CLOUD BASED PROJECT TEAM COLLABORATION AND PERFORMANCE OF ROAD CONSTRUCTION IN SELECTED COUNTIES IN KENYA

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ABSTRACT

Project team collaboration is facilitated by advances in technology including cloud computing through the remote access to information from disparate locations, internal wikis and intranets where team members are able to communicate with each other in real time regardless of their geographical location. This study sought to analyse the influence of cloud-based project team collaboration on the performance of road construction projects in selected counties in Kenya. Its specific objectives include: to determine the influence of knowledge management practices; team monitoring as components of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya. This was undertaken over a period of 44 days. The study was supported by DIKW Chain Model, and Theory of Change. This study adopted a descriptive survey research design. The research study limited itself to five road constructions projects under Kenya National Highways Authority (KeNHA) in selected counties in Kenya. The target population included 155 comprising of clients, consultants and contractors. Questionnaires were used to collect quantitative data while qualitative data was collected by use of interview guide. Data collected using questionnaires was coded and keyed into a computer and analysed using the Statistical Package for Social Sciences (SPSS version 23) and the Microsoft Excel. The study concludes that knowledge management practices have a positive and significant effect on performance of road construction projects in selected counties in Kenya. In addition, the study concludes that team monitoring has a positive and significant effect on performance of road construction projects in selected counties in Kenya. Based on the findings, the study recommends that the management of road construction projects in Kenya should implement a robust knowledge-sharing platform. By creating a centralized digital repository where project stakeholders, including engineers, contractors, and government officials, can document and share lessons learned, best practices, and innovative solutions.

Key Words: Cloud-Based Project Team Collaboration, Performance of Road Construction Projects, Knowledge Management Practices, Team Monitoring

Background to the Study

The management of projects is a challenging proposition for many organisations across the world. There are so many dependencies that need to be factored into consideration that, ultimately, optimisation rather than maximisation becomes the only outcome. One of these considerations is the project team collaboration. The Project Management Institute (PMI) (2017) defines a project as a unique product, service or result that has been undertaken on a temporary basis to enable the attainment of predetermined objectives through the production of deliverables. It goes on to define project management as the process of applying knowledge, techniques, tools, and skills to project undertakings to ensure the accomplishment of project deliverables. Martens and Carvalho (2017) define the project team collaboration as the mechanisms involved in enabling the concerted efforts of project team members in pursuit of the accomplishment of project objectives.

An increasingly crucial sphere within the technical context for the implementation of projects is the use of cloud computing. According to Ahmad *et al.* (2017), cloud computing refers to a construct of computing design that enables the separation of components such as applications, operating systems and hardware from each other so as to prevent the loss of the entire system in the event of failure or viral attacks since it provides for the automated migration of an application or operating system to a different server through the use of virtual technology. Cloud computing, thus, promotes cost cutting and operational efficiency as no hardware requirement is required locally (Müller *et al.*, 2015). Cloud computing offers numerous benefits including pay-for-use, fast deployment, lower costs, rapid restocking, scalability, rapid elasticity, cost-effective disaster recovery and data storage solutions, universal network access, real time detection of system interference, security controls when needed, and rapid re-constitution of services (Kaur & Pateriya, 2013).

According to Dania *et al.* (2018), collaboration refers to the process that involves the interaction of individuals, teams or organisations in pursuit of a common goal. Vahdat-Nejad *et al.* (2019) posited that in order for the effective incorporation of cloud computing into project management contexts, innovative collaborative techniques such as Context-Aware Cloud Computing Information Systems (CACCIS) need to be implemented in the projects. Such techniques synthesise information pertaining the user's context including role, task, preferences, location and project site conditions so as to improve the effectiveness of project delivery. In supporting this view, Mwangi (2021) opined that such systems enable the thorough examination of the inherent complexities of different scenarios through a high level of automation then ensuring informed decision making on the basis of context-oriented requests in the implementation of building construction projects. Berthoud and Gliddon (2018) affirmed that project team collaboration is facilitated by advances in technology including cloud computing through the remote access to information from disparate locations, internal wikis and intranets where team members are able to communicate with each other in real time regardless of their geographical location. Kim *et al.* (2017) maintained that complex projects are able to enhance their collaborative endeavours through the use of building information modelling (BIM) technology that ensures the provision of a supportive collaborative design that features well synchronized filing and access protocols for project team members in an environment that is spread out.

Statement of the Problem

Organisations all over the world experience difficulties in collaborating in cloud-based projects owing to a number of challenges including deficiencies in the existing IT infrastructures, resistance by some of the staff to change, financial constraints, lack of the requisite technical competences, cultural issues, and inadequate finances to invest in the technology (Alsanea *et al.*, 2014). Additionally, many public sector organisations in Kenya experience challenges in incorporating knowledge management practices which have been found to be critical towards the collaboration among stakeholders. Additionally, the centralisation of knowledge

repositories by large institutions and organisations has handicapped the cooperative efforts of technical personal involved in key projects (Cheruiyot *et al.*, 2020). Additionally, projects run into collaboration challenges owing to the involvement of multicultural teams since these tend to have an adverse effect on the team dynamics and pose trust issues, thereby necessitating more advanced team collaboration techniques (Swart *et al.*, 2022).

The adoption of cloud computing as well as the collaboration in cloud-based projects is a fairly recent phenomenon in Kenya with the pioneering organisations using it in 2010, however, with the growth of the country as an ICT hub in the region, many organisations have adopted the technology with an estimated 48% small and medium enterprises adopting it as of 2017 and a further 28% expressing the interest to adopt it in the near future (Oredo *et al.*, 2019). A report by the KeNHA (2022) established that for the period of 2018/2019 to 2022/2023 the authority was only able to construct and improve the capacity of 336 km of road compared to a target of 429 km; and the maintenance of 12,818 km against the targeted 13,9769.5 km. Such implementation challenges call for the integration of improved methods of project execution including cloud computing.

The works of Strahorn *et al.* (2017); Bond-Barnard *et al.* (2018); and Hussein (2019) have established that many infrastructure projects have been hampered by trust issues where key stakeholders have remained suspicious of the intentions of the project team and held back from complete collaboration thereby leading to poorer project success.

The study has identified a number of gaps in the body of knowledge. Firstly, there has not been much work done on the correlation between project trust collaboration and success and the lack of research on comparative assessments of the successful and failed projects on the research variables (Oyugi & Simba, 2023; Waweru, 2018; Mbatha, 2024) which represents a conceptual gap. Additionally, there has been little research conducted on the implementation of cloud-based team collaboration techniques and their effect on road construction projects apart from the likes of Zhang (2018); Afolabi *et al.* (2018); and Kineber *et al.* (2022) which also represents a conceptual gap. Thirdly, a number of studies on cloud-based team collaboration have not been focused on road construction projects (Bykov *et al.*, 2020; Kotb *et al.*, 2019; Mourtzis *et al.*, 2020) representing a contextual gap. Thus, the findings from this study provided new insights in this regard. Therefore, the study sought to analyse the influence of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya.

Objectives of the Study

The main objective of this study was to analyse the influence of cloud-based project team collaboration on the performance of road construction projects in selected counties in Kenya.

Specific Objectives

i. To determine the influence of knowledge management practices as components of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya.

ii. To establish the influence of team monitoring as components of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya.

LITERATURE REVIEW

Theoretical Review

Data Information Knowledge Wisdom (DIKW) Chain Model

The Data Information Knowledge Wisdom (DIKW) Chain Model, which was originally advanced by Russell Ackoff in 1989, held that the understanding of every concept is made up of four dimensions including wisdom, knowledge, information and data such that at the most elementary level there is the raw data which is then processed into a meaningful form as information, then it is analysed further as tacit and explicit knowledge, and finally during the

wisdom stage, knowledge is evaluated in order to ensure the attainment of desired goals and objectives (Wang, 2007). According to Deepu and Ravi (2021), the DIKW hierarchical model can be applied as an effective decision-making tool by ensuring more effective utilisation of data, information, knowledge and wisdom by managers in an organisational setting.

Thus, this theory is consistent with independent variable one (knowledge management practices) since knowledge is one of the four dimensions that make up every concept. The theory helps in explaining the nature of knowledge (tacit or explicit) as well as the evaluation of knowledge in order to ensure the attainment of desired goals and objectives. It can also be surmised that since it is targeted at ensuring the attainment of goals then it is also linked to the dependent variable of performance (this is the ultimate goals of the project).

According to Frické (2009), the DIKW Chain Model is constrained by the fact that the data that it uses only relates to statements that are partially factual and susceptible to inaccuracies on the part of the respondent. In other words, information that is beyond the perception of the respondent will not be included in the assessment. Additionally, Frické (2009) felt that the theory lends itself to uninspired methodology since data which has not undergone a proper transformation process is treated as information and used as a basis for decision making. Van Meter (2020) explained that the model assumes that the greater the amount of data, the greater the amount of information, knowledge and wisdom, respectively. It also assumes that all data and information is valuable.

Theory of Change

The Theory of Change (ToC) was popularised in 1959 by Donald Kirkpatrick as a means of providing a systematic and efficient tool through which managers could explain outcomes of organisational processes and activities (Cahapay, 2021). Serrat (2017) supposed that the ToC sought to explain the linkage between pathways of change and the eventual outcome through the descriptions of associated assumptions, beliefs and hypotheses related to the occurrence of change in the short-, medium-, and long-term in a given context.

This theory is aligned with independent variable two (team monitoring) since project monitoring is a technique used by the project management team to explain how change occurs in outcomes when compared to the pre-determined performance targets. Thus, through the influence of cloud-based team collaboration in general and team monitoring in particular, changes are anticipated to occur in the outcome (performance) thereby demonstrating linkages to the dependent variable.

Vogel (2012) explained that the ToC fails to provide clarity on the actual definition of the concept of change as well as an established methodology thus leading to a wide ranging spread of definitions and interpretations. Thus, it should be applied flexibly rather than prescriptively depending on the situation at hand. Effective application of the theory calls for the establishment of explicit assumptions that inform the resultant interpretations by the project teams.

Conceptual framework

Grant and Osanloo (2016) defined as a conceptual framework as a structure that is arranged in a logical manner so as to offer a visual articulation of the relationship between various study concepts. Adom, Hussein and Agyem (2018) added that a conceptual framework establishes the foundation for the exploration of research problem by the researcher. Figure 2.1 illustrates the study's conceptual framework where the relationships between each of the independent variables and the dependent variable are shown.

Cloud Based Team Collaboration Techniques

Knowledge Management	
• The extensiveness of knowledge accumulation	
• The effectiveness of knowledge utilization	
• The level of knowledge sharing	

Team Monitoring
• Frequency of information analysis
• Extent of beneficiary accountability
• The level of learning capacity

Performance of Road Construction Projects
• Completion within time
• Quality of finished product
• Completion within stipulated budget
• Coordination of team efforts

Independent variables   **Dependent variable**
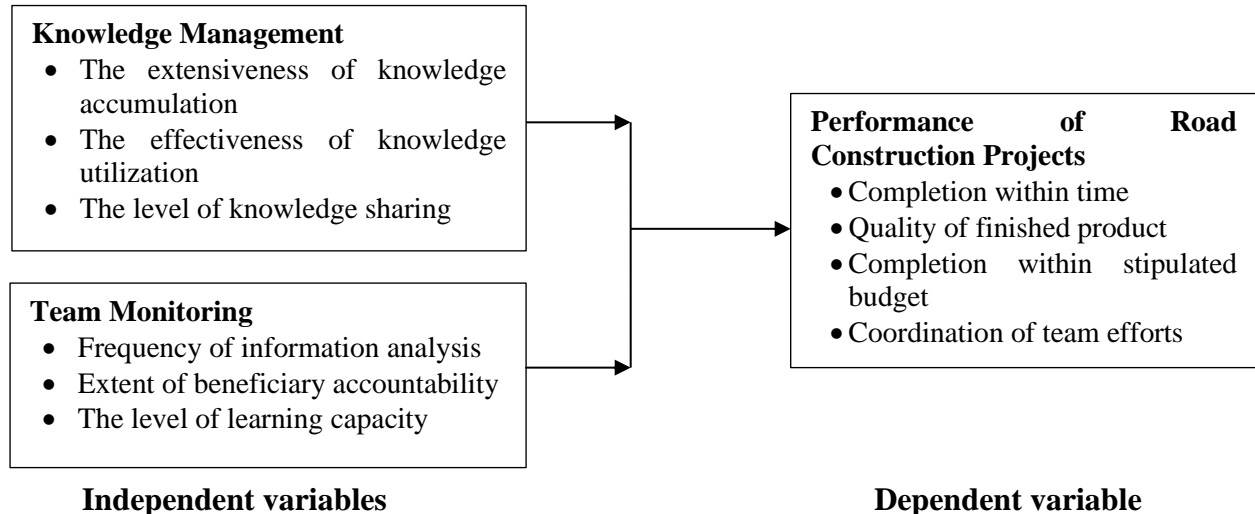
Figure 2. 1: Conceptual framework (Source: Researcher, 2024)

Empirical Review

Knowledge Management Practices

Knowledge Management (KM) practices refers to procedures employed by an organization to apply knowledge from previous experiences to influence present decision making so as to enhance the organisation's effectiveness of accomplishing its objectives (Bolisani & Bratianu, 2018). As a component of cloud based teams, KM practices entail the application of cloud based technology to identify, generate, store, represent, and disseminate knowledge to all the key project stakeholders (Musa *et al.*, 2018).

The first indicator of knowledge management practices is the extensiveness of knowledge accumulation. Wehn and Montalvo (2018) explained that the accumulation of knowledge in organisations involves the use of knowledge repositories to capture experiences and all the stored information that is critical towards the growth of the organization. Nawroth *et al.* (2015) posited that through the use of cloud computing organisations are able to accumulate knowledge more effectively in a more secure and cost-effective manner. A study by Suresh *et al.* (2016) on the impact of knowledge management on construction projects found that the accumulation of tacit knowledge had a positive effect on the lessening of the cost of poor quality of construction projects, especially in the transfer of accumulated knowledge from senior employees and consultants through apprenticeships and mentoring. Omari and Otieno (2018) studied factors affecting road construction projects' completion rate in Kenya and established that the selection of the project management team is premised on the competence and wealth of accumulated knowledge of the individuals on similar previous projects and special insights into the process of implementation.

The second indicator of knowledge management practices is the effectiveness of knowledge utilization. According to Diehr and Gueldenberg (2017), knowledge utilization refers to the different means through which organisations are able to use and commercialise various types of knowledge resources effectively. Ibrahim and Inan (2022) established that through the application of cloud computing, organisations are able to achieve more seamless and effective utilisation of knowledge resources provided there are appropriate organisational learning aids. Alashwal *et al.* (2016) examined knowledge utilisation process in highway construction projects and determined that the increased adoption of public private partnership (PPP) models of project implementation has enabled the development of new knowledge utilisation frameworks that leverage on the transfer of new knowledge from private partners that have led to the development of new solutions or enhanced decision making flexibility on prevailing

issues. Chepkemoi (2020) investigated the influence of project management skills on performance of road construction projects in Machakos County, Kenya and ascertained that thanks to effective knowledge management mechanisms, road construction projects have benefitted through suitable knowledge utilisation protocols that ensure the application of the right project management practices during the implementation process.

The third indicator of knowledge management practices is the level of knowledge sharing. Alhammadi (2016) affirmed that cloud computing enables the sharing of knowledge remotely from anywhere amongst organisational members where information pertaining to critical issues can be retrieved, referred to and shared accordingly to all the key decision makers so as to expedite the process of decision making. Mburia and Bett (2020) studied the influence of KM practices on project performance in Tharaka Nithi County, Kenya and determined that the establishment of a knowledge sharing culture has enabled effective knowledge sharing among the project management team where employees have been encouraged to generate and share knowledge on appropriate project implementation techniques. In a study on effects between information sharing and knowledge formation and their impact on complex infrastructure projects' performance, Li *et al.* (2022) established that organisations need to institutionalise effective knowledge organisation and knowledge integration in order to manage the process of knowledge sharing from experts to other project stakeholders which, in turn, will lead to optimal performance of complex infrastructure projects.

Team Monitoring

Team monitoring refers to the process through organisations are able to keep track of performance anomalies by team members by identifying and making corrections where necessary so as to act as a trigger for taking remedial action (Arshad & Niazi, 2018). Cloud computing technology ensures quick access to large volumes of data and running it through an organization's monitoring systems on a real-time basis to ensure faster decision making by the project management team (Pourmajidi *et al.*, 2018).

The first indicator of team monitoring is the frequency of information analysis. Wakiru *et al.* (2019) stated that information analysis is the process through which organisations define a given set of information so as to provide support for decision making in a particular situation. Langmead and Nellore (2018) explained that cloud computing technology facilitates more accurate information analysis through the access to huge volumes of data from various servers. A study was conducted by Gachungi (2017) on the influence of information and communication technology (ICT) application on the management of road construction projects in Kenya and determined that the integration of ICT technology has resulted in more innovative implementation of the projects including the analysis of information using sophisticated data analysis techniques which has transformed the quality of information available and ensured more informed decision making. Kabacia (2018) examined the influence of management practices on the performance of road construction projects in Imenti North Sub-County, Kenya and affirmed that the investment in monitoring and evaluation (M&E) systems had ensured more effective information analysis on a regular basis which had ensured quicker discovery of problem areas and led to faster resolution of the problems.

The second indicator of team monitoring is the extent of beneficiary accountability. Beneficiary accountability refers to the process through which individuals who have received project support whether financial or resource support provide an opportunity to understand and impact on the decisions taken during the course of the project; it involves listening to beneficiaries and adapting and responding to information in a dynamic manner (Thomas, Crawford, Beale, Richardson & Eklof, 2017). Sule (2021) carried out a study on beneficiary monitoring on implementation of devolved road construction projects in Kisumu East Sub-County, Kisumu County, Kenya and found that the involvement of intended project beneficiaries in the monitoring of project implementation has ensured greater accountability by the project management teams to key stakeholders and led to the enhancement of the implementation of these projects. Mandala (2018) examined the influence of stakeholders' involvement in project

management on the performance of road construction projects in Kenya and established that there was adequate involvement of stakeholders in project identification, project initiation, project planning and project implementation which had led to greater accountability and the enhancement of the attainment of project outcomes.

The third indicator of team monitoring is the level of learning capacity. Lesort *et al.* (2020) defined learning capacity as the manner in which individuals are able to recognise, absorb and apply knowledge. Baharuddin *et al.* (2021) ascertained that cloud computing has revolutionised the capacities of organisations to absorb and manipulate knowledge as part of the learning process thanks to superior storage and network resources. Ejiofor and Ovat (2023) conducted a study on the influence of project planning on the performance of road construction project and ascertained that effective project planning includes the determination of the resource capacity of the implementing organisation, especially the learning capacity of the project management team which minimises the chances of failure in the pursuit of project implementation objectives. Mushori *et al.* (2020) carried out a study on the influence of management ability of contractors on performance of road construction infrastructural projects and established that the implementation of such projects is dependent upon the management ability of the project management team including the learning capacity since this enables the determination of their readiness to accept new experiences and opportunities to grow and improve.

Performance

According to Gyadu-Asiedu (2014), project performance refers to a determination of how successfully a project has been able to achieve its pre-determined goals and objectives through continuous assessment. Alqahtani *et al.* (2015) affirmed that project performance is influenced by a number of factors including: clarity in the characterisation of objectives, sufficiency of the project schedule, communication, clarity in the description of stakeholder roles, top management support, project manager competencies, and organisational values, norms, artefacts and leadership.

The first indicator of performance is completion within time. On the basis of the established project implementation schedule, timelines are typically established on the duration of the project and these inform the assessment of how well the project has been delivered within the timelines of completion. Milestones are usually developed to provide meaningful time references for performance during pre-determined phases of implementation (Nyamamba & Omwenga, 2022). Ogweno *et al.* (2016) investigated the determinants of timely completion of road construction projects financed by Kenya Roads Board in Kisumu County and found that the most critical factor in ensuring timely completion of such projects is the availability of adequate top management support particularly where it pertains to client consultation with key stakeholders, the provision of an enabling working environment, the provision of adequate opportunities for staff advancement, and incentives for contractors to finish the work ahead of projected timelines. A study by Macharia (2016) on factors influencing completion of road construction projects in Nairobi County, Kenya and determined that the adequacy of resources, stakeholder participation, staff competency, and adherence to procurement procedures are critical towards the timely completion of road construction projects. However, some of the projects have been adversely affected by untimely allocation of resources and poor engagement of stakeholders.

The second indicator of performance is the quality of finished product. Whilst acknowledging the difficulty of getting a universal definition of quality, Welzant *et al.* (2015) affirmed that it as a determination of how well a project has conformed to established specifications, standards, and requirements. This is typically done through comparisons between the actual performance and the projected performance. Kipchirchir (2022) studied resource management and performance road construction projects run by the Kenya National Highways Authority (KeNHA) and determined that many projects have been characterised by poor compliance with quality standards owing to inadequate integration of quality control procedures and as a result

there has an increasing propensity towards public private partnerships which have been found to improve quality control. Otieno and Mbugua (2020) examined the influence of contractor preparedness on completion of construction projects in Nairobi County, Kenya and affirmed that contractors have become more committed towards enhancement of quality of the roads by carrying out regular materials inspection; and ensuring that all the project equipment are in proper working condition ahead of commencement.

The third indicator of performance is completion within stipulated budget. The completion of projects within stipulated budget refers to the level of success with which a project management team has been able to meet the pre-determined cost estimates of a project upon completion. This demands that the cost overruns be kept to a minimal, and that accurate budget estimation methods be developed beforehand (Kwon & Kang, 2018). In a study on the effect of budgetary compliance on the performance of county governments in Kenya, Odhiambo (2022) established that owing to resource constraints that were caused by poor revenue collection, many county government projects including road construction projects were dependent on budgetary allocations from the national government which were usually delayed during the disbursement process leading to cost overruns. Wafula (2017) investigated factors influencing road construction projects in Machakos County, Kenya and determined that inherent bureaucracies in the disbursement of budgetary allocations led to resource constraints which further hampered the performance of road construction projects in the County.

The fourth indicator of performance is coordination of team efforts. Team coordination refers to the activities involved in the application of strategies and behavioural patterns that seek to incorporate interdependent individual's efforts, knowledge, and objectives so as to ensure the attainment of common team objectives (Reeves, Xyrichis & Zwarenstein, 2018). Waweru (2018) conducted a study on the influence of teamwork approach on road construction project performance in Kericho County, Kenya and established that through the integration of effective structures that stipulate team member roles and the involvement of all team members in planning of project implementation, the project managers are able to coordinate the efforts of all key stakeholders so as to align the implementation process with pre-determined objectives. A study by Ali, Hussain, Ali, Hussain and Murtaza (2021) on the impact of coordination factors on construction project success in Pakistan affirmed that given the sheer scale of the projects and the number of stakeholders involved, some of the projects failed due to poor coordination by the project management teams as exemplified by the lack of adequate consultation of representatives of intended beneficiaries leading to the absence of poor linkage between the implementation of the expectations of project beneficiaries.

RESEARCH METHODOLOGY

This study adopted a descriptive survey research design. The research study limited itself to five road constructions projects under Kenya National Highways Authority (KeNHA) in selected counties in Kenya as follows: Mau Mau Road Project Lot 1A; Mau Mau Road Project Lot 1B - Kiambu County Section; Rehabilitation and Improvement of Uplands – Githunguri – Ruiru; Duelling of Athi-River Machakos Turnoff; and Capacity Enhancement of James Gichuru-Rironi (KeNHA, 2022). This comprised the unit of analysis. The sample population targeted top management and middle management from KeNHA, Consultants and Contractors who are directly involved in the implementation of the project. The target population was 155 respondents from the five road construction projects in their Nairobi premises. These included 10 clients, 85 consultants and 60 contractors. This study employed the use of primary data that was collected by use of both the questionnaire and interview guide. Questionnaires were used to collect quantitative data while qualitative data was collected by use of interview guide. Data collected from questionnaires was coded and keyed into a computer and analysed using the Statistical Package for Social Sciences (SPSS version 23) and the Microsoft Excel. Descriptive statistics including the means and standard deviations were used to analyse quantitative data and capture the characteristics of the variables under study. Inferential statistics was used to test the nature and magnitude of the relationships between the research objectives. Simple

linear regression analysis and Pearson's Correlation Coefficient (r) was computed to test hypothesis and to determine the nature and strength of the relationship among the variables, with r ranging from -1 to +1. Both descriptive and inferential statistics were employed to analyse and test the research objectives.

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The researcher sampled 155 respondents who were each administered with the questionnaires. From the 155 questionnaires 135 were completely filled and returned hence a response rate of 87.1%. The response rate was considered as suitable for making inferences from the data collected. As indicated by Metsamuuronen (2018), a response rate that is above fifty percent is considered adequate for data analysis and reporting while a response rate that is above 70% is classified as excellent. Hence, the response rate of this study was within the acceptable limits for drawing conclusions and making recommendations.

Descriptive statistics

Knowledge Management Practices and Project Performance

The first specific objective of the study was to determine the influence of knowledge management practices as components of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya. The respondents were requested to indicate their level of agreement on various statements relating to knowledge management practices and performance of road construction projects in selected counties in Kenya. The results were as shown Table 1.

From the results, the respondents agreed that the accumulation of tacit knowledge had a positive effect on the lessening of the cost of poor quality of construction projects (M=3.995, SD= 0.896). In addition, the respondents agreed that the selection of the project management team is premised on the competence and wealth of accumulated knowledge of the individuals on similar previous projects (M=3.900, SD= 0.876). Further, the respondents agreed that the increased adoption of public private partnership (PPP) models of project implementation has enabled the development of new knowledge utilization frameworks (M=3.887, SD= 0.782).

The respondents agreed that thanks to effective knowledge management mechanisms, road construction projects have benefitted through suitable knowledge utilization protocols (M=3.855, SD= 0.685). The respondents also agreed that the establishment of a knowledge sharing culture has enabled effective knowledge sharing among the project management team (M=3.797, SD= 0.698). In addition, the respondents agreed that the organization has institutionalized effective knowledge organization and knowledge integration in order to manage the process of knowledge sharing from experts to other project stakeholders (M=3.771, SD= 0.727).

Table 1: Knowledge Management Practices and Project Performance

Statements	Mean	Std. Dev.
The accumulation of tacit knowledge had a positive effect on the lessening of the cost of poor quality of construction projects.	3.995	0.896
The selection of the project management team is premised on the competence and wealth of accumulated knowledge of the individuals on similar previous projects.	3.900	0.876
The increased adoption of public private partnership (PPP) models of project implementation has enabled the development of new knowledge utilization frameworks.	3.887	0.782
Thanks to effective knowledge management mechanisms, road construction projects have benefitted through suitable knowledge utilization protocols.	3.855	0.685
The establishment of a knowledge sharing culture has enabled effective knowledge sharing among the project management team.	3.797	0.698
The organization has institutionalized effective knowledge organization and knowledge integration in order to manage the process of knowledge sharing from experts to other project stakeholders.	3.771	0.727
Aggregate	**3.868**	**0.777**

Team Monitoring and Project Performance

The second specific objective of the study was to establish the influence of team monitoring as components of cloud-based team collaboration on the performance of road construction projects in selected counties in Kenya.The respondents were requested to indicate their level of agreement on various statements related to team monitoring and performance of road construction projects in selected counties in Kenya. The results were as shown Table 2.

From the results, the respondents agreed that the integration of ICT technology has resulted in more innovative implementation of the projects including the analysis of information using sophisticated data analysis techniques (M=3.940, SD=0.772). In addition, the respondents agreed that the investment in monitoring and evaluation (M&E) systems had ensured more effective information analysis on a regular basis (M=3.840, SD=0.889). Further, the respondents agreed that the involvement of intended project beneficiaries in the monitoring of project implementation has ensured greater accountability by the project management teams to key stakeholders (M=3.827, SD=0.768). The respondents also agreed that there is adequate involvement of stakeholders in project identification (M=3.800, SD=0.562).

As shown in the results, the respondents agreed that effective project planning includes the determination of the resource capacity of the implementing organisation, especially the learning capacity of the project management team (M=3.743, SD=0.879). In addition, the respondents agreed that the implementation of such projects is dependent upon the management ability of the project management team including the learning capacity (M=3.708, SD=0.692).

Table 2: Team Monitoring and Project Performance

Statements	Mean	Std. Deviation
The integration of ICT technology has resulted in more innovative implementation of the projects including the analysis of information using sophisticated data analysis techniques.	3.940	0.772
The investment in monitoring and evaluation (M&E) systems had ensured more effective information analysis on a regular basis.	3.840	0.889
The involvement of intended project beneficiaries in the monitoring of project implementation has ensured greater accountability by the project management teams to key stakeholders.	3.827	0.768
There is adequate involvement of stakeholders in project identification.	3.800	0.562
Effective project planning includes the determination of the resource capacity of the implementing organization, especially the learning capacity of the project management team.	3.743	0.879
The implementation of such projects is dependent upon the management ability of the project management team including the learning capacity	3.708	0.692
Aggregate	**3.810**	**0.760**

Correlation Analysis

This research adopted Pearson correlation analysis to determine how the dependent variable (performance of road construction projects in selected counties in Kenya) relates with the independent variables (knowledge management practices, team monitoring).

Table 4: Correlation Coefficients

		Project Performance	Knowledge Management Practices	Team Monitoring
	Pearson Correlation	1		
Project Performance	Sig. (2-tailed)			
	N	135		
Knowledge	Pearson Correlation	.815**	1	
Management	Sig. (2-tailed)	.003		
Practices	N	135	135	
	Pearson Correlation	.825**	.327	1
Team Monitoring	Sig. (2-tailed)	.002	.032	
	N	135	135	135

From the results, there was a very strong relationship between knowledge management practices and performance of road construction projects in selected counties in Kenya (r = 0.815, p value =0.003). The relationship was significant since the p value 0.003 was less than 0.05 (significant level). The findings are in line with the findings of Ibrahim and Inan (2022) who indicated that there is a very strong relationship between knowledge management practices and project performance.

Moreover, there was a very strong relationship between team monitoring and performance of road construction projects in selected counties in Kenya (r = 0.825, p value =0.002). The relationship was significant since the p value 0.002 was less than 0.05 (significant level). The findings are in line with the findings of Wakiru *et al.* (2019) who indicated that there is a very strong relationship between team monitoring and project performance.

Regression Analysis

Multivariate regression analysis was used to assess the relationship between independent variables (knowledge management practices, team monitoring) and the dependent variable (performance of road construction projects in selected counties in Kenya).

Table 5: Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	**Std. Error**	**Beta**		
(Constant)	0.331	0.083		3.988	0.000
knowledge management practices	0.386	0.097	0.387	3.979	0.000
team monitoring	0.376	0.095	0.375	3.957	0.001

The regression model was as follows:

$Y = 0.331 + 0.386X_1 + 0.376X_2$

According to the results, knowledge management practices has a significant effect on performance of road construction projects in selected counties in Kenya $\beta_1 = 0.386$, p value= 0.000). The relationship was considered significant since the p value 0.000 was less than the significant level of 0.05. The findings are in line with the findings of Ibrahim and Inan (2022) who indicated that there is a very strong relationship between knowledge management practices and project performance

The results also revealed that team monitoring has a significant effect on performance of road construction projects in selected counties in Kenya $\beta_1 = 0.376$, p value= 0.001). The relationship was considered significant since the p value 0.001 was less than the significant level of 0.05. The findings are in line with the findings of Wakiru *et al.* (2019) who indicated that there is a very strong relationship between team monitoring and project performance.

Conclusions

The study concludes that knowledge management practices have a positive and significant effect on performance of road construction projects in selected counties in Kenya. Findings revealed that the extensiveness of knowledge accumulation, the effectiveness of knowledge utilization and the level of knowledge sharing influences performance of road construction projects in selected counties in Kenya.

In addition, the study concludes that team monitoring has a positive and significant effect on performance of road construction projects in selected counties in Kenya. Findings revealed that frequency of information analysis, extent of beneficiary accountability and the level of learning capacity influences performance of road construction projects in selected counties in Kenya.

Recommendations

The study recommends that the management of road construction projects in Kenya should implement a robust knowledge-sharing platform. By creating a centralized digital repository where project stakeholders, including engineers, contractors, and government officials, can document and share lessons learned, best practices, and innovative solutions, organizations can foster collaboration and streamline communication.

In addition, the study recommends that the management of road construction projects in Kenya should implement regular performance review meetings combined with real-time progress tracking tools. By establishing a structured schedule for these meetings—such as weekly or bi-

weekly check-ins—project managers can assess team performance, address challenges, and celebrate milestones.

Suggestions for Further Studies

This study was limited to the influence of cloud-based project team collaboration on the performance of road construction projects in selected counties in Kenya hence the study findings cannot be generalized to project performance in other organizations in Kenya. The study therefore suggests further studies should explore how cloud-based collaboration can contribute to sustainable practices in road construction, including resource management, waste reduction, and environmental impact tracking and study the integration of AI tools in cloud computing for predicting delays, cost overruns, and enhancing decision-making for project management

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