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ABSTRACT

The purpose of the study was to investigate the effect of resource management on completion of road infrastructure projects in Kenya. The study specific objectives are to establish the effect of resource scheduling, capacity planning, resource monitoring and resource forecasting on completion of road infrastructure projects. The study is anchored on planning theory, resource dependence theory and systems theory. The study utilized cross-sectional research design. This study target population comprised project supervisors, technical staff of KURRA and supervising engineers involved in Kibwezi-Mutomo-Kitui road project. The unit of observation was 27 project supervisors of China Road and Bridge Corporation (CR&BC), 24 technical staff of KURRA directly involved with the project and 9 project contractors' representatives. Sample size of this study was 84 respondents derived using Slovins formula. Data was collected by use of questionnaires and recorded performance reports for the target projects. Pilot study was tested on the collected data to ascertain reliability and validity of data collection tools. Collected data was analysed quantitatively by use of SPSS version 26. Data analysis techniques employed in the study are descriptive statics and inferential statistics. Analyzed data was presented in form of tables and charts where applicable. The study results revealed that resource scheduling, capacity planning, resource forecasting and resource monitoring has significant effect on completion of road infrastructure projects in Kenya. The study concludes that resource scheduling has significant effect on completion of road infrastructure projects in Kenya. Project managers have the ability to successfully reorganize tasks and resources, achieving objectives even under limited resources and budget constraints. Also a detailed approach to project planning is evident, as project parts are routinely broken down into individual tasks. The study recommends that the project should develop clearer guidelines and protocols specifying when and how audits and reviews should be conducted. Also the project should standardize procedures to ensure consistency across all project phases.

Key Words: *Resource Scheduling, Capacity Planning, Resource Monitoring, Resource Forecasting*

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INTRODUCTION

World over, road infrastructure projects environment forms the single most challenging and dynamic undertakings (Kiara, 2018). This is because the road constructions are usually major infrastructural projects that take a long period of time to be completed and command significant investments. Due to the size and complexity of the road project, substantial resources must be allocated to these initiatives (Musyoki, 2018). This has led to a series of problems with resources, including those related to the needed quantity, sources, scheduling, storage, and best use of the resources as well as the demobilization period for the resources (Kerzner & Kerzner, 2019). Road infrastructure projects are important because they contribute to economic growth both directly and indirectly (Khadaroo & Seetanah, 2020). Furthermore, according to Abhinaya and Nidhu (2017), road building projects frequently deal with a great deal of uncertainty, putting them at risk for scope reduction, poor quality delivery, and cost and time overruns.

In Italy, according to Calamai (2017), the governance of road infrastructure has been hampered by numerous financial resource issues as well as differences in financial support for road infrastructure projects across different regions, leaving 15% of regions with road infrastructural issues while others have an adequate supply. In the last three decades, India's rise from a least developed to a middle developed country was largely attributed to the large-scale road infrastructure investments.

In South Africa, according to Nokulunga, Mashwama, and Mushatub (2018), road construction issues are one of the most often occurring issues in South Africa's construction sector. Numerous projects encounter significant difficulties as a result of going over budget and running over schedule due to changes in the scope and procurement method. The results of Ndayisaba and Mulyungi's (2018) study in Rwanda, which looked at the impact of resource management on project success implementation, showed that resources management had an impact on improving rural Muhanga district livelihoods. Additionally, Umulisa, Mbabazize, and Shukla's (2019) investigation of the effects of project resource planning practices on the Agaseke Project in Kigali, Rwanda, discovered a substantial positive link between all of the practices examined and project performance.

In Kenya, due to its 10% contribution to the Gross National Product, road construction is essential to the nation's development (GNP). High-quality road connectivity lowers transportation costs and increases investment profitability (Chakrabarti, 2018). Despite the widely acknowledged advantages of expanding the road network, the majority of road construction projects in Kenya are neither finished on time nor within the allocated budget. It has been stated that more than 70% of Kenya's road development projects experience completion time and expense delays (Kihara, 2018). According to Seboru (2018), the majority of road development projects in the nation rarely get finished on time. For instance, the Thika Superhighway project was delayed by more than a year even though the budgeted amount was surpassed by Kenya Shillings 7 billion (Kagiri & Wainaina, 2017). Project delays hinder development, have enormous economic costs for society, and can damage the reputations of those who are involved in carrying out the projects.

Kitui County has witnessed sporadic road expansion initiatives in the last six years. However, the majority of these road projects incur cost overruns because they are not finished on schedule. The numerous road projects that haven't been finished on time are evidence of this. Even worse are those road projects that are ultimately completed but at a higher cost and a date that was not originally scheduled. A well-known example is the US $182 million Kibwezi-Mutomo-Kitui road project, which was supposed to be finished in fifteen months but took twenty-five and incurred significant cost overruns due to changes in scope and price

variations. There were difficulties with acquiring land for the project. Other county road projects are finished, however the workmanship is of very low quality (Kenya Engineer Magazine, 2015).

According to the Institute of Certified Public Accountants of Kenya's Devolution Baseline Survey from 2014, many counties report having inherited subpar infrastructure, which prevents them from carrying out their duties effectively. As one of the five counties with less than 15% infrastructure expansion, which has an impact on the county's growth and development, Kitui County is not an exception. According to Manowang and Ogunlana (2010), the lack of community involvement, the contractors' lack of capacity, and the availability of funds are the main causes of the delays, subpar service delivery, and cost overruns typical of road construction projects.

Statement of the Problem

Road infrastructure projects are recognized as critical drivers of economic growth globally, regionally, and locally. At the global level, the challenge of completing road infrastructure projects on time and within budget has been widely documented, with material resource management identified as a key factor in project performance (World Bank, 2019). Regionally, studies from sub-Saharan Africa reveal persistent delays and budget overruns in road construction, particularly in resource-constrained environments where material management inefficiencies are prevalent (AfDB, 2018). Despite Africa's growing infrastructure investment, the region continues to face significant gaps in the successful completion of road projects, largely due to ineffective resource planning and forecasting.

In Kenya, road infrastructure is a cornerstone of the national development agenda, as highlighted in Vision 2030, which underscores the importance of a robust road network for economic growth (GoK, 2017). However, similar to global trends, Kenya faces chronic delays and budget escalations in road projects. Over 70% of road construction projects in the country experience significant time and cost overruns (Edriss & Chiunda, 2017). For instance, the Nairobi Expressway's budget ballooned from KES 62.5 billion to KES 72.8 billion, with a KES 7.6 billion increase attributed to resource management challenges (Kimuyu, 2021). Despite ongoing government investment, approximately 55% of road projects fail to meet completion timelines or quality standards, pointing to gaps in material resource management (Macharia, 2016).

Empirical studies on project performance in Kenya, such as those by Beldinne and Gachengo (2022) on stakeholders' resource management in Siaya County and Ondieki and Makhokha (2018) on project planning in Uasin Gishu, emphasize project management practices. However, there is a limited understanding of how specific material resource management components, such as scheduling, capacity planning, forecasting, and monitoring, affect the completion of road infrastructure projects. This presents a significant local and contextual gap, particularly for large-scale projects like the Nairobi Expressway. Furthermore, existing research primarily focuses on general project management without delving deeply into the material resource dimension, signaling a conceptual gap. To address the identified gaps, this study sought to examine the effect of material resource scheduling, material capacity, material resource forecasting, and material resource monitoring on the completion of road infrastructure projects in Kitui County, Kenya.

Objectives of the Study

The general objective of the study is to examine the effect of material resource management on completion of road infrastructure projects in Kitui County, Kenya. The specific objectives of this study include:

- To investigate the effect of material resource scheduling on completion of road infrastructure projects in Kitui County, Kenya.
- To determine the effect of material capacity planning on completion of road infrastructure projects in Kitui County, Kenya.

- To evaluate the effect of material resource forecasting on completion of road infrastructure projects in Kitui County, Kenya.
- To assess the effect of material resource monitoring on completion of road infrastructure projects in Kitui County, Kenya.

LITERATURE REVIEW

Theoretical Review

Systems Theory

In the context of material resource scheduling, systems theory suggests that if this subsystem fails—perhaps due to poor planning or inadequate communication—delays and budget overruns are inevitable, as inefficiencies in one part of the system disrupt the entire project timeline. Similarly, material capacity planning is critical to ensuring that the right amount of resources is available when needed. Systems theory underscores that failure in this area can jeopardize the entire project, causing shortages or wastage, which in turn lead to cost escalations.

Material resource forecasting also aligns with systems theory, as effective forecasting helps to predict future resource needs, thereby ensuring that projects do not face disruptions due to unforeseen shortages. If this subsystem fails, the entire project may face delays, as there is insufficient foresight into the resources required for project completion. Lastly, material resource monitoring ensures that resources are being utilized as planned and adjustments can be made if deviations occur. According to systems theory, monitoring acts as a feedback mechanism, helping the system to self-regulate and avoid failures that could affect project performance. Thus, the application of systems theory to the variable of material resource scheduling illustrates how these subsystems must operate synergistically to ensure the successful completion of road infrastructure projects in Kenya.

Planning Theory

The PMBOK Guide provides a comprehensive description of the planning theory of projects from the standpoint of several knowledge areas. The planning processes are divided into supporting processes and core procedures. Gregory, Lauri, and Koskela (2002). There are ten main processes: planning the scope, defining the scope, defining the activities, allocating resources, sequencing the activities, estimating the duration of the activities, estimating the costs of the activities, estimating the schedule, allocating the costs, and developing the project plan. The project plans that are the result of these processes serve as an input to the processes that carry out the projects.

The theory is crucial to this subject because the ability of an organization to gather, modify, and exploit resources might be crucial to success. Resources are frequently in the control of entities other than the organization that needs them, so solutions for preserving open access to resources must be properly thought out. The theory is significant in this research because the ability of an organization to gather, modify, and utilize resources can be critical to success.

Resource Dependence Theory

However, there are those who disagree with the theory, such as Fapohunda and Stephenson (2010), who claim that some organizations have succeeded despite lacking resources, demonstrating the need to take into account additional factors like management effectiveness, organizational culture, and the implementation of suitable strategies. Even if these criticisms are valid given the theory's general premises, it is crucial to remember that having the necessary resources must be combined with other enablers like having a positive work atmosphere and a sound plan.

The resource dependency theory is extremely pertinent to this study since it gave researchers a theoretical knowledge of how the availability of resources affects an organization's capacity to complete a project, in this case, road construction

projects. Finances, the quality of human resources, and the accessibility of supplies and equipment are some of the crucial resources that have been recognized as being essential to the success of road construction projects. Similar to this, successful completion of such projects will depend on whether the government has the necessary resources in terms of people and technical capability to carry out effective and efficient monitoring and evaluation of road construction projects.

Conceptual Framework

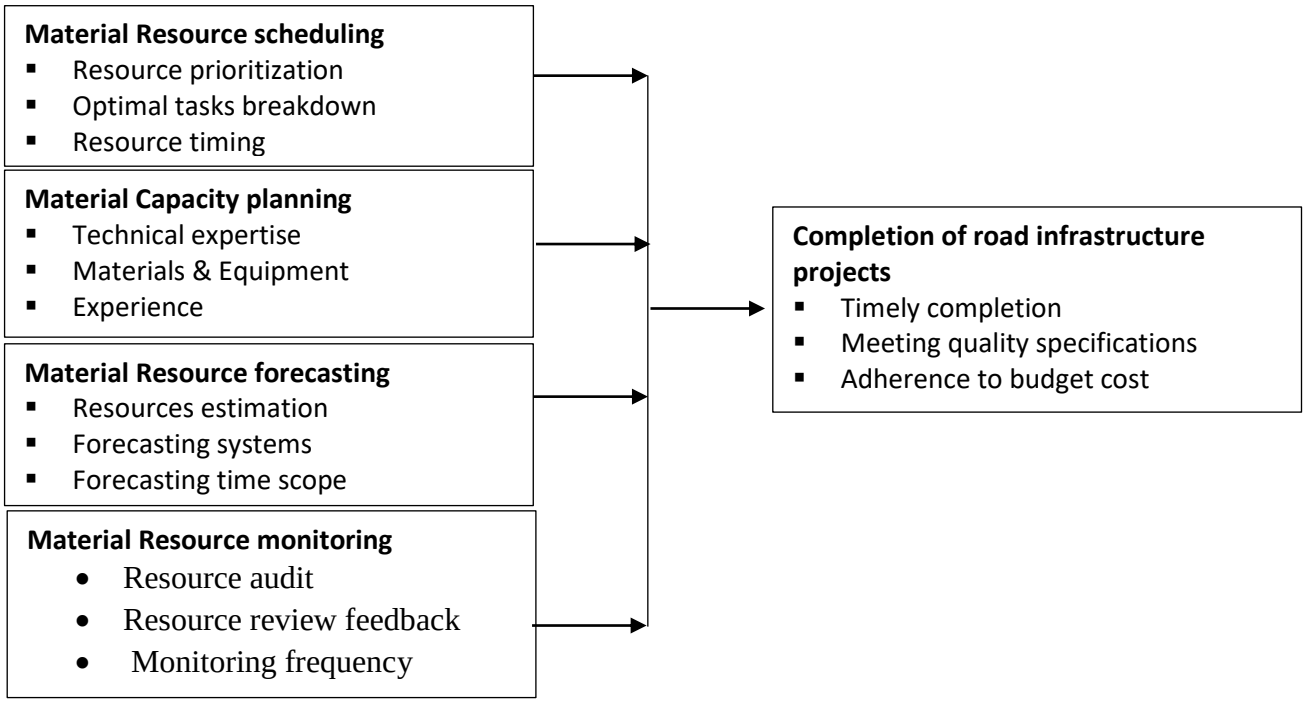

Figure 1: Conceptual Framework

Empirical Review

Dong, Li, Zhao, Li, and Yan (2016) conducted an analysis of resource scheduling in projects using many software. The research used a comparative study approach. The evaluation found that resource scheduling was essential for creating project schedules that worked in addition to increasing resource utilization. It was underlined that improper resource scheduling will lead to ineffective project resource utilization and increased expenditures. The positioning of schedules within project activities, such as the dates for starting and finishing the tasks and the resources needed to complete them, according to the research, allowed for a better understanding of how the project should be performed. However, the contextual setting of this study varies from the one being focused. Also this study utilized comparative design of study, which varies from the descriptive one being relied upon.

Lamka and Masu (2018) assessed how much resource scheduling affected the success of construction enterprises in the county of Nairobi. A mixed approaches approach was used. It was emphasized that poor resource scheduling led to project teams allocating utilities at the wrong times and in the wrong places. It was discovered that when resource scheduling was done, it was simpler for project managers to rearrange project tasks and resources in order to meet the project's primary quality, time, and cost objectives within a tight budget and when resources were insufficient. However, this study focused on construction projects carried out by private developers which are carried out in different contextual factors from that

those of the county of Wajir hence findings cannot be automatically generalized.

In their 2017 study, Murithi, Makokha, and Otieno evaluated the elements that determine how quickly public building projects in Kenya's Trans-Nzoia county are completed. The research design was a descriptive survey. Results showed that resource distribution within the project had a substantial impact on the timely completion of public construction projects. The success of the project was impacted by adequate resource allocation. Projects were actually delayed as a result of financial difficulties and late payments for completed work. Construction material procurement was delayed due to a lack of sufficient resources. However, the contextual setting of this project varies from the one being focused and only looks at one aspect of project performance which is time performance contrary to the current one which looks at other aspects of delivery of projects such as cost and quality.

The impact of resource management techniques on the timely completion of road projects carried out by the County Government of Kakamega County, Kenya, was examined by Koyi, Miroga, and Otinga (2021). In this study, a descriptive survey design was used. Stratified random sampling was used to choose the sample. A structured questionnaire was used to collect the initial data. Statistical Package for Social Sciences was used to analyze quantitative data using descriptive and inferential statistics. A multiple linear regression model helped to identify relationships between resource management methods and the effectiveness of road improvements in the county of Kakamega. The timely completion of road improvements carried out by the County Government of Kakamega was shown to be significantly and positively impacted by resource planning as well as resource scheduling.

In Wajir County, Kenya, Abdi (2020) conducted study on resource management techniques and the effectiveness of road development projects. The research used a descriptive survey approach. 193 project stakeholders who were involved in the 47 significant road projects carried out by the county government in the sub-counties of Wajir North, Wajir East, and Wajir South between 2013 and 2017 were the intended audience. Stratified random sampling was used to choose the sample. Using semi-structured questionnaires, primary data were gathered. Statistical Package for Social Sciences was used to analyze quantitative data using descriptive and inferential statistics. The performance of road projects in Wajir County was linked to resource management techniques, according to a multiple linear regression model. It was discovered that the activities of resource planning, scheduling, allocation, and monitoring had a favorable and significant impact on project performance.

METHODOLOGY

The research design used in this study was cross-sectional research design. A cross-sectional study is a style of research design in which you gather information from a large number of individuals all at once. You observe variables in cross-sectional research without changing them (Kothari, 2014). The research design has been used successfully by (Lamka and Masu, 2018; Murithi, Makokha, and Otieno, 2017; Koyi, Miroga, and Otinga, 2021 in their studies on resources management.

The Kibwezi-Mutomo-Kitui road projects was the study's unit of analysis whereas the project managers, KURRA technical staff members, and supervisory engineers participating in the Kibwezi-Mutomo-Kitui road project was the study's unit of observation

A sample is a group of people chosen at random from a population with the intention of representing that population in a research study (Neumann, 2016). Therefore, stratified sampling was used in the study. Project managers, KeNHA representatives, and contractors will make up the stratum.52 participants made up the study's sample, which was determined using Slovin's formula.

Primary data was used in the investigation. A semi-structured questionnaire with closed-ended

questions was used to gather the primary data. According to Kothari (2014), primary data are those that are gathered from scratch and for the first time, making them unique by nature. Closed-ended questions have the main benefit of being simpler to analyze because they may be used right away. Because other answers are provided for each item, they are also simple to administer and inexpensive (Kothari, 2014).

For high accuracy pilot studies, the pilot test size should range from 1% to 20% of the sample (Lancaster, Dodd & Williamson, 2015). For the purposes of this study, a pilot test was carried out utilizing questionnaires that were only be given to 20% of the study's sample size. Ten questionnaires would result from this.

As a data analysis tool, the Statistical Package for Social Sciences (SPSS) version 29 was used to code and analyze the acquired data. Both descriptive and inferential data analysis methods were applied in this investigation. Measures of central tendencies and measures of dispersion will be determined using descriptive statistics (mean and standard deviation). To determine whether the strength of the link between the independent factors and the dependent variable is statistically significant, regression analysis was used

FINDINGS AND DISCUSSION

Response Rate

The researcher distributed 52 questionnaires and 50 respondents filled and returned the questionnaires making a response rate of 96.2% as shown in Table 1.

Table 1: Response Rate

Questionnaires	Frequency	Percentage
Response	50	96.2
Non-response	02	3.8
Total	**52**	**100%**

Table 1, indicated that 50 questionnaires were duly filled and returned representing 96.2%. This indicated high level of respondents' cooperation during the exercise. For an effective representative, this response rate was sufficient. According to Mugenda & Mugenda (2013), a response rate of 50% is sufficient for analysis and reporting, 60% is good, and 70% and more is exceptional. According to the comments, the study was excellent.

Descriptive Analysis of Study Variables

Descriptive analysis was conducted on the study variables to check the mean and standard deviation. The results are presented in the following tables.

Resource Scheduling

The researcher asked respondents to rate their agreement or disagreement on the various aspects of resource scheduling. They were required to do this on a 5 point Likert scale where 1 represented Strongly disagree while 5 represented Strongly agree. The results are presented in Table 2.

Table 2: Resource Scheduling

	Mean	Std. Deviation
The resources available are always considered throughout the process of scheduling when implementing road projects	4.98	.325
There is efficient assignment of resource to different project activities throughout road project cycles	4.16	.708
Project managers have always successfully reorganized road project tasks and resources so as to achieve project objectives under limited resources and budget constraints	4.11	.616
We break down each project part in to individual tasks	4.79	.552

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The results in Table 2have shown that respondents agreed to the large extent that the resources available are always considered throughout the process of scheduling when implementing road projects as shown by a mean of 4.98 and standard deviation of 0.325. Also respondents agreed to the statement that there is efficient assignment of resource to different project activities throughout road project cycles (mean = 4.16, std. dev = .708) and that project managers have always successfully reorganized road project tasks and resources so as to achieve project objectives under limited resources and budget constraints (mean = 4.11). In addition, results showed that respondents agreed to large extent that they break down each project part in to individual tasks as shown by a mean of 4.79. The results agree with Abdi (2020) whose study revealed that resource scheduling has significant impact on project performance.

Capacity Planning

The study respondents were asked to rate their agreement or disagreement on the various aspects of capacity planning. They were required to do this on a 5 point Likert scale where 1 represented Strongly disagree while 5 represented Strongly agree. The results are presented in Table 3.

Table 3: Capacity Planning

	Mean	Std. Deviation
The project manager assembles personnel with technical expertise prior to project commencement	4.86	.217
The project requirements in terms of materials and equipment is planned priori	4.79	.135
The project managers engage the contractors with prior experience	4.93	.214
There is centralization and gathering relevant information on resource availability	4.12	.966

The results in Table 3 have shown that respondents agreed to the great extent that the project manager assembles personnel with technical expertise prior to project commencement (mean = 4.86). Results also showed that respondents agreed to the statement that The project requirements in terms of materials and equipment is planned priori (mean = 4.79) and that the project managers engage the contractors with prior experience as indicated by a mean of 4.93. Respondents were in agreement with the statement that there is centralization and gathering relevant information on resource availability (mean = 4.12, std. deviation = .966).

Resource Forecasting

The study respondents were asked to rate their agreement or disagreement on the various aspects of resource forecasting. They were required to do this on a 5 point Likert scale where 1 represented Strongly disagree while 5 represented Strongly agree. The results are presented in Table 4.

Table 4: Resource Forecasting

	Mean	Std. Deviation
The project resources are estimated priori	4.98	.283
The institution has dynamic resource forecasting systems	4.14	1.007
The resources forecasting time scope is well articulated	4.27	.656
The forecasting function is undertaken based on historical information available	4.01	1.292

The results in Table 4 have shown that respondents agreed to the statement that the project resources are estimated priori and that the institution has dynamic resource forecasting systems as indicated by a mean of 4.98 and 4.14 respectively. Respondents also were in agreement to the statement that the resources forecasting time scope is well articulated and that the forecasting function is undertaken based on historical information available as indicated by a mean of 4.27 and 4.01 respectively.

Resource Monitoring

The study respondents were asked to rate their agreement or disagreement on the various aspects of resource monitoring. They were required to do this on a 5 point Likert scale where 1 represented Strongly disagree while 5 represented Strongly agree. The results are presented in Table 5.

Table 5: Resource Monitoring

	Mean	Std. Deviation
The institution has a recognized framework and tools for monitoring the use of resources in executing road projects	4.77	.410
There is continuity in inspecting the physical and financial progress of road projects against established resource plans	4.56	.296
Project supervisors give emphasis to auditing and reviewing the use of road project resources at frequent intervals and on a timely basis	3.44	1.022
Results and feedback from road project resource audits and reviews are always provided on time	4.56	.879

The results in Table 5 have shown that respondents agreed to the statement that the institution has a recognized framework and tools for monitoring the use of resources in executing road projects (mean = 4.77). Also results revealed that respondents were in agreement to the statement that there is continuity in inspecting the physical and financial progress of road projects against established resource plans as indicated by a mean of 4.56. Respondents were indifferent to the statement that project supervisors give emphasis to auditing and reviewing the use of road project resources at frequent intervals and on a timely basis as shown by a mean of 3.44 and standard deviation of 1.022. Finally, respondents agreed to the statement that results and feedback from road project resource audits and reviews are always provided on time (mean=4.56).

Project Completion

The study respondents were asked to rate their agreement or disagreement on the various aspects of project completion. They were required to do this on a 5 point Likert scale where 1 represented Strongly disagree while 5 represented Strongly agree. The results are presented in Table 6.

Table 6: Project Completion

	Mean	Std. Deviation
The road projects are completed on time planned	2.56	.320
The road projects are completed within the planned budget	2.84	.632
The road projects are completed within the set project schedule	2.60	.525
Road construction projects are done to the satisfaction of shareholders	4.99	.667

The results in Table 6 have revealed that respondents disagreed to the statement that the road projects are completed on time planned as shown by a mean of 2.56. Further, respondents disagreed to the statement that the road projects are completed within the planned budget (Mean=2.84) and that the road projects are completed within the set project schedule as indicated by a mean of 2.60 and standard deviation of .525. Respondents were in agreement with the

statement that road construction projects are done to the satisfaction of shareholders (mean=4.99).

Correlation Analysis Results

Correlation analysis was done to determine the correlation between the materials resource management and project completion using the Pearson's product moment correlation analysis. The results are shown in Table 7.

Table 7: Correlation Results

		Resource scheduling	Capacity planning	Resource forecasting	Resource monitoring	Project completion
Resource scheduling	Pearson Correlation	1				
	Sig. (1-tailed)					
	N	50				
Capacity planning	Pearson Correlation	.418	1			
	Sig. (1-tailed)	.021				
	N	50	50			
Resource forecasting	Pearson Correlation	.176*	.276	1		
	Sig. (1-tailed)	.041	.028			
	N	50	50	50		
Resource monitoring	Pearson Correlation	.182*	.358	.255	1	
	Sig. (1-tailed)	.036	.057	.093		
	N	50	50	50	50	
Project completion	Pearson Correlation	.518	.497*	.404	.321	1
	Sig. (1-tailed)	.000	.031	.005	.000	
	N	50	50	50	50	50

*. Correlation is significant at the 0.05 level (1-tailed).

From the bivariate correlation results, it was established that resource scheduling had the highest correlation with project completion as shown by correlation coefficient of 0.518 and p-value<0.05. This was followed by the correlation between capacity planning and project completion with correlation coefficient of 0.497 and p-value<0.05. Correlation between resource forecasting and project completion was significant at r = 0.404 and correlation between resource monitoring and road projects completion (r=0.321) was the least correlation coefficient of all considered variables.

Diagnostic Tests

The data collected using the research questionnaire was subjected to two diagnostic tests, that is, normality, and multi-collinearity test. The fact that the collected data were categorical (precisely, ordinal) informed the aforesaid diagnostic tests.

Test of Normality

The assumption was tested using Shapiro-wilk test. Findings are as shown in Table 8.

Table 8: Test of Normality

	Shapiro-Wilk		
	Statistic	Df	Sig.
Project completion	.794	11	.118

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The p-value was .118 which implies that residuals assumed a normal distribution.

Test of Multi-collinearity

Multi-collinearity in the study was assessed through the use of tolerance and Variance Inflation Factor (VIF), as outlined by Kim (2019). Tolerance for each independent variable was determined using the formula 1 - R^2, while the reciprocal of tolerance is referred to as Variance Inflation Factor (VIF). The presence of multi-collinearity is indicated when the VIF exceeds 5 and the tolerance value falls below 0.2. The findings are detailed in Table 9.

Table 9: Test of Multi-collinearity

	Collinearity Statistics	
Study Constructs	**Tolerance**	**VIF**
Resource scheduling	.818	1.411
Capacity planning	.796	1.092
Resource forecasting	.784	1.324
Resource monitoring	.811	1.293

a. Dependent Variable: Project completion

Based on the results presented in Table 9, all four independent variables—resource scheduling (VIF = 1.411), capacity planning (VIF = 1.092), resource forecasting (VIF = 1.324), and resource monitoring (VIF = 1.293)—exhibited VIF values well below 5. This suggests that there were no significant issues of multi-collinearity detected in the study. As highlighted by Kimaku (2021), the mean centering of data helps eliminate the potential for multi-collinearity in a given dataset. This was accomplished by subtracting the means of each individual variable from the overall mean.

Multiple Regression Analysis Results

The data was used to regress project completion on material resource management constructs. The results of regression analysis are presented as follows.

Table 10: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.653[a]	.426	.369	.27417

a. Predictors: (Constant), Capacity planning, Resource scheduling, Resource monitoring, Resource forecasting

The regression results in Table 10, showed a moderate regression between the study variables. In the model summary, the R^2 is 0.426 indicating that predictors explain 42.6 per cent change in project completion in road construction projects.

Table 11: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.911	4	3.977	8.552	.000[b]
	Residual	21.407	46	.465		
	Total	37.318	50			

a. Dependent Variable: Project completion

b. Predictors: (Constant), Capacity planning, Resource scheduling, Resource monitoring, Resource forecasting

From the Analysis of Variance results in Table 11, it was established that the significance value in testing the validity of the model was obtained as 0.000 which is less than 0.05, the critical value at 99% significance level. Therefore, the model is statistically significant in predicting the relationship between the study variables.

Table 12: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.975	.716		2.758	.000
	Resource scheduling	.489	.232	.314	2.108	.026
	Capacity planning	.416	.197	.291	2.112	.021
	Resource forecasting	.367	.139	.082	2.640	.011
	Resource monitoring	.253	.095	.028	2.663	.005

a. Dependent Variable: Project completion

The optimal regression model is:

Project completion = $1.975 + .489X_1 + .416X_2 + .367X_3 + .253X_4$

The regression results showed that independent variables had significant value less than 0.05 implying that they are all significant. From the results, it showed that holding all factors constant at zero, the change in project completion would be 1.975. Further, the regression results showed that a unit change in resource scheduling, on average, would lead to 0.489 unit change in project completion. Further, regression results showed that a unit change in capacity planning, on average, would lead to 0.416 unit change in project completion. A unit change in resource forecasting, on average, would lead to 0.367 unit change in project completion and a unit change in resource monitoring, on average, would lead to 0.253 unit change in project completion.

Discussion of Key Findings

The first objective of the study sought to determine the effect of resource scheduling on completion of road infrastructure projects in Kenya. Regression analysis conducted proved that there was a positively significant effect of resource scheduling and project completion as indicated by the values $\beta_1 = 0.489$, $p<0.05$. The study concludes that a unit change in resource scheduling, on average, would lead to 0.489 unit change in project completion. On hypothesis test, since p-value is less than 0.05, null hypothesis that there is no significant effect of resource scheduling on completion of road infrastructure projects in rejected. The results agree with Abdi (2020) whose study revealed that resource scheduling has significant impact on project performance.

The second objective of the study sought to establish the effect of capacity planning on completion of road infrastructure projects in Kenya. Regression analysis conducted proved that there was a positively significant effect of capacity planning on completion of road infrastructure projects as indicated by the values $\beta_2 = 0.416$, $p<0.05$. The study concludes that a unit change in capacity planning, on average, would lead to 0.416 unit change in project completion. On hypothesis test, since p-value is less than 0.05, null hypothesis that there is no significant effect of capacity planning on completion of road infrastructure projects in rejected.

The third objective of the study sought to examine the effect of resource forecasting on completion of road infrastructure projects in Kenya. Regression analysis conducted proved that there was a positively significant effect of resource forecasting on completion of road infrastructure projects as indicated by the values $\beta_3 = 0.367$, $p<0.05$. The

study concludes that unit change in resource forecasting, on average, would lead to 0.367 unit change in project completion. On hypothesis test, since p-value is less than 0.05, null hypothesis that there is no significant effect of resource forecasting on completion of road infrastructure projects in rejected.

The study sought to determine the effect of resource monitoring on completion of road infrastructure projects in Kenya. Regression analysis conducted proved that there was a positively significant effect of resource monitoring on the dependent variable as indicated by the values β_4 = 0.253, $p<0.05$. The study concludes that a unit change in resource monitoring, on average, would lead to 0.253 unit change in project completion. On hypothesis test, since p-value is less than 0.05, null hypothesis that there is no significant effect of resource monitoring on completion of road infrastructure projects in rejected.

CONCLUSION AND RECOMMENDATIONS

The study concludes that resource scheduling has significant effect on completion of road infrastructure projects in Kenya. It is concluded that in road project implementation Resources are consistently considered throughout the scheduling process, ensuring resource availability shapes planning. The study concludes that there is efficient assignment of resources to different project activities, optimizing resource use across project cycles. Project managers have the ability to successfully reorganize tasks and resources, achieving objectives even under limited resources and budget constraints. Also a detailed approach to project planning is evident, as project parts are routinely broken down into individual tasks.

The study concludes that capacity planning has significant effect on completion of road infrastructure projects in Kenya. Based on the descriptive analysis provided, the study concludes that project managers place a high emphasis on assembling a technically competent team early in the project lifecycle. Also it is concluded that there is a strong emphasis on advance planning for materials and equipment to ensure project readiness. There is a centralized approach to gathering and managing information on resource availability.

The study concludes that resource forecasting has significant effect on completion of road infrastructure projects in Kenya. The study concludes that the project integrates proactive planning, sophisticated forecasting tools, well-defined timelines, and historical data to optimize resource allocation. It is concluded that the project prepares and allocates resources in advance, ensuring preparedness for project demands. Also there is dynamic resource forecasting systems suggests the use of advanced, adaptable tools. The resource forecasting time scope is well articulated, implying that the institution establishes specific and clear timeframes for its forecasting activities.

The study concludes that resource monitoring has significant effect on completion of road infrastructure projects in Kenya. The project has a formal and established system designed to oversee resource utilization, providing a solid foundation for effective project management. Also the project has continuity in inspecting both the physical and financial progress of road projects against established resource plans. However, despite the existence of a monitoring framework, audits and reviews may not be conducted as regularly or promptly as needed.

The study recommended that project managers should invest in advanced resource planning tools that provide real-time visibility into resource availability, usage, and constraints. Such tools can enable dynamic updates to project schedules, ensuring that resource considerations remain accurate and relevant throughout the project lifecycle. Additionally, conducting regular resource availability reviews at key project milestones is recommended. These reviews can proactively identify potential shortages or surpluses, allowing teams to adjust schedules or reallocate resources in a timely manner.

Based on the results, it is recommended to implement a robust inventory management system that tracks materials and equipment in real-time. This system could predict future needs based on project schedules, automate reordering to avoid delays, and provide alerts for potential shortages. Furthermore, strengthening relationships with suppliers through long-term contracts or preferred supplier agreements can secure priority access to critical resources during high-demand periods. These steps will minimize disruptions and reinforce the organization's ability to execute projects seamlessly.

The study recommends that the project should invest in the latest forecasting technologies and software that offer advanced insights and automation capabilities. This will ensure the project stays at the forefront of resource forecasting. Also the project should provide regular training for the team on these tools to maximize their potential. The project management should implement flexible scheduling techniques to make timelines more adaptable to changes. This will allow the project to respond quickly to unexpected events while maintaining clear timeframes.

The study recommends that the project should develop clearer guidelines and protocols specifying when and how audits and reviews should be conducted. Also the project should standardize procedures to ensure consistency across all project phases. The project should establish a fixed schedule for audits and reviews, aligned with key project milestones (e.g., completion of project phases or significant resource expenditures). Audits should be conducted at critical points to enable timely identification and resolution of issues. Auditing activities should be prioritized within the project budget and timeline to prevent them from being overshadowed by other priorities. This will ensure that audits are not constrained by resource shortages, enabling their consistent execution.

Recommendation for Further Research

The scope of this study was limited to material resource management in the context of roads infrastructure projects in Kenya. However, the coefficient of determination (r^2) revealed that material resource management indicators only explained 42.6% change in project completion. Therefore, other studies should be done to determine the other material resource management constructs not factored in the current study and explore them to establish their effect on project completion not only in road infrastructure projects but also in other projects.

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