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EFFECT OF PROJECT SCHEDULING ON PERFORMANCE OF INFRASTRUCTURE PROJECTS IN RWANDA: A CASE STUDY OF KIGALI INFRASTRUCTURE PROJECT

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ABSTRACT

This study investigates the relationship between project schedule management practices and the performance of Kigali infrastructure project in Rwanda. Specifically, the study focused on tasks dependence mapping, project tasks definition, scheduling procedures communication and project resourcing planning on performance of construction projects in Rwanda. The study focused on a target demographic consisting of 314 engineers employed at KIP who specialize in road construction. The collection of primary data was facilitated by the administration of questionnaires. The test-retest methodology was utilized in order to ascertain the reliability of the measurements. The Cronbach's coefficient was employed to evaluate the reliability of the instruments. Primary data was collected using a structured questionnaire, and descriptive statistics were employed to evaluate the data. Descriptive statistical tests comprise several measurements, including percentages, frequencies, and counts, which are used to summarize and describe data. On the other hand, inferential statistical tests involve the application of multiple regression. The results show that Project Resourcing Planning has the strongest positive relationship with project performance (B = 0.472, Beta = 0.548), followed by Project Tasks Definition (B = 0.228, Beta = 0.266) and Task's Dependence Mapping (B = 0.184, Beta = 0.213). In contrast, Scheduling Procedures Communication has a negative relationship with project performance (B = -0.132, Beta = -0.136), indicating that poor communication in scheduling negatively affects project outcomes. In conclusion, the study reveals that task dependence mapping, project tasks definition, scheduling procedures communication, and project resourcing planning significantly influence road construction project performance, with resourcing planning having the strongest positive impact. It is recommended that project managers prioritize improving resource planning and task definition while addressing communication challenges in scheduling to enhance overall project outcomes. Future studies should explore the integration of advanced technologies like AI in scheduling and resourcing.

Keywords: *Project schedule management, Infrastructure projects, Kigali Infrastructure Project, Resource planning, Construction performance.*

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INTRODUCTION

In the worldwide construction sector, a prevalent concern arises whereby projects often exceed their originally allocated expenditures. Road construction industry plays a pivotal role in global economic development, contributing significantly to Gross Domestic Product (GDP) and employment in numerous countries (Li *et al.,* 2020). Efficient project schedule management within this sector is imperative as it directly influences the timely completion and overall performance of construction projects. Proper scheduling ensures that resources are allocated effectively, costs are controlled, and project objectives are achieved within predetermined timeframes (Gan et al., 2015). A well-structured schedule management system not only provides a roadmap for project execution but also enhances communication, coordination, and decision-making among project stakeholders (Papadonikolaki & Hopfe, 2019). Furthermore, in the context of the global construction industry, adherence to schedules has gained increased importance due to the growing emphasis on sustainability and environmental impact (Sweis *et al.,* 2019).

The road construction industry represents a significant portion of economic activity in developed countries, contributing to infrastructure development, economic growth, and employment opportunities (Chen, 2016). Project schedule management is a critical facet of construction projects, as it plays a pivotal role in ensuring project completion within specified timeframes (Abbas, 2017). Delays and disruptions in construction schedules can result in significant cost overruns, disputes, and reduced overall project performance (Yuan *et al.,* 2018). Therefore, understanding the relationship between project schedule management and construction performance is of paramount importance, particularly in the context of developed nations where projects are often complex and subject to stringent regulations and quality standards (Love et al., 2019).

In a study conducted by Memon, Rahman, and Azis in 2017, it was found that cost overruns emerged as the predominant obstacle in construction projects. According to their estimation, it has been seen that 90% of projects encounter this particular issue, with cost overruns varying between 50% and 100%. In a similar vein, a separate investigation carried out by Naveenkumar and Prabhu in 2016 revealed that timetable overruns are prevalent across 87 projects, with an average rate of 10.3%. A notable instance can be noticed in the United Kingdom (UK), where around one-third of all customer situations report that their projects surpass the allocated budget. It is worth noting that Malaysia also experiences significant effects from cost overruns. According to a study conducted by Memon in 2016, the completion rates of public sector projects and private sector projects in Malaysia within their allocated budgets were found to be 46.8% and 37.2% respectively.

Road construction industry in Sub-Saharan Africa has experienced significant growth and development over the past decade, driven by increasing infrastructure demands, urbanization, and economic expansion (World Bank, 2020). However, this burgeoning sector has also faced numerous challenges, including project delays, cost overruns, and suboptimal project performance, which can have adverse effects on economic development and public welfare (Adeyemi & Fagbenle, 2019). Project schedule management is recognized as a critical aspect of construction project success (Akindele et al., 2019) as it not only ensures the timely completion of projects but also contributes to cost control and stakeholder satisfaction. In Sub-Saharan Africa, where the construction industry is characterized by its unique set of challenges, such as inadequate infrastructure, regulatory constraints, and resource limitations Oluwole *et al.,* 2016) it becomes imperative to investigate the relationship between effective project schedule management and the overall performance of construction projects.

Effective project schedule management is critical to mitigating these issues and ensuring the successful completion of road construction projects (Osei-Kyei & Chan, 2018). The timely and efficient delivery of construction projects is not only crucial for the construction companies but also for the broader economy of Ghana, as it contributes to infrastructure development, job creation, and economic growth (Ameyaw, *et al.,* 2018). Timely project completion not only enhances stakeholder satisfaction but also minimizes the financial burden associated with project extensions (Hoonakker et al., 2018). Despite this, there is a growing concern

that project schedule management practices in the Ghanaian construction industry may not be optimized to their full potential, leading to suboptimal performance (Saka *et al.*, 2018).

Delays in scheduling commonly plague the construction industry, particularly in developing nations. As noted by Bentil, Nana-Addy, Asare & Fokuo-Kusi (2017), this issue poses significant challenges for building construction projects, which are often intricate undertakings associated with substantial expenses and lengthy timelines. Meeting the fundamental criteria for success in these projects namely, completing them within the designated budget, timeframe, and with impeccable quality to satisfy client requirements becomes an arduous task. Santoso and Soeng (2016) emphasize that this pursuit of project success is of paramount importance, especially since construction companies often operate on slim profit margins. Adding to this, Kholif, Hosny, and Sanad (2017) stress that despite the availability of various scheduling control software and techniques, the problem of schedule overruns continues to persist in building construction endeavors.

Efficient project schedule management within this sector is crucial for ensuring the timely completion of construction projects, cost control, and overall project success. However, construction projects in Kenya have frequently faced challenges related to delays, cost overruns, and quality issues, all of which are closely tied to project schedule management (Adeyemi et al., 2018; Ondicho & Mundia, 2017). The avoidance of delays and overruns, which are often intrinsic to such endeavors and a commonly encountered issue (Acquah, Eyiah & Oteng, 2018), hinges on this management. Dolage and Pathmarajah (2017) suggest that these challenges frequently arise throughout the project's duration, frequently culminating in disputes and legal actions. A vital measure of a project's success lies in the ability to adhere to the timeframes outlined in the contract. Despite the acknowledged significance of this aspect, instances abound where construction projects falter in accomplishing their objectives. The repercussions of schedule overruns in construction projects are far-reaching, affecting all stakeholders involved, including the client (Awolesi, Fabi & Akinseinde, 2017).

Rwanda's construction industry faces several challenges that can impact project schedule management. Limited availability of skilled labor, supply chain disruptions, and regulatory complexities are some of the factors that can lead to schedule deviations (Jones & Kim, 2019). Additionally, unforeseen events such as adverse weather conditions and unforeseen site conditions can further complicate project timelines (Black et al., 2018). Research indicates that projects with well-defined schedules are more likely to achieve their objectives within the allocated time frame (García et al., 2018). Conversely, delays in project completion can lead to increased costs, disputes among stakeholders, and a negative reputation for the involved parties (Chan et al., 2016). The need for a systematic approach to project schedule management in the Rwandan construction sector arises from the growing complexity of projects, with multiple stakeholders and varying project constraints. Previous research has highlighted that delays and cost overruns are recurring issues in the Rwandan construction industry (Nkurunziza *et al.*, 2019).

In Rwanda, the Kigali Infrastructure Project stands as a significant endeavor aimed at enhancing transportation networks and supporting urban growth. However, the successful execution of such projects relies heavily on effective project scheduling, as it directly impacts performance outcomes. Previous studies, such as those by Oluwole et al. (2018) and Mbarika et al. (2016), emphasize the critical role of project scheduling in ensuring timely completion, cost management, and resource optimization. Yet, there remains a gap in understanding the specific influence of project scheduling on the performance of Kigali infrastructure project in Rwanda, particularly within the context of the Kigali Infrastructure Project (Kigali Infrastructure Report, 2023). Thus, this study seeks to address this gap by examining the effect of project scheduling on the performance of Kigali infrastructure project in Rwanda, focusing on the Kigali Infrastructure Project, thereby contributing to the existing body of knowledge and informing future infrastructure development endeavors.

Statement of the Research Problem

Construction schedule overruns are a common issue in construction projects worldwide, and the Rwandan construction industry is no exception, facing challenges in delivering projects on time. The development of

road infrastructure in Rwanda, especially within the Kigali Infrastructure Project, is essential for stimulating economic growth and improving citizens' quality of life. Despite significant investments, the execution and timely completion of these projects remain problematic. One of the critical factors contributing to these issues is project scheduling, which plays a pivotal role in managing resources, sequencing tasks, and adhering to project timelines. While studies such as those by Oluwole et al. (2018) and Mbarika et al. (2016) highlight the importance of project scheduling in construction management, there is a gap in research focused specifically on its impact on the performance of the Kigali Infrastructure Project in Rwanda.

To address schedule overruns, it is crucial to first identify their causes (Maturi, 2019). The inefficiencies in resource scheduling have consistently led to poor performance in construction projects. Literature reveals that many public and road construction projects continue to struggle with performance issues related to project management practices (Boru, 2016). Delays in completing projects as scheduled have become a persistent issue, leading to inefficiency within the construction industry in Rwanda. The study aims to tackle these challenges by focusing on the Kigali Infrastructure Project, emphasizing the importance of effective project scheduling for timely and cost-effective project completion. Many infrastructure projects in Rwanda face delays and cost overruns due to improper scheduling, stemming from inadequate planning, poor resource management, and insufficient stakeholder engagement, which negatively impacts project performance. By identifying the root causes of these scheduling issues, the study aims to propose solutions to improve the efficiency of infrastructure projects in Rwanda.

Objectives of The Study

The general objective of this study was to evaluate the effect of project schedule management on Kigali infrastructure project in Rwanda. The study was guided by the following specific objectives:

- To evaluate the effect of tasks dependence mapping on performance of Kigali infrastructure project in Rwanda.
- To analyze the effect of project tasks definition on performance of Kigali infrastructure project in Rwanda.
- To establish the effect of scheduling procedures communication on performance of Kigali infrastructure project in Rwanda.
- To examine the effect of project resourcing planning on performance of Kigali infrastructure project in Rwanda.

LITERATURE REVIEW

Conceptual Framework

In the study on "Project Schedule Management and Its Impact on the Performance of Kigali infrastructure project in Rwanda," the conceptual framework is guided by the premise that effective project schedule management plays a pivotal role in determining the overall success and performance of construction projects (Odeh & Battaineh, 2022; Ibrahim, 2017). This framework revolves around two main categories of variables. The first category includes independent variables such as project scheduling techniques, resource allocation, and project team competence (Abbas & Nawi, 2019; Chen & Jin, 2020). The second category encompasses dependent variables, notably project performance metrics like cost efficiency, completion time, and quality (Enshassi et al., 2017; Ogunlana et al., 2022). Project scheduling techniques, influenced by factors such as technology and software applications (Bubshait & Duffuaa, 2002), are hypothesized to have a direct impact on project performance. Furthermore, the competence of the project team, influenced by training and experience (Shen et al., 2015), is expected to mediate this relationship. This conceptual framework serves as the foundation for empirical research to be conducted in Rwanda, with the aim of understanding the intricate

relationships between project schedule management practices and construction project performance. The conceptual framework delineates the dependent and independent variables, as expounded upon in the literature study and further elucidated in Figure 1 elucidates the interconnection between the independent and dependent variables.

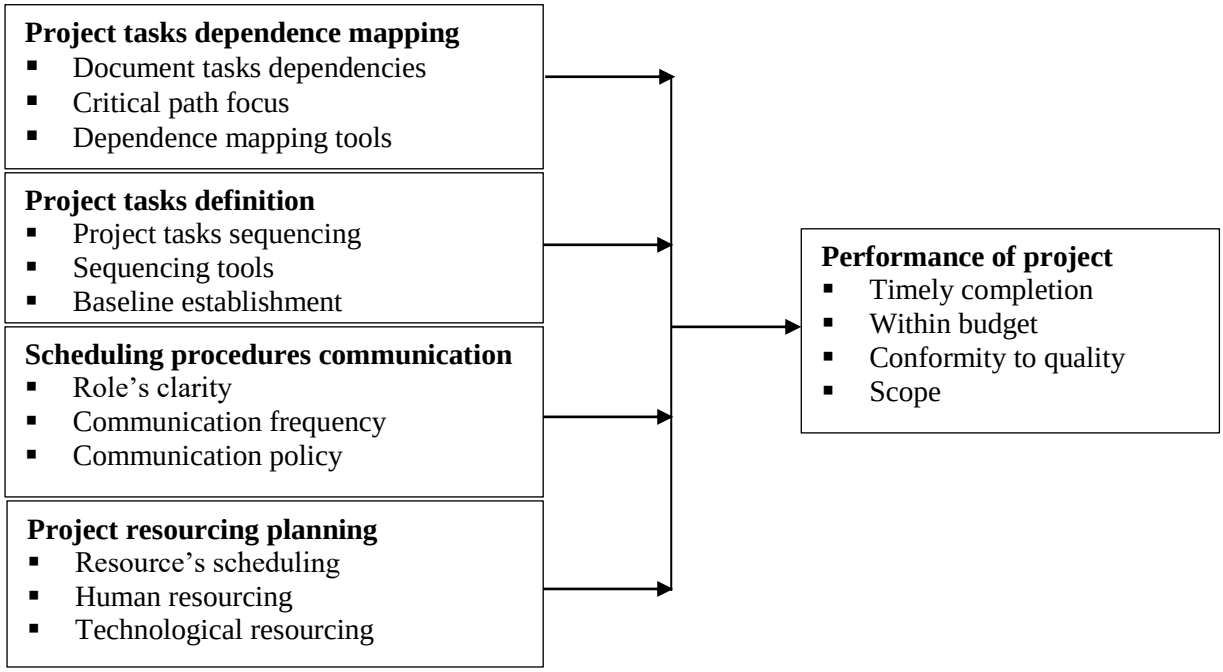

Figure 1: Conceptual Framework

Source: Researcher, 2024

Task dependence mapping refers to the process of analyzing and understanding the interconnections between various tasks in a construction project, assessing how each task depends on others. Studies have shown that effective task dependence mapping improves project outcomes by facilitating better coordination and minimizing delays (Belout & Gauvin, 2014). In Rwanda's construction sector, this approach suggests that clearly identifying and mapping task dependencies can lead to enhanced project performance by reducing delays and issues related to resource allocation.

Clear and accurate task definition is a key factor in successful project management. Research has emphasized that well-defined project tasks positively influence project outcomes (Lechler & Cohen, 2017). In the context of Rwandan construction projects, it is anticipated that precisely defining tasks has contributed to the timely and efficient completion of projects. Furthermore, effective communication of scheduling procedures is crucial for ensuring strong project performance (Hwang & Ng, 2013). In Rwanda, the clarity of communication among stakeholders—such as construction teams, subcontractors, and management—regarding scheduling directly impacts the overall success of the project. Additionally, efficient resource planning is critical for project success (Kerzner, 2017). In Rwanda's construction projects, careful planning and resource allocation improve performance by preventing shortages and optimizing the use of available resources.

Research Gaps

Despite the growing body of literature on project management in the construction industry, there are notable research gaps concerning the specific influence of project scheduling on the performance of Kigali infrastructure project in Rwanda, particularly within the context of the Kigali Infrastructure Project. While

studies such as those by Ogunlana *et al.* (2018) and Chileshe *et al.* (2016) have examined project scheduling practices in various construction contexts, there is limited empirical evidence on how these practices are implemented and their effectiveness in Rwandan road construction projects. Consequently, there is a need for research that delves into the unique socio-economic, institutional, and environmental factors that shape project scheduling dynamics in the Rwandan context, thereby providing insights tailored to the local context and informing evidence-based decision-making.

Moreover, existing literature predominantly focuses on the technical aspects of project scheduling, such as critical path analysis, resource leveling, and schedule compression techniques, without sufficiently addressing the broader socio-economic implications of scheduling decisions on project outcomes. For instance, while studies like those by Mbarika *et al.* (2016) have explored the role of information and communication technology (ICT) in infrastructure development in sub-Saharan Africa, including Rwanda, there is limited research on how ICT-enabled scheduling tools and techniques are utilized in Rwandan road construction projects and their impact on project performance. Therefore, there is a gap in understanding how socio-economic factors, stakeholder dynamics, and technological innovations intersect with project scheduling practices to influence the success of Kigali infrastructure project in Rwanda.

Furthermore, while previous studies have identified the importance of integrating scheduling with risk management processes in construction projects, little is known about the specific risk factors and mitigation strategies relevant to Kigali infrastructure project in Rwanda. For example, studies such as those by Oluwole et al. (2018) emphasize the role of risk assessment and mitigation in project success, yet there is limited empirical evidence on how risk management practices are integrated into project scheduling processes in Rwandan road construction projects like the Kigali Infrastructure Project. Therefore, there is a gap in understanding the interplay between project scheduling, risk management, and project performance outcomes in the Rwandan construction industry, warranting further research to address this gap and inform more effective project management practices.

METHODOLOGY

This study adopted a descriptive and correlational survey design to investigate the effect of project scheduling on the performance of infrastructure projects, specifically focusing on the Kigali Infrastructure Project. The descriptive aspect of the research involved systematically collecting and analyzing data to describe the current state of project scheduling practices and their outcomes. This approach provided a detailed account of how scheduling practices are implemented and their perceived effectiveness in the context of the Kigali Infrastructure Project. Descriptive statistics was used to summarize the data, offering insights into the distribution of scheduling practices and performance metrics across the project (Creswell, 2014).

The target population of this study was Three Hundred and Fourteen engineers at KIP dealing with road construction. Utilizing Slovin's method, the determination of a sample size of 176 respondents was conducted from a target population consisting of 314 individuals.

$$n = \frac{N}{1 + N\,(e)^2}$$

Where n = the sample size.

e = probability of error, i.e., the desired precision, 0.05 for 95% confidence

$$n = \frac{314}{1 + 314\,(0.05)^2} = 176$$

The study utilized three primary data collection methods: questionnaires, document review, and interviews, each contributing uniquely to understanding the effect of project scheduling on the performance of infrastructure projects.

A preliminary test was done on the data collection tools and procedures to identify likely problems. This test was conducted at NPD, whereby 18 questionnaires were administered to the employees in the respective departments. The filled questionnaires were later checked for consistency. Pilot study is a prerequisite for conducting validity and reliability of the research instruments

To establish the face validity of the research instrument, a thorough evaluation process was undertaken. This process included an in-depth review of relevant literature to ensure the instrument captured all critical dimensions of the study variables. In addition, the instrument underwent rigorous peer review, where experts in the field—specifically project supervisors and lecturers—provided their professional feedback

Validity of the tools was assessed using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity, which help determine whether the data is suitable for factor analysis.

Reliability analysis was conducted to ensure the consistency and accuracy of the research instruments used in the study. A test-retest method was employed, where the same participants completed the same test twice, with a two-week interval between tests. This interval allowed sufficient time for analyzing the initial test results and ensured reliable responses during the second round. Cronbach's Alpha was applied to determine the reliability of the tools, with an Alpha value of 0.7 or above considered acceptable, indicating that the instruments were reliable.

Data analysis primarily involved the utilization of statistical techniques. Quantitative data was analyzed using software such as SPSS allowing for the examination of relationships and patterns within the dataset (Hair *et al.*, 2018). Descriptive statistics was employed to summarize and present the data, while inferential statistics like regression analysis may be used to assess the impact of various variables on the performance of construction projects. Qualitative data, if collected, was subjected to thematic analysis, a process of identifying and examining recurring themes and patterns within the qualitative data (Braun & Clarke, 2016). This mixed-method approach provided a comprehensive understanding of the factors affecting project performance in the context of construction projects in Rwanda.

Regression analysis was employed to investigate the influence of various factors on the performance of construction projects in Rwanda.

RESULTS AND FINDINGS

Correlation Analysis

Correlation analysis is a statistical technique used to measure the strength and direction of the relationship between two or more variables. In the context of this study, correlation analysis helps to identify how project variables such as task dependence mapping, project task definition, scheduling procedures communication, and project resourcing planning relate to the performance of the Kigali Infrastructure Project. A positive correlation indicates that as one variable increases, the other tends to increase as well, while a negative correlation suggests that as one variable increases, the other decreases. The analysis also includes the correlation coefficient value, which ranges from 0.0 to 1.0, with values closer to 1.0 indicating a stronger relationship. The coefficient of determination, or r^2, is used to assess the effective size of the correlation, providing insight into how much of the variation in one variable can be explained by the relationship with the other. Table 1 below presents the correlation matrix for the variables involved in the study.

Table 1: Correlations Matrix

		Road construction Project Performance	Task's dependence mapping	Project tasks definition	Scheduling procedures communication	Project resourcing planning
Road construction Project Performance	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	165				
Task's dependence mapping	Pearson Correlation	.643**	1			
	Sig. (2-tailed)	.000				
	N	165	165			
Project tasks definition	Pearson Correlation	.684**	.581**	1		
	Sig. (2-tailed)	.000	.000			
	N	165	165	165		
Scheduling procedures communication	Pearson Correlation	.434**	.477**	.501**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	165	165	165	165	
Project resourcing planning	Pearson Correlation	.773**	.623**	.663**	.612**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	165	165	165	165	165

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data, (2024).

Table 1 presents the correlation matrix for various factors influencing road construction project performance, including task dependence mapping, project task definitions, scheduling procedures communication, and project resourcing planning. The correlations show a strong and significant relationship between project resourcing planning and road construction project performance, with a Pearson correlation of 0.773, which is the highest among the variables. This suggests that effective resourcing is closely associated with improved project performance, reinforcing the importance of well-managed resource allocation in construction projects (Sweis et al., 2021). Additionally, the correlation between project resourcing planning and project task definitions (0.663) indicates that resource planning is also linked to the clarity and effectiveness of task definitions in project execution. Similarly, project task definition and task dependence mapping have a positive correlation of 0.581, highlighting the importance of clear task breakdowns in ensuring the smooth execution of construction tasks (Ahsan et al., 2020).

Further, scheduling procedures communication also demonstrates significant correlations with other factors, such as project task definitions (0.501) and task dependence mapping (0.477), suggesting that effective communication in scheduling enhances the clarity and understanding of project tasks and their dependencies (Zhang et al., 2022). The relatively lower correlation of scheduling procedures communication with road construction project performance (0.434) may indicate that while scheduling is important, its impact on overall performance is moderated by other factors like resource planning and task definition clarity. These findings emphasize the interconnectedness of project management practices and their collective influence on road construction performance, suggesting that a holistic approach to task planning, communication, and resource management is essential for achieving successful project outcomes (Al-Tabtabai & Salem, 2021).

Regression Analysis

Table 2 presents the model summary for Project Schedule Performance, exploring the combined effect of four independent variables—Task's Dependence Mapping, Project Tasks Definition, Scheduling Procedures Communication, and Project Resourcing Planning—on Road Construction Project Performance. The R-value of 0.826 indicates a strong positive correlation between the predictors and the project performance, highlighting the effectiveness of these factors in influencing project outcomes. The R Square value of 0.683 suggests that the model, indicating a high degree of explanatory power, can explain 68.3% of the variance in road construction project performance. The Adjusted R Square of 0.675 takes into account the number of predictors and still demonstrates the model's robustness in predicting project performance. The Standard Error of the Estimate of 0.15727 indicates that the model's predictions are relatively accurate, with a modest margin of error. These findings align with recent literature that emphasizes the importance of comprehensive project management practices, including scheduling and resource planning, in driving successful project performance (Zhang & Li, 2021).

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.826[a]	.683	.675	.15727

a. Predictors: (Constant), Task's dependence mapping, Project tasks definition, Scheduling procedures communication and Project resourcing planning

b. Dependent Variable: Road construction Project Performance

Source: Primary data, (2024).

Table 3 presents the ANOVA results for Project Schedule Performance, assessing the statistical significance of the relationship between the predictors—Project Resourcing Planning, Scheduling Procedures Communication, Task's Dependence Mapping, and Project Tasks Definition—and Road Construction Project Performance. The Regression sum of squares is 8.528, with 4 degrees of freedom, indicating that the combined effect of these variables explains a significant portion of the variance in project performance. The Mean Square for regression is 2.132, and the F-statistic of 86.204, accompanied by a p-value of 0.000, confirms that the model is statistically significant, with the predictors collectively having a strong impact on project performance. These results are in line with recent research emphasizing the importance of effective planning, task scheduling, and resource management in enhancing project outcomes (Wang & Liu, 2021).

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.528	4	2.132	86.204	.000[b]
	Residual	3.957	160	.025		
	Total	12.486	164			

a. Dependent Variable: Road construction Project Performance

b. Predictors: (Constant), Project resourcing planning, Scheduling procedures communication, Task's dependence mapping, Project tasks definition

Source: Primary data, (2024).

Table 4 presents the regression coefficients for Project Schedule Performance, where four predictors—Task's Dependence Mapping, Project Tasks Definition, Scheduling Procedures Communication, and Project Resourcing Planning—are evaluated for their impact on Road Construction Project Performance. The unstandardized coefficients indicate the amount of change in the dependent variable for a one-unit change in each predictor. The constant term is 1.132, with a p-value of 0.000, indicating a significant base level for project performance. Task's Dependence Mapping has a positive and significant impact with a coefficient of 0.184 ($p = 0.000$), suggesting that better mapping of task dependencies enhances project performance. Project

Tasks Definition also has a positive effect (0.228, p = 0.000), reinforcing the importance of clearly defined tasks in project success. Scheduling Procedures Communication shows a negative impact (-0.132, p = 0.019), implying that ineffective communication of scheduling procedures may hinder performance. Lastly, Project Resourcing Planning has the highest positive impact (0.472, p = 0.000), underlining the importance of well-structured resource planning in improving project outcomes. These findings are consistent with recent research emphasizing the role of detailed planning and communication in construction project success (Chen & Wang, 2021).

Table 4: Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.132	.221		5.127	.000
	Task's dependence mapping	.184	.052	.213	3.559	.000
	Project tasks definition	.228	.054	.266	4.244	.000
	Scheduling procedures communication	-.132	.056	-.136	-2.371	.019
	Project resourcing planning	.472	.060	.548	7.880	.000
a. Dependent Variable: Road construction Project Performance						

Source: Primary data, (2024).

From the Coefficients table above the regression model can be derived as follows:

$Y = 1.132 + 0.184X_1 + 0.228X_2 - 0.132X_3 + 0.472X_4$

The positive coefficients for X1, X2, and X4 (0.184, 0.228, and 0.472) suggest that improvements in these areas will enhance project performance, while the negative coefficient for X3 (-0.132) indicates that ineffective communication of scheduling procedures could reduce performance. This equation emphasizes the importance of structured planning, clear task definitions, and effective resource allocation in improving project outcomes, aligning with current research on construction project management (Chen & Wang, 2021).

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, Task's Dependence Mapping is a significant determinant of road construction project performance. The positive relationship identified in both the descriptive and regression analyses suggest that clearly mapping task dependencies enhances project efficiency by improving planning, resource allocation, and coordination. By identifying critical paths and task interdependencies, project managers can better anticipate challenges and avoid delays, thereby contributing to the overall success of the project. Therefore, integrating task dependence mapping into project planning is crucial for achieving optimal performance in road construction projects.

The conclusion drawn indicates that Project Tasks Definition is a key factor in improving road construction project performance. Well-defined project tasks contribute to clearer expectations, better coordination, and reduced ambiguity, all of which are essential for successful project execution. The positive correlation between project tasks definition and performance highlights the importance of ensuring that all tasks are clearly outlined and assigned, as this leads to more efficient use of resources, better time management, and improved overall project outcomes.

Scheduling Procedures Communication plays a critical role in road construction project performance. While effective communication of scheduling procedures generally facilitates better project execution, the negative relationship observed suggests that poor communication of schedules can lead to delays and

misunderstandings, ultimately hindering project performance. Therefore, enhancing the clarity, timeliness, and consistency of scheduling communications is essential to ensure that all stakeholders are aligned, reducing the likelihood of project disruptions and improving the chances of successful project delivery.

Project Resourcing Planning is a vital element for ensuring the success of road construction projects. The strong positive correlation between resource planning and project performance emphasizes the importance of ensuring that sufficient resources, including labor, equipment, and materials, are available when needed. Effective resourcing planning helps mitigate delays and cost overruns, ensuring that projects proceed according to schedule and within budget. Therefore, proper resourcing is fundamental to achieving the desired outcomes in road construction projects, making it a critical factor for project managers to address throughout the project lifecycle.

The study came up with a number of recommendations.

Based on the findings of this study, it is recommended that project managers in road construction prioritize the development and implementation of clear Task's Dependence Mapping, Project Tasks Definition, Scheduling Procedures Communication, and Project Resourcing Planning. Managers should invest in training for staff to improve their skills in task dependency analysis and clear project task definitions, as these elements significantly contribute to project performance. Additionally, enhancing communication channels for scheduling procedures will help ensure that all stakeholders are on the same page regarding project timelines and expectations. Furthermore, effective resourcing planning is critical; therefore, managers should regularly assess resource availability and ensure that adequate resources are allocated in alignment with the project schedule to minimize delays and disruptions.

From a policy perspective, it is recommended that government and regulatory bodies develop and enforce standards that promote best practices in task dependency mapping, project task definition, scheduling procedures communication, and resourcing planning in road construction projects. Policies should encourage the use of advanced project management tools and software to facilitate better planning, task identification, and communication. Additionally, policies should emphasize the importance of transparency and clear communication between contractors, suppliers, and regulatory agencies to improve project efficiency. Implementing such policies will enhance the overall quality and performance of road construction projects, contributing to better infrastructure development and economic growth.

Suggestions for Further Studies

Given the scope of this study, future research could explore the impact of technological innovations, such as Artificial Intelligence (AI) and Building Information Modeling (BIM), on project performance in road construction. These technologies have shown great potential in enhancing project management processes, particularly in scheduling, resource allocation, and task dependency analysis. By examining how the integration of AI and BIM affects project outcomes, future studies could provide valuable insights into their potential for improving efficiency, reducing costs, and ensuring timely project completion. Additionally, research could focus on comparing the impact of these technologies across different geographical regions or types of infrastructure projects to determine their effectiveness in diverse contexts.

Another area for further investigation is the role of stakeholder engagement in road construction projects and its influence on the implementation of project management practices like task mapping, scheduling, and resource planning. While this study focused on technical factors, exploring the socio-political and organizational aspects of stakeholder collaboration could provide a more comprehensive understanding of project success. Future studies could examine how stakeholders' decision-making processes, communication styles, and involvement in project planning impact the overall performance of road construction projects. This would contribute to the broader body of knowledge on effective stakeholder management and its role in enhancing project outcomes.

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