IMES PROJECT DATA MANAGEMENT AND PERFORMANCE OF ROAD PROJECT IN KENYA

Olympia Muhanga Musonye.
PhD Student, Jomo Kenyatta University of Agriculture and Technology, Kenya.
Dr. Peter Ngatia.
Lecturer, Jomo Kenyatta University of Agriculture and Technology, Kenya.
Prof. Patrick Karanja Ngugi
Lecturer, Jomo Kenyatta University of Agriculture and Technology, Kenya.

Citation: Musonye, O. M., Ngatia, P., Ngugi, P. K. (2026). IMES project data management and performance of road project in Kenya. *International Academic Journal of Information Sciences and Project Management, 3*(7), 440-459.

ABSTRACT

Road projects in Kenya have been characterized by substandard quality of work, cost overruns, poor stakeholder management and poor schedule management. This has been attributed to poor project management systems. Integrated Monitoring and Evaluation System is part of such systems. This study therefore sought to analyze the relationship of IMES Project Data Management on performance of road projects in Kenya through hypothesis testing and at the same time establish the moderating effect of Project Risks on the relationship between IMES Project Data Management and performance of road projects in Kenya. The unit of analysis was the road construction projects implemented by National Government Road Agencies (KURA, KeRRA, and KeNHA) in Kenya, while the unit of observation was the project managers involved in the implementation of these road construction projects. The population for the research was 188 projects initiated and completed between the year 2015 and 2022 by the three agencies. The overall sample size for this study was determined using a formula by Fisher's exact formula, which obtained 126 respondents. This study employed stratified random and purposive sampling method to select the study sample. Primary data was used and was collected using a semi-structured questionnaire. Samples of the questionnaire were pilot tested with 18 respondents to test for reliability and validity. The data was analyzed using the Statistical Package for Social Sciences (SPSS). The qualitative data collected was analyzed using thematic analysis and presented in text form. The study concluded that project data management positively and significantly influences performance of road projects in Kenya. In addition, the study concluded that project risks have significant moderating effect on the relationship between IMES Project Data Management and performance of road projects in Kenya. Based on the findings, the study recommends embedding continuous performance tracking into the evaluation process, project managers can make timely and informed decisions, promptly address emerging challenges, and align implementation strategies with desired outcomes. In addition, the study recommends that the management of road projects in Kenya should embed proactive risk management protocols within the M&E framework. This involves identifying potential risks early in the project lifecycle and continuously assessing their likelihood and impact through the M&E system.

Keywords: Project data management (IMES), Performance of Road Project, Project Data Management, Kenya.

INTRODUCTION

Background of the Study

Effective and efficient execution of public infrastructure projects is a central contributor to economic growth of a nation. In fiscal planning, countries allocate resources, from either from loans or taxes, through direct procurement or public-private partnerships, to build roads, houses, railways and bridges. All these projects contribute to national development. However, there are cases of project failure in terms of quality, cost, stakeholder management and time. Diaz's (2020) classification of reasons for project failures includes poor management decisions and change in fundamental variables of the project. In road infrastructure projects in Kenya, the government has attempted to forestall management related problems by professionalizing project management process. In project management processes, monitoring and evaluation tools should be deployed deliberately, to ensure project success. Governments have adopted qualitative and quantitative tools like checklists, key performance indicators, plans and dashboards to improve road project performances (Tengan *et al*. 2021). An integrated approach to monitoring and evaluation is continuously being adopted by governments as a technique for efficient delivery of projects. This technique has different parts whose effect on the project performance may vary. It has been suggested that this system as a whole function only fairly (Welime, 2019). These suggestions have however not been quantitatively justified. For improvement of performance of roads projects in public sector, it is essential to understand the effectiveness the variables of this monitoring and evaluation tools. However, there is scarce literature on the performance of the variables of this tool. Presented in this work is a proposal to analyze the performance of the National Integrated Monitoring and Evaluation System (NIMES). This proposed work contributed to the existing debate on effectiveness of monitoring and evaluation, by singling out performances of specific aspects of the NIMES.

Road projects are vital components in economies in global scales. Globally, for example, there has been heavy investment in road infrastructure, mostly meant to boost their local economies. However, there have been cases of poor performance of these projects, with a number of them being cancelled. In the United States (US), as cited in Huo *et al*., (2018), 77% of the America's freeway projects failure is attributed to cost overruns. In Norway, cost overruns accounted for 7.9% of project failure (Amadi & Higham, 2017). Road projects cause environmental degradation and pollution during and after construction. In Thailand, it was estimated that the country would need to invest roughly 4.2trillion baht in infrastructure projects during the period of 2014-2020. Of this, about 71% was to be allocated to transportation projects. Accordingly, the country was expected to deplete its natural resources more rapidly in the coming years due to the construction of these projects (Kokkaew & Rudjanakanoknad, 2017). It is thus clear that failures, like the cost overruns and unsustainable tendencies are bound to occur in road projects when managed poorly especially in terms of monitoring. Project performance in road and bridge construction has also had challenges in the United States of America (USA). Falcetelli *et al*., (2022) however reported that monitoring experts use advanced structural health monitoring (SHM) for infrastructure project assessment, which is thought to be accurate. The accuracy notwithstanding, the large sizes of most bridge structures make the techniques cost prohibitive. This cost prohibition could be one of the reasons why visual verification method

is also employed. Culligan, (2019) explored some of the challenges posed this verification method, especially for monitoring construction and maintenance of bridges. Here, performance has been affected by multiple errors resulting from different ratings provided by different inspectors. The method has also been said to be time and labor intensive. Tanzania as one of the middle-income countries in the world, road transport is the most widely used form of transport. Road transportation carry over 90% of the passengers and 75% of the freight traffic in the country.

Road project performance in Africa has similarly had challenges. A case in point is in Nigeria. Project performance in this country has been hampered by cost overruns. Anigbogu et al., (2019) cited overruns of 39.7 %, and these have been said to be the highest in the world. This is despite the formation of Department of Monitoring and Evaluation in 2010. Radin *et al.,* (2017) state that this department was meant to improve stakeholder management in road construction projects. In South Africa, just as in Nigeria, there have been reports of road project performance failure. Nyakala *et al.,* (2019) study indicated that road construction projects indicate that 30.1% to 39.4% does not attain efficiency. This was attributed to poor project control. Road transport is one of the most used forms of transport in Tanzania. This carries over 90% of passenger and 75% freight traffic annually. Tanzania's Strategic development stresses that extensive and efficient road infrastructure is essential in growth of the country's economy.

Despite this being one of the strategic focus, Tanzania still faces the problem of road project failures. Studies have shown that one of the main causes of failure is by not completing the projects on schedule which goes up to an estimate of 110%. Although performance of the same has been noted as a hindrance, investments in road projects in Kenya have improved. In Kenya, road projects failed at a rate of 80%, according to Lakmeeharan et al., 2020's study of time performance. Kenya has, however, embraced the use of an Integrated Monitoring and Evaluation System, which is worth highlighting. This system was hoped to contribute to improvement of performance of road projects. It is vital to understand the level of contribution of this system to this performance. This project explored the contribution of this system to performance of road projects, with focus of the roads constructed by KeNHA and KeRRA. These national entities are responsible for construction of national government road networks.

Statement of the Problem

Kenyan roads record an annual growth in traffic by 8.3 %. Growth in the number of developed roads is not however in tandem with this traffic growth. This disparity has been said to hinder growth of Gross National Product by 0.9 % (Wafula, 2017). According to Wambui and Mercy, (2019) road network projects in Kenya get precedence in budgetary allocations. In the financial year 2013/2014, for example, 7.7% of the budget was allocated to the ministry of transport and infrastructure. According to Beldinne and Gachengo, (2022) Kenya allocated $954mn, $1.1bn, $1.3bn in 2013/14, 2014/15, 2015/2016 respectively for roads. Despite these high budgetary allocations, there are recorded performance problems in road construction projects. Such problems include cost overruns, delivery delays, cases of poor quality finishing and non-adherence to scope of work. Annual reports of KENHA have revealed some of the projects

performing poorly. Out of the 34 projects reported in the 2021-2022 Annual Report, half of them have a cost performance index below 1.0. In the same report, slightly more than half of the projects have a negative cost variance (KENHA, 2022). Out of the nine Auditors General's Report (2022) sampled projects in KERRA, four were behind schedule. Similar observations have been made in the Auditor Generals (2020) report for KURA, with more than half of the sampled projects behind schedule. An audit for FY 2020/21, done by KRB, showed that KeNHA had an accountability rating of 82.52%, while KURA and KeRRA achieved 79.85% and 67.36% ratings, respectively. The accountability index ratings measure the performance of road authorities in the implementation of roadwork programs financed by KRB (KRB, 2022). Researchers and Project Management experts have developed interest in understanding the poor performance of road projects. Some of the issues investigated include contract management, schedule, Project Risks, financial controls and government policies (Oyolla, 2019). Other studies, for instance work reported by Njeru & Kirui, (2022), Mucheke & Paul, (2019) and Abdi & Kimutai, (2018) suggest that performance of road construction projects is dependent on Monitoring and Evaluation practices.

These studies provide invaluable information on the roles played by different aspects of project management and road project performance. However, there is limited works carried out to analyze the role of integrated monitoring and evaluation system on performance of road projects in Kenya. As well, there is no framework for evaluating the performance of this system. This study therefore attempted to analyze Integrated Monitoring and Evaluation System and performance of road projects in Kenya.

Specific Objectives

The following are the specific objectives that guided this study:

i.   To examine the relationship between IMES Project Data Management and the performance of road projects in Kenya
ii. To determine the moderating effect of project risks on the relationship between IMES and performance of road projects in Kenya

Research Hypotheses

H01: IMES Project Data Management has no significance impact on performance of road projects in Kenya

H02: Project Risks has no significance moderating effect on relationship between Project Data Management and performance of road projects in Kenya

LITERATURE REVIEW

Theoretical Literature Review

Adaptive Structuration Theory

Adaptive structuration theory provides an explanation on the use and effects of technologies to an organization. Rains and Bonito, (2017) posits that the theory explains how the structures presented by technologies are used by the organizations. An example is how particular documents produced by a particular technology can be used collaboratively within an organization. Developed by Anthony Giddens, the theory began as a critique of what was seen as two unacceptable sides of the social theory. One that stressed on the importance of structure

and the other that stressed on the importance on an individual or agency. This developed into an elaborate theory of the nature of social structure, institutions, human agency, time and space, and modernity (Morse, 2020).

Adaptive Structuration theory depicts a state that leads to the stability in structure. When a structure has transformed it creates the bases for reformation of social arrangements. This theory emphasizes on human being establishing systems and using them accordingly (Badcock *et al.*, 2019). The key element related to this theory is linked to a way human activity and the structure are examined. According to Barrett, (2018), technologies are comprised of both structure potential and structures in use. The alignment of the potential structure of a technology and the structures in use depends on how groups appropriate the technology, or generate ideas about how the technology can satisfy their desires, situational needs, or pertinent practices. This theory is therefore ideal for studying how Project Data Management relates to performance of road projects. This is essential to the researcher while examining IMES ICT established structures and the structures that actually emerge in the project team as it faithfully uses, adapt, or ignore the technological features after which was measured against road project performance.

Conceptual Framework

A conceptual framework is a visual or written product that explains graphically or in narrative form the main things to be studied. This includes the key factors, concepts and the presumed relationships among them (Sarma *et al.*, 2021). According to Duvenage, (2019) the conceptual framework explains the path of a research. The main purpose of the framework being to make research findings more meaningful, acceptable to the theoretical constructs in the research field and ensures generalization. The concepts also assist in stimulating research while ensuring the extension of knowledge by providing both direction and an incentive to the research inquiry. The conceptual framework of this study sought to demonstrate the relationship between Integrated Monitoring and Evaluation System and performance of road projects in Kenya.

Project Data Management	Performance of Road Projects
• Project Data storage • Project Data retrieval • Project Data analysis • Project Data reporting	• Accepted deliverables. • Project cost variance. • Project schedule variance

Independent Variable   **Dependent Variable**

Project Risks

• Litigations.
• Political interference
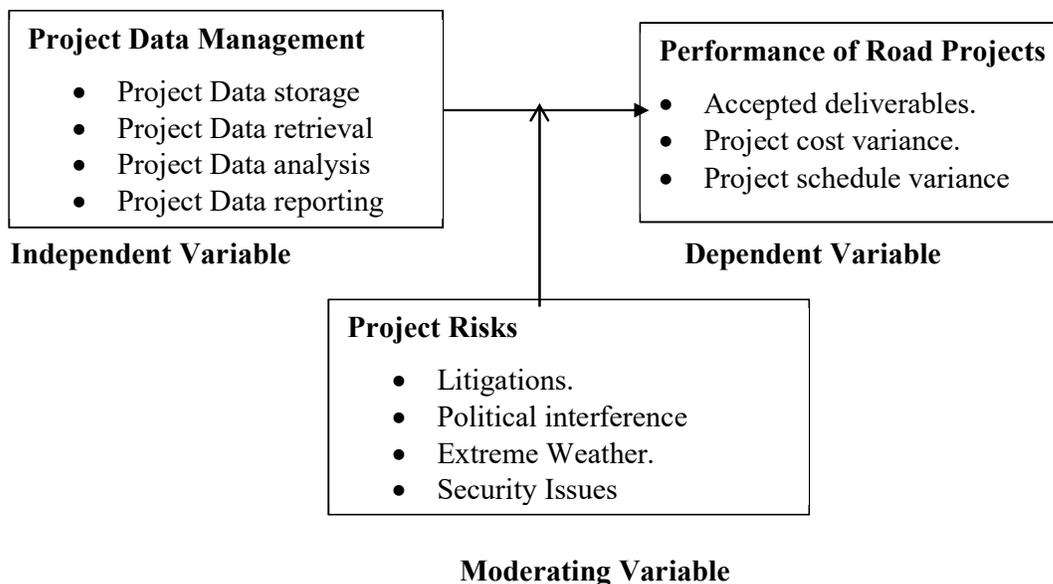• Extreme Weather.
• Security Issues

Moderating Variable

Figure 1: Conceptual Framework

Project Data Management

Project data management is the process of collecting, organizing, storing, and using data in a way that supports the goals and objectives of an organization (Choenni *et al*, 2022). Project data management involves different types of data. For example (Onwujekwe *et al*, 2020) mentions that data can be categorized as structured, unstructured, semi-structured, databases, files, APIs, and web pages. The authors go on to state that to manage project data effectively and efficiently, project managers need to use appropriate tools and methodologies that suit the scope, complexity, and requirements of each project. There are several steps in project data management. The first stage is to define the data management project lifecycle. Typically, the cycle consists of four phases: planning, design, implementation, and maintenance (Liuet *et al*., 2022). Takyi-Annan & Zhang (2023) state that in each phase, there is need to identify the tasks, deliverables, roles, and responsibilities that are involved in managing the data. The third element is the adoption of a suitable methodology that can guide through the project data management lifecycle (Kimet *et al*., 2020). According to Pan, & Zhang, (2021) efficient collaboration among project participants is a key factor in completing construction projects on time and within budget. The reason collaboration is to share accountable information among the participants. However, the construction industry is fragmented, with many geographically dispersed participants working together toward a common goal. This spurs inconsistency and delays in data communication among the participants and deprives accountability for project related information sharing. Data management in monitoring and evaluation system is a widely-used practice within a number of industries and sectors (Omri *et al*., 2020). This project data management should involve a wide variety of activities, including data collection on relevant indicators, storage, analysis of the collected data, and a reporting system to ensure that the properly analyzed data is seen by key people at every level.

Project Risks

Construction related Risks are unforeseen events that occur during the process of construction projects (Viles *et al*., 2020). The construction industry (Alaloulet *et al*., 2020) is subjected to uncertainties than any other industry. This is because of the complex nature of construction business activities, process, environment and organization. Being able to identify and manage risks requires robust strategic project management. When risks occur, they can negatively affect successful completion of road projects. Deep *et al*., (2022) state that risks that occur in highway projects lead to inability to achieve desired project objectives. So, risk assessment consisting of risk identification, risk classification and risk analysis is necessary for maintaining cost, schedule and quality of road construction project. It is the duty of the project team to collaborate in mitigating risks using appropriate processes and tools. Katushabe *et al*., (2022) state that before a prevention plan is fully put in place, the project team needs to understand the security risks such as equipment theft, vandalism, Arson, Cyber and other threats it might be facing. This enables the team to develop methods to strengthen security and reduce project related losses. Construction has always been a sector impacted by weather related risks. Disruptions such as increased rainfall can cause delays and inflate project costs (Adu-Gyamfi *et al*., 2023).

According to Cruz and Polinar, (2023) litigation and disputes in the construction industry occur because of miscommunication, lack of manpower or inexperience. To remain profitable, most players in the industry need to focus on effective methods that reduce unexpected job delays, conflicts, and costs. Some road projects instigate serious social unrest. Tassadiq, (2022) points out that in the initial phases of development, real or perceived inadequacies in community consultation can be flash-points for conflict hence affecting project delivery.

Road Project Performance

Infrastructure project development presents numerous challenges such as projects are time consuming, costly, and not always sustainable. Amiril *et al*., (2018) argue that Sustainability performance across the life cycle of construction project is a crucial aspect in achieving the goal of sustainable development. Sustainability factors have the function of monitor and drive performance towards the construction project performances. Hence, the degree of sustainability performance of construction project is highly influenced by the implementation of sustainability factors such as customer satisfaction (Kivilä *et al*., 2017). According to Bertram *et al*., (2019) cost and schedule growth in construction projects occurs due to various reasons. Some of the factors influencing the cost and schedule growth are project characteristics, project delivery methods, contract types, unforeseen site conditions, inaccurate bidding design fees and weather conditions.

Empirical Literature Review

There has been increased interest in studying the roles of System Data Management in management of road projects. In Kenya, for instance, Wambui and Mercy, (2019) examined the influence of information and communication technology application on management of road projects in Kenya. The study targeted 114 staff at KeNHA headquarters. It was found that electronic communication has a significant influence on the management of road projects in KeNHA. The results of this study play a significant role in affirming the importance of focusing on ICT as one of the ways of improving project performance. However, it fell short of quantifying the much Project Data Management contributes in comparison to other factors, in project performance. The MapSafe system is vital in improving safety in road construction projects. The system which was tested by using road construction project functions include, (Zou et al.,2017), Pre-Starting Safety Meeting Recording, Permit to Penetrate Request and Approval, Job Safety Analysis, and Safety Incident Reporting. Van and Firdaus (2020) state that a study was carried out to explore and establish factors affecting adoption and implementation of information and communication technology (ICT) in large ICT experienced Australian construction organizations. An online survey, supplemented by a hardcopy collection option was used to gather data from three major construction organizations with many years' experience with implementing and adopting IT. Management, individual, technology and workplace environment were enlisted as factors affecting adoption and implementation of information and communication technology in these organizations. Welime (2019) carried out a study to establish how effective NIMES is. The study sought to respond to this question by carrying out an assessment of the NIMES. The study employed the 12 components M&E strengthening tool proposed by the UNAID (2009) for assessing Monitoring and Evaluation Systems. The study employed the Delphi approach and purposive sample

selection methods as it applied the 12 components M&E strengthening tool. Results from the study indicated that Kenya's NIMES is only fairly functioning given the several aspects that are missing or not being done. For example, supportive supervision and data auditing is hardly ever done, similarly evaluation and research agenda are not institutionalized and neither is it being frequently set.

RESEARCH METHODOLOGY
Research Design
The study employed a descriptive research design to analyze relationships between variables without manipulation. This design was appropriate for establishing the association between IMES Project Data Management and project performance, as well as testing the moderating role of project risks (Veal, 2017; Rahman, 2017).

Research Philosophy
The study was guided by the positivist research philosophy, which supports objective measurement and statistical testing of relationships among variables. This approach was suitable for testing the stated hypotheses using quantitative data (Ghiara, 2020).

Target Population
The target population comprised 188 road construction projects implemented by KeNHA, KeRRA, and KURA between 2015 and 2022. Completed projects were considered to allow accurate assessment of performance outcomes.

Sampling Technique and Sample Size
A **s**ample size of 126 projects was determined using Fisher's formula with finite population correction. Purposive sampling was used to select project managers as respondents due to their direct involvement and expertise in project implementation.

Data Collection Methods
Data were collected using structured questionnaires administered through both physical and electronic means. The instrument captured information on IMES Project Data Management, project risks, and project performance.

Reliability and Validity
Reliability of the instrument was tested using Cronbach's alpha, with a threshold of 0.7 indicating acceptable internal consistency. Validity was ensured through discriminant validity to confirm that constructs were distinct and accurately measured.

Data Analysis
Data were analyzed using descriptive and inferential statistics. Multiple linear regression was used to test the relationship between IMES Project Data Management and project performance in line with H01. Moderated multiple regression analysis was applied to examine the moderating effect of project risks on this relationship in line with H02. Statistical significance

was tested at the 95% confidence level, and model strength was evaluated using the coefficient of determination (R^2).

Diagnostic Tests

Diagnostic tests, including linearity, multicollinearity (VIF), normality (Shapiro-Wilk), and homoscedasticity (Breusch-Pagan), were conducted to ensure that regression assumptions were satisfied and results were reliable.

RESEARCH FINDINGS AND DISCUSSION

The number of questionnaires, administered to all the respondents was 126. A total of 110 questionnaires were properly filled and returned from the project managers implementing roads projects in KeNHa, KURA and KeRRA. This represented an overall successful response rate of 87%. According to Mugenda and Mugenda (2019), a response rate of 50% or more is adequate for data analysis and reporting rate of 60 percent is good and a response rate of 80 percent and over is excellent. Babbie (2018) also asserted that return rates of 50% are acceptable to analyze and publish, 60% is good and 70% is very good. This implies that 87% response rate for this study was suitable for data analysis and reporting.

Descriptive Statistics

Project Data Management

The first objective of the study was to examine the relationship of IMES project Data Management on performance of road projects in Kenya. The study findings in Table 1 illustrate that 48.2% of the respondents indicated that data storage influences the performance of road projects to a large extent, 36.4% of the respondents indicated to a very large extent and 15.5% indicated to a small extent. On a five-point scale, the average mean of the responses was 4.21 which implies that majority of the respondents agreed on the statement; however, the answers were varied as shown by the standard deviation of 0.692. On the statement whether "Data retrieval influences the performance of road projects", 45.5% of the respondents indicated to large extent, 44.5% indicated to a very large extent while 10% indicated to a medium extent. The mean score for responses on this statement is 4.35 which implies that majority of the respondents agreed to a large extent on the statement; however, the answers were varied as shown by the standard deviation of 0.656. This concurs with Wambui and Mercy, (2019) study on 114 staff at KeNHA headquarters on the influence of information and communication technology application on management of road projects in Kenya. The study concluded that electronic communication has a significant influence on the management of road projects in KeNHA. The respondents were further asked to indicate data analysis influences the performance of road projects; 46.4% of the respondents indicated to large extent, 43.6% indicated to a very large extent, and 10% indicated to a medium extent. The mean score for the statement is 4.34 implying that majority of the respondents agreed on the statement; however, the answers were varied as shown by the standard deviation of 0.654. In regards to whether, Data reporting influences the performance of road projects; 51.8% of the respondents indicated to a very large extent, while 36.4% indicated to a large extent and 11.8% indicated to medium extent. The aggregate mean score for this section was 4.33 which imply that IMES project data management influences the performance of road projects to a large extent.

Table 1: IMES Project Data Management

Statement	No influence	Small extent	Medium extent	Large extent	Very large extent	Mean	Std. Deviation
Data Storage influences the performance of road projects.	0.0%	0.0%	15.5%	48.2%	36.4%	4.21	0.692
Data retrieval influences the performance of road projects.	0.0%	0.0%	10.0%	45.5%	44.5%	4.35	0.656
Data Analysis influences the performance of road projects.	0.0%	0.0%	10.0%	46.4%	43.6%	4.34	0.654
Data reporting influences the performance of road projects.	0.0%	0.0%	11.8%	36.4%	51.8%	4.4	0.693
Aggregate Score	**0.0%**	**0.0%**	**11.8%**	**44.1%**	**44.1%**	**4.3 3**	**0.674**

Project Risks and IMES Project Data Management and Performance of Road Projects

The respondents were asked to indicate whether Litigations enhances the influence of IMES Data management system on the performance of road projects, 51.8% of the respondents indicated to a very large extent, 30.9% indicated to a large extent, and 17.3% indicated to a medium extent as shown in Table 2. The mean score for the statement is 4.35 implying that majority of the respondents agreed on the statement; however, the answers were varied as shown by the standard deviation of 0.759. In regards to whether, Political interference enhances the influence of IMES Data management system on the performance of road projects; 33.6% of the respondents indicated to a very large extent, 38.2% indicated to a large extent and 28.2% indicated to a medium extent. The mean score for the statement was 4.05 which imply that majority of the respondents agreed with the statement; however, the answers were varied as shown by the standard deviation of 0.788. Additionally, 52.7% of the respondents indicated that Extreme weather enhances the influence of IMES data management system on the performance of road projects to a very large extent, 30% to a large extent and 17.3% to a medium extent. The mean score for the statement was 4.35 which imply that the respondents agreed with the statement to a very large extent. On whether security issues enhance the

influence of IMES data management system on the performance of road projects; 55.5% of the respondents indicated to a very large extent, 34.5% indicated to a large extent while 10% indicated to a medium extent. The mean score for the statement was 4.45 which imply that majority of the respondents agreed with the statement; however, the answers were varied as shown by the standard deviation of 0.672. The aggregate mean score for this section was 4.30 which imply that project risk and IMES project data management influences the performance of road projects to a large extent.

Table 2: Project Risks and IMES Project Data Management

Statement	No influence	Small extent	Medium extent	Large extent	Very large extent	Mean	Std. Deviation
Litigations enhance the influence of IMES Data management system on the performance of road projects.	0.0%	0.0%	17.3%	30.9%	51.8%	4.35	0.759
Political interference enhances the influence of IMES Data management system on the performance of road projects.	0.0%	0.0%	28.2%	38.2%	33.6%	4.05	0.788
Extreme weather enhances the influence of IMES Data management system on the performance of road projects.	0.0%	0.0%	17.3%	30.0%	52.7%	4.35	0.761
Security issues enhances the	0.0%	0.0%	10.0%	34.5%	55.5%	4.45	0.672

influence of IMES Data management system on the performance of road projects.							
Aggregate Score	0.0%	0.0%	18.2%	33.4%	48.4%	4.3	0.745

Project Performance

Table 3 presents descriptive statistics for road construction performance measured by eight constructs. Most of the respondents agreed to a large extent that IMES influences the performance of road construction projects in Kenya (mean score=4) and detailed in table 4.12

Table 3: Road Project Performance

Statement	Mean	Std. Deviation
Effective IMES improves on the efficiency and/or productivity and effectiveness of the road construction projects.	3.7636	.86658
Embracing IMES improves on resources utilization, benefits ratio and reduces maintenance costs and learning possibilities.	4.4182	.66886
Use of IMES reduces response time to incidents and complaints in road construction projects.	3.6364	1.34592
Effective IMES helps to track on investments protection on road construction projects	3.7455	1.10409
Effective use of IMES helps to improve on level of public acceptability or reduce opposition to road projects	3.7455	1.10409
Use of effect IMES improves on speed reliability, affordability, integration and satisfaction in road construction projects	3.6364	1.34592
Effective IMES reduces operating costs, increase welfare of communities and unit saving in fuel.	3.8727	1.29295
Embracing effective IMES helps in reducing design risks, promoting functionality and increasing designed life span of roads.	3.5455	1.05480

Correlation Analysis

The present study used Pearson correlation analysis to determine the strength of association between independent variable (project data management) and the dependent variable (performance of road project in Kenya). Pearson correlation coefficient range between zero and one, where by the strength of association increase with increase in the value of the correlation coefficients.

Table 4: Correlation Coefficients

		Project Performance	Project Data Management
Project Performance	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	110	
Project Data Management	Pearson Correlation	.866**	1
	Sig. (2-tailed)	.000	
	N	110	110

The results revealed that there is a very strong relationship between project data management and performance of road project in Kenya (r = 0.866, p value =0.000). The relationship was significant since the p value 0.000 was less than 0.05 (significant level). The findings conform to the findings of Van and Firdaus (2020) that there is a very strong relationship between project data management and project performance.

Test for Hypothesis One

The first objective of the study was to examine the relationship between IMES project data management and the performance of road projects in Kenya. The corresponding hypothesis was IMES project data management has no significance impact on performance of road projects in Kenya.

A univariate analysis was therefore conducted to test the null hypothesis. From the model summary findings in Table 5, the r-squared for the relationship between project data management and performance of road projects in Kenya was 0.271; this is an indication that at 95% confidence interval, 27.1% variation in performance of road projects in Kenya can be attributed to changes in project data management. Therefore, project data management can be used to explain 27.1% change in performance of road projects in Kenya. However, the remaining 72.9% variation in performance of road projects in Kenya suggests that there are other factors other than project data management that explain performance of road projects in Kenya.

Table 5: Model Summary for Project Data Management

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.458[a]	.210	.209	.68365

a. Predictors: (Constant), project data management

The analysis of variance was used to determine whether the regression model is a good fit for the data. From the analysis of variance (ANOVA) findings in Table 6, the study found out that that Prob>$F_{1, 108}$= 0.000 was less than the selected 0.05 level of significance. This suggests that the model as constituted was fit to predict performance of road projects in Kenya. Further, the F-calculated, from the table (28.55) was greater than the F-critical, from f-distribution tables (3.929) supporting the findings that project data management can be used to predict performance of road projects in Kenya.

Table 6: ANOVA for Project Data Management

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	15.643	1	15.643	28.55	.000[b]
1	Residual	59.13	108	0.548		
	Total	74.656	109			

a. Dependent Variable: performance of road projects in Kenya

b. Predictors: (Constant), project data management

From the results in table 7, the following regression model was fitted.

$$Y = 0.233 + 0.319 X_1$$

(X_1 is Project Data Management)

The coefficient results showed that the constant had a coefficient of 0.233 suggesting that if project data management was held constant at zero, performance of road projects in Kenya would be at 0.233 units. In addition, results showed that project data management coefficient was 0.319 indicating that a unit increase in project data management would result in a 0.319 increase in performance of road projects in Kenya. It was also noted that the P-value for project data management coefficient was 0.000 which is less than the set 0.05 significance level indicating that project data management was significant. Based on these results, the study rejected the null hypothesis and accepted the alternative that project data management has a positive and significant influence on performance of road projects in Kenya.

Table 7: Beta Coefficients for Project Data Management

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	0.233	.062		3.758	.000
1	project data management	0.319	0.082	0.318	3.890	0.000

a. Dependent Variable: performance of road projects in Kenya

Test for Hypothesis Two

The second objective of the study was to determine the moderating effect of project risks on the relationship between IMES and performance of road projects in Kenya. Moderation happens when the relationship between the dependent variable and the independent variables is dependent on a third variable (moderating variable). The effect that this variable has is termed as interaction as it affects the direction or strength of the relationship between the dependent and independent variable. To achieve the fifth research objective, the study computed moderating effect regression analysis. This (moderating effect regression analysis) also guided the study in testing the fifth research hypothesis. Project risks (M) was introduced as the moderating variable.

Ho_2: Project Risks has no significance moderating effect on relationship between Project Data Management and performance of road projects in Kenya.

From the model summary findings in Table 8, the first model for which is the regression between project data management (X) without moderator, project risks (M) and interaction, the value of R-squared was 0.356 which suggests that 35.6% change in performance of road projects in Kenya can be explained by changes in project data management. The p-value for

the first model (0.000) was less than the selected level of significance (0.05) suggesting that the model was significant. The findings in the second model which constituted project data management, project risks and performance of road projects in Kenya (X*M) as predictors, the r-squared was 0.621. This implies that the introduction of project risks in the second model led to a 0.265 increase in r-squared, showing that project risks positively moderates performance of road projects in Kenya.

Table 8: Model Summary for Moderation Effect

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.597[a]	.356	.357	.65170	.356	386.860	1	108	.000
2	.788[b]	.621	.620	.52727	.621	537.10	2	107	.000

a. Predictors: (Constant), project data management

b. Predictors: (Constant), project data management, project risks, Interaction (X*M)

From the model summary findings in Table 9, the F-calculated for the first model, was 281.996 and for the second model was 438.141. Since the F-calculated for the two models were more than the F-critical, 3.929 (first model) and 3.081 (second model), the two models were good fit for the data and hence they could be used in predicting the moderating effect of project risks on performance of road projects in Kenya.

Table 9: ANOVA for Moderation Effect

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	72.191	1	72.191	281.996	.000[b]
1	Residual	27.621	108	0.256		
	Total	99.812	109			
	Regression	111.287	2	55.644	438.141	.000[c]
2	Residual	13.621	107	0.127		
	Total	124.908	109			

a. Dependent Variable: performance of road projects in Kenya

b. Predictors: (Constant), project data management

c. Predictors: (Constant), project data management, project risks, Interaction

Further, by substituting the beta values as well as the constant term from the coefficient's findings for the first step regression modelling, the following regression model was fitted:

$$Y = 0.244 + 0.329X$$

Where X is Project data management

The findings show that when project data management is held to a constant zero, performance of road projects in Kenya will be at a constant value of 0.244. The findings also show that

project data management has a statistically significant effect on performance of road projects in Kenya as shown by a regression coefficient of 0.329 (p-value= .002).

By substituting the beta values as well as the constant term from model 2 emanating from the second step in regression modeling the following regression model was fitted:

Y= 0.297+ 0.281 X + 0.341 M + -0.354 X*M

Where X is project data management; M is project risks and X*M is the interaction term between project data management and project risks.

The findings show that when project data management, project risks, interaction (X*M) are held to a constant zero, performance of road projects in Kenya will be at a constant value of 0.297. The model also indicated that project data management had a positive and statistically significant effect on performance of road projects in Kenya as shown by a regression coefficient of 0.281 (p-value= 0.003). However, it is seen that project risks had a negative and significant effect on performance of road projects in Kenya as shown by a regression coefficient -0.341. On the other hand, interaction of project data management and project risks (X*M) also had a negative and insignificant effect on performance of road projects in Kenya as shown by a regression coefficient of -0.354 (p-value= 0.000).

It is therefore seen that project data management on its own has 28.1% effect on performance of road projects in Kenya. However, when interacted with project risks, it has an effect of -35.4%. This is a clear indication that introduction of project risks as moderating variable has a negative influence on performance of road projects in Kenya. The study therefore fails to reject the null hypothesis that project risks has no significant moderating effect on the relationship between project data management and performance of road projects in Kenya.

Table 4.1: Beta Coefficients for Moderation Effect

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.244	.063		3.873	.000
	project data management	.329	.088	.328	3.739	.002
2	(Constant)	0.297	0.079		3.759	.000
	project data management	.281	.073	.282	3.849	.003
	project risks	.-341	.091	.340	-3.747	.061
	Interaction (X*M)	.-354	.093	.255	-3.806	.062

a. Dependent Variable: performance of road projects in Kenya

Conclusions

The first null hypothesis test was 'IMES Project Data Management has no significance impact on performance of road projects in Kenya. The study found that project data management is statistically significant in explaining performance of road projects in Kenya. The influence was found to be positive. This means that unit improvement in project data management would lead to an increase in performance of road projects in Kenya. Based on the findings, the study

concluded that project data management positively and significantly influences performance of road projects in Kenya.

The second research hypothesis tested was that 'Project Risks has no significance moderating effect on relationship between IMES and performance of road projects in Kenya. The study found that project risks had a negative and significant effect on performance of road projects in Kenya. On the other hand, interaction of project data management and project risks (X*M) also had a negative and insignificant effect on performance of road projects in Kenya. It is therefore seen that project data management on its own has 28.1% effect on performance of road projects in Kenya. However, when interacted with project risks, it has an effect of -35.4%. This is a clear indication that introduction of project risks as moderating variable has a negative influence on performance of road projects in Kenya. The study therefore fails to reject the null hypothesis that project risks has no significant moderating effect on the relationship between project data management and performance of road projects in Kenya.

Recommendations

In addition, the study recommends that the management of road projects in Kenya should adopt a centralized digital data management system that ensures real-time access, accuracy, and consistency of project information across all stakeholders. By consolidating data such as project plans, budgets, progress reports, and geospatial information into a single, accessible platform, decision-making becomes more efficient and evidence-based.

In addition, the study recommends that the management of road projects in Kenya should embed proactive risk management protocols within the M&E framework. This involves identifying potential risks early in the project lifecycle and continuously assessing their likelihood and impact through the M&E system.

Recommendations for Further Studies

This study was limited to the relationship between project data management (IMES) and the performance of road project in Kenya hence the study findings cannot be generalized to performance of projects in other sectors in Kenya. The study therefore suggests further studies on the relationship between project data management on performance of projects in other sectors in Kenya.

REFERENCES

Abdi, A. H., & Kimutai, G. (2018). Monitoring and evaluation and performance of constituency development fund projects in Garissa County, Kenya. *International Academic Journal of Information Sciences and Project Management, 3*(2), 418–445.

Adu-Gyamfi, A., Poku-Boansi, M., Darpoh, L., Asibey, M. O., & Owusu-Ansah, J. K. (2023). Rainfall challenges and strategies to improve housing construction in Sub-Saharan Africa: The case of Ghana. *Housing Studies, 38*(7), 1155–1190.

Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Kennedy, I. B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities. *Ain Shams Engineering Journal, 11*(1), 225–230.

Amiril, A., Nawawi, A. H., Takim, R., & Latif, S. N. F. A. (2018). Sustainability factors and performance of construction projects. *Asian Journal of Quality of Life, 3*(9), 151–160.

Anigbogu, N. A., Ahmad, Z. B., & Molwus, J. J. (2019). Cost overruns on federal capital territory road construction projects. *FUTY Journal of the Environment, 13*(1), 1–14.

Baker, C. (2017). *Quantitative research designs: Experimental, quasi-experimental, and descriptive*.

Bhardwaj, P. (2019). Types of sampling in research. *Journal of the Practice of Cardiovascular Sciences, 5*(3), 157–163.

Brace, I. (2018). *Questionnaire design: How to plan, structure and write survey material for effective market research* (4th ed.). Kogan Page.

Bunea, O. I., Corbos, R. A., & Popescu, R. I. (2019). Influence of financial indicators on return on equity ratio in the Romanian energy sector: A competitive approach using a DuPont-based analysis. *Energy, 189*, 116251.

Choenni, S., Bargh, M. S., Busker, T., & Netten, N. (2022). Data governance in smart cities: Challenges and solution directions. *Journal of Smart Cities and Society, 1*(1), 31–51.

Cruz, R. D. D., & Polinar, M. A. N. (2023). Causes and mitigation schemes of project delays among selected construction companies. *International Journal of Multidisciplinary: Applied Business and Education Research, 4*(6), 1758–1766.

Deep, S., Banerjee, S., Dixit, S., & Vatin, N. I. (2022). Critical factors influencing the performance of highway projects: An empirical evaluation. *Buildings, 12*(6), 849.

Duvenage, P. C. (2019). *A conceptual framework for cyber counterintelligence* (Doctoral dissertation, University of Johannesburg).

Falcetelli, F., Yue, N., Di Sante, R., & Zarouchas, D. (2022). Probability of detection, localization, and sizing: The evolution of reliability metrics in structural health monitoring. *Structural Health Monitoring, 21*(6), 2990–3017.

Ghiara, V. (2020). Disambiguating the role of paradigms in mixed methods research. *Journal of Mixed Methods Research, 14*(1), 11–25.

Huo, T., Ren, H., Cai, W., Shen, G. Q., Liu, B., Zhu, M., & Wu, H. (2018). Measurement and dependence analysis of cost overruns in mega transport infrastructure projects. *Journal of Construction Engineering and Management, 144*(3).

Katushabe, D., Nakato, J., Kagoya, P., & Basuuta, S. (2022). *Designing a records disaster management plan for Lubaga Hospital* (Doctoral dissertation, Makerere University).

Kivilä, J., Martinsuo, M., & Vuorinen, L. (2017). Sustainable project management through project control in infrastructure projects. *International Journal of Project Management, 35*(6), 1167–1183.

Liu, C., Le Roux, L., Körner, C., Tabaste, O., Lacan, F., & Bigot, S. (2022). Digital twin-enabled collaborative data management. *Journal of Manufacturing Systems, 62*, 857–874.

Mohajan, H. K. (2017). Two criteria for good measurements in research: Validity and reliability. *Annals of Spiru Haret University, 17*(4), 59–82.

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative and qualitative approaches*. Acts Press.

Rahman, M. S. (2017). The advantages and disadvantages of using qualitative and quantitative approaches.

Staller, K. M. (2021). Qualitative sampling methods.

Taherdoost, H. (2016). Validity and reliability of the research instrument.

Turkmen, S., et al. (2019). Analysis of variance in statistical research.

Veal, A. J. (2017). *Research methods for leisure and tourism* (5th ed.). Pearson.

Vishnoi, S., et al. (2024). Discriminant validity in measurement models.

Wambui, P., & Mercy, K. (2019). Influence of ICT on management of road projects in Kenya.

Welime, K. (2019). Effectiveness of the National Integrated Monitoring and Evaluation System in Kenya.