner in which knowledge is acquired and used in construction projects (Utomo, 2023).

While literature recognizes the influence of knowledge acquisition on construction project performance at the international level as well as in Africa, there is a significant research lag as far as its effect in Rwanda is concerned. Studies mostly deal with general topics of knowledge management without separating knowledge acquisition as an independent cause for project success. In addition, Rwanda's fast-evolving construction industry provides special opportunities and challenges in the acquisition of knowledge. A more thorough comprehension of how project performance is influenced by local cultural factors, staff training programs, and knowledge-exchange practices remains unexplored. Hence, research is warranted to create context-specific strategies for increased knowledge acquisition and utilization within Rwanda's construction sector.

Knowledge sharing (KS)

Knowledge sharing (KS) is a central aspect of knowledge management (KM) that greatly contributes to construction project performance by facilitating the exchange and assimilation of intellectual capital among stakeholders. In project-oriented sectors such as construction, where success depends on mutual collaboration and resourceful management, KS harmonizes mutual knowledge with organizational goals, leading to efficiency and innovation. Although global studies highlight the strategic value of KS in enhancing KM practices, African and Rwandan contexts are under researched, calling for a more in-depth examination of its role in these contexts.

At the global level, knowledge sharing is a pillar of KM that facilitates the transfer and application of key information to enhance project performance. Knowledge graphs and transfer learning systems have improved the effectiveness of KS, especially in handling intricate construction projects ("A novel framework of knowledge transfer system for construction projects based on knowledge graph and transfer learning," 2022). Evidence shows that successful KS drives innovation and sustainable KM practices, resulting in enhanced organizational performance in small and medium-sized enterprises (SMEs) in the construction industry (Sucena et al., 2024). Additionally, digital platforms and virtual spaces enable smooth knowledge integration, highlighting the revolutionary power of technology in contemporary KM (Jia et al., 2024).

In Africa, KS has been recognized as a key driver of KM and project performance, despite the challenges of limited technological infrastructure. Research emphasizes the significance of teamwork and effective communication in maximizing KS for better construction project results (Liu et al., 2022). Training and education are especially important in overcoming KS obstacles, as they create positive practitioner attitudes, thus improving KM efficiency (Bashir et al., 2024). Additionally, the use of automated systems and smart knowledge transfer models, although still in its early stages in most African nations, holds promising potential to improve KM practices and project performance (Xu et al., 2022).

In Rwanda, KS's contribution to affecting KM and construction project performance is not explored enough, even though the industry has growth potential. Previous studies indicate that information sharing and intellectual capital integration impact project performance positively through strengthened KM practices (Liu et al., 2022). Yet technological infrastructure inadequacy and change resistance remain huge hindrances to efficient KS for Rwandan construction companies. Automated systems of knowledge transfer, like knowledge graphs, may solve these problems by simplifying KM processes ("A novel framework of knowledge transfer system for construction projects based on knowledge graph and transfer learning," 2022). Strategic alignment of KS with KM practices is essential to enhance the performance and competitiveness of Rwandan construction projects.

Although global and African studies give interesting insights into the impact of KS on KM and project performance, there is a significant lack of research within Rwanda's construction industry. The distinct challenges and opportunities in the Rwandan environment are still mostly untouched, especially in relation to integrating digital resources and sustainable KM practices. This highlights the need for an immediate study focused on how KS affects KM in Rwandan construction projects, in order to come up with custom-made frameworks addressing the region's unique challenges and taking advantage of its growth prospects.

Knowledge Application

Knowledge application is a very significant part of knowledge management with a direct influence on the performance of construction projects through enhancing productivity, decision-making, and resource use. In global, African, and Rwandan settings, the appropriate application of knowledge by workers increases efficiency, cost control, and overall project performance. Although it has been identified as very important, there is insufficient research on knowledge application in Rwanda's construction industry, which highlights the necessity for more investigation.

At the global level, application of knowledge is a core determinant of enhancing project performance. Web-based knowledge management systems (KMS) have been found to improve the productivity of employees through easy access and sharing of information (Yumhi et al., 2024). The systems enable centralized documentation, enhancing the efficiency of knowledge retrieval and application, which is crucial for project success.

Tacit knowledge sharing is also a critical component of knowledge application that encourages collaboration, problem-solving, and innovation during construction projects. Its effectiveness is, however, threatened by difficulties such as inefficient project planning, communication breakdown, and mismanagement of resources, calling for the incorporation of organized knowledge application models (Korkmaz & Bahidrah, 2018). Effective international projects call for extensive knowledge management strategies that enable ongoing learning and knowledge application for construction workers.

In Africa, knowledge application has a great impact on construction project performance. Studies pinpoint that workers' knowledge and experience account for around 79.5% in performance results, highlighting the importance of ongoing training and development (Yani & Suyarti, 2023). The capacity of employees to implement knowledge gained is directly related to efficiency, quality, and compliance with project schedules.

Despite this, knowledge application is limited by barriers including lack of access to knowledge-sharing platforms, cultural disparities, and ineffective knowledge transfer mechanisms. Organizational culture's ability to support or hinder knowledge sharing is especially prominent, necessitating context-based approaches to guaranteeing maximum application of knowledge in construction companies (Boamah et al., 2022). Training investments, digital knowledge banks, and mentorship initiatives are key to reinforcing knowledge application in the African construction sector.

In Rwanda, application of knowledge has been found to affect construction project performance immensely. Research shows that successful project cost control, driven by the effective application of employee knowledge, is directly associated with timely and quality project delivery (Baributsa & PhD, 2023). Employees who actively apply knowledge they have learned are more likely to be able to foresee challenges, utilize resources effectively, and apply innovative solutions that improve project results.

Though critical, application of knowledge in the Rwandan construction industry is hindered by challenges such as poor training programs, poor leadership support, and limited availability of knowledge management tools. Structural barriers also pose to be major challenges to effective knowledge application in the form of ineffective project planning and weak resource allocation (Gatsinzi, 2023). To overcome these, there needs to be a systematic effort that merges knowledge application with project management practice.

Though vast amounts of research have been conducted on knowledge management and acquisition, the gap in knowledge application studies specifically for Rwanda's construction industry is significant. Most literature focuses on general knowledge management approaches rather than the actual effects of knowledge application on project performance. Furthermore, Rwanda's rapid infrastructural development poses challenges and opportunities for knowledge application that are not fully researched.

There is a need for additional research to evaluate the effect of knowledge application on project performance in Rwanda, especially in light of local industry dynamics, skills of the workforce, and knowledge-sharing practices prevailing in the region. Knowledge about these factors will enable the provision of insights in designing interventions focused on improving knowledge application, and consequently, better construction project performance in Rwanda.

Knowledge Evaluation

Knowledge evaluation is a critical aspect of knowledge management that significantly impacts construction project performance by ensuring that employees possess the necessary skills and competencies to manage complex projects effectively. In global, African, and Rwandan contexts, knowledge evaluation directly influences project cost control, monitoring and evaluation (M&E) practices, and project leadership. Despite its recognized importance, research on knowledge evaluation in Rwanda’s construction sector remains limited, highlighting the need for further investigation.

Globally, knowledge evaluation has been identified as a key determinant of project success. Evaluating employee competencies enables firms to identify skill gaps and implement targeted training programs, leading to improved project outcomes (Abdul-Rahman & Radzi, 2014). Effective knowledge evaluation promotes the adoption of advanced construction techniques, enhances problem-solving capabilities, and improves efficiency in project execution.

Research has indicated that incorporating digital tools like Artificial Intelligence (AI)- powered tests and Building Information Modeling (BIM) improves knowledge evaluation processes, making decision-making and resource allocation better (Korkmaz & Bahidrah, 2018). Nevertheless, issues like the lack of sufficient training opportunities and resistance to technological advancements hamper effective knowledge evaluation, calling for systematic assessment frameworks.

In Africa's construction industry, knowledge assessment is pivotal to guaranteeing workforce competence and project success. Despite this, issues like the absence of standardized training programs, limited exposure to advanced construction technology, and the lack of adequate knowledge assessment tools restrain the effective evaluation of knowledge across the continent.

Research has shown that poor knowledge assessment practices are responsible for cost overruns, delays, and quality problems in African construction projects (Boamah et al., 2022). In order to counter these challenges, organizations are advised to introduce systematic knowledge evaluation mechanisms, such as certification programs, competency-based assessments, and mentorship programs. Enhancing the competencies of the workforce through knowledge assessment has been proven to enhance productivity, quality, and project sustainability.

In Rwanda, knowledge assessment is an important aspect of construction project performance. Project cost control, driven by the competency assessment of employees, has been established to improve project success (Baributsa & PhD, 2023). Sophisticated cost control practices, including Earned Value Management (EVM) and BIM, are advised for improved resource use and minimizing budget overruns.

Monitoring and evaluation (M&E) practices also play a vital role in project performance assessment. Evidence from Rwanda's Gasabo district indicates that M&E planning and ICT management have a significant influence on the performance of construction projects (Moussa & Akims, 2024). Nevertheless, skills management for M&E staff failed to yield a significant impact, calling for ongoing training and development.

Effective project management and leadership skills, such as risk management and resource organization, are necessary for project success (Gatsinzi, 2023). Strategic resource procurement and organization have also been found to determine project performance substantially in Rwanda's Kamonyi district ("Influence of Project Management Practices on Performance of Public Construction Projects in Kamonyi District, Rwanda", 2022).

Though the existing literature recognizes the influence of knowledge evaluation on construction project performance across the world and in Africa, there is a significant research gap as far as its specific influence in Rwanda is concerned. The majority of studies are general in terms of knowledge management without singling out knowledge evaluation as a standalone factor in project success.

In addition, Rwanda's burgeoning construction sector provides special challenges and opportunities for the evaluation of knowledge. What cultural dynamics in Rwanda, training schemes for the labor force, and practices of assessing knowledge affect the performance of projects is an unexplored terrain. More studies are required to formulate specific interventions that improve the process of evaluating knowledge, eliminate competency gaps, and maximize the outcomes of projects in Rwanda's construction sector.

Total Quality Management Practices in the Construction Industry

The building sector is a key driver of the socio-economic growth of countries. Yet, its dynamic nature necessitates firm management practices in terms of quality, efficiency, and customer satisfaction. Total Quality Management (TQM) has proven to be an essential approach to meeting these challenges. Through the encouragement of continuous improvement and building quality principles into all facets of an organization, TQM has the ability to improve project performance and competitiveness.

System Reliability

System reliability is one of the key elements of Total Quality Management (TQM) that has a major impact on construction project performance. It ensures processes are stable, predictable, and able to satisfy quality requirements. TQM stresses continuous improvement, customer satisfaction, and effective use of resources, which are supported by reliable systems. Although global studies have emphasized the significance of system reliability in strengthening TQM practices, there is scarce research aimed at its role in developing economies such as Rwanda. This literature review considers global, African, and Rwandan views, finding gaps that call for further studies in Rwanda's construction industry.

Internationally, system reliability plays a key role in the successful application of TQM in construction. Consistent processes are provided by reliable systems, which are essential for ensuring compliance with global quality standards like ISO 9000 (Hayden, 1996). Research highlights the fact that good risk management practice strengthens the TQM-project performance relationship, such that it ensures improved alignment to project objectives (Bong et al., 2024). In addition, incorporating sustainable TQM practices, including green technology and artificial intelligence, greatly enhances project efficiency and long-term performance (Jabi et al., 2024). Nevertheless, challenges like change resistance and resource constraints within the organization continue to affect the worldwide efficacy of TQM practices.

System reliability is progressively being identified in Africa as the major determinant for TQM implementation success in construction projects. Sound systems reduce threats like delays and cost overruns, which are common in construction in the region (Unegbu et al., 2023). From studies, integrating TQM and good risk management practices improves efficiency and project success (Bong et al., 2024). Nevertheless, there are constraints affecting

most African nations, such as poor planning, weak stakeholder participation, and a lack of technological infrastructure (Adeyemi et al., 2022). The constraints emphasize the necessity of having context-relevant strategies to enhance system reliability and maximize TQM practices in the construction sector of Africa.

System reliability is an important factor in the performance of the construction industry in Rwanda, but its impact on TQM remains unexplored. Previous research has shown that successful project management practices, such as resource organization and risk management, have a significant effect on project performance, contributing to more than 35% of success in performance (Aimee & Eugenia, 2022). TQM practices like top management commitment and employee involvement are directly related to enhanced efficiency and project performance (Matoke & Irechukwu, 2021). In spite of this, the absence of thorough research into system reliability and its incorporation into TQM frameworks hinders Rwandan construction companies from maximizing their operations.

Despite the well-documented global and regional significance of system reliability in boosting TQM practices, Rwanda's construction sector is under researched in academia. This is most notable in how system reliability is integrated with contemporary TQM strategies to tackle issues of resource scarcity and technological deficiency in the local context. More research is required to formulate specific frameworks that utilize system reliability for better TQM implementation and construction project performance in Rwanda. Filling this research gap will offer practical recommendations for

practitioners and policymakers to improve the efficiency and sustainability of the construction industry.

Stakeholder involvement

In the construction sector, Total Quality Management (TQM) becomes an important key to ensuring projects are successfully finished, meeting standards of quality along with satisfying expectations of stakeholders. Stakeholder involvement is one of the essential factors of TQM and is fast becoming a crucial factor in deciding the success or failure of projects. Stakeholders, including the client, the contractor, workers, and even members of society, contribute fundamental inputs at varied stages of the construction project. Successful involvement of these stakeholders improves communication, encourages cooperation, and aligns project objectives with expectations, leading to better project performance. Globally, stakeholders' participation has been recognized as an essential variable to enhance Total Quality Management as well as success in construction projects. Studies establish that incorporating stakeholder views within the decision process enhances a setting of cooperation and concurrence wherein the expectations of stakeholders are united with project targets. Successful management of stakeholders in the project lifecycle boosts communication, openness, as well as mutual working, all being essential ingredients of TQM which lead towards enhanced project outputs. Involvement by stakeholders impacts multiple quality management dimensions that incorporate project implementation, planning, as well as appraisal.

Research indicates that when stakeholders are engaged right from the beginning, the project is more in line with their requirements, and this leads to fewer conflicts and better- quality outputs (Tor & Gambo, 2024). In addition, models that integrate stakeholder views into quality management practices are linked to remarkable improvements in project performance (Preece et al., n.d.). Nonetheless, issues like communication failure, political factors, and cultural differences are still major obstacles in stakeholder interaction (Tor & Gambo, 2024).

Even with the beneficial effect of stakeholder engagement, caution is raised by some research that over-involvement may result in conflicts and delays. As such, achieving a balance between stakeholder engagement and upholding project schedule and quality is key to delivering the best results (Ochie'ng, 2024b).

In Africa, stakeholder participation in TQM in the construction industry has been found to have a positive impact on project performance. African nations are confronted with special challenges in managing stakeholder participation, such as political instability, cultural diversity, and resource constraints. Notwithstanding these challenges, various studies on the continent have emphasized the need for stakeholder participation in enhancing construction project performance.

For example, in Rwanda, a study has proved that stakeholder participation in the planning stage has a direct, positive impact on project performance and that a 0.325 unit rise in performance is related to increased engagement (Mukakarisa & Njoroge, 2024). Participation at the implementation stage also greatly enhanced project performance (0.268- unit rise), showing the necessity of ongoing involvement throughout the entire project life. In Kenya, the engagement of stakeholders in risk management and reconciling project objectives with stakeholder expectations was critical for achieving successful project outcomes (Ochieng, 2024).

Likewise, in Somaliland, stakeholder collaboration was linked with positive project performance outcomes, with high correlation coefficients for milestone achievement and knowledge sharing (Nour, 2024). Notwithstanding these achievements, improper communication, political interference, and cultural aspects continue to hamper Africa, curtailing the complete potential of stakeholder participation in construction projects (Tor & Gambo, 2024).

In Rwanda, stakeholder participation in Total Quality Management has been an area of increasing interest, especially in the construction industry. Stakeholder involvement, according to local research, is crucial in involving stakeholders at all stages of the project cycle to enhance project performance and quality standards. Research on the issue shows that stakeholder engagement during project planning, execution, and monitoring has greatly improved overall project performance.

Mukakarisa & Njoroge (2024) do point out that higher stakeholder participation during the planning stage is associated with a 0.325 boost in project performance, and participation at the implementation stage brings about a 0.268-unit improvement in performance. In addition, the effect of stakeholder involvement in monitoring and evaluation is even stronger, with a 0.409-unit improvement in performance. These results highlight the importance of ongoing stakeholder interaction, not only in the early phases of a project, but throughout the life of the project.

In addition, conflict management and stakeholders' engagement have been given added importance in terms of ensuring proper project implementation with a 0.450 rise in performance, as explained by Muhimpundu & De Dieu Dushimimana (2024). Challenges including the resolution of conflict and dissimilar engagement rates exist nonetheless, and these should be dealt with if Rwanda's construction projects are to gain optimal returns from the stakeholder participation.

Although the international and African literature is in support of the need for stakeholder participation in improving Total Quality Management in construction projects, there is still a clear research gap in the area of the direct effect of stakeholder participation on TQM in the Rwandan construction industry. The majority of research in Rwanda is more concerned with the general context of construction project management but does not extend to a thorough investigation of how stakeholder participation affects TQM and project performance

Continuous improvement

Continuous improvement is a core aspect of Total Quality Management (TQM) with a direct influence on the performance of construction projects through the promotion of a culture of continuous development and quality improvement. This review of literature discusses the global, African, and Rwandan contexts in light of the essential role played by continuous improvement in optimizing TQM practices.

At the global level, continuous improvement becomes a part of integrating TQM principles at all levels of an organization. Leadership buy-in, employee participation, and compliances with standards such as ISO 9000 provide a systematic approach to quality improvement (Ugwu, 2023).

Such practices enhance project competitiveness and sustainability along with developing long-term collaborations with stakeholders (Ugwu, 2023). But overemphasis on continuous improvement occasionally leads to decreasing returns, hence the requirement for balanced resource allocation (Miller, 1993).

In Africa, continuous improvement is the driving force for alignment with TQM principles through the focus on quality culture and innovative practices. South African frameworks identify the interdependence between superior process performance and continuous improvement (Ugwu, 2023). Employee empowerment and managerial commitment are essential for maintaining improvements and improving overall project results (Mashoeda & Waluyowati, 2022). Though these developments have been made, several studies indicate that the rewards might take some time to realize, necessitating strategic and custom implementation of TQM (Mashoeda & Waluyowati, 2022).

In Rwanda, continuous improvement is key to TQM through the improvement of resource management, quality planning, and employee involvement. Leadership ensures a culture of quality, which results in improved project performance (Matoke & Irechukwu, 2021). The success of energy projects illustrates how continuous improvement practices support quality planning and performance (Aline & PhD, 2024). But the influence of economic conditions and regulatory issues also has an effect on construction results, pointing to the necessity of localized measures ("Influence of Project Management Practices on Performance of Public Construction Projects in Kamonyi District, Rwanda," 2022).

Although there have been extensive studies of the application of continuous improvement in TQM around the world and in Africa, there is little research on Rwanda. Further research is needed to determine how continuous improvement can be adapted to Rwanda's specific construction industry challenges. This study could fill the existing gap and offer practical recommendations for enhancing project performance in Rwanda.

Quality Management and Their Influence on Construction Project Performance

The seven quality management principles, with roots in Total Quality Management (TQM), are the generic guidelines for enhanced construction project performance. The seven principles focus on an integrated model of customer orientation, leadership, people management, process approach, continuous improvement, evidence-based thinking, and relationships. This discussion examines the world, African, and Rwandan contexts of these principles, discerning gaps as well as the implications for the performance of construction projects.

Customer focus

Internationally, customer orientation has been identified as a key to effective construction project management. It provides alignment between project deliverables and customer expectations, which, in turn, leads to project sustainability and customer satisfaction. Druhova and Dongsheng (2024) claim that strong customer feedback loops, implemented from planning to execution, not only improve deliverables but promote long-term relationships. Additionally, the use of digital technologies like Building Information Modeling (BIM) and Customer Relationship Management (CRM) has transformed the means of gathering and responding to feedback, with immediate access to clients' needs. Notwithstanding all these, barriers like communication difficulties and varying priorities among stakeholders always interfere with easy customer interaction in complicated projects.

In Africa, customer-centricity is well-integrated into the socio-economic conditions and local cultures of the continent. Recurrent client interaction and community involvement have been central to adapting construction projects according to local demands. Omotayo et al. (2022) explain how successful communication practices in Nigerian projects resulted in greater satisfaction and better results through the use of client workshops, focus groups, and stakeholder meetings. But the uneven implementation of these practices usually leads to misaligned priorities and delays. Also, the absence of access to sophisticated digital tools in most regions is a major hindrance to real-time customer feedback and engagement, and context- specific strategies are needed to overcome these gaps.

Customer involvement in Rwanda has been critical in influencing the success of major infrastructure development projects. Such as the Amahoro Stadium renovation project, for instance, Tuyishime and Njoroge (2024) identified that 83.6% of stakeholders contributed the success of the project to active customer feedback mechanisms. Domestic practices, like stakeholder meeting sessions and repeat design processes, have been used to improve trust and cooperation among clients and the construction team (Uwamahoro et al., 2023). Though these achievements exist, there are still challenges, including inadequate formal incorporation of customer orientation into project management structures and no standard tools for gauging customer satisfaction. Cultural issues, including hierarchical dynamics and language differences, can also hinder communication between contractors and clients.

Although customer orientation is generally considered to be essential, its concrete application in the construction industry in Rwanda is a relatively uninvestigated area of research. While previous research in this area has mostly ignored how cultural and socio- economic contexts contribute to customer interaction strategies, empirical research on models that incorporate customer orientation into structured project management processes at the local level is critically needed. Additionally, the role of emerging technologies like BIM in enhancing customer feedback systems in Rwanda has not yet been researched. Bridging such research gaps will not only contribute to better project performance but also lead to a more client-centric construction sector in the region.

Leadership

Internationally, leadership is generally accepted as a key driver of effective construction project performance. Good leadership guarantees the congruence of project goals with organizational objectives, promotes team working, and improves project efficiency. Transformational leadership, in specific, has been found to be very effective in team motivation and job satisfaction. Purwadi (2024) cites beta coefficients of 0.45 and 0.42 for motivation and job satisfaction, respectively, under transformational leadership, highlighting its positive impact. Transformational leadership is defined by inspiring a shared vision, promoting innovation, and developing individual growth, which are essential in addressing the complexities of contemporary construction projects. Yet, international issues including resistance to change, communication failures in multicultural

teams, and differences in leadership capabilities among managers sometimes hinder the efficacy of leadership practices.

In Africa, construction project leadership is influenced by the convergence of cultural, political, and organizational forces. Shammari et al. (2024) highlights the need to adopt transformational leadership to overcome communication obstacles and develop subordinate capabilities. Where hierarchical organizational forms dominate, transformational leadership can reduce difficulties by being inclusive, empowering team members, and enabling them to solve problems through collaboration.

In addition, leadership in Africa tends to be influenced by socio-political considerations such as government policy and community involvement. For instance, the engagement of traditional leaders and community stakeholders in project planning has been noted to increase acceptance and alignment with local needs of projects. Though these benefits are realized, irregular use of transformational leadership approaches and the predominance of autocratic leadership in certain environments curb the possibility of optimal project success.

In Rwanda, leadership has a complex role to play in construction project performance, with increasing focus on transformational leadership. Studies by Gatsinzi (2023) show that transformational leadership promotes team cohesiveness, responsibility, and anticipatory problem-solving, which are critical for effective project delivery. Leaders who use this style are more able to manage the challenges of scarce resources and to motivate their teams to produce quality results in spite of constraints. For instance, development projects like the Kigali Convention Center have been served by leadership focused on open communication, stakeholder engagement, and responsive tactics.

Nonetheless, Rwanda's leadership effectiveness is frequently challenged by the availability of resources, bureaucratic obstacles, and socio-political influences that impact decision-making mechanisms. In certain situations, these limitations result in delays, increased costs, and compromised project quality, so there is a necessity for context-specific models of leadership.

Though transformational leadership is well-documented in the international literature and across Africa, relatively little is known about how practices are being shaped to fit Rwanda's specific socio-political and economic context. Current research typically does not capture the subtleties of low-resource settings or the influence of cultural considerations on effective leadership. Particularly, it will be essential to seek hybrid models of leadership that marry transformational and transactional styles of leadership in order to meet the twin imperatives of energizing teams and ensuring operational efficiency. These models would blend transactional elements, including reward-based incentives and tight accountability systems, with the motivational and visionary components of transformational leadership.

Future studies can also examine how leadership development programs specifically designed for Rwanda's environment can enhance project management results and mitigate systemic constraints. Furthermore, the influence of upcoming leadership movements, including distributed leadership and the application of technology in leadership, is also worth investigating to make construction project management in Rwanda more effective.

Engagement of People

Worldwide, the active involvement of people, especially stakeholders, is the bedrock for successful construction project implementation. Encouragingly engaging employees, customers, contractors, and other stakeholders ensures varied input is embedded in project planning and execution. Druhova and Dongsheng (2024) highlight the key importance of training and development among employees for upgrading individual abilities, which in turn has a direct link to better project performance. Engaged workers are more likely to feel a sense of ownership for project objectives, leading to increased teamwork, innovation, and adherence to quality benchmarks. Global construction projects also increasingly prioritize inclusive stakeholder involvement, with models like the Project Management Institute (PMI) guidelines promoting stakeholder mapping and ongoing engagement throughout the project life cycle. In spite of these developments, issues like resistance to change, communication issues in multicultural teams, and unequal stakeholder participation are still common in international construction practice.

Stakeholder involvement has also shown major positive effects in planning, implementation, and monitoring construction projects in Africa. There is a strong association between stakeholder participation and better project performance, especially during the planning and appraisal stages, according to Mukakarisa and Njoroge (2024). Bringing together the various perspectives of stakeholders assists in responding to local issues and ensures that projects are better suited to meeting community demands and expectations. For example, participatory planning approaches in Kenya and Ghana have enhanced project acceptance and minimized conflicts. Nonetheless, constraints like scarce capacity-building activities, inadequate communication mechanisms, and institutional framework weaknesses often get in the way of proper stakeholder participation. In addition, the hierarchical structures of most African societies may lead to imbalances of power, where the interests of marginalized groups are left out of decision-making processes. These factors serve to underscore the necessity for organized methods of stakeholder participation that ensure inclusiveness and equal participation.

In Rwanda, stakeholder involvement is a critical factor in the success of construction projects. research evidence from Mukakarisa and Njoroge (2024) indicated that stakeholder involvement at the initial stages of planning enhanced performance through a statistically significant coefficient of 0.325. This explains the significance of engaging all interested parties from the government department to contractors to locals in the preliminary stages of developing a project. Participatory stakeholders lead to accurate project planning, efficient allocation of resources, and enhanced monitoring and evaluation mechanisms. But problems peculiar to Rwanda, including imbalances of power among stakeholders, conflicting interests, and poor channels of communication, frequently hinder successful participation. For example, massive projects like road development and urban housing construction have experienced delays and conflicts because of conflicting stakeholder priorities and a lack of proper consultation with the local people. Resolving such problems calls for an enhanced comprehension of Rwanda's socio- political environment and stakeholder interaction dynamics. Although the advantages of stakeholder engagement are widely reported, research on how to deal with the power imbalances and conflicting interests that commonly thwart effective engagement in Rwanda's construction sector is sparse. Most existing studies report the advantages of stakeholder

participation but do not delve into how inclusive engagement frameworks that recognize the varying needs and power relationships of stakeholders can be established.

Process Approach

On an international level, embracing a systematic process approach is essential for maximizing construction efficiency, quality, and cost-effectiveness. A process approach ensures alignment of construction processes with predetermined objectives through well- defined workflows, key performance indicators (KPIs), and constant monitoring. Bhatti and Nazir (2024) emphasize the necessity of process-based KPIs in reducing delays, cost control, and enhanced overall project performance. For example, the collaboration of Building Information Modeling (BIM) and Lean Construction theories has helped major companies around the world maximize use of resources and streamline construction operations. Nevertheless, issues like effective management of supply chains, including scope changes, and stakeholder alignment remain issues, particularly when dealing with giant infrastructure projects. These issues support the importance of strong process paradigms which can evolve around the dynamic processes of the building industry.

Process management is an important impetus for optimizing resources and ensuring quality in construction works in Africa. With the expansion of the construction sector in most African nations to address growing demands for urbanization, orderly business processes have played a pivotal role in ensuring quality service delivery and competitiveness in the market. Naygolnova (2023) stresses that process-based strategies are most important for African construction companies, especially during planning and execution phases of projects. For instance, adopting modular building techniques has enhanced efficiency in South Africa and Kenya. Yet, most African nations are confronted with poor technological infrastructure, restricted access to skilled human resources, and disintegrated regulatory systems, which frequently halt systematic process methodology adoption. Improving these involves specific investments in capacity development and setting integrated process standards throughout the continent.

In Rwanda, the use of process approaches has greatly enhanced project delivery schedules and resource utilization, in line with the nation's vision for accelerated infrastructure development. Projects like the Kigali Convention Centre and other urban housing projects have shown the advantages of systematic process management, such as improved utilization of resources and compliance with schedules. Managing scope changes, however, continues to be a recurring challenge, tending to cause delays and cost overruns. Perkovic et al. (2011) studies indicate that incorporating process improvement methodologies, including agile project management and continuous quality checks, can reduce such problems. The Rwandan construction sector still struggles with complexities associated with compliance issues, limited resources, and coordinating multiple stakeholders despite these improvements, indicating the importance of adaptive and localized process frameworks.

Although the significance of process management in enhancing construction performance is well established, there are few targeted studies on its integration with Rwanda's construction regulatory framework. Current research often discusses general process management concepts without exploring how they can be adapted to tackle Rwanda's specific issues.

Continuous Improvement

Continuous improvement practices have become the pillars to improve construction project results globally. Principles like Lean Construction, Six Sigma, and Total Quality Management (TQM) focus on the elimination of waste, increasing efficiency, and adding value to stakeholders. España et al. (2012) point to the revolutionary effect of tools such as the Last Planner System, which enhances project planning and teamwork, and Buffer Management, which decreases variability and increases predictability. Internationally, businesses using these practices have seen considerable increases in productivity, cost reduction, and general project success. Large projects in the U.S. and Europe that use real-time data monitoring and feedback loops, for example, have achieved an average 20–30% efficiency improvement. Still, issues remain, such as change resistance, new system implementation costs, and the difficulty of applying these practices across varying project environments.

In Africa, persistent improvement initiatives are more commonly implemented to respond to issues of cost overruns, inefficiencies in resources, and delays. According to Omotayo et al. (2022), whereas Lean Construction principles have proven effective in enhancing efficiency and minimizing costs, universal application is hampered by insufficient technical capacity, poor financing, and insufficient awareness among construction stakeholders. For example, work in South Africa has shown that the adoption of continuous improvement approaches can decrease project delays by 15–20%. Yet, uneven training, dependence on legacy practices, and disjointed supply chains persist to stifle the achievement of these gains across the continent. Building robust capacity-building programs and collaboration among industry stakeholders are essential first steps to scaling continuous improvement practices in Africa.

In Rwanda, improvement is increasingly seen as critical to driving the construction sector forward, especially in alignment with the nation's ambitious Vision 2050 development plan. Firms are adopting practices like frequent performance assessments, quality audits, and Lean Construction techniques to improve project outcomes. Mukakarisa and Njoroge (2024) highlight the importance of strong performance measurement systems to drive accountability and areas for improvement. Nonetheless, the Rwandan construction environment tends to be dynamic and unpredictable due to resource scarcity, volatile material prices, and changing project scope. Such problems have a tendency to thwart the initiatives for sustained improvement. Further, although a few companies have initiated the usage of digital devices to monitor and analyze, general use of state-of-the-art technology is constrained, hindering the industry in harnessing the true potential of decision-making on the basis of data.

Even though there is increased focus on on-going improvement within Rwanda's building industry, various important gaps persist Evidence-Based Decision Making

Across the world, evidence-based decision-making (EBDM) is identified as a key strategy for improving risk management, resource reallocation, and overall project success. Guo et al. (2022) bring out the efficacy of EBDM models that leverage cutting-edge data analytics and

predictive models in helping to avoid risks in complex projects, including metro tunnels and high-rise buildings. These techniques, such as real-time monitoring and simulation software, allow project managers to project future delays, maximize resource utilization, and enhance safety performance. Internationally, companies that use EBDM approaches realize substantial improvements, including 25% less project delay and 30% fewer cost overruns. Challenges like data confidentiality issues, implementation expenses, and resistance to new practices tend to prevent extensive uptake.

In Africa, the potential of EBDM to reshape construction project outcomes is increasingly recognized but not maximized because of numerous constraints. Omotayo et al. (2022) highlight that although data-driven approaches improve project planning, implementation, and assessment, their utilization is hampered by poor data infrastructure, low access to technology, and inadequate human capacity. For instance, pilot projects involving geographic information systems (GIS) and building information modeling (BIM) in South Africa have proved the viability of EBDM in mitigating project risks and enhancing sustainability. Such efforts are not yet prevalent on the continent, though. The lack of harmonized data collection and analysis frameworks makes it even more difficult to adopt EBDM, and this calls for policy reforms and capacity-building programs.

EBDM is slowly becoming more accepted in Rwanda, conforming to Rwanda's development ambitions under Vision 2050. Decision-making, which relies on data, has been utilized in infrastructure initiatives like the Kigali City Master Plan in a bid to enhance the precision of planning and utilize resources. Numerous challenges prevent the common practice of EBDM.

Limited availability of credible data, inadequate technological infrastructure, and high costs of implementation are significant hindrances. Moreover, the construction industry is also hindered by cultural resistance to data-driven approaches, as conventional stakeholders tend to use experience-based decision-making. In spite of these, efforts such as the Rwanda Integrated Electronic Case Management System (IECMS) for infrastructure development show an increasing trend towards adopting data-driven approaches.

However, important research gaps exist in the comprehension and utilization of EBDM in Rwanda's construction industry. Localized EBDM models specific to Rwanda's socio- economic and regulatory context are not well explored. Additionally, few studies discuss means of enhancing data reliability, including the development of standardized collection systems or the use of low-cost technologies for data management. It also lacks adequate inquiry into how more sophisticated technologies such as AI, IoT, and data analytics may be incorporated in EBDM practice in Rwanda. Moreover, there is a need for more studies on capacity development to enable experts with data analytical skills and digital literacy. Finally, the possibilities of public-private partnerships in advancing the use of EBDM via sharing resources and knowledge transfer must be explored further. Filling these gaps would substantially improve the performance of Rwanda's construction industry and contribute to economic growth and sustainable development.

Relationship Management

Internationally, relationship management has been known to be a critical factor in developing cooperation and coordination between construction project stakeholders. Mansour et al. (2018) researches highlight that trust, communication, and common goals are essential in sustaining effective partnerships. For example, long-term partnerships between suppliers and contractors have been known to improve supply chain reliability and project efficiency. Additionally, the use of collaborative systems, for example, partnering contracts and IPD systems, has greatly enhanced the success of projects by minimizing disagreements and promoting accountability. Nevertheless, issues like power disparities, incompatible incentives, and cultural differences among stakeholders can demote relationship management outcomes. Overcoming such issues tends to demand customized plans, for instance, continuous stakeholder interaction and conflict mediation processes. Relationship management is an important factor in Africa to handle the diversity of stakeholder priorities and interests.

Omotayo et al. (2022) point out that collaborative platforms, including participatory governance and community-inclusive planning, have played a vital role in bringing about project harmony. These mechanisms have been found to be highly effective in huge infrastructure projects in which various actors, including local communities, governments, and private investors, are required to collaborate. Relationship management in Africa generally encounters issues that pertain to poor communication avenues, low levels of stakeholder trust, and the lack of formal conflict management systems. For instance, in Nigeria, poor communication among stakeholders has been attributed to construction project delays and cost overruns. Hence, improving relationship management practices is critical for solving these problems and enhancing overall project performance.

In Rwanda, relationship management plays a central role in integrating stakeholder aspirations with construction project aspirations, especially in national development projects. Tuyishime and Njoroge (2024) highlight the role of trust-building behaviors, including open communication and participatory decision-making, in ensuring project success. For example, the Kigali Convention Centre project showed how trust-building and collaboration among government agencies, contractors, and local communities enhanced project efficiency and stakeholder satisfaction considerably. Though these achievements exist, relationship management in Rwanda commonly faces issues like misaligned expectations of stakeholders, inadequate mechanisms for conflict resolution, and inadequate regard for cultural differences. Such concerns are compounded by the absence of formalized guidelines for stakeholder involvement, whose lack of alignment can generate misconceptions and discord in project implementation.

Although the significance of relationship management in Rwanda's construction industry is increasingly recognized, research gaps persist. There is scarce investigation into the ways in which stakeholder relationships are influenced by cultural aspects and incorporated within project management principles. For instance, Rwanda's collectivist culture and community engagement could be used as a basis for developing culturally adapted approaches to relationship management. Moreover, there are limited studies that have explored the contribution of technology, including digital collaboration platforms and real-time communication tools, to effective stakeholder engagement. There is a need for research on strategies for power balancing and enabling fair decision-making among stakeholders. Moreover, the role of public-private partnerships in relationship management through resource sharing, capacity building, and trust establishment is not well explored. By filling these gaps, subsequent research can present actionable

recommendations to enhance stakeholder cooperation and better construct project performance in Rwanda.

In Summary, the practices of quality management have shown widespread impacts on performance of construction projects in the world, in Africa, and Rwanda at large. Various gaps continue to exist such as the imperative to develop local guidelines, incorporate superior technology, and stakeholder management strategies. Redressing such gaps can realize improvements in how practices of quality management can transform the construction sector of Rwanda.

Assessing the Practices of Construction Companies in Terms of Workers' Competencies

The construction sector is a dynamic, labor-intensive, and competency-reliant sector that depends primarily on the capability of its people to produce high-quality results and respond to the needs of a project. Employees' capabilities cover not just hard skills but soft skills, resilience, and skills in coping with complex regulatory environments and technological advancement. In contrast to the strategic importance of the sector to national economic growth, gaps in human capability continue to be an entrenched problem.

Across the world, the construction sector is confronted with huge challenges in the development of competency among workers, which affect productivity and project success. A large percentage of construction workers are not formally certified, with research showing that fewer than 10% of Indonesian construction workers are certified (Afrida, 2022). Skills shortages are most evident in specialized fields like MEP, where skills gaps in core skills such as reading and numeracy are reported (Prabhashwara & Waidyasekara, 2022).

Globalization of the construction markets has also added to the complexity of competency demands. Employees must now work more frequently in multicultural groups and respond to international norms (Sertyesilisik, 2017). This creates the need for wider sets of skills such as cross-cultural communication and awareness of different regulatory systems (Gook et al., 2014).

Solutions to such gaps involve the creation of certification agencies and training program modernization, which have been found to enhance worker efficiency and productivity (Afrida, 2022; Manoharan et al., 2022). Work-based training and on-the-job learning paradigms have also proven effective competency development approaches. Although efforts are being made, the rate of adoption being slow indicates a need for increased efforts worldwide.

In Africa, the construction sector is confronted with systemic issues that inhibit the development of workforce competency. Educational history, skill development attitudes, and work environment have a significant influence on workers' skills (Orando & Isabirye, 2018). Certification procedures are still not adequate, with fewer than 10% of workers in certain areas possessing competency certificates, highlighting the necessity for expedited certification and industry demand alignment (Afrida, 2022).

Motivational practices are also essential to enhance worker performance. Reasonable remuneration, career advancement opportunities, and a good work environment contribute notably to productivity and retention, as shown in research in Ghana and South Africa (Mustapha et al., 2024; Aghimien et al., 2019). Moreover, the knowledge transfer between foreign construction companies and local labor is still an issue, with few attempts made to make skills development sustainable (Seriki, 2020).

Though these studies highlight the need for competency development, they also indicate pervasive barriers such as a lack of resources, lack of training infrastructure, and resistance to change. Resolution of these systems is key for the sustainable development of Africa's construction industry.

In Rwanda, the construction sector is more and more acknowledging the necessity for competent labor, but practices in developing workforce competency are not consistent. Most of the workers do not have formal competency certification, with certification levels corresponding to international trends below 10% (Afrida, 2022). Research by ROKO Construction Company highlights that workforce competency is a key driver of project success, especially in cases like effective communication and project planning (Ong'aro & Asumptah, 2017).

Improving competencies involves launching certification bodies and renovating training schemes to match workers' skills to the needs of the industry (Afrida, 2022). Institutions such as Umutara Polytechnic have a critical responsibility in preparing graduates with the appropriate skills, implying that increased academic-industry cooperation could further boost the readiness of the workforce (Kiptum et al., 2014).

In spite of these efforts, there are still challenges. Budget limitations, disorganized stakeholder initiatives, and restricted access to training facilities undermine the overall performance of competency development programs. These challenges emphasize the necessity for a more integrated and strategic effort towards workforce development in Rwanda's construction industry.

Although the international and regional literature emphasizes the importance of workers' competencies in the construction sector, there is limited research that has specifically focused on the practices of construction firms in Rwanda regarding workforce competency development. Previous studies have given a general overview of challenges and strategies but have not provided an in-depth analysis specific to Rwanda's context.

The Influence of Knowledge Management, Total Quality Management, and Worker Competencies on Construction Project Performance

Construction project performance is a multifaceted concept influenced by various management approaches, including Knowledge Management (KM), Total Quality Management (TQM), and labor productivity. Each of these dimensions plays a significant role in determining the efficiency, quality, and outcomes of construction projects. This review explores the existing literature on how KM, TQM, and labor productivity affect project performance, with a focus on identifying research gaps, particularly in the Rwandan context.

Knowledge Management (KM) has become a strategic resource in construction projects, assisting in streamlining processes, risk management, and innovation. Good KM practices allow organizations to capture, retain, and share useful information, resulting in enhanced decision-making and enhanced project outcomes.

Around the world, research emphasizes the positive influence of KM on project performance. For instance, research in Nigeria illustrates that KM practices placed first increase competitiveness and overall project success. The research highlights the necessity of constant training and appropriate

human resource management to ensure efficient use of knowledge throughout the project life cycle (Josephine et al., 2024). Research by Jia et al. (2024) further shows that the use of digital knowledge-sharing platforms enhances management performance, with knowledge integration capabilities acting as an important mediator.

Among the essential areas where KM is of prime importance is risk management. In those complex projects in construction where uncertainty is the highest, risk management becomes a priority. A research study by Cerezo-Narváez et al. (2022) indicates that KM is responsible for 75.1% of project success in risk management, which reflects its importance in maneuvering challenges and uncertainties.

In addition, sustainability and innovation are increasingly associated with KM in building projects. The idea of Green Knowledge Management (GKM) is especially noteworthy since it assists green technological innovation and improves the sustainability performance of construction companies. A research article by Khan et al. (2024) discusses how GKM investment can reap long-term gains through facilitating green practices and maintaining environmental regulations compliance.

Even though the benefits of KM are well known, there have been issues with its proper application in construction projects, as it continues to face numerous challenges. Among these are resistance to change, poor training, and the absence of a knowledge-sharing culture that prevents organizations from unleashing the full potential of KM (Korkmaz & Bahidrah, 2018). Such challenges indicate that more strategic and formalized approaches to KM, especially in settings such as Rwanda, where formalized KM practices are still nascent, are necessary.

Total Quality Management (TQM) is one of the important factors affecting the performance of construction projects, aimed at constant improvement, quality management, and satisfying stakeholders. QM focuses on a holistic project management approach, where all organizational members are involved in ensuring quality standards throughout the project life cycle.

Evidence has been established that application of TQM practices improves project results in various manners. The factors of focus on operations, management commitment, and participation of employees are very significant and tend to impact the success of TQM in construction projects. Afzal et al. (2022) established that projects with high operational focus and high employee participation experienced enhanced performance measures such as efficiency, quality, and customer satisfaction.

Quality assurance and ongoing improvement are at the core of TQM. Waheed & Abbas (2024) point out that by avoiding mistakes and guaranteeing regular compliance with quality norms, TQM can significantly improve the overall quality of construction works. In addition, research indicates that TQM techniques like benchmarking, empowerment of employees, and supplier quality management have a positive effect on project performance, especially in lowering costs and enhancing customer satisfaction (Vijayabanu et al., 2022).

Yet, the connection between TQM and project performance is not without intervening factors. Bong et al. (2024) discovered that successful risk management is a key factor in maximizing the effect of TQM on project performance. Through proactive risk management, organizations can enhance the chances of successful project delivery while ensuring quality standards.

Despite the proven benefits of TQM, its implementation in construction projects is often hindered by organizational resistance. The reluctance to embrace change, along with the high costs associated with TQM systems, can limit the effectiveness of this approach in certain contexts. In Rwanda, where the construction industry is still developing, the application of TQM is likely to face similar challenges, necessitating further research to explore how TQM can be adapted to the local context.

Conceptual framework

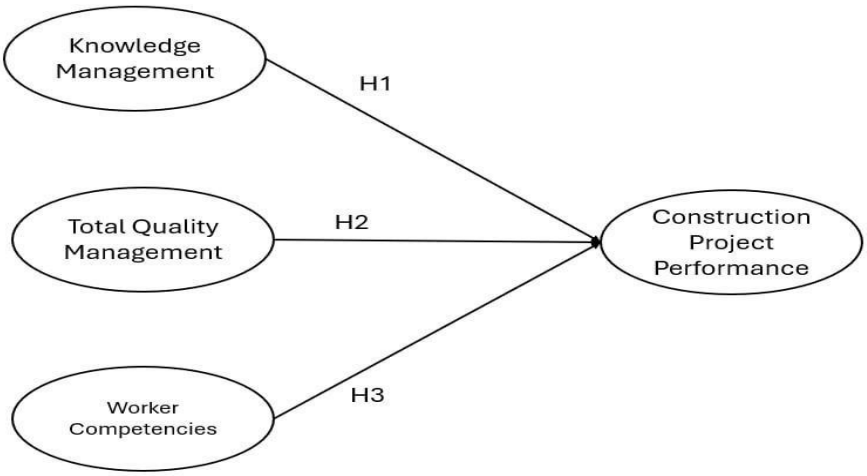


Figure 2. Conceptual Framework of the Study

Figure 1 shows the conceptual framework for this study where KM, TQM, and Worker Competencies have a direct impact on the Construction Project Performance. The framework is built around three hypotheses (H1, H2, and H3), each describing a special relationship— between an independent variable and the dependent variable.

H1: Knowledge Management will have a positive influence in construction project performance. KM is a fundamental field of research that helps in capturing the best practices in a project and transferring that knowledge for better future performance. Conducive KM practices such as knowledge acquisition, sharing, and usage result in enhanced planning, better problem resolution, and reduced risk. KM contributes to improved cost, time, and quality outcomes for projects by improving decision-making processes and limiting inefficiencies.

Similarly, Total Quality Management (H2) is anticipated to have a significant impact on construction project performance. TQM focuses on continuous improvement, customer satisfaction, and adherence to standardized procedures, which are essential in construction projects. TQM is based on principles like leadership commitment, process management, and employee involvement, ensuring that projects meet quality specifications while minimizing defects and rework. When TQM is done right, it can improve productivity, minimize project delays, and increase stakeholder satisfaction.

Worker Competencies (H3) are another important factor that determines construction project performance. These construction tasks require skilled and knowledgeable workers who can work swiftly and safely. The quality of workers themselves—their technical and soft skills and ability to work in a project environment—directly affects productivity levels, safety compliance, and project execution. When adequately trained, a skilled workforce minimizes mistakes, shortens turnaround time, and leads to a much higher project success rate.

Each of these areas is expected to show significant relationships to Construction Project Performance, which refers to performance outcomes related to time, cost, quality, and other factors. This framework provides a reference basis for a future empirical investigation to clearly evaluate how these factors interact and their influences on project performance for the Rwandan construction industry.

Chapter III METHODOLOGY

This chapter outlines the comprehensive methodology employed to address the research questions and objectives of the study, emphasizing the research design, population and sampling techniques, profile of the respondents, research instruments, pilot study, data gathering procedure, ethical considerations, and data analysis.

Research Design

This study employed a quantitative descriptive research design to systematically collect structured data and analyze the impact of Knowledge Management (KM), Total Quality Management (TQM), and Worker Competencies on construction project performance in Rwanda. This design was selected as it allows for the objective measurement of key variables, facilitates hypothesis testing, and enables the identification of relationships between management practices and project performance. By utilizing a structured data collection approach, this study ensures reliability and generalizability of findings, contributing to a data- driven understanding of the factors influencing construction project success.

Respondents of the Study Geographic Distribution

Rwanda is divided into five geographic regions: Kigali, Southern, Northern, Western, and Eastern Provinces. To ensure a balanced representation of construction employees across the country, a stratified random sampling technique was employed. This method ensures that respondents are drawn from all regions, providing a comprehensive understanding of the influence of Knowledge Management (KM), Total Quality Management (TQM), and worker competencies on construction project performance.

Selected Construction Companies

The study specifically focused on employees from construction companies operating within these five provinces of Rwanda. Those companies represent a diverse range of construction firms, ensuring that the findings are applicable to different organizational contexts within the sector.

Random Selection Process

To make the selection process easier, the study used a "Fish Bowl" method of random selection. Five individual fish bowls were prepared, one for each province, with the names of all the construction firms working in that province. One firm was randomly picked from each fishbowl, with equal provincial representation and reducing selection bias. Firms that were not chosen for the main study were assigned to a pilot study to test the research tools prior to the primary data collection.

Number of Respondents

To determine the appropriate sample size, Krejcie and Morgan's (1970) table was applied, using a 95% confidence level and a 0.05 margin of error.

Summary of Sample Size

	Total Number	Sample Size
Pillars Construction	282	69
Loxton Homes Ltd	181	44
Step Two Construction	172	42
SWAD Ltd	288	70
M LINKS	267	65
Total	1190	290

Based on the Rwanda Construction Workers Report (July 2024), which identified 1,190 employees across five construction firms, a sample size of 290 participants was selected. The number of participants for each firm was proportionally allocated based on workforce size. Specifically,

Pillars Construction, with 282 employees, required 69 participants; Loxton Homes Ltd, with 181 employees, needed 44 participants; Step Two Construction, with 172 employees, required 42 participants; SWAD Ltd, with 288 employees, needed 70 participants; and M LINKS, with 267 employees, required 65 participants. The proportional distribution ensured a representative sample across the firms using stratified random sampling.

To maintain data integrity, only complete questionnaires were included in the analysis. Informed consent was obtained from all participants before data collection, ensuring voluntary participation. Additionally, ethical clearance was secured from the Adventist University of the Philippines' Ethics Review Board (ERB), and permission was obtained from the selected construction firms to uphold research ethics and participant confidentiality.

Formula for determining sample size

$$s = X^2 NP (1 - P) \div d^2 (N - 1) + X^2 P (1 - P)$$

s = required sample size
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)
N = the population size
P = the population proportion (assumed to be .50 since this would provide the maximum sample size)
d = the degree of accuracy expressed as a proportion (.05)

Figure 3. ***Krejcie and Morgan (1970) formula***

Exclusion Criteria

After data collection, exclusion criteria will be applied to ensure the validity and integrity of the data. Responses that are incomplete or do not meet the specified criteria will be excluded from the analysis. This process helps eliminate unreliable data and ensures that the findings accurately represent the relationships between Knowledge Management (KM), Total Quality Management (TQM), Labor Productivity Metrics, and construction project performance. The collected information will be thoroughly analyzed using appropriate statistical techniques to identify patterns, correlations, and trends in the variables of interest. The research follows a structured sampling approach, divided into several stages. Stage 1 involves stratifying the population based on Rwanda's provinces—Kigali City, South, North, West, and East—to ensure a well-distributed sample. Stage 2 organizes the sampling process by creating five fish bowls, corresponding to the different strata. Stage 3 consists of a random selection from these fish bowls, ensuring an unbiased representation of individuals from each province. Stage 4 applies convenience sampling, refining the selection based on accessibility and relevance. Stage 5 ensures informed consent is obtained from all selected participants, upholding ethical research standards. Stage 6 involves data collection from the selected sample, followed by Stage 7, where statistical techniques are applied to analyze the data for meaningful insights. This structured methodology enhances the reliability and representativeness of the findings.

Research Instruments

In the present study, a survey questionnaire was the main tool of data collection. Instructions are about the proper selection of tools and equipment to be used to collect data, including the design of the instrument, procedures, and conditions (Patel & Patel, 2023). There were four self-developed sections in the survey, each developed based on relevant literature and research work, intended to collect data holistically for the study.

Part 1 of This part will contain 14 items that are aimed at eliciting useful information from the participants about Knowledge Management (KM) practices. This part is intended to measure the level of awareness and implementation of KM strategies in the construction industry in Rwanda.

Part 2 This part will assess the respondents' perception of the Total Quality Management (TQM) principles covered under 14 items. It is this section that will help analyze the usage and perceived adequacy of the application of TQM practices as a means to improve project deliverables in construction.

Part 3 of This part consists of 14 questions aimed at measuring the perceptions of the respondents regarding worker competencies. It is concerned with testing the level of skills, flexibility, and ability of the workforce to cope with the challenges of construction works in Rwanda.

Part 4 There will be 14 items in this section on the general construction project performance. This section will aim to measure different indicators of project success, such as time, cost, and quality measures.

Content validation will be carried out before the administration of the questionnaire to ascertain clarity, sufficiency of items for data collection, relevance to study objectives, absence of bias, and appropriateness. Seven experts and two laypeople will be involved in the content validation. The expert panel will consist of a statistician, a methodologist, four construction management experts, and one quality management expert, while two laypeople will offer additional insights. Input and feedback from these experts will be taken seriously in developing the final instruments.

The study utilized a structured questionnaire divided into four sections to measure Knowledge Management (KM), Total Quality Management (TQM), Worker Competencies, and Construction Project Performance. Each section employed a 4-point Likert scale to assess respondents' perceptions, ensuring a clear and quantifiable interpretation of the data.

Measurements of variables

Part 1 assessed respondents' understanding of Knowledge Management (KM) strategies using a 4-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree).

Table 1. ***Interpretation for Knowledge Management Practices***

Score	Scaled Response	Mean rating	Qualitative descriptor
4	Strongly Agree	3.50 – 4.00	Very High KM Practice
3	Agree	2.50 - 3.49	High KM Practice
2	Disagree	1.50 - 2.49	Low KM Practice
1	Strongly Disagree	1.00 - 1.49	Very Low KM Practice

As outlined in Table 2, responses were coded as follows: a mean interval score of 3.50 - 4.00 (Strongly Agree) indicates Very High Knowledge Management Practice, 2.50 – 3.49 (Agree) represents High Knowledge Management Practice, 1.50 - 2.49 (Disagree) corresponds to Low Knowledge Management Practice, and 1.00 - 1.49 (Strongly Disagree) signifies Very Low Knowledge Management Practice

Part 2 measured Total Quality Management (TQM) using a self-developed 14-item questionnaire, with responses scored on the same 4-point Likert scale. As detailed in Table 3, a mean interval score of 3.50 - 4.00 (Strongly Agree) signifies Very High TQM, 2.50 – 3.49 (Agree) denotes High TQM, 1.50 - 2.49 (Disagree) indicates Low TQM, and 1.00 - 1.49 (Strongly Disagree) represents Very Low TQM.

Table 2. ***Interpretation for Total Quality Management***

Score	Scaled Response	Mean rating	Qualitative descriptor
4	Strongly Agree	3.50 – 4.00	Very High TQM Practice
3	Agree	2.50 - 3.49	High TQM Practice
2	Disagree	1.50 - 2.49	Low TQM Practice
1	Strongly Disagree	1.00 - 1.49	Very Low TQM Practice

Part 3 evaluated Worker Competencies using a 4-point Likert scale, as presented in Table 4. A mean interval score of 3.50 - 4.00 (Strongly Agree) corresponds to Very High Competency, 2.50 - 3.49 (Agree) indicates High Competency, 1.50 - 2.49 (Disagree) signifies Low Competency, and 1.00 - 1.49 (Strongly Disagree) reflects Very Low Competency.

Table 3. ***Interpretation for Total Quality Management***

Score	Scaled Response	Mean rating	Qualitative descriptor
4	Strongly Agree	3.50 – 4.00	Very High Competency
3	Agree	2.50 - 3.49	High Competency
2	Disagree	1.50 - 2.49	Low Competency
1	Strongly Disagree	1.00 - 1.49	Very Low Competency

Part 4 assessed Construction Project Performance, focusing on key performance indicators such as time, cost, and quality. This was measured through a self-structured questionnaire consisting of 14 items, each scored using a 4-point Likert scale. The responses were interpreted based on mean ratings, where 3.50 – 4.00 indicates Very High project performance, 2.50 – 3.49 represents High performance, 1.50 – 2.49 corresponds to Low performance, and 1.00 – 1.49 signifies Very Low project performance.

Table 4. ***Interpretation for Total Quality Management***

Score	Scaled Response	Mean rating	Qualitative descriptor
4	Strongly Agree	3.50 – 4.00	Very High Project Performance
3	Agree	2.50 - 3.49	High Project Performance
2	Disagree	1.50 - 2.49	Low Project Performance
1	Strongly Disagree	1.00 - 1.49	Very Low Project Performance

Pilot Study

A pilot survey will be taken with a sample of 30 respondents randomly selected from various Construction companies from all five study areas. This sample was then not included in the final list for the primary survey. The pilot study was conducted on October 20th, 2024, with the main objective of assessing the validity and reliability of the research tools and making sure that no problems occur in terms of understanding, language clarity, and data accuracy. Any item that has Cronbach's alpha value less than 0.70 will be dropped or excluded from application in the actual data collection, while those with a Cronbach's alpha value greater than 0.70 will be kept being utilized in the main study.

Data Gathering Procedure:

Data collection in this study used a combined online and in-person strategy. In view of the different schedules and preferences of the participants, an online survey version was offered for those with difficulties in participating in face-to-face interactions, including individuals on leave, distant assignment, or with other activities that restricted their schedules. This two- pronged data collection strategy helped ensure wide coverage and better overall representativeness of the data collected.

Face-to-Face Surveys

Smooth conduct of face-to-face data collection was ensured by a properly prepared research team. Prior to interacting with respondents, the researcher went through a thorough briefing via Zoom or Google Meet meetings with directors of the shortlisted Construction companies. The meetings gave elaborate details regarding the objectives of the study, methodology, and random selection of officers. The co-operative process also involved obtaining permission and approval from the administrators of the construction companies, with full observance of ethical standards.

The researcher's involvement went beyond the extent of facilitation. While having face- to-face interactions with participants, the researcher explained the study to participants, highlighting its ethical aspects, including confidentiality and voluntary participation. This ensured that the participants were well aware and participated in the study willingly. Participants' rights were explained by the researcher, creating an impression of partnership and trust.

During the process of data collection, the researcher handed out hard copies of questionnaires to respondents who were specifically chosen. Precise instructions were given to enable clear response to the questions, and respondents were invited to inquire for clarification when necessary.

Upon the completion of the face-to-face interactions, the researcher carefully verified that all the items on the questionnaires were completed to guarantee the completeness of the data. This process served to reaffirm the validity of the gathered information. After the data collection, it was stored securely to guarantee participant confidentiality.

After both online questionnaires and personal data collection, the researcher thoroughly
reviewed the collected data. Missing responses were handled prior to encoding the data into Excel and then importing it into the Statistical Package for Social Sciences (SPSS). The analytical software allowed for a thorough descriptive analysis and the use of the Pearson product-moment correlation. All information were kept on password-protected electronic devices to ensure that they were not accessed without authorization, and only those who were officially attached to the study could access the information. The information was to be destroyed six months after the study had been completed.

Online Survey

For those participants who chose the online survey because of their schedules and preferences, the researcher requested approval from the university's Research Ethics Review Board (ERB) to carry out the online surveys. After gaining approval, extensive Google Forms and informed consent materials were prepared to be distributed.

Online survey participants received a detailed introduction and orientation through email or messaging apps. The message explained the objectives, methods, and ethics of the study. Participants were well-informed regarding the intent of the study, their rights, and the confidentiality procedures adopted.

Google Forms link of the online survey was distributed and sent to respondents via email or WhatsApp. It provided the advantage of allowing the respondents to complete the survey in their own free time, enhancing flexibility and responses.

The duration of the online survey was from October 30 to December 04, 2024, giving participants sufficient time to respond. Throughout this time, the researcher kept track of responses to guarantee the data gathered was complete and accurate. Like face-to-face surveys, all data was kept in password-protected electronic devices, with access restricted to authorized personnel only.

After the completion of the online questionnaires, the researcher checked the collected data to fill in any missing responses. The data was then encoded into Excel and transferred into SPSS for further analysis, such as detailed descriptive analysis and correlation testing. To maintain confidentiality, strict security measures were taken. All data collected was planned to be destroyed six months after the end of the study.

Data Analysis

To ensure accuracy and reliability, a statistician will assist in data analysis. The data will be organized, processed, and analyzed using SPSS version 25 and WarpPLS version 8. Various statistical techniques will be used to test hypotheses and interpret results, which will be presented through tables and charts for clarity. The following statistical methods were used

Mean and Standard Deviation was applied to measure central tendencies and variations in responses, particularly regarding KM, TQM, Workers' Competencies and construction performance.

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze the effects of KM, TQM, and Workers' Competencies on project performance. Reliability and Validity was assessed using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted

(AVE). Discriminant Validity was checked using the Fornell-Larcker Criterion. Structural Model Evaluation examined the path coefficients, p-values, and R^2 values to determine relationships' strength and significance.

CHAPTER IV. RESULTS AND DISCUSSIONS

This study explored the influence of Knowledge Management (KM), Total Quality Management (TQM), and workers competencies in Construction Project Performance in Rwanda. Accordingly, tables and descriptive statistics were used to present and discuss the study findings.

Knowledge Management Practices in terms of Knowledge Identification

Table 5 describes the respondents' views of knowledge identification practices in their construction companies. The grand mean for knowledge identification was 3.36 with a standard deviation of 0.770. In terms of the response scale, this represents a "High" level of knowledge identification practices in the organizations surveyed.

Table 5. ***Respondents' Knowledge management Practices in terms of Knowledge identification***

No.	Knowledge identification	Mean	SD	Scale Response	Qualitative Descriptor
1	My organization systematically identifies valuable insights for project success.	3.50	0.841	Agree	High
2	I actively participate in identifying knowledge assets within my team.	3.33	0.707	Agree	High
3	My organization provides structured mechanisms to recognize	3.22	0.811	Agree	High
4	I believe that effective knowledge Identification enhances construction	3.36	0.736	Agree	High
5	My organization encourages a culture of knowledge recognition	3.39	0.759	Agree	High
Grand mean (Knowledge identification)		**3.36**	**0.770**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50-4.00 = Strongly Agree*

The highest mean score was obtained on the item "My organization systematically identifies valuable insights for project success" (Mean = 3.50, SD = 0.841). This indicates that respondents overall agree that their organizations do have the practice of identifying valuable insights, reflecting a relatively strong level of commitment towards knowledge identification.

On the contrary, the lowest mean score was noted for the item "My organization provides structured mechanisms to recognize knowledge" (Mean = 3.22, SD = 0.811), meaning that although there is knowledge identification, there are possibilities of lapses in the formalization and structuring of such processes. The comparatively low standard deviation across all items means low variability in response, implying there is consensus among respondents for knowledge identification processes.

But the lowest mean score was recorded for "My organization provides structured mechanisms to recognize knowledge" (Mean = 3.22, SD = 0.811), which indicates that though knowledge identification is appreciated, the formal support systems for it might be unreliable or immature. This indicates a potential area of improvement for organizations to have more systematic structures in place to facilitate knowledge identification processes.

These results imply that though the practice of knowledge identification is vigorously pursued, opportunities exist to better create more systematic mechanisms for knowledge identification so that valuable lessons can be captured and utilized regularly. This is consistent with the knowledge management cycle as emphasized by (Tow et al., n.d.), who argued that the identification of existing knowledge assets is a foundational step in ensuring effective knowledge sharing and reuse. Similarly, Li (2019) stresses the importance of knowledge identification, especially in the form of tacit knowledge, as a precursor to knowledge creation and innovation in organizations.

Olubajo (2024) also highlighted that construction firms often struggle to implement structured mechanisms for knowledge identification due to contextual and technological barriers, a finding which supports the relatively low score on structured recognition in the present study. Adekunle et al. (2022) further assert that while there is awareness of knowledge management's importance in construction, there is a need for institutional support to

formalize practices that capture and identify critical knowledge assets.

Organizations must invest in the formulation of standard knowledge identification frameworks that are incorporated into their day-to-day operational practices to ensure knowledge recognition. Staff should also be encouraged to contribute actively towards knowledge identification activities, supported by capacity development programs and leadership-led knowledge-sharing cultures.

These findings are in line with those of Project Risk Knowledge Management (2024), which highlight that good knowledge identification is crucial for successful project management. A robust knowledge identification culture helps to enhance project efficiency, mitigate risks, and increase innovation in the construction industry. Abstracting more from the results, the participants revealed that they acknowledge the significance of knowledge identification (Item 4, Mean = 3.36, SD = 0.736), and the organizations promote a knowledge recognition culture (Item 5, Mean = 3.39, SD = 0.759). These characteristics signify that although there is a favorable attitude towards knowledge management's contribution to project success, additional institutional support is necessary to formalize and maximize knowledge identification mechanisms.

Knowledge Management Practices with regard to Knowledge Acquisition

Table 6 shows respondents' views on knowledge acquisition practices in their firms. The grand mean for knowledge acquisition was 3.35, with a standard deviation of 0.752. From the response scale, this translates to “High" knowledge acquisition practices among the construction organizations surveyed.

Table 6 ***Respondents' Knowledge management Practices in terms of Knowledge Acquisition***

No.	Knowledge Acquisition	Mean	SD	Scale Response	Qualitative Descriptor
6	My organization provides continuous learning to enhance employee knowledge	3.40	0.697	Agree	High
7	I seek new knowledge or skills to improve my performance in construction projects.	3.31	0.827	Agree	High
8	My organization facilitates access to training	3.36	0.722	Agree	High
9	I believe that acquiring new knowledge helps me solve project related challenges efficiently.	3.35	0.753	Agree	High
10	My organization encourages employees to gain industry-specific knowledge through research	3.34	0.763	Agree	High
Grand Mean (Knowledge Acquisition)		**3.35**	**0.752**	**Agree**	**High**

Legend: *1.00-1.4S = Strongly Disagree; 1.50-2.4S = Disagree; 2.50-3.4S=Agree; 3.50-4.00 = Strongly Agree*

The highest mean score was captured in "My organization offers on-going learning opportunities to increase workers' knowledge" *(Mean = 3.40, SD = 0.697),* showing that the availability of regular learning opportunities through structured systems is prominent across organizations. This reflects organizational awareness regarding the importance of workforce competency through continuous learning and the overall enhancement of project execution. Similarly, the statement "My organization provides access to training" *(Mean = 3.36, SD = 0.722)* supports the claim that employees have access to structured development programs. The focus on training and knowledge acquisition is in line with international best practices, where continuous learning is a key factor for organizational effectiveness and competitive edge (Mogea, 2023).

Yet, the lowest mean score was indicated in "I seek new knowledge or skills to enhance my performance in construction projects" *(Mean = 3.31, SD = 0.827).* Although still in the "High" category, this result indicates that self-directed knowledge seeking might not be as highly valued as organization-led initiatives. This points towards a potential opportunity for fostering a more active knowledge-seeking environment among staff. As highlighted by Bergman and Hermansson (2015), the encouragement of personal initiative in knowledge acquisition is key to long-term organizational adaptability and innovation. Ahsan (2024) also emphasize that while structured training is beneficial, cultivating a learning culture that empowers individual curiosity and initiative is equally crucial. Furthermore, Halmaghi and Todăriță (2023) noted that personal motivation significantly influences the extent to which employees pursue new knowledge and apply it effectively in their job roles.

These results suggest that construction organizations prioritize formal learning mechanisms, but there is scope to enhance self-directed

learning programs. Motivating employees toward individual responsibility for their knowledge development will prove fruitful in driving problem-solving ability and innovation (Research |, n.d.). Organizations must contemplate adopting incentives for independent learning, including certifications, knowledge exchange platforms, and mentorship programs. Additionally, incorporating research opportunities aligned with specific industries can prompt employees to learn and apply new information within their respective fields, thereby improving overall project success.

These findings are further supported by the works of Odunladi and Olakunle (2024), who found that successful knowledge acquisition strategies involve a balanced mix of formal training and informal, self-driven learning approaches. The study results suggest that knowledge acquisition approaches in Rwanda's construction industry are greatly emphasized and actively fostered. Nonetheless, organizations must particularly emphasize facilitating self- directed learning so that staff members do not remain overly dependent on organized training. Such reinforcement will improve overall organizational responsiveness, employee competence, and construction project performance. Subsequent research needs to investigate the particular obstacles to self-directed learning and develop specific interventions to foster a more proactive knowledge-seeking culture in the construction sector.

Knowledge management Practices in terms of Knowledge Sharing

Table 7 shows the grand means of knowledge sharing to be 3.38 on a scale with a standard deviation of 0.737. Based on the results, it is seen broadly that the respondents are practicing knowledge-sharing activities at a high level, reflecting a strong culture of information sharing in their organizations.

Table 7. ***Respondents' Knowledge management Practices in terms of Knowledge Sharing***

No.	Knowledge Sharing	Mean	SD	Scale Response	Qualitative Descriptor
11	I share my knowledge with colleagues to improve project outcomes.	3.35	0.712	Agree	High
12	My team follows clear communication practices for knowledge sharing.	3.35	0.778	Agree	High
13	I use digital tools to exchange information with team members.	3.44	0.711	Agree	High
14	My organization encourages collaboration to share lessons from past projects.	3.39	0.741	Agree	High
15	I participate in workshops to enhance knowledge sharing in my organization.	3.40	0.743	Agree	High
Grand mean (Knowledge Sharing)		**3.38**	**0.737**	**Agree**	**High**

Legend: *1.00-1.4S = Strongly Disagree; 1.50-2.4S = Disagree; 2.50-3.4S=Agree; 3.50-4.00 = Strongly Agree*

Table 7 reveals the results on the knowledge-sharing dimension of knowledge management. Items 13, *"I use digital tools to exchange information with team members,"* and item 15, *"I participate in workshops to enhance knowledge sharing in my organization,"* both had high mean scores of 3.44 (SD = 0.711) and 3.40 (SD = 0.743), respectively. These high ratings emphasize the importance of digital tools and structured learning events in facilitating knowledge exchange. This underscores the need for organizations to invest in digital infrastructure and continuous learning opportunities to facilitate effective knowledge exchange (Aghaee, 2024).

Additionally, item 14, *"My organization encourages collaboration to share lessons from past projects,"* had a mean score of 3.39 (SD = 0.741), reinforcing the necessity of fostering a collaborative work environment where employees learn from previous experiences. This supports the assertion by Geada (2023) that knowledge sharing is essential for collective learning and innovation. The lowest mean score in this category was for item 11, *"I share my knowledge with colleagues to improve project outcomes,"* which had a mean score of 3.35 (SD = 0.712), indicating a potential gap in direct peer-to-peer knowledge sharing. This gap could be narrowed through structured mentorship and informal team discussions. As noted by Novais et al. (2023), interpersonal dynamics, trust, and recognition greatly influence knowledge- sharing behaviors.

These results are in accordance with research by Ekambaram (2024), which highlighted that sound knowledge-sharing practices play a significant role in organizational learning and project effectiveness. Moreover, (Prinsloo et al., 2017) emphasized that encouraging employees to share

experiential knowledge can reduce project risks and increase efficiency. Similarly, (Lee et al., 2015) noted that effective knowledge sharing contributes to the development of sustainable competitive advantage, especially in knowledge-intensive sectors like construction.

Ultimately, promoting a culture that supports both digital and interpersonal channels for knowledge sharing is crucial. Organizations should explore innovative approaches such as communities of practice, social collaboration platforms, and knowledge-sharing incentives to strengthen internal communication and learning ecosystems.

Overall, Knowledge management Practices

Table 8 reveals the grand mean of overall knowledge management practices is *3.36* with a standard deviation of *0.753*. Based on the results, it is generally observed that respondents demonstrate a high level of engagement in knowledge management practices, indicating a strong organizational culture of knowledge identification, acquisition, and sharing.

The highest mean score was recorded for "*Knowledge Sharing*" (*mean = 3.38, SD = 0.737*) with an interpretation of *high*, which indicates that the respondents actively participate in sharing knowledge within their organizations. This reflects that knowledge-sharing initiatives are well-implemented, possibly through structured programs such as workshops, digital tools, and collaborative discussions.

However, "*Knowledge Acquisition*" received the *lowest* mean score of *3.35* (*SD = 0.752*) with an interpretation of *high*, indicating that while respondents recognize the importance of acquiring knowledge, there may be some limitations in access to training, resources, or structured learning opportunities. This suggests that organizations should further enhance mechanisms for knowledge acquisition, such as continuous professional development programs, mentorship initiatives, and access to up-to-date information sources.

Table 8. ***Respondents' Overall Knowledge Management Practices***

No.	Knowledge Sharing	Mean	SD	Scale Response	Qualitative Descriptor
1	Knowledge identification (KI)	3.36	0.770	Agree	High
2	Knowledge Acquisition (KA)	3.35	0.752	Agree	High
3	Knowledge Sharing (KS)	3.38	0.737	Agree	High
4.	Knowledge Application (KAP)	3.31	0.758	Agree	High
5	Knowledge Evaluation (KE)	3.34	0.692	Agree	High
Overall mean (Knowledge Management Practices)		3.35	0.742	Agree	High

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50-4.00 = Strongly Agree*

Taken together, the overall results revealed that the respondents exhibit strong knowledge management practices with a grand mean of *3.36 (SD = 1.537)*, indicating that knowledge identification, acquisition, and sharing are well-integrated into organizational operations. This finding is consistent with similar studies that highlight the significance of knowledge management in improving organizational performance and decision-making.

For example, a study conducted by Farhan and Raheem (2024) found that effective knowledge-sharing mechanisms contribute to increased productivity and innovation within organizations. Furthermore, investing in knowledge acquisition strategies, such as continuous learning and professional training, enhances the ability of employees to apply new insights to their work environments.

Total Quality Management Practices in terms of Customer Focus

Table 9 presents the respondents' perception of total quality management practices in construction companies, specifically in terms of customer focus. The grand mean is *3.31*, and the standard deviation is *0.753.* The results revealed that the overall respondents' assessment of customer focus in construction companies was high, indicating that customer-centered practices are well integrated into project management processes.

Table 9. ***Total Quality management of construction Companies in terms of customer focus***

	Mean	SD	Scale Response	Qualitative Descriptor
1	I ensure that my project deliverables align with client expectations	3.47	0.762	Agree	High

	I actively seek and incorporate customer feedback throughout the project lifecycle.	3.19	0.664	Agree	High
	I use advanced tools (e.g., CRM systems) to improve client engagement.	3.18	0.887	Agree	High
4	I participate in regular stakeholder meetings to tailor projects to their needs	3.32	0.723	Agree	High
5	My organization has standardized methods that I use to measure customer satisfaction effectively.	3.40	0.733	Agree	High
Grand mean (Customer Focus)		**3.31**	**0.753**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50-4.00 = Strongly Agree*

Specifically, the highest mean *(Mean = 3.47, SD = 0.762)* was from item 1, "*I ensure that my project deliverables align with client expectations."* This suggests that respondents prioritize meeting client expectations, which is a crucial element of customer satisfaction and project success.

This was followed by item 5, *"My organization has standardized methods that I use to measure customer satisfaction effectively,"* with a mean of *3.40 (SD = 0.733).* This implies that structured methodologies for assessing customer satisfaction are widely implemented. The third among the options was item 4, "*I participate in regular stakeholder meetings to tailor projects to their needs,*" with a mean of *3.32 (SD = 0.723),* indicating that engagement with stakeholders is a common practice in ensuring project alignment with customer requirements. This was followed by item 2, "*I actively seek and incorporate customer feedback throughout the project lifecycle,*" with a mean score of *3.19 (SD = 0.664),* suggesting that while customer feedback is considered, there may be areas for improvement in how feedback is gathered and utilized.

Finally, the lowest is item 3, "*I use advanced tools (e.g., CRM systems) to improve client engagement,"* with a mean score of *3.18 (SD = 0.887).* This suggests that while respondents acknowledge the importance of technology in client engagement, its adoption may not be as strong compared to other customer-focused practices. The overall result indicated that construction companies have a strong customer focus (Mean = 3.31, SD = 0.753), emphasizing the importance of aligning project deliverables with client expectations and implementing standardized customer satisfaction measures. The finding implies that there is a significant emphasis on customer satisfaction in the construction sector, which is critical for maintaining long-term business success (Mean = 3.31, SD = 0.753).

A study done by Yashchenko et al. (2024) asserted that customer-focused strategies are crucial for improving project success rates and client retention in the architecture and construction industry by fostering long-term relationships, enhancing service quality, and adapting to market changes and customer needs effectively.

In contrast, the lowest scoring item was the use of advanced tools such as CRM systems (Mean = 3.18, SD = 0.887), and this was interpreted as a potential area for improvement in customer relationship management practices. This could be attributed due to limited investment in technology or a lack of training in utilizing customer engagement tools effectively (Khan et al., 2024). To increase overall customer orientation in construction firms, organizations need to invest in technology-based client engagement initiatives, enhance feedback systems, and enhance stakeholder collaboration to better align projects with customer requirements.

Total Quality Management Practices in terms of Leadership

Table 10 shows the opinion of the respondents regarding leadership practice in the construction companies' total quality management in Rwanda. Grand mean is 3.34, and the standard deviation is 0.716. The finding indicated that the overall ratings of the respondents towards leadership among construction companies were high, confirming that effective practices are known and adopted.

Table 10. ***Respondents' Total Quality management of construction Companies in terms of leadership***

No.	Leadership	Mean	SD	Scale Response	Qualitative Descriptor
6	My leadership inspires a shared vision and fosters collaboration within the team.	3.34	0.695	Agree	High

7	I make decisions inclusively and ensure they are transparent.	3.30	0.782	Agree	High
8	I adopt transformational leadership styles to drive team performance.	3.36	0.717	Agree	High
9	I effectively manage challenges related to resource limitations.	3.35	0.672	Agree	High
10	My leadership practices align with the cultural and socio-political context of my projects	3.34	0.712	Agree	High
Grand mean (Leadership)		**3.34**	**0.716**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

Precisely, the highest mean (Mean = 3.36, SD = 0.717) in this case was from item 8, "I adopt transformational leadership styles to drive team performance." This implies that the leaders in construction firms focus more on transformational leadership, which tends to increase motivation and efficiency among team members.

This was preceded by item 9, "I effectively manage challenges related to resource limitations," with a mean of 3.35 (SD = 0.672). This reflects that leaders take the initiative in overcoming resource-based constraints to enable smooth project delivery despite limitations. The third of the options was item 6, "My leadership inspires a shared vision and fosters collaboration within the team," with a mean of 3.34 (SD = 0.695). This indicates the significance of visionary leadership and teamwork in construction management.

This was preceded by item 10, "My leadership habits take into account the socio- political and cultural context of my projects," with a mean score of 3.34 (SD = 0.712). This implies that leaders take into account the socio-political and cultural context in their decision- making, which contributes to the acceptance of projects as well as stakeholder involvement. Lastly, the lowest is item 7, "I make decisions inclusively and ensure they are transparent," with a mean score of 3.30 (SD = 0.782). This indicates that although inclusivity and transparency are important, there are perhaps areas for further improvement of these elements in leadership decision-making.

The general outcome showed that Rwandan construction firms demonstrate high leadership behaviors (Mean = 3.34, SD = 0.716), with evidence of adhering to transformational leadership, management of resources, and cultural fit. The result suggests that leaders within the firms pay attention to creating teamwork, handling issues in anticipation, and achieving strategic fit with the wider organizational and societal environment.

The outcome revealed that the most highly rated leadership dimension was the implementation of transformational leadership approaches (Mean = 3.36, SD = 0.717). Another study conducted by Purwadi (2024) purported that transformational leadership promotes workers' engagement, creativity, and overall project success within the construction industry. Thus, the development of a culture of transformational leadership can also enhance project outcomes and team performance.

On the contrary, the lowest-rated item was inclusive and transparent decision-making (Mean = 3.30, SD = 0.782), and this was seen as a point that needs development in leadership practices in construction firms. This might be due to hierarchical decision-making frameworks, minimalist participatory practices, or inadequate avenues for communication (Rehan et al., 2024).

Total Quality Management in terms Of Engagement Of People

Table 11 is a summary of the perceptions of engagement of individuals in total quality management among construction firms in Rwanda. The grand mean score for people engagement was 3.31, with a standard deviation of 0.765. According to the interpretation of the Likert scale, this shows a "High" level of engagement, meaning that companies involve employees actively in discussions and decision-making related to projects.

Table 11. ***Respondents' Total Quality management of construction Companies in Rwanda in terms of engagement of People***

No.	Engagement of People	Mean	SD	Scale Response	Qualitative Descriptor
11	I actively involve employees in setting and achieving project goals.	3.32	0.753	Agree	High
12	My organization provides me with regular training and development opportunities to enhance my competencies	3.30	0.771	Agree	High

13 I ensure diverse stakeholder perspectives are integrated into project planning.	3.36	0.766	Agree	High
14 I feel empowered to contribute innovative ideas to improve project outcomes.	3.30	0.732	Agree	High
15 I benefit from clear communication channels for project-related discussions.	3.28	0.803	Agree	High
Grand mean (engagement of people)	**3.31**	**0.765**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

The highest-rated item was item 13, *"I ensure diverse stakeholder perspectives are integrated into project planning"* (Mean = 3.36, SD = 0.766), highlighting that inclusivity in planning is highly valued by respondents. This aligns with research by Sanka (2024), who emphasized that incorporating diverse stakeholder perspectives is crucial for project sustainability, adaptability, and long-term success. Similarly, Paratz et al. (2022) noted that stakeholder engagement enhances strategic alignment and increases accountability in project execution.

Meanwhile, item 15, *"I benefit from clear communication channels for project-related discussions,"* received the lowest mean score of 3.28 (SD = 0.803). This suggests that although communication systems exist, they may lack effectiveness, accessibility, or clarity—thereby signaling a need for improvement. Ibdayanti et al. (2023) point out that miscommunication or ineffective communication structures can create misunderstandings and delays, reducing overall project efficiency. Supporting this, Fahad and Musa (2023) found that in construction, poor communication is one of the leading causes of conflict and project failure.

Overall, Table 11 indicates a high level of employee participation in TQM practices, particularly in knowledge sharing, collaborative planning, and capacity development. The grand mean score of 3.31 confirms that construction firms in Rwanda recognize the value of engaging employees in quality management processes. The results also echo the findings of Fahad et al. (2024), who highlighted that active employee involvement is a critical factor for the successful implementation of TQM, especially in dynamic and collaborative sectors like construction.

Additionally, Mukakarisa and Njoroge (2024) emphasized that improving communication is a cornerstone of effective project risk management. Enhanced communication fosters collaboration, supports knowledge flow, and ultimately contributes to project success. As such, while inclusivity and training are strengths, addressing communication gaps should be a priority.

Total Quality Management Practices in terms of Process Approach

Table 12 shows respondents' views regarding the process approach to Total Quality Management (TQM) among construction firms in Rwanda. *The grand mean value for the process approach was 3.354 with a standard deviation of 0.734.* On the response scale, this is equivalent to a qualitative rating of "High", demonstrating that respondents strongly agree that structured and effective process management practices exist in their firms.

The highest mean score was obtained for item 17, *"I continuously monitor key processes to ensure they align with project objectives." (Mean = 3.39, SD = 0.714).* This shows the respondents highly prioritize the necessity of continuous monitoring of processes, indicative of realizing the significance of aligning operations with project goals in order to sustain quality and efficiency. According to Thakkar (2022), continuous process evaluation is one of the central elements of TQM, as it supports early detection of deviations, facilitates real-time decision-making, and ensures that organizational processes remain aligned with quality objectives.

Table 12. ***Respondents' Total Quality management of construction Companies in terms of Process approach***

No. Process Approach	Mean	SD	Scale Response	Qualitative Descriptor
16 My construction activities are guided by clearly defined workflows.	3.37	0.711	Agree	High
17 I continuously monitor key processes to ensure they align with project objectives.	3.39	0.714	Agree	High
18 My team adopts tools like BIM principles	3.34	0.767	Agree	High

to optimize processes.				
19 I systematically plan and evaluate resource utilization during projects.	3.30	0.746	Agree	High
20 I effectively manage scope changes to avoid delays or cost overruns.	3.37	0.733	Agree	High
Grand mean (Process Approach)	**3.354**	**0.734**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

Similarly, item 16, *"My construction activities are guided by clearly defined workflows."* (Mean = 3.37, SD = 0.711), also received a high score. This reflects an awareness among respondents that structured workflows promote project consistency and reduce variability in task execution. As (Moradi et al., 2021) asserted, consistent processes and defined procedures form the basis of quality improvements by reducing uncertainty and enhancing predictability in operations.

Another item with a high score was item 20, *"I effectively manage scope changes to avoid delays or cost overruns."* (Mean = 3.37, SD = 0.733). This underscores the importance of change management as a key process within TQM. Martha (2023) noted that effective change and scope management minimizes project disruption, thereby ensuring that projects remain within budget and are delivered on time—key metrics of quality in project execution.

On the other hand, the lowest score was recorded in item 19, *"I systematically plan and evaluate resource utilization during projects."* (Mean =3.30, SD = 0.746). This score, although still classified as "High," suggests that improvements are needed in planning and evaluating resource allocation. This is in line with findings from Sapiro (2024), who emphasized that lack of structured resource management often leads to inefficiencies and increased project costs. Their study in the context of construction firms showed that integrated resource management strategies significantly improve quality outcomes and resource optimization.

Item 18, *"My team adopts tools like BIM principles to optimize processes."* (Mean = 3.34, SD = 0.767), also scored slightly lower than others. While still indicating strong agreement, it reflects that the adoption and full integration of BIM (Building Information Modeling) in process improvement is still evolving. Sapiro (2024) demonstrated in his study that the integration of BIM tools in construction enhances productivity, promotes better visualization of workflows, and fosters real-time collaboration among stakeholders, making it a valuable TQM asset when fully utilized.

In addition to these insights, Al-Rubaiei et al. (2018) highlight that the implementation of Lean Construction principles in process design reduces waste and leads to improved project cycle times—further aligning with TQM's focus on process efficiency. Similarly, Sapiro (2024) found that process-based TQM implementation significantly enhances customer satisfaction and productivity in construction firms, especially when supported by strong leadership and data-driven process monitoring.

Lastly, the importance of an integrated process approach is supported by ISO 9001:2015, which advocates for a process-based Quality Management System (QMS). This standard encourages organizations to define, monitor, and improve interconnected processes to achieve consistent outcomes that meet customer and regulatory requirements.

Total Quality management in terms of Continuous Improvement

Table 13 shows the continuous improvement perception by the respondents regarding Total Quality Management (TQM) in Rwandan construction companies. The grand mean for continuous improvement was 3.298 with a standard deviation of *0.734.* This according to the response scale represents a qualitative label of "High" and shows that respondents in their majority perceive their organizations as implementing structured and effective continuous improvement approaches.

The highest mean score was achieved by **item 25**, *"I use digital tools to track progress and foster accountability in my projects"* (Mean = 3.43, SD = 0.686). This suggests that respondents highly prioritize the use of **digital tools** in monitoring and accountability. The high score confirms a general acknowledgment of **technology as a key driver of efficiency and transparency** in construction project management. These findings are consistent with the work of Berawi et al. (2024**),** who emphasized that the adoption of digital technologies such as Building Information Modeling (BIM), cloud-based tools, and digital dashboards plays a vital role in fostering real-time tracking, enhancing project transparency, and supporting continuous improvement initiatives.

Furthermore, **item 21**, *"I prioritize eliminating waste to improve project efficiency"*

*(*Mean = 3.42, SD = 0.736), was also highly rated. This reflects that respondents appreciate the importance of minimizing waste in maximizing resource utilization and enhancing overall project performance. This aligns with the principles of **Lean Construction**, which emphasize waste reduction, value creation, and efficiency optimization. As noted by Kamal and Belal (2023), integrating lean thinking into construction practices not only improves process flow but also strengthens the culture of continuous improvement across project phases.

Additionally, these findings support Wang et al. (2024), who reported that sustainable construction practices—including waste reduction,

continual staff training, and use of digital innovations contribute significantly to long-term improvement in quality, time management, and cost control.

Table 13. ***Respondents' Total Quality management of construction Companies in terms of Continuous improvement***

No.	Continuous improvement	Mean	SD	Scale Response	Qualitative Descriptor
21	I prioritize eliminating waste to improve project efficiency.	3.42	0.736	Agree	High
22	I conduct performance evaluations regularly to identify areas for improvement.	3.24	0.650	Agree	High
23	My project practices include regular quality audits.	3.09	0.866	Agree	High
24	I adopt continuous improvement methodologies (e.g., Lean, Six Sigma) in my work.	3.31	0.733	Agree	High
25	I use digital tools to track progress and foster accountability in my projects.	3.43	0.686	Agree	High
Grand mean (continuous improvement)		**3.298**	**0.734**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

On the other hand the lowest mean score was found for item 23, *"My project practices include regular quality audits." (Mean = 3.09, SD = 0.866).* Although still ranked as *"High",* this indicates that while quality audits are performed, their application may not be as strict or routine as other continuous improvement activities. This result indicates a possible shortcoming in the mechanisms of quality assurance that would be a target for improvement to enhance construction project results.

Table 13 shows that the respondents confirm the significance of ongoing improvement in Total Quality Management, as evidenced by the grand mean score of *3.298 (SD = 0.734),*
which is equivalent to a *"High"* qualitative interpretation. These results indicate that construction firms in Rwanda place great emphasis on process improvement, performance measurement, and the utilization of digital technologies to enhance efficiency.

But the results also indicate that although quality audits are identified as being important, their implementation in practice can be strengthened. More formalized quality audit frameworks should be introduced by organizations and regular checks carried out to improve project performance. Further improvement of efficiency and quality control in the industry could be achieved by integrating more advanced continuous improvement methods like Six Sigma and Lean Construction.

These findings corroborate the arguments of Shueili et al. (2023), which highlighted that sustained improvement approaches have a strong influence on cost reduction, project effectiveness, and sustainable longevity. The arguments of Handayani and Syahrial (2024) are also supported by their findings that digital tool utilization and systematic performance appraisals enhance accountability and success in projects.

Total Quality Management in terms of Evidence Based Decision Making

Table 14 shows the perception of respondents regarding evidence-based decision making in Total Quality Management (TQM) in construction firms in Rwanda. The grand mean of evidence-based decision making was *3.316* with a standard deviation of *0.723*. From the response scale, this is a qualitative label of *"High"*, suggesting that respondents tend to concur that their decision-making process is informed by credible data, systematic methods, and best practices.

Item 30, *"I incorporate evidence-based practices with local regulatory standards in my projects,"* received the highest mean score (Mean = 3.44, SD = 0.711). This confirms that respondents prioritize embedding evidence-based decision-making practice with local regulation to a very great extent. This reflects the finding by Capezio and Decosta (2023), who emphasized that integrating local compliance frameworks into data-driven

decisions enhances long-term project success and stakeholder satisfaction.

Similarly, **item 26**, *"My decisions are based on sound data,"* (Mean = 3.43, SD = 0.760) was highly rated, reinforcing that participants value data-driven insights to enhance operational efficiency and output quality. This supports the results of Kurien et al. (2022), who concluded that using reliable data throughout the construction lifecycle significantly minimizes errors and improves productivity.

On the other hand, the lowest mean score was found for **item 28**, *"My data collection and analysis methods are standardized and efficient"* (Mean = 3.13, SD = 0.799). Although still classified as "High," this score points to a slight inconsistency in applying standardized protocols across firms. This aligns with (Capezio & Decosta, 2023), who identified that in many developing construction sectors, the inconsistency in data practices hampers optimal project evaluation and learning.

Table 14 ***Respondents' Total Quality management of construction Companies in terms of Evidence- based decision making***

No.	Evidence based decision making	Mean	SD	Scale Response	Qualitative Descriptor
26	My decisions are based on reliable data	3.43	0.760	Agree	High
27	I utilize advanced tools for real-time monitoring my projects.	3.22	0.638	Agree	High
28	My data collection and analysis methods are standardized and efficient.	3.13	0.799	Agree	High
29	I ensure that resource allocation decisions are informed by evidence-based practices.	3.33	0.707	Agree	High
30	I adapt evidence-based practices to local regulatory in my projects.	3.44	0.711	Agree	High
Grand mean (Evidence based decision Making)		**3.316**	**0.723**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

The results also indicate that although data collection and analysis practices (item 28) are identified as critical, their standardization and effectiveness might need further improvement. Organizations need to establish more formalized data management systems, invest in sophisticated analytical software, and foster best practices in evidence-based decision
-making. Further integration of real-time monitoring tools (item 27) might also improve project control and operational effectiveness.

These findings are consistent with those of Senić et al. (2025), who highlighted that evidence-based decision making plays a key role in project quality, efficiency, and risk reduction. In addition, the results of Ansyari (2024) also validate the notion that the alignment of decision-making processes with regulatory requirements supports project sustainability and compliance.

Total Quality management in terms of Relationship Management

Table 15 indicates the perceptions of the respondents about relationship management under Total Quality Management (TQM) in Rwanda's construction firms. The grand mean score of relationship management was *3.33*, while its standard deviation was *0.723*. This, as indicated by the response scale, corresponds to a qualitative descriptor of "High" that shows the respondents tend to agree that relationship management is effectively implemented in their projects.

The most significant mean score was registered for item 31, *"I promote trust with all stakeholders in my projects." (Mean = 3.48, SD = 0.740).* This means respondents acknowledge trust as an important element in relationship management that facilitates cooperation and successful project execution. The high score indicates that trust development among stakeholders is a common and adopted practice in Rwandan construction project management.

Table 15. ***Respondents' Total Quality management of construction Companies in terms of Relationship Management***

No.	Relationship Management	Mean	SD	Scale Response	Qualitative Descriptor
31	I foster trust among all stakeholders in my projects	3.48	0.740	Agree	High

32 I foster collaboration among all stakeholders in my projects.	3.25	0.655	Agree	High
33 I resolve conflicts among stakeholders using structured mechanisms.	3.16	0.806	Agree	High
34 I address power imbalances to promote equitable decision-making in my projects.	3.31	0.751	Agree	High
35 My long-term relationships with contractors contribute to mutual project success.	3.43	0.696	Agree	High
36 My long-term relationships with suppliers contribute to mutual project success.	3.35	0.688	Agree	High
Grand mean (Relationship management)	3.33	0.723	Agree	High

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

Correspondingly, item 35*, "My long-term relationships with contractors support mutual project success." (Mean = 3.43, SD = 0.696)* was also highly rated, indicating that the creation and upkeep of strong contractor relationships is viewed as critical to project success. This indicates that the respondents appreciate long-term collaboration and recognize its contribution to improved project outcomes.

On the other hand, the lowest mean score was obtained for item 33, *"I resolve conflicts among stakeholders using structured mechanisms." (Mean = 3.16, SD = 0.806).* Although still scored as "High", this indicates that conflict resolution practices might not be as highly adopted or formalized as other relationship management aspects. The comparatively higher standard deviation also suggests some heterogeneity in how various respondents view or experience conflict resolution practices in their projects.

Table 15 reveals that respondents place significant emphasis on relationship management in construction projects, as reflected in the grand mean score of *3.33 (SD = 0.723),* corresponding to a *"High"* qualitative interpretation. These findings suggest that building trust, fostering collaboration, and maintaining long-term relationships with contractors and suppliers are key aspects of effective relationship management in Rwanda's construction industry.

Nonetheless, the research suggests that formalized mechanisms of resolving conflicts could use additional improvement so as to more frequently and more efficiently resolve conflicts. Organizations ought to create and adopt clear guidelines of conflict resolution, conduct conflict management training, and foster free channels of communication between stakeholders.

These findings corroborate those of Nyquist (2024), who stressed that successful stakeholder relationships lead to project success and sustainability. Additionally, the outcomes of Onukwulu et al. (2025) also underscore the significance of trust and long-term cooperation in enhancing quality and efficiency in construction projects.

Respondents' overall Total quality Management

Table 16 shows the grand total findings of Total Quality Management (TQM) among the respondents. The results show a grand mean value of *3.32* and a standard deviation of *0.735,* indicating that respondents, on average, have a high degree of Total Quality Management practices.
Among the various dimensions of TQM, the maximum mean score was found for "Process Approach" *(Mean = 3.35, SD = 0.734),* indicating that the respondents strongly recognize the significance of systematic processes in maintaining quality management.

Table 16. ***Respondents' Overall total Quality Management***

No.	Total Quality management	Mean	SD	Scale Response	Qualitative Descriptor
1	Customer focus	3.31	0.753	Agree	High
2	Leadership	3.34	0.716	Agree	High

3	Engagement of People	3.31	0.765	Agree	High
4	Process Approach	3.35	0.734	Agree	High
5	Continuous improvement	3.30	0.734	Agree	High
6	Evidence-Based decision Making	3.32	0.723	Agree	High
7	Relationship Management	3.33	0.723	Agree	High
Overall mean (Total Quality Management)		**3.32**	**0.735**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

However, "Continuous Improvement" received the lowest mean score of 3.30 (*SD = 0.734*), which, while still categorized as high, indicates that there may be areas for further enhancement in fostering a culture of continuous development and innovation.

Overall, the findings indicate that respondents reflect a high commitment to TQM principles, especially leadership, customer focus, and evidence-based decision-making. The findings are consistent with earlier studies that highlight the important role of TQM in organizational performance improvement.

A study by Chandran (2024) identified that effective TQM strategy implementation results in increased efficiency, customer satisfaction, and competitive advantage in organizations. This highlights the need to constantly improve quality management practices to maintain high performance and operational excellence levels.

Respondents' Worker Competencies

Table 17 shows the respondents' views on worker competencies in construction firms in Rwanda. The grand mean score for worker competencies was *3.30*, with a standard deviation of *0.722.* According to the response scale, this is a qualitative descriptor of *"High",* meaning that respondents tend to agree that their competencies are in good alignment with the requirements of their jobs in construction projects.

Item 1, "I have the required technical abilities for my work", received the highest mean score (Mean = 3.43, SD = 0.737). This demonstrates that respondents strongly believe in their technical capabilities—an essential component in delivering high-quality outputs and maintaining productivity in construction. This finding aligns with the work of Mercado and Facelli (2024), who emphasized that technical proficiency in the construction industry significantly contributes to project success, especially in developing countries where skill- based labor is critical for quality assurance.

In addition, item 5, "I can communicate effectively with stakeholders", was also highly rated (Mean = 3.40, SD = 0.702). This indicates a clear recognition of communication as a vital competency that ensures collaboration, proper understanding of project expectations, and conflict minimization among stakeholders. This supports Akinshipe et al. (2022), who stated that communication skills are foundational in managing stakeholder expectations, resolving conflicts, and ensuring that construction activities are carried out seamlessly across teams.

Furthermore, the overall findings are supported by Ekwuno (2022), who highlighted that competencies in both technical skills and soft skills such as communication, adaptability, and leadership are indispensable for the workforce in the modern construction industry. They argue that fostering a workforce with a balanced competency profile is key to achieving Total Quality Management (TQM) and sustainable performance in construction firms.

Table 17. ***Respondents' Worker Competencies***

No.	**Worker Competencies**	**Mean**	**SD**	**Scale Response**	**Qualitative Descriptor**
1	I possess the necessary technical skills for my role.	3.43	0.737	Agree	High
2	I demonstrate adaptability to project	3.21	0.636	Agree	High

changes					
3	I am proficient in using modern construction tools.	3.12	0.816	Agree	High
4	I believe training programs enhance my skills effectively.	3.24	0.674	Agree	High
5	I can communicate effectively with stakeholders.	3.40	0.702	Agree	High
6	I am confident in my problem-solving skills.	3.31	0.676	Agree	High
7	I feel motivated to perform at my best.	3.26	0.780	Agree	High
8	I contribute to my team's success through strong teamwork.	3.29	0.723	Agree	High
9	My supervisor provides me with effective guidance and support	3.34	0.740	Agree	High
10	I can meet tight project deadlines.	3.31	0.730	Agree	High
11	I exhibit creativity in resolving construction challenges.	3.26	0.741	Agree	High
12	My company supports my professional growth.	3.34	0.689	Agree	High
13	My performance is reviewed regularly.	3.36	0.718	Agree	High
14	I feel unprepared for some of the tasks assigned to me	3.36	0.748	Agree	High
Grand mean (Worker Competencies)		**3.30**	**0.722**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

On the contrary, the lowest mean score was found for item 3, *"I am skilled in the use of contemporary building tools." (Mean = 3.12, SD = 0.816).* Although still interpreted as *"High",* it indicates that certain workers might require more training or experience in modern building technology. The relatively high standard deviation also implies some variation in the level of proficiency among respondents.

Table 17 indicates that participants score high in their worker competencies, as demonstrated in the grand mean score of *3.30 (SD = 0.722),* which is equivalent to a *"High"* qualitative descriptor. What these results indicate is that workers in Rwanda's construction industry overall have the required skills, flexibility, and problem-solving skills for effective project delivery.

The top mean score for technical skills (item 1) reflects the confidence of workers in their capabilities, which is essential for upholding quality levels and operational efficiency. Likewise, the high score for communication (item 5) underscores the significance of proper stakeholder communication in construction projects.

Nevertheless, the lowest mean score for competence in advanced construction equipment (item 3) indicates that workers could be missing out on some level of technological adjustment. This indicates that businesses need to invest more in training sessions aimed at modern construction technologies to improve efficiency and competitiveness in business.

To fill this void, organizations need to adopt formal training programs to increase the skill level of workers in contemporary construction equipment. Additionally, mentorship programs and ongoing learning programs can bridge the skill gap and keep workers abreast of changing industry practices.

These findings are in accordance with those of Odunladi and Olakunle (2024), who noted that worker skills have a direct impact on project efficiency and quality. Additionally, the results of Gatsinzi (2024) also underscore the significance of ongoing training and development to improve workforce productivity.

Construction Project Performance

Table 18 shows respondents' views of construction project performance. The grand mean score of construction project performance was *3.30* and had a standard deviation of *0.722.* According to the response scale, this corresponds to a qualitative descriptor of *"High",* and it suggests that respondents tend to agree that their construction projects are performing well against various performance measures.

Item 1, *"My projects are consistently finished on schedule"*, had the highest mean rating (Mean = 3.44, SD = 0.720). This indicates that project scheduling and timely delivery are perceived as key strengths in Rwanda's construction sector. This finding aligns with Gatsinzi (2023), who noted that time performance is one of the most critical success criteria for construction projects and is often used to evaluate the effectiveness of project management and contractor performance.

Similarly, item 5, *"My team uses resources efficiently"* (Mean = 3.42, SD = 0.685), and item 13, *"My projects contribute to my company's reputation and growth"* (Mean = 3.42, SD = 0.695), were also highly rated. These highlight a strong awareness of the importance of resource optimization and the strategic contribution of projects to long-term organizational success. This aligns with the work of Iwacu and Akims (2024), who emphasized that efficient resource management not only reduces costs but also improves productivity and boosts overall project performance thereby enhancing organizational growth and reputation.

On the other hand, item 3, *"My projects meet client quality expectations"* (Mean = 3.16, SD = 0.841), received the lowest mean score. Although still classified as "High", the relatively higher standard deviation suggests inconsistencies in meeting quality expectations across projects. This reflects variability in performance that may be due to differences in project size, complexity, or quality control practices.

Table 18. ***Respondents' Construction Project performance***

No.	Construction Project Performance	Mean	SD	Scale Response	Qualitative Descriptor
1	My projects are consistent completed on schedule	3.44	0.720	Agree	High
2	My projects are completed within the allocated budget.	3.21	0.666	Agree	High
3	My projects meet client quality expectations	3.16	0.841	Agree	High
4	My projects achieve stakeholders satisfaction.	3.27	0.718	Agree	High
5	My team uses resources efficiently	3.42	0.685	Agree	High
6	My team manages project risks effectively.	3.37	0.683	Agree	High
7	My projects require minimal rework during construction	3.30	0.754	Agree	High
8	My team delivers clearly defined project outcomes.	3.33	0.735	Agree	High
9	My team employs innovative construction methods and techniques.	3.40	0.687	Agree	High
10	My communication with stakeholders are effective.	3.34	0.686	Agree	High
Grand mean (Construction Project Performance)		**3.30**	**0.722**	**Agree**	**High**

Legend: *1.00-1.49 = Strongly Disagree; 1.50-2.49 = Disagree; 2.50-3.49=Agree; 3.50 -4.00 = Strongly Agree*

Table 18 indicates that the respondents view their construction project performance as relatively high, as indicated by the grand mean score of *3.30 (SD = 0.722)*, which is equivalent to a *"High"* qualitative descriptor. The findings indicate that construction companies in Rwanda are performing well in terms of timely completion, efficiency in resource utilization, and stakeholder satisfaction.

The highest average score for project scheduling (item 1) demonstrates that building teams are proficient at managing timeliness and bringing in projects within schedules, an important success criterion within the construction business. Equally, high marks for efficiency with resources (item 5) and business reputation (item 13) reveal the emphasis placed on managing cost and planned business expansion in construction.

But the lower score for quality expectations in meeting clients' needs (item 3) indicates that quality assurance is still an issue in some projects. This could be attributed to uneven workmanship, material defects, or poor monitoring in project implementation.

To improve project performance even more, construction companies need to invest in ongoing quality improvement initiatives. This would involve implementing higher quality control processes, intensifying training for site staff, and using up-to-date construction technology to satisfy clients' quality requirements.

Additionally, companies need to adopt formal risk management systems to foresee and preclude project issues. In this manner, they will be able to keep projects in balance between being completed on time, costing less, and producing high-quality results.

These findings are consistent with those of Svp (2024), who underscored that timely project delivery and resource effectiveness are major drivers of the performance of the construction industry. Additionally, Okonicha and Okwuanaso (2024) findings also underscore the critical Nature of strategic planning of projects towards improving construction efficiency.

Relationship Between Knowledge Management Practices, Total Quality Management, Worker competencies and Construction Project performance Convergent Validity

Table 19 shows convergent validity results which have strong measurement reliability, with a few areas requiring refinement. The item loadings for most constructs exceed the 0.70 threshold, confirming that indicators effectively measure their respective latent variables (Hair et al., 2022). Knowledge Management and Total Quality Management exhibit particularly strong item loadings, while some indicators in Worker Competencies (e.g., WC3 = 0.634, WC2 = 0.658) are comparatively lower, potentially affecting construct validity.

The Average Variance Extracted (AVE) results reveal that Knowledge Management (AVE = 0.806), Total Quality Management (AVE = 0.749), and Construction Project Performance (AVE = 0.500) meet the recommended ≥ 0.50 threshold (Fornell & Larcker, 1981). However, Worker Competencies (AVE = 0.545) fall below this benchmark, indicating weak convergent validity. Researchers should consider refining this construct by removing low-loading items or conducting exploration factor analysis (EFA).

The internal consistency reliability, measured by Cronbach's Alpha and Composite Reliability (CR), is robust, with all constructs exceeding the 0.70 threshold (Sarstedt et al., 2021). Knowledge Management (CA = 0.940, CR = 0.952) and Total Quality Management (CA = 0.944, CR = 0.954) demonstrate excellent reliability, while Worker Competencies (CA = 0.849, CR = 0.882) and Construction Project Performance (CA = 0.849, CR = 0.898) also indicate strong consistency (Hair et al., 2022).

Table 19 ***Convergent Validity***

Variables	Item	Item Loading	AVE	Cronbach Alpha	Composite Reliability
Knowledge Management	KI	0.864	0.806	0.940	0.952
	KA	0.932			
	KS	0.913			
	KAP	0.895			
	KE	0.884			
Total Quality Management	CF	0.865	0.749	0.944	0.954
	L	0.902			
	EP	0.876			
	PA	0.875			
	CI	0.861			
	EBD	0.851			
	RM	0.824			
Worker Competencies	WC1	0.685			
	WC2	0.658			
	WC3	0.634			
	WC4	0.714			
	WC5	0.715			

	WC6	0.639	0.545	0.849	0.882
	WC7	0.73			
	WC8	0.618			
	WC9	0.665			
	CP1	0.632			
	CP2	0.744			
	CP3	0.700			
Construction Project Performance	CP4	0.669	0.500	0.849	0.898
	CP5	0.636			
	CP6	0.713			
	CP7	0.692			
	CP8	0.690			
	CP9	0.707			
	CP10	0.664			

Discriminant Validity

The discriminant validity assessment using the Fornell-Larcker Criterion confirms that each construct in the model is distinct from the others. According to this criterion, the square root of the Average Variance Extracted (AVE) (diagonal values) should be greater than its correlation with any other construct (Fornell & Larcker, 1981). The results indicate that Worker Competencies (0.847), Construction Project Performance (0.827), Knowledge Management (0.898), and Total Quality Management (0.865) all have square root of AVE values higher than their corresponding inter-construct correlations, confirming that each construct shares more variance with its own indicators than with any other construct.

Table 20 ***Discriminant Validity using Fornell Lacker Criterion***

	WC	CP	KM	TQM
WC	**0.847**			
CP	0.827	**0.827**		
KM	0.730	0.667	**0.898**	
TQM	0.478	0.786	0.849	**0.865**

Legend: *WC – Worker Competencies' CP- Construction Project Performance; KM - Knowledge Management; TQM- Total Quality Management*

However, there are some notable inter-construct correlations that should be considered. The correlation between Construction Performance and Worker Competencies (0.827) is relatively high but still below the square root of AVE (0.847 for WC and 0.827 for CP), supporting discriminant validity. Additionally, the correlation between Total Quality Management and Knowledge Management (0.849) is also close to the square root of AVE for Knowledge Management (0.898), suggesting a strong but distinguishable relationship. Overall, the findings confirm that the model meets the Fornell-Larcker Criterion, ensuring that each construct uniquely represents its theoretical domain, thereby supporting the robustness of the measurement model.

Model Fit Indices

The model fit indices presented in the table indicate that the Structural Equation Modeling (SEM) framework used in the study exhibits strong explanatory power and acceptable collinearity levels

Table 21 Model Fit Indices

	Value	P-value	Interpretation
Average path coefficient (APC	0.303	<0.001	Significant
Average R-squared (ARS)	0.738	<0.001	Significant
Average adjusted R-squared (AARS)	0.736	<0.001	Significant
Average block VIF (AVIF)	4.400		Acceptable
Average full collinearity VIF (AFVIF)	4.491		Acceptable
Tenenhaus GoF (GoF)	0.676		Large

The Average Path Coefficient (APC) = 0.303, $p < 0.001$ confirms that the relationships between constructs are statistically significant,

supporting the hypothesized causal links (Hair et al., 2022). Additionally, the Average R-squared (ARS) = 0.738, $p < 0.001$ and Average Adjusted R-squared (AARS) = 0.736, $p < 0.001$ indicate that the independent variables collectively explain a substantial proportion of the variance in the dependent variables, signifying a strong predictive capability (Sarstedt et al., 2021).

The collinearity statistics, represented by the Average Block Variance Inflation Factor (AVIF) = 4.400 and Average Full Collinearity Variance Inflation Factor (AFVIF) = 4.491, are within the acceptable range (below 5.0), indicating that multicollinearity is not a significant concern in the model (Hair et al., 2022). Lastly, the Tenenhaus Goodness-of-Fit (GoF) index = 0.676 is categorized as large, confirming that the overall model demonstrates a strong fit (Tenenhaus et al., 2005).

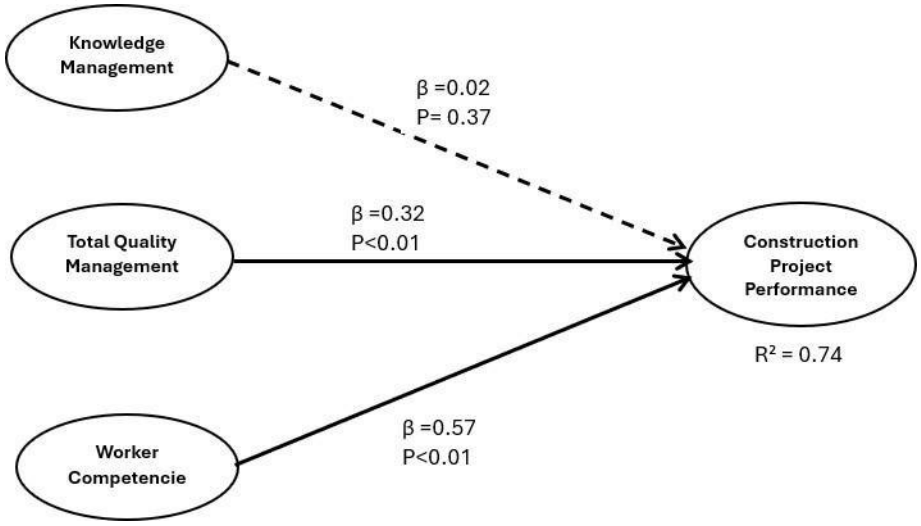


Figure 4. Structural Model of Knowledge Management, Total Quality Management, Worker Competencies and Construction Project Performance.

Table 22. ***Hypothesis Test Results***

	Latent Variables	Path Coefficient	SE	P-value	Effect Size	Interpretation
H1	Knowledge Management ----------> Construction Project Performance	0.019	0.055	0.371	0.013	Not Significant
H2	Total Quality Management ----------> Construction Project Performance	0.319	0.057	<0.001	0.251	Significant
H3	Worker Competencies ----------> Construction Project Performance	0.572	0.053	<0.001	0.474	Significant

Legend: *if p-value <=0.05 - Significant; p-value > 0.05 - Not Significant*

The hypothesis testing results provide insights into the relationships between Knowledge Management, Total Quality Management, Worker Competencies, and Construction Project Performance. The results indicate that Knowledge Management does not have a significant direct effect on Construction Project Performance ($\beta = 0.019$, $p = 0.371$, effect size = 0.013). This suggests that while Knowledge Management is essential for organizational learning and decision-making, its impact on project performance in the construction sector may be indirectly influenced by other factors such as leadership, organizational culture, or technological infrastructure (Wang et al., 2023). Prior studies have shown that Knowledge Management contributes to performance improvements when effectively integrated with digital transformation and process standardization (Chang et al., 2022).

Conversely, Total Quality Management (TQM) significantly influences Construction Project Performance ($\beta = 0.319$, $p < 0.001$, effect size = 0.251), reinforcing its critical role in ensuring project success. This aligns with recent research emphasizing that TQM practices— such as continuous improvement, process optimization, and defect prevention—enhance project efficiency and quality outcomes in the construction industry (Al-Tahat et al., 2023). The moderate effect size indicates that organizations that implement TQM frameworks experience better construction performance through improved risk management, compliance, and stakeholder satisfaction (Jaca et al., 2022).

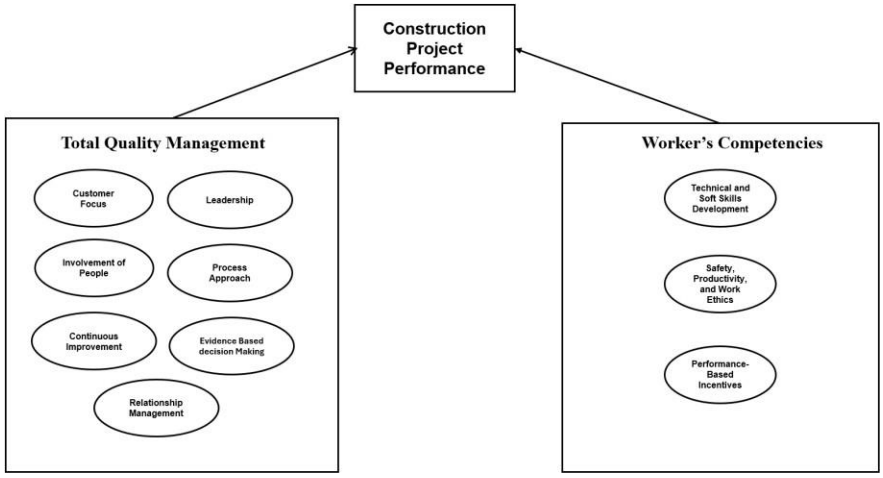
The most substantial impact on Construction Project Performance comes from Worker Competencies ($\beta = 0.572$, $p < 0.001$, effect size =

0.474), indicating that skilled labor plays a decisive role in driving project success. This finding supports literature highlighting that well- trained construction workers with technical expertise, problem-solving skills, and safety awareness contribute to higher productivity, cost efficiency, and adherence to quality standards (Zhang et al., 2023). The large effect size suggests that organizations should prioritize workforce development through training programs, competency-based hiring, and knowledge- sharing initiatives to maximize project outcomes (Fernandez-Solis et al., 2023).

Strategic Framework for Increased Performance of Construction Projects in Rwanda

1.1 Purpose

The framework explains the route to enhance Construction Project Performance (CP) in Rwanda by utilizing Worker Competencies (WC) and Total Quality Management (TQM). This is aimed at increasing the efficiency of construction, promoting the timely and quality delivery of projects, and minimizing delays and reworks in accordance with Rwanda's National Strategy for Transformation (NST1) and Vision 2050.



1.2 Scope

This framework applies to all construction projects in Rwanda, including government- funded infrastructure projects, commercial real estate, and residential developments. It aligns with Rwanda's Building Code, Rwanda Green Building Minimum Compliance System, and the Rwanda Housing Authority (RHA) construction standards.

This framework has been refined based on findings from study, highlighting key challenges such as low labor productivity, poor quality control, cost overruns, and stakeholder engagement gaps.

2.1 Worker Competencies (WC)

The study highlights worker competencies as the most significant factor influencing construction project performance. To address this:

2.1.1 Technical and Soft Skills Development

- Mandatory Technical and Vocational Education and Training (TVET) certification for all construction workers, in collaboration with the Workforce Development Authority (WDA).
- Communication, teamwork, and problem-solving training as part of competency development.
- Specialized training programs in masonry, welding, electrical work, plumbing, and modern construction tools (e.g., BIM software).
- Leadership training for supervisors to improve project management and efficiency.

2.1.2 Safety, Productivity, and Work Ethics

- Workers must adhere to Rwanda OSH regulations to reduce workplace accidents.
- Onsite training and ergonomic assessments to enhance efficiency and reduce worker fatigue.
- Regular job performance assessments to ensure continuous competency improvement.

2.1.3 Performance-Based Incentives

- Implementation of a reward system for workers demonstrating high productivity and safety compliance.
- Quarterly competency evaluations to assess skill improvement and quality of work.
- Career development pathways to encourage retention and professional growth.

2.2 Total Quality Management (TQM)

The research findings emphasize that TQM significantly enhances construction project performance through structured process management, stakeholder engagement, and continuous improvement.

2.2.1 Customer Focus

- Integrate customer expectations through participatory design workshops.

- Develop a customer feedback loop via surveys at each project milestone.
- Assign customer satisfaction KPIs in project dashboards.
- Create a "Voice of the Customer" (VoC) protocol to document changing needs.

2.2.2 Leadership

- Institute leadership development programs tailored to the construction sector.
- Mandate regular site visits and inspections by senior leaders.
- Establish project quality champions in each site team to promote a quality-first culture.

2.2.3 Involvement of People

- Institutionalize employee involvement programs (e.g., Quality Circles).
- Conduct regular toolbox meetings with a structured agenda on quality improvement.
- Provide soft skills training (communication, problem-solving, teamwork).
- Recognize and reward top-performing workers quarterly.

2.2.4 Process Approach

- Map all major construction processes using standard operating procedures (SOPs).
- Use construction flow diagrams and checklists to ensure standardization.
- Conduct quarterly process audits and analyze bottlenecks.
- Establish cross-functional process improvement teams.

2.2.5 Continuous Improvement

- Apply PDCA (Plan-Do-Check-Act) cycles across all construction activities.
- Institutionalize root cause analysis (RCA) for every project delay or defect.
- Implement an internal knowledge-sharing portal on lessons learned.
- Conduct semi-annual kaizen events focused on improving key processes

2.2.5 Evidence-Based Decision Making

- Establish KPIs across project domains: quality, cost, schedule, safety.
- Implement real-time digital dashboards for project monitoring.
- Train site managers and engineers on data analytics and reporting tools.
- Require data validation reports before every major site decision

2.2.5 Relationship Management

- Institute annual supplier evaluations based on delivery, compliance, and responsiveness.
- Sign long-term contracts with prequalified vendors aligned with RSB standards.
- Facilitate stakeholder forums quarterly to align expectations and resolve issues.
- Include subcontractor satisfaction surveys as part of project closeout.

3. Implementation Strategy

Phase	Key Activities	Responsible Entities	Timeline
Phase 1: Assessment & Planning	Gap analysis, stakeholder consultation, TQM maturity assessment	Project Owners, RHA, RSB	0–3 months
Phase 2: Capacity Development	Leadership training, SOP documentation, staff orientation	TVET Institutions, WDA, HR Units	3–6 months
Phase 3: Execution & Monitoring	Deployment of systems, internal audits, customer feedback tracking	Site Managers, QA/QC Officers	6–12 months
Phase 4: Review & Continuous Improvement	Review metrics, update frameworks, capture lessons learned	Senior Management, External Evaluators	Ongoing

4. **Mathematical Model**

$TQM=0.81CF + 0.84LD + 0.79IP + 0.83PA + 0.80CI + 0.78EB + 0.82RM+\varepsilon$

where:

TQM = Total Quality Management (latent construct)

CF, LD, IP, PA, CI, EB, RM = First-order latent variables

ε = Error term (residual)

$$CPP=0.319TQM + 0.572\ WC + \varepsilon$$

where:

CPP = Construction Project Performance TQM = Total Quality Management

WC = Worker Competencies

$\beta_1 = 0.319$ (significant, $p < 0.001$) $\beta_2 = 0.572$ (significant, $p < 0.001$)

ε = Error term (unexplained variance

The mathematical model revealed that both Total Quality Management ($\beta = 0.319$, $p < 0.001$) and Worker Competencies ($\beta = 0.572$, $p < 0.001$) have a significant positive influence on Construction Project Performance. The path coefficient for Worker Competencies indicates a stronger impact, supported by a higher effect size ($f^2 = 0.474$) compared to Total Quality Management ($f^2 = 0.251$). Knowledge Management was excluded due to its non-significant relationship ($p = 0.371$).

Expanded Mathematical Model

$$CPP=0.258CF + 0.268LD + 0.252IP + 0.265PA + 0.255CI + 0.249EB + 0.262RM + 0.572WC + \varepsilon$$

Where:

CF = Customer Focus LD = Leadership

IP = Involvement of People PA = Process Approach

CI = Continuous Improvement

EB = Evidence-Based Decision Making RM = Relationship Management

CPP = Construction Project Performance

ε = Error term (unexplained variance)

The expanded model revealed that Worker Competencies ($\beta = 0.572$) had the strongest direct influence on Construction Project Performance. Additionally, the indirect influence of Total Quality Management was decomposed into its first-order dimensions, with Leadership ($\beta = 0.268$) and Process Approach ($\beta = 0.265$) exerting the most substantial contributions to project outcomes.

CHAPTER 5. SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

This chapter presents the summary of the findings, the conclusion drawn, and the recommendations based on the findings of the research study.

Summary of Findings

The study examines the KM, TQM, and Worker Competencies impact on construction project performance in Rwanda. KM practices, such as Knowledge Identification, Knowledge Acquisition, and Knowledge Sharing, were confirmed to be significantly implemented, with grand means of 3.36, 3.35, and 3.38, respectively. The study reported that, while mechanisms and strategies to identify and organize knowledge remained at a formative stage, the culture of seeking out and sharing knowledge was strong. However, the statistical analyses indicated that KM was not a significant predictive factor of construction project performance ($\beta = 0.019$, $p = 0.371$), implying that its influence might be indirect and mediated by other factors.

Conversely, TQM positively influenced construction project performance ($\beta = 0.319$, $p < 0.001$, effect size = 0.251), indicating that organizations that practice TQM principles achieve better performance. Additionally, the mean scores of the top three rated TQM dimensions were Process Approach (mean = 3.35), Relationship Management (mean = 3.33), and Evidence- based Decision Making (mean = 3.316). This indicates that construction firms are emphasizing efficient workflows, solid stakeholder relationships, and data-driven decision-making. In contrast, Continuous Improvement (mean = 3.298) has the least average rating, signifying that although organizations acknowledge the necessity of continuous quality improvement, systematic quality audits and improvement processes require fortification.

Most importantly, the Worker Competencies factor was the driving force in controlling construction project performance, showing a great level of statistical significance ($\beta = 0.572$, $p < 0.001$, effect size = 0.474). Mean scores of worker-task fit clearly showed a high use of digital tools (mean = 3.43) and waste elimination practices (mean = 3.42) reflecting that the workers have an efficiency-oriented mindset. But the lowest score was observed for conflict resolution among stakeholders (mean = 3.16), which underscores the paramount necessity to reengineering the dispute resolution mechanisms for the construction industry.

Regarding the general performance of the construction project, the highest grand mean of 3.30 was attained, which shows that most projects were completed in a timely manner and within budget with the strongest stakeholder communications (mean 3.34). One challenge is meeting client

expectations on quality (mean = 3.30), which may still be influenced by different quality control practices. Strong model fit of the structure was also found (GoF = 0.676), supporting study's predictive validity. In particular, its findings indicate the direct effects of TQM and Worker Competencies on project performance, whereas the direct effect of KM on project performance was not significant, indicating that this area has a second-order effect through its interactive effect with other management practices on project performance.

Conclusion

This study examined the influence of Knowledge Management (KM), Total Quality Management (TQM), and Worker Competencies on construction project performance in Rwanda.

The findings highlight that while KM practices are widely recognized and applied, their impact on project performance is indirect. Effective knowledge-sharing alone does not guarantee improved outcomes; rather, KM must be integrated with structured processes and quality management systems to enhance decision-making and operational efficiency.

Organizations should strengthen formal mechanisms for knowledge acquisition, retention, and dissemination to maximize KM's potential in construction projects.

TQM emerged as a critical driver of project success, significantly improving efficiency and quality. Firms that implemented structured process approaches, relationship management, and evidence-based decision-making achieved better project outcomes. However, challenges remain in sustaining continuous improvement practices due to inconsistencies in quality audits and refinement mechanisms. A more proactive approach to quality monitoring and stakeholder collaboration is necessary to ensure long-term improvements in construction performance.

Among the three factors, Worker Competencies had the strongest influence on project performance. A highly skilled and adaptable workforce contributed to greater efficiency, cost control, and quality assurance. While technical skills and process optimization were rated highly, gaps in conflict resolution among stakeholders were identified. Addressing this requires investment in structured competency development programs that encompass technical training, leadership development, and stakeholder engagement strategies to enhance workforce capabilities.

Overall, the study concludes that TQM and Worker Competencies play a direct and significant role in improving construction project performance, while KM acts as a supporting mechanism that enhances efficiency when effectively integrated with structured management systems. To optimize project success, construction firms should strengthen TQM practices, invest in workforce training, and refine KM processes. By doing so, the Rwandan construction industry can achieve higher efficiency, mitigate project risks, and align with international best practices, fostering sustainable infrastructure development and economic growth.

Recommendations

Construction Industry Practitioners

Construction professionals should integrate Knowledge Management, Total Quality Management, and Worker Competencies into project management frameworks to optimize performance outcomes. Firms should develop structured training programs and encourage knowledge-sharing initiatives to improve efficiency and project quality. Adoption of digital tools and data-driven decision-making should be prioritized to enhance knowledge application in project execution.

Policymakers

The Ministry of Infrastructure and construction regulatory bodies should establish policies that encourage the adoption of best practices in Knowledge Management, Total Quality Management, and Worker Competencies. Strengthening regulatory frameworks to promote continuous professional development, quality assurance, and workforce certification programs will enhance industry standards and construction outcomes.

Economic Development Stakeholders

Stakeholders in the construction sector should advocate for evidence-based management practices to improve project efficiency, cost-effectiveness, and sustainability. Investments in research and development should be encouraged to explore innovative quality control measures and workforce development strategies to enhance national infrastructure growth.

Academic Institutions:

Educational institutions should incorporate Knowledge Management, Total Quality Management, and Worker Competencies into their construction management curricula. Collaborative research between universities and construction firms should be encouraged to provide empirical insights into improving the industry's best practices and project performance.

Future Research Directions:

Further studies should explore the moderating effects of demographic variables such as age, experience, and educational background on the relationships between Knowledge Management Practices, Total Quality Management, Worker Competencies, and Construction Project Performance. Future research should examine the role of digital transformation, advanced construction technologies, and artificial intelligence in enhancing construction management practices and overall project efficiency in Rwanda.

DEDICATION

This research is dedicated to my irreplaceable loving parents,
NZARAMYIMANA Christophe, and MUSABIMANA, Peresi
My siblings,

IRADUKUNDA Clarisse, UMUBYEYI Alice, INEZA UMWALI Henriette, **and IMENA RUKUNDO Christian**
for their constant encouragement and inspiration.

To the Rwandan construction industry, whose commitment to excellence in infrastructure development continues to inspire and shape future innovations in the field.

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To relatives, **friends**, and **colleagues** who encouraged me during the challenging times, I am indebted to you for being my source of strength. Your belief in my abilities has been a constant motivator.

To those whose names might not appear here, however, has positively influenced my academic and personal life--thank you. Your impact has not gone unnoticed.

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REFERENCES

1) Adekunle, P., Aigabvboa, C., Thwala, W., Akinradewo, O., & Oke, A. (2022). Challenges confronting construction information management. *Frontiers in Built Environment*, *8*. https://doi.org/10.3389/fbuil.2022.1075674
2) Aghaee, N. (2024). Using digital tools for information management in higher education. *European Conference on Knowledge Management*, *25*(1), 1–9. https://doi.org/10.34190/eckm.25.1.2734
3) Ahsan, M. J. (2024). Cultivating a culture of learning: the role of leadership in fostering lifelong development. *The Learning Organization*. https://doi.org/10.1108/tlo-03-2024-0099
4) Akinshipe, O., Aigbavboa, C., Fatai, O. B., & Thwala, D. (2022). Core competencies required for construction project success: The project management angle. *AHFE International*. https://doi.org/10.54941/ahfe1002368
5) Al-Rubaiei, Q. H. S., Nifa, F. a. A., & Musa, S. (2018). Project scope management through multiple perspectives: A critical review of concepts. *AIP Conference Proceedings*, *2016*, 020025. https://doi.org/10.1063/1.5055427
6) Berawi, M. A., Miraj, P., & Sari, M. (2024). Advancing Construction Practices: Innovations, efficiency, and safety in the digital era. *CSID Journal of Infrastructure Development*, *7*(2), 225–227. https://doi.org/10.7454/jid.v7.i2.1162
7) Bergman, R., & Hermansson, S. (2015). *Erfarenhetsåterföring av egenkontroller i byggproduktionen*. DIVA. http://www.diva-portal.org/smash/record.jsf?pid=diva2:838568
8) Capezio, A., & Decosta, P. L. (2023a). Evidence-Based Decision-Making and practice in organizations. *Oxford Research Encyclopedia of Psychology*. https://doi.org/10.1093/acrefore/9780190236557.013.9
9) Capezio, A., & Decosta, P. L. (2023b). Evidence-Based Decision-Making and practice in organizations. *Oxford Research Encyclopedia of Psychology*. https://doi.org/10.1093/acrefore/9780190236557.013.9
10) Ekwuno, N. a. O. (2022). Key factors employers look for in hiring construction managers for public and private construction projects. *International Journal of Scientific Research in Science and Technology*, 516–545. https://doi.org/10.32628/ijsrst229589
11) Fahad, M., Mohamad, H. M., Sulaiman, M. F., & Suro, S. M. (2024). The ramifications of poor communication in construction projects: unraveling complex litigation and arbitration. *Journal of Human Earth and Future*, *5*(4), 704–719. https://doi.org/10.28991/hef-2024-05-04-012
12) Fahad, M., & Musa, H. (2023). A Review on Impact of Ineffective Communication in Construction Projects leads to Complicated Litigation and Arbitration. *International Journal of Business and Technology Management*. https://doi.org/10.55057/ijbtm.2023.5.3.3
13) Gatsinzi, R. (2023). Project Management Practices and Performance of Construction Projects: A Case of Kigali Golf club and Kigali Arena Stadium Projects under Supervision of Rwanda Housing Authority. *Journal of Entrepreneurship & Project Management*, *7*(11), 59–71. https://doi.org/10.53819/81018102t4202
14) Geada, N. (2023). Enhancing business communications and collaboration. In *Advances in business information systems and analytics book series* (pp. 15–26). https://doi.org/10.4018/978-1-6684- 6786-2.ch002
15) Halmaghi, E., & Todăriță, E. (2023). Creating a learning culture in the organisation. *Scientific Bulletin*, *28*(2), 210–214. https://doi.org/10.2478/bsaft-2023-0021
16) Ibdayanti, N. D. R., Oktavani, C. Z., & Husin, N. S. (2023). KEPENTINGAN RELATIF FAKTOR- FAKTOR INTEGRASI

MANAJEMEN KOMUNIKASI PADA PROYEK KONSTRUKSI DI BANDA ACEH. *JMTS Jurnal Mitra Teknik Sipil*, 39–48. https://doi.org/10.24912/jmts.v6i1.20781

17) Iwacu, P., & Akims, M. A. (2024). Resource management practices and completion of road construction projects in Rwanda: Base-Butaro-Kidaho Road project. *International Journal for Multidisciplinary Research*, *6*(6). https://doi.org/10.36948/ijfmr.2024.v06i06.29991
18) Kamal, S., & Belal, U. (2023). Enhancing Lean Tools and Practices with Digital Solutions. In *Lecture notes in civil engineering* (pp. 401–406). https://doi.org/10.1007/978-981-99-5455-1_34
19) Kurien, V. T. V., Shamsuddeen, S., Mahitha, M. C., & Rasheed, D. S. (2022). Evidence-Based Decision- Making. *Journal of Head & Neck Physicians and Surgeons*, *10*(1), 48–52. https://doi.org/10.4103/jhnps.jhnps_5_22
20) Lee, L., Reinicke, B., Sarkar, R., & Anderson, R. (2015). Learning through Interactions: Improving Project Management through Communities of Practice. *Project Management Journal*, *46*(1), 40–52. https://doi.org/10.1002/pmj.21473
21) Li, D. B. a. H. (2019, December 30). *A summary of research on tacit knowledge sharing at home and abroad*. https://webofproceedings.org/proceedings_series/article/artId/13153.html
22) Martha, L. (2023). Evaluating the Impact of Scope Changes on Project Cost Overruns. *Ieeexplore*. https://doi.org/10.31219/osf.io/x9v4u
23) Mercado, L., & Facelli, P. (2024). Systematic review of the most relevant competencies for projects managers in the construction industry. *Obras Y Proyectos*, *36*, 95–110. https://doi.org/10.21703/0718-2813.2024.36.3011
24) Mogea, N. T. (2023). Knowledge management and organizational learning in organizational development. *Populer Jurnal Penelitian Mahasiswa*, *2*(1), 215–229. https://doi.org/10.58192/populer.v2i1.648
25) Moradi, S., Ansari, R., & Taherkhani, R. (2021). A Systematic Analysis of Construction Performance Management: Key Performance Indicators from 2000 to 2020. *Iranian Journal of Science and Technology Transactions of Civil Engineering*, *46*(1), 15–31. https://doi.org/10.1007/s40996- 021-00626-7
26) Ndikumana, S., Wanjiku, C., PhD, & Bwankarikari, E. (2023). EFFECT OF AUTOMATED PROJECT TASK SCHEDULING ON PERFORMANCE OF CONSTRUCTION PROJECTS IN RWANDA. A CASE OF BETTER DESIGN AND CONSTRUCTION LIMITED. *Strategic Journal of Business & Change Management*, *10*(4). https://doi.org/10.61426/sjbcm.v10i4.2802
27) Novais, Z., Gomes, J. V., & Romão, M. (2023). Sharing knowledge in projects. In *Advances in business information systems and analytics book series* (pp. 178–197). https://doi.org/10.4018/978-1- 6684-5859-4.ch010
28) Odunladi, I. B., & Olakunle, M. G. (2024). Effect of knowledge acquisition on organizational performance. *IIARD INTERNATIONAL JOURNAL OF ECONOMICS AND BUSINESS MANAGEMENT*, *9*(8), 10–24. https://doi.org/10.56201/ijebm.v9.no8.2023.pg10.24 Olubajo, O. (2024). Analysing the knowledge management culture of construction firms in Abuja. *Environmental Technology and Science Journal*, *14*(2), 51–55. https://doi.org/10.4314/etsj.v14i2.7
29) Paratz, E. D., Page, G., Maris, J., Orchard, J., Semsarian, C., & La Gerche, A. (2022). Diverse stakeholder engagement at the heart of co-designing cardiac arrest care. *Heart Rhythm O2*, *3*(2), 213–217. https://doi.org/10.1016/j.hroo.2021.12.006
30) Prinsloo, J. W., Van Waveren, C. C., & Chan, K. (2017). FACTORS THAT IMPACT KNOWLEDGE DISSEMINATION IN PROJECTS. *The South African Journal of Industrial Engineering*, *28*(1). https://doi.org/10.7166/28-1-1566
31) *Research* |. (n.d.). UCLan - University of Central Lancashire. https://clok.uclan.ac.uk/12382/
32) Resources Management Practices and Project Performance in Rwanda: A case of Skills Development Fund project. (2023). *Journal of Entrepreneurship & Project Management*, *7*(7), 114–130. https://doi.org/10.53819/81018102t2167
33) Sanka, E. (2024). Impact of stakeholder engagement on the success of water, sanitation, and hygiene projects in Babati, Tanzania. *Journal of Policy and Development Studies*, *17*(1), 46–53. https://doi.org/10.4314/jpds.v17i1.4
34) Sapiro, A. (2024a). Change and project management. In *Classroom companion: business* (pp. 251–274). https://doi.org/10.1007/978-3-031-55669-2_9
35) Sapiro, A. (2024b). Change and project management. In *Classroom companion: business* (pp. 251–274). https://doi.org/10.1007/978-3-031-55669-2_9
36) Thakkar, J. J. (2022). Project monitoring and control. In *Management and industrial engineering* (pp. 279–298). https://doi.org/10.1007/978-981-15-3695-3_10
37) Tow, W. N. H., Venable, J. R., & Dell, P. (n.d.). *Developing a theory of knowledge identification Effectiveness in knowledge management*. AIS Electronic Library (AISeL). https://aisel.aisnet.org/pacis2015/85/
38) Wang, J., Khoo, T. J., & Esa, M. (2024). The impact of digital technology applications on construction industry project performance. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *53*(1), 311–322. https://doi.org/10.37934/araset.53.1.311322