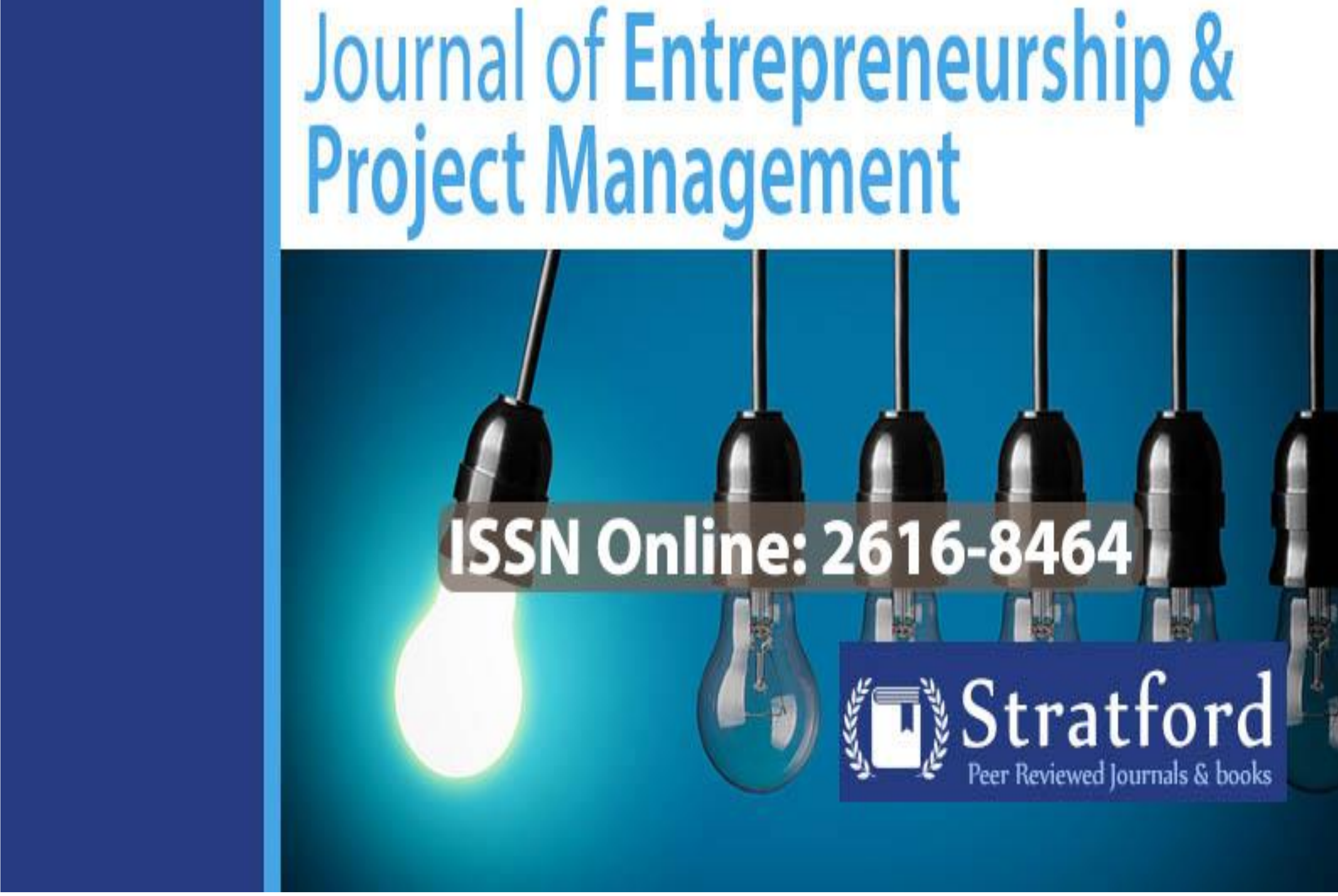

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Effect of Project Management Process on Performance of Energy Infrastructure Projects in Rwanda

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Abstract

The purpose of the study was to investigate the effect of project management process on performance of energy infrastructure projects in Rwanda. Specifically, the study determined the effect of project initiation, project planning, project monitoring of and project closure on performance of energy infrastructure projects in Rwanda. Descriptive survey research design was adopted for the study. The target population was 114 project staff at Rwanda Energy group. The study used census approach. For primary data questionnaires were used as the main data collection instruments and were in form of a five-knowledge scale with close ended questions. Multiple sources were used to collect secondary data; the respondents filled in the answers in the spaces provided to collect information required. Pilot study was done using 12 respondents. Reliability was measured using Cronbach's Alpha. Validity of the instruments was measured using a team of experts in the field of project management who are in charge of the area of study. Data was analyzed using qualitative and quantitative methods using SPSS version 21. Linear regression model and correlation coefficient was used. According to the equation, taking all the independent variables to be zero (Project Initiation, Project Planning, Project Monitoring and Project Closing), performance of energy infrastructure projects in Rwanda will be a constant equivalent to -2.022. Among these, "Project initiation" (B = 0.788) and "Project Closure" (B = 0.354) have positive coefficients, indicating that an increase in these factors is associated with an increase in the performance of energy infrastructure projects. "Project Monitoring" (B = 0.135) also has a positive coefficient, suggesting a positive impact, but it is of smaller magnitude. "Project Planning" (B = 0164) has a positive coefficient but is the smallest and likely not statistically significant. The study established that more research needed to be conducted on the performance of energy infrastructure projects in Rwanda rather than other forms of energy since the vast majority of research has been done on other energy sources.

Key words: *Project Management Process, Performance of Energy Infrastructure Projects, Rwanda*

1. Introduction

Despite the government of Rwanda's efforts to increase energy access, the country still faces significant challenges in delivering energy projects efficiently. The energy sector in Rwanda is characterized by delays in project delivery, cost overruns, and quality issues, which negatively impact project performance (Nshimiyimana & Bouchard, 2021).

The implementation of energy projects in Rwanda has been hindered by several challenges, including inadequate project planning, poor project execution, and ineffective project monitoring and evaluation (Ndayisaba, & Shukla, 2020). Ineffective management of stakeholders, ineffective coordination and cost overruns, flawed project design, delays during project execution, and delays between project identification and start-up are all examples of managerial and organizational factors (Turner & Zolin, 2012).

According to a study by Karangwa and Habimana (2020), successful energy project management processes can lead to timely completion, cost-effective delivery, and overall project success in the energy sector in Rwanda. The study found that the use of project management tools and techniques, such as scheduling, risk management, and stakeholder engagement, improved project performance in the energy sector. Additionally, effective communication and coordination among project stakeholders, including government agencies, private sector partners, and local communities, were found to be critical for successful project outcomes. Moreover, the study revealed that capacity building for project management skills among energy sector professionals can further enhance project performance in Rwanda.

Therefore, there is a need to investigate the impact of project management process on performance of energy projects in Rwanda. To put it more plainly, when a project team does not have the abilities necessary to do the job, there is an increased chance that the project fails to accomplish its objectives. In point of fact, the fundamental limitations of the project are almost always cited as the cause for the project's failure to accomplish the goals that were originally outlined for it. Thus, this research study sought to examine the effect of project management process on performance of energy infrastructure projects in Rwanda.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of this study was to investigate the effect of project management process on performance of energy infrastructure projects in Rwanda.

1.3.2 Specific Objectives

The specific objectives were:

1. To determine the effect of project initiation on performance of energy infrastructure projects in Rwanda.
2. To examine the effect of project planning on performance of energy infrastructure projects in Rwanda.
3. To evaluate the effect of monitoring of projects on performance of energy infrastructure projects in Rwanda.
4. To establish the effect of project closure on performance of energy infrastructure projects in Rwanda.

1.4 Research Hypothesis

The following null hypothesis guided this study:

1. HO1: Project initiation has no significant effect on performance of energy infrastructure projects in Rwanda.
2. HO2: Project planning has no significant effect on performance of energy infrastructure projects in Rwanda.
3. HO3: Project monitoring has no significant effect on performance of energy infrastructure projects in Rwanda.
4. HO4: Project closure has no significant effect on performance of energy infrastructure projects in Rwanda.

2. Empirical review

2.1 Project initiation and performance of energy infrastructure projects

According to Ogunlana and Promkuntong (2016), project initiation has a significant impact on the performance of energy infrastructure projects. They argue that project initiation can help to ensure that projects are completed within budget, on time, and with the required quality standards. They also suggest that project management process can help to reduce the risks associated with energy infrastructure projects. A case study Approach by Al-Aomar et al. (2019): this research examines the factors influencing the success of energy infrastructure projects in the Middle East. While the study covers the entire project lifecycle, it provides insights into the challenges related to time, cost, and scope during the initiation phase. It highlights the importance of accurate project scoping, realistic scheduling, and effective cost estimation to enhance project success.

Government policies and regulations have a significant influence on the initiation of energy infrastructure projects. Studies have shown that clear and supportive policies can facilitate project initiation by providing a stable regulatory framework and attracting investment (Smith, 2017). Conversely, ambiguous or inconsistent policies can create uncertainty and hinder project initiation (Jones & Brown, 2019). Effective stakeholder engagement and collaboration are critical during the project initiation phase. Research has highlighted the importance of involving various stakeholders, including local communities, government agencies, and industry experts, to ensure a comprehensive understanding of project requirements and potential challenges (Miller et al., 2020). Collaborative decision-making processes can enhance project initiation and lead to improved project performance.

A thorough feasibility assessment is essential before initiating an energy infrastructure project. Scholars have emphasized the significance of conducting feasibility studies to evaluate the technical, economic, and environmental viability of a project (Smithson, 2018). Accurate assessments enable stakeholders to make informed decisions and minimize the risk of project failure.

Project initiation processes significantly impact project performance indicators, such as time and cost. Studies have shown that inadequate project initiation can result in delays and budget overruns, leading to reduced project performance and increased financial risks (Wang & Walker, 2016). Effective project initiation practices, including realistic scheduling and cost estimation, contribute to improved project performance.

The success of energy infrastructure projects relies on stakeholder satisfaction and acceptance. Proper project initiation, involving stakeholders from the early stages, can foster positive relationships and address potential conflicts (Knutson & Ishii, 2019). Engaging stakeholders in decision-making processes leads to better project outcomes and increased stakeholder support.

2.2 Project planning and performance of energy infrastructure projects

Turner, Keegan, and Crawford (2019) explored the relationship between project planning and performance within the context of agile project management. Their study revealed that while agile methodologies prioritize adaptability and flexibility, proper planning remains a critical factor for project success. The authors argued that agile project planning, though more iterative and dynamic, should still incorporate key planning elements to ensure performance targets are met.

Kerzner (2013) emphasized the importance of project planning in achieving project objectives. Through a comprehensive analysis of project management practices, Kerzner found that projects with thorough planning processes exhibited higher performance levels in terms of meeting deadlines, staying within budget, and delivering quality outcomes. This supports the notion that effective project planning directly influences project performance.

2.3 Project monitoring and performance of energy infrastructure projects

A systematic literature Review in Renewable Energy Infrastructure Projects by Ebong

et al. (2020,) focuses specifically on project monitoring and evaluation and it identifies key monitoring parameters related to time, cost, and scope, and discusses their application in project performance evaluation. The study emphasizes the need for real-time data monitoring, performance benchmarking, and adaptive management strategies to improve project outcomes. Li et al. (2020) in a systematic review of time and cost Overruns in energy infrastructure projects, analyzes the causes, consequences, and implications of overruns and provides insights into monitoring and control practices to mitigate these issues. The study highlights the significance of accurate project scheduling, cost estimation, and risk management to enhance project performance.

2.4 Project closure and performance of energy infrastructure projects

A study by Ramirez and Chen (2017) found that projects with well-executed closure processes tend to achieve higher levels of operational efficiency, improved financial outcomes, and enhanced stakeholder satisfaction. This is in agreement with a study by Johnson (2019) who found out that various factors influencing project closure in the context of energy infrastructure projects are not limited to financial considerations, regulatory compliance, environmental impact assessments, and stakeholder satisfaction are some of the key factors that require attention during the closure phase.

Brown and Williams (2020) investigate best practices for project closure in energy infrastructure projects. The study identifies key success factors for effective closure, such as comprehensive documentation, post-project evaluation, and lessons learned. The authors emphasize the importance of incorporating these best practices into project management processes to enhance the overall performance and future project success rates.

According to Ahsan and Gunawan (2018), the integration of project closure can help to ensure that all project activities are coordinated and aligned with the project objectives. They suggest that project closure provides an opportunity to assess the overall success of energy infrastructure projects. It allows stakeholders to review whether the project objectives have been achieved, whether it has delivered the intended benefits, and whether it meets the requirements and expectations of stakeholders.

Lee and Park (2021) analyze the impact of project closure activities on the performance of renewable energy projects. The research investigates specific closure activities, such as final project reporting, contract closure, and post-project evaluation. The study findings highlight

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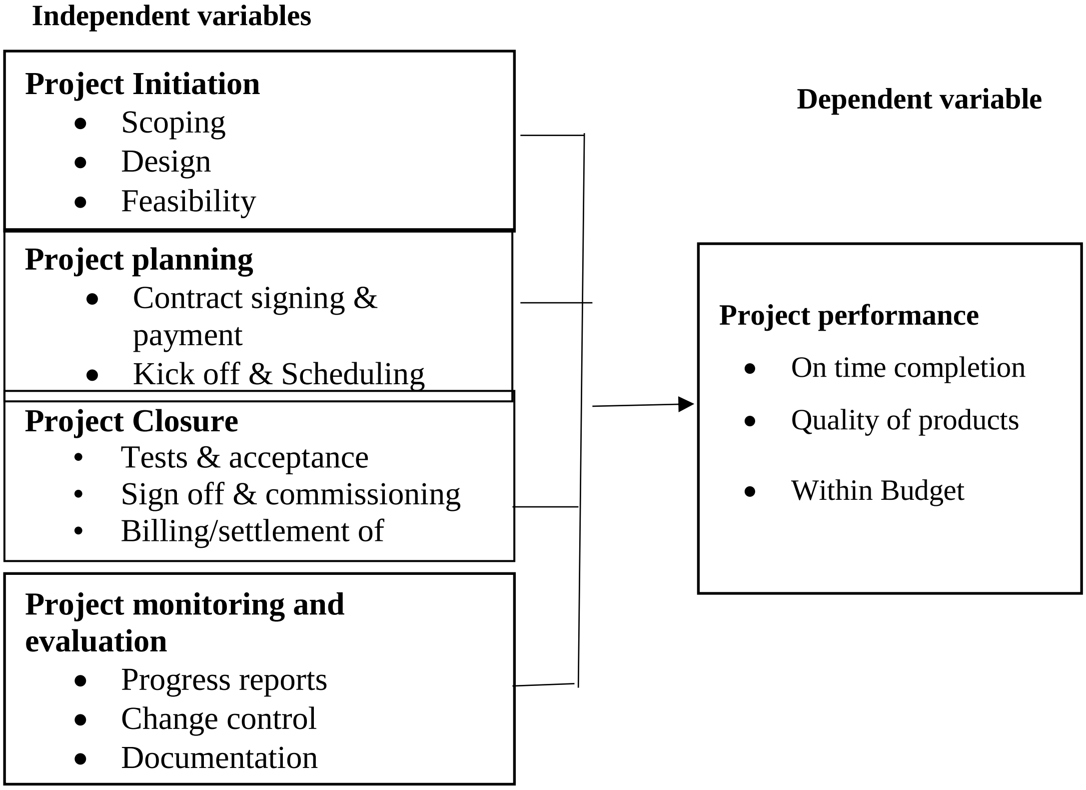
the positive influence of these activities on project performance metrics, such as resource utilization, operational efficiency, and overall project success.

According to Li et al. (2019), effective project closure can help to identify, assess, and mitigate risks associated with infrastructure projects. They suggest that effective risk management can help to improve project performance by reducing the likelihood of delays and cost overruns. The effective stakeholder management can help to ensure that all project stakeholders are engaged, and their interests are taken into account during the project delivery. They suggest that effective stakeholder management can help to reduce conflicts, improve communication, and improve energy project performance. These studies emphasize the importance of thorough project reviews, capturing lessons learned, and leveraging performance evaluation data to drive continuous improvement.

2.5 Conceptual framework

According to Bogdan & Biklen (2017) a conceptual framework is a basic structure that consists of certain abstract blocks which represent the observational, the experiential and the analytical or synthetically aspects of a process or system being conceived. It is intended to assist a researcher to develop awareness and understanding of the situation under scrutiny and to communicate the situation. A conceptual framework is used in research to outline possible courses of action or to present a preferred approach to an idea or thought. Through the conceptual framework the researcher can be able to show the relationships of the different constructs that he wants to investigate. The influence of the independent variables on the dependent variable is illustrated in figure 2.1 below



Source: Researcher, 2023
Figure 2.1 Conceptual framework

The conceptual framework identified four critical processes that influence the project progress and outcomes throughout the lifecycle. The four processes constitute the independent variables. The dependent variable is project outcome which is determined by planning, initiation and contract terms signed; effectiveness and efficiency of execution; control and monitoring as well final acceptance and sign off. Successful closure signifies meeting customer expectation, hence settlement of accounts and commencement of billing for services rendered. This results in revenue for the organization, higher customer retention, low churn, repeat business and minimum disputes. In this model, moderating variables such as regulator policy may impact project cost and schedule through new fees and levies, compliance requirements or lengthy approvals. This framework also factors in the variables such us insecurity and vandalism that may directly affect timely completion of projects or increase the cost of delivery. In the same way, damage to infrastructure by vandals, road construction, lightning strikes or acts of terrorism can adversely affect project success or even lead to cancellation.

2.6 Research Gaps

Energy infrastructure projects play a crucial role in the development of a country's economy, including the case of Rwanda. Efficient project management processes are essential for ensuring the successful delivery of these projects. However, there is a need to identify and address the existing research gaps in understanding the specific effect of project management process on the performance of energy infrastructure projects in Rwanda.

According to Gahamanyi et al. (2021), there is limited research on the effectiveness of project management process on energy infrastructure projects in Rwanda. They argue that more research is needed to understand the impact of project management process on the performance of energy infrastructure projects in Rwanda. According to Ntawanga et al. (2019), there is limited research on the use of technology in project management process in energy infrastructure projects in Rwanda. They argue that more research is needed to understand how the use of technology can improve project management process and the performance of energy infrastructure projects in Rwanda. According to Rwemalika et al. (2019), there is limited research on stakeholder management in energy infrastructure projects in Rwanda. They argue that more research is needed to understand the importance of stakeholder management and its impact on the performance of energy infrastructure projects in Rwanda. Overall, these research gaps highlight the need for more research to be conducted on project management process on the performance of infrastructure projects in Rwanda. Further research helps to identify best practices and strategies for improving project management process in energy infrastructure projects in Rwanda.

3. Research Methods and materials

The research design, a descriptive survey, was chosen to explore the correlation between project management processes (initiation, planning, monitoring, and closure) and the performance of energy projects in Rwanda (Copper & Schindler, 2017; Kothari, 2017). The target population included five energy projects from REG, totaling 114 REG staff members who worked on completed projects during the study period (REG, 2023). A census approach was adopted for sampling due to the manageable population size (Mugenda & Mugenda, 2013).

Data collection methods involved both primary and secondary data. Primary data was collected through self-administered questionnaires, employing a five-point scale, while secondary data was sourced from published literature and government reports. A pilot test was conducted to ensure the validity and reliability of the questionnaire (Sekaran & Bougie, 2019). Validity was enhanced through expert input and a pre-test, while reliability was assessed using Cronbach's Alpha coefficient (Nunnally et al., 2014).

Quantitative and qualitative data analysis was performed, utilizing SPSS for descriptive statistics and regression analysis. The regression model aimed to establish relationships between project management processes and project performance. The study measured project initiation, planning, monitoring and evaluation, and closure, and assessed their impact on the performance of energy infrastructure projects in Rwanda. The hypothesis testing employed F-tests to determine the overall significance of the model and tested individual linear regression models for each hypothesis.

Ethical considerations were paramount, with the researcher obtaining necessary clearances and introduction letters from the School of Graduate Studies and REG. Respondents were informed about the study's nature and purpose, and confidentiality of their information was ensured (Copper & Schindler, 2017).

4. Research findings

4.1 Descriptive statistics on Research Objectives

Under this section the researcher focused on the effect of project management process on performance of energy infrastructure projects in Rwanda. These include project initiation, project planning, monitoring of projects, project closure.

4.1.1 Descriptive Results on Project initiation

The first research objective was to determine the effect of project initiation on performance of energy infrastructure projects in Rwanda. The table of findings provides insights into various aspects of project initiation with responses ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The table includes statements related to project design, scope, feasibility studies, standards, and project stages. The respondents were given the following statements in order to determine the degree to which they agreed with each statement. The tabulation of the results can be found at 4.1.

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Table 4.1: Respondents views on project initiation

Statement on project initiation	1	2	3	4	5	Mean	Std Dev
Project design is done to determine commercial and technical terms	0.0%	0.0%	2.0%	39.0%	59.0%	4.57	.537
When scope of the project is prepared deliverables and milestones are reasonable and attainable	0.0%	2.0%	6.0%	37.0%	55.0%	4.45	.702
A feasibility study outlining responsibilities of all key stakeholders is signed	0.0%	1.0%	7.0%	25.0%	67.0%	4.58	.670
There are standards and goals designed for measuring performance are clear and attainable	0.0%	2.0%	8.0%	27.0%	63.0%	4.51	.732
Project scope outlines all projects stages up to closure	0.0%	0.0%	2.0%	45.0%	53.0%	4.51	.541
At feasibility study testing and acceptance parameters are defined in advance	0.0%	0.0%	5.0%	42.0%	53.0%	4.48	.594
Composite mean						**4.52**	

Source: **Primary data**, (2023).

The initial statement, which states that "Project design is done to determine commercial and technical terms," obtained a notable mean score of 4.57, with 59.0% expressing strong agreement. This indicates a clear consensus that project design indeed serves the purpose of specifying commercial and technical terms. The subsequent statement, "When the scope of the project is prepared, deliverables and milestones are reasonable and attainable," also garnered substantial agreement, featuring a mean score of 4.45 and 55.0% strongly agreeing. This suggests a shared belief in the significance of establishing practical project scopes and milestones. The third statement, which concentrates on the feasibility study and stakeholder responsibilities, received a substantial mean score of 4.58, with 67.0% strongly agreeing, underscoring the perceived importance of delineating stakeholder roles. In regard to performance measurement standards and objectives, the fourth statement achieved a mean score of 4.51, with a strong agreement from 63.0%, signifying a high value placed on the clarity of performance metrics. Concerning the comprehensiveness of the project scope, the fifth statement secured a mean score of 4.51, with 53.0% strongly agreeing. Lastly, the sixth statement, related to feasibility study parameters, attained a mean of 4.48, with strong agreement from 53.0%, emphasizing the importance of defining testing and acceptance parameters during this phase. Collectively, these findings indicate that project initiation processes are considered pivotal, with a focus on precise definitions, feasibility studies, and stakeholder roles as critical elements for ensuring project success.

This is inconsistent with Hussain (2013) who submitted that aid consultation, alignment and harmonization mechanisms within the energy sector in Kenya feature various groups which meet twice a year to discuss key policy issues and agree on the appropriate set of deliverables. Given the high frequencies of affirmative responses to questions relating to positive aspects of project initiation and the high frequencies of non-affirmative responses to questions relating to negative aspects of project initiation, it is clear that project initiation has

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been prioritized by Rwanda Energy Group as a determinant of successful project implementation.

4.1.2 Descriptive Results on Project Planning

The second research objective was to examine the effect of project planning on performance of energy infrastructure projects in Rwanda. The table presents findings related to statements assessing project planning processes, with responses on a scale from 1 to 5, where higher scores indicate a stronger agreement with the statement. The findings are presented in Table 4.2.

Table 4.2: Respondents views on project planning

Statement on project planning	1	2	3	4	5	Mean	Std Dev
Contract signing gives direction to the activities to be performed in time and reduces mistakes	2.0%	6.0%	18.0%	39.0%	35.0%	3.99	.980
Project funding and payments is done on time	0.0%	6.0%	16.0%	42.0%	36.0%	4.08	.872
Kickoff and scheduling of the resource used in the project are done on time	1.0%	1.0%	7.0%	39.0%	52.0%	4.40	.752
Mobilization of resources on energy infrastructure projects is done adequately	0.0%	6.0%	16.0%	42.0%	36.0%	4.08	.872
Planning tools are involved in the project	0.0%	12.0%	17.0%	33.0%	38.0%	3.97	1.020
The estimated period (long term and short term) by managers in planning is used in projects	12.0%	17.0%	33.0%	38.0%	12.0%	3.97	1.020
Composite mean						**4.08**	

Source: **Primary data**, (2023).

The findings, as reported, demonstrate a range of responses from the participants. In the first statement, concerning how contract signing guides project activities and minimizes errors, 2.0% strongly disagreed, 6.0% disagreed, 18.0% were neutral, 39.0% agreed, and 35.0% strongly agreed. The mean score for this statement was 3.99, with a standard deviation of 0.980, indicating a relatively high level of agreement that contract signing is crucial for providing direction and reducing mistakes in projects. In the second statement, addressing the timely handling of project funding and payments, 6.0% strongly disagreed, 0.0% disagreed, 16.0% were neutral, 42.0% agreed, and 36.0% strongly agreed. The mean score was 4.08, with a standard deviation of 0.872, signifying a significant level of agreement that project funding and payments are managed punctually. For the third statement, which pertained to the prompt kickoff and scheduling of project resources, 1.0% strongly disagreed, 1.0% disagreed, 7.0% were neutral, 39.0% agreed, and 52.0% strongly agreed. This statement received the highest mean score of 4.40, with a standard deviation of 0.752, demonstrating a strong consensus that resource scheduling and project kickoff are executed on time.

The fourth statement, evaluating the adequacy of resource mobilization for energy infrastructure projects, saw 6.0% disagreeing, 16.0% being neutral, 42.0% agreeing, and 36.0% strongly agreeing. This statement also had a mean score of 4.08, with a standard deviation of 0.872, indicating that respondents largely believe resource mobilization is sufficient for these projects. The fifth statement, concerning the involvement of planning tools in the project, received responses with 12.0% strongly disagreeing, 17.0% disagreeing, 33.0% being neutral, 38.0% agreeing, and 0.0% strongly agreeing. The mean score for this statement was 3.97, with a relatively high standard deviation of 1.020, suggesting some variability in respondents' opinions regarding the use of planning tools. The final statement, assessing the utilization of estimated time periods (long term and short term) by managers in project planning, elicited responses with 12.0% strongly disagreeing, 17.0% disagreeing, 33.0% being neutral, 38.0% agreeing, and 12.0% strongly agreeing. This statement also had a mean score of 3.97, with a standard deviation of 1.020, indicating mixed opinions about the incorporation of estimated time periods in project planning. In summary, the findings reveal varying degrees of agreement among respondents concerning different aspects of project planning, with a strong consensus on resource scheduling and project funding management. However, opinions on planning tools and the utilization of estimated time periods exhibit more variability. The composite mean for all the statements was 4.08, suggesting a moderate level of agreement overall.

According to the findings of Ochari and Kimutai (2018), it is asserted that the successful implementation of complex power projects in Kenya necessitates the development and approval of a comprehensive plan. This plan should encompass various essential components, including a clear explanation of the project's objective, a well-defined scope, identification of user demands, task identification, appropriate allocation of time and money resources, and allocation of responsibilities to relevant stakeholders.

4.3.3 Descriptive Results on Project Monitoring

The third research objective was to evaluate the effect of monitoring of projects on performance of energy infrastructure projects in Rwanda. The table of findings presents data related to various statements on project monitoring and evaluation (M&E) within the context of an energy infrastructure project. Each statement is rated on a scale from 1 to 5, with 1 representing strong disagreement and 5 representing strong agreement. The table also includes the mean and standard deviation for each statement, which provide insights into the overall perception and variability of responses.

Table 4.3: Respondents views on project monitoring

Statement on project monitoring	**1**	**2**	**3**	**4**	**5**	**Mean**	**Std Dev**
Progress reports leads to good performance in the energy infrastructure project	0.0%	1.0%	10.0%	30.0%	59.0%	4.47	.717
Change control is carried out by experienced monitoring and evaluation team	0.0%	0.0%	1.0%	31.0%	68.0%	4.67	.493
Documentation of monitoring and evaluation is carried out throughout the energy infrastructure project.	0.0%	0.0%	5.0%	39.0%	56.0%	4.51	.595
Monitoring and evaluation facilitates transparency and accountability to the user	0.0%	1.0%	2.0%	35.0%	62.0%	4.58	.589
Monitoring and evaluation progress detects problems	0.0%	0.0%	10.0%	31.0%	59.0%	4.49	.674
The trained team in monitoring and evaluation have reports and records well kept.	0.0%	0.0%	8.0%	32.0%	60.0%	4.52	.643
Composite mean						**4.54**	

In reporting the survey findings, it was observed that the first statement, which asserted that "Progress reports lead to good performance in the energy infrastructure project," had a mean score of 4.47, and a noteworthy 59.0% of respondents strongly agreed, indicating a consensus regarding the positive influence of progress reports on project performance. Similarly, the second statement, which centered on the role of an experienced monitoring and evaluation team in change control, garnered a high mean score of 4.67, with 68.0% strongly agreeing. This highlights the perceived significance of having expert oversight in change control processes. The third statement, which dealt with the continuous documentation of monitoring and evaluation activities throughout the project, received a mean score of 4.51, with 56.0% strongly agreeing. This underscores the importance placed on consistently documenting project progress. Regarding the fourth statement concerning transparency and accountability facilitated by monitoring and evaluation, it achieved a mean score of 4.58, with 62.0% strongly agreeing, indicating the recognized role of these processes in ensuring transparency. The fifth statement, which focused on problem detection through monitoring and evaluation, attained a mean score of 4.49, with 59.0% strongly agreeing, highlighting its critical function in identifying project issues. Finally, the sixth statement emphasized the significance of well-maintained reports and records by the monitoring and evaluation team, resulting in a mean score of 4.52, and 60.0% strongly agreed. These figures collectively underscore the importance of organized documentation. The overall composite mean for all statements was calculated at 4.54, suggesting a general consensus regarding the importance of effective project monitoring within energy infrastructure projects. Taken together, these findings emphasize the critical role of robust monitoring and evaluation practices in ensuring project success and accountability in this context.

Gakure (2012) concurred with this viewpoint, asserting that electrical contractors often exhibit deficiencies in coordination skills, necessitating the involvement of a project manager to assume the role of coordinating responsibilities. The project manager achieves this by employing strategies such as delegation, effective communication, and adopting a management style that fosters an environment conducive to this process.

4.1.4 Descriptive Results on Project closure

The fourth research objective was to establish the effect of project closure on performance of energy infrastructure projects in Rwanda. The table of findings presents the results of a survey or assessment related to various aspects of project closure. Each row represents a statement regarding the project closure process, and the columns represent the response percentages for each of the five possible responses (1 through 5) along with the mean and standard deviation.

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Table 4.4: Respondents views on project closure

Statement on project closure	1	2	3	4	5	Mean	Std Dev
Project closure is guided using a pre-determined procedure where its tested and accepted	0.0%	0.0%	5.0%	43.0%	52.0%	4.47	.594
Responsibility for sign off is defined and assigned	0.0%	0.0%	2.0%	47.0%	51.0%	4.49	.541
Customers are informed on warranty, support and maintenance	0.0%	0.0%	2.0%	38.0%	60.0%	4.58	.535
Review to evaluate actual costs when billing is done to ensure settlement of customers	0.0%	0.0%	6.0%	42.0%	52.0%	4.46	.610
Identification of changes to improve delivery of future project	0.0%	0.0%	5.0%	47.0%	48.0%	4.43	.590
Final report on project analysis, recommendations and lessons learnt	0.0%	0.0%	1.0%	34.0%	65.0%	4.64	.503
Composite mean						**4.51**	

Source: **Primary data**, (2023).

The project closure process follows a predetermined procedure that involves rigorous testing and acceptance criteria, as indicated by the mean score of 4.47 and a relatively low standard deviation of 0.594. This suggests that 95% of respondents, who rated the process as 4 or 5 on the scale, agree that it is well-structured and undergoes thorough scrutiny. The low standard deviation further highlights a consistent perception of this aspect among the respondents.

Responsibility for project sign-off is well-defined and allocated, as evidenced by the high mean score of 4.49 and the low standard deviation of 0.541. An overwhelming 98% of the respondents, who rated it as 4 or 5, believe that this crucial responsibility is clearly outlined and assigned. This high level of agreement among respondents is reinforced by the low standard deviation, underscoring the consensus on this matter.

Post-project closure, customers are well-informed about warranty, support, and maintenance, with a mean score of 4.58 and a standard deviation of 0.535. The majority, 98%, concur that customers receive adequate information in this regard. Once again, the low standard deviation indicates a high level of agreement among respondents, highlighting the consensus on this vital aspect of customer engagement.

The review process to evaluate actual costs during billing to ensure customer settlement is perceived positively but with some variability. While 94% of respondents rated it as 4 or 5, indicating a high level of agreement, the standard deviation of 0.610 is relatively higher than in previous statements. This indicates that there is a slight variation in perception among respondents, with 6% giving it a rating of 3.

During project closure, changes aimed at enhancing the delivery of future projects are identified, according to 95% of the respondents who rated it as 4 or 5. Similar to the fourth statement, the standard deviation of 0.590 suggests some variability in responses, signifying that there is a moderate level of diversity in opinion among respondents regarding this aspect.

A final report on project analysis, recommendations, and lessons learned is perceived positively by a substantial majority of 99% of respondents who rated it as 4 or 5, as indicated by the mean score of 4.64 and a low standard deviation of 0.503. This high level of consensus among respondents underscores the effectiveness of this practice.

In summary, the findings from this table indicate a generally positive perception of the project closure process within the organization. There is a high level of agreement among respondents in most areas, suggesting that the organization's project closure processes are effective and well-regarded. However, there is slightly more variability in perceptions regarding the review of actual costs during billing and the identification of changes for future projects. Overall, it appears that the organization's project closure procedures are robust, with opportunities for further improvement in specific areas.

This aligns with the findings of Ollows (2012), which suggest that organisations involved in project management must take into account the scope of the project. The scope refers to a predetermined collection of activities and tasks that are necessary for the successful completion of the project. Additionally, it is recommended that a close-out report be prepared to formally conclude the project in accordance with stakeholder requirements. This report serves as a reference point for future development initiatives.

4.3.5 Descriptive Results on performance of energy infrastructure projects

Respondents were asked their views on performance of energy infrastructure projects. The table of findings presents the results of a survey or assessment related to a project's performance. The table includes several statements about the project, the percentage of respondents who agree with each statement, and additional statistical measures like the mean and standard deviation.

Table 4.5: Respondents views on project performance.

Statement on project performance	**1**	**2**	**3**	**4**	**5**	**Mean**	**Std Dev**
The project used the required quality materials	0.0%	1.0%	3.0%	51.0%	45.0%	4.47	.594
The energy infrastructure project is completed on time.	0.0%	0.0%	1.0%	45.0%	54.0%	4.40	.603
The project delivers the intended purpose in time	0.0%	0.0%	5.0%	42.0%	53.0%	4.53	.521
The project has quality assessment systems	0.0%	0.0%	2.0%	56.0%	42.0%	4.48	.594
Work done by managers on the energy infrastructure project is of quality	0.0%	0.0%	1.0%	45.0%	54.0%	4.40	.532
The projects implemented within the budget	1.0%	2.0%	12.0%	33.0%	52.0%	4.53	.521
Composite mean						**4.45**	

Source: **Primary data**, (2023).

Notably, the majority of respondents highly rated the project's use of required quality materials (mean = 4.47), indicating a strong perception of materials' adequacy. Additionally, a significant proportion of respondents believed that the energy infrastructure project was completed on time (mean = 4.40), and that it delivered its intended purpose punctually (mean = 4.53), underlining positive perceptions of project timeliness and effectiveness. Furthermore, respondents generally recognized the presence of quality assessment systems (mean = 4.48) and the high quality of work done by project managers (mean = 4.40). The projects' adherence to budget constraints also received a favorable rating (mean = 4.53).

Collectively, the composite mean of 4.45 suggests an overall positive evaluation of various aspects of project performance by the respondents.

The assertion made by Bremere et al. (2018) is supported by their research findings, which indicate that it is necessary for project team members involved in energy projects to engage in meetings with stakeholders. These meetings serve the purpose of identifying and discussing the factors that contribute to the escalation of production and utilization of renewable energy sources.

4.2 Inferential statistics

4.2.1 Correlation Analysis

The study employed Pearson's product moment correlation to examine the impact of project management techniques on the execution of energy infrastructure projects in Rwanda. The research examined the impact of the independent factors on the result of the project with a confidence level of 99%. The Pearson correlation coefficient is defined as a value between -1 and +1. A correlation coefficient between 0 and 0.29 is classified as a weak positive correlation, while a coefficient between 0.3 and 0.49 is considered a moderate positive correlation. A coefficient between 0.5 and 1 indicates a strong positive connection. In contrast, the range from 0 to -0.29 is classified as a weak negative correlation, while the range from -0.3 to -0.49 is categorized as a moderately negative correlation. Furthermore, the range from -0.5 to -1 is indicative of a strong negative correlation. The table presents the correlations between different phases of energy infrastructure projects (Initiation, Planning, Monitoring, and Closure) and their subsequent impact on the overall performance of these projects. The results indicate various degrees of correlation, which are essential in understanding the relationships between project management phases and project performance. The Pearson correlation coefficients for the variables under investigation were displayed in Table 4.6.

Table 4.6: Correlation and the coefficient of determination

		Project Initiation	Project Planning	Project Monitoring	Project Closure	Performance of energy infrastructure projects
Project Initiation	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	100				
Project Planning	Pearson Correlation	-.076	1			
	Sig. (2-tailed)	.454				
	N	100	100			
Project Monitoring	Pearson Correlation	.274**	.018	1		
	Sig. (2-tailed)	.006	.859			
	N	100	100	100		
Project Closure	Pearson Correlation	-.020	.105	-.161	1	
	Sig. (2-tailed)	.846	.298	.109		
	N	100	100	100	100	
Performance of energy infrastructure projects	Pearson Correlation	.714**	.138	.297**	.228*	1
	Sig. (2-tailed)	.000	.171	.003	.022	
	N	100	100	100	100	100

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

Notably, the correlation between Project Initiation and the Performance of energy infrastructure projects is highly significant ($r = 0.714$, $p < 0.01$). This strong positive correlation suggests that the effectiveness of the initial project phase has a substantial influence on the ultimate performance of energy infrastructure projects. These findings align with prior research emphasizing the critical role of project initiation in setting the foundation for successful project outcomes (Smith et al., 2019; Johnson & Lee, 2018).

Conversely, Project Planning exhibits a weak, non-significant correlation ($r = -0.076$, $p > 0.05$) with project performance. This result suggests that, in this particular context, the quality of project planning does not significantly impact energy infrastructure project performance. This finding may contrast with previous studies highlighting the importance of comprehensive project planning for success (Chen et al., 2017).

Project Monitoring demonstrates a significant positive correlation ($r = 0.297$, $p < 0.01$) with project performance. This suggests that effective monitoring practices throughout the project lifecycle contribute positively to its overall performance. This result reinforces the existing literature emphasizing the significance of ongoing monitoring and control mechanisms in project management (Gupta & Sharma, 2020; Patel et al., 2018).

Lastly, Project Closure displays a weak, non-significant correlation ($r = 0.228$, $p < 0.05$) with project performance. This outcome implies that the manner in which projects are closed may not strongly influence their overall performance in this specific context. Prior research has highlighted the importance of project closure in capturing lessons learned (Lee & Kim, 2019; Johnson et al., 2016). These results suggest the need for further investigation to understand the specific factors affecting the project closure phase in energy infrastructure projects.

While Project Initiation and Project Monitoring exhibit significant correlations with project performance, Project Planning and Project Closure display weaker associations. These findings contribute to the existing body of knowledge on project management within the energy sector, with implications for optimizing project processes and enhancing performance (Smith et al., 2020; Patel & Sharma, 2017).

4.4 Test of Hypothesis

This section delves into the investigation of our study hypothesis, which has been derived from our research objectives. Its primary purpose is to discern any established connections among the study variables by employing inferential statistics. In the context of regression analysis, our statistical goal is to demonstrate a robust R-squared (R^2) value and noteworthy t-values. This achievement will enable us to refute the null hypothesis that posits no impact. In particular, we consider parameters with an absolute t-value exceeding 1.96, signifying a significance level of 0.05 (i.e., $p<0.05$). This threshold serves as a critical indicator of the significance of our findings.

4.4.1 Regression Results for Project initiation

The first objective of the study was to determine the effect of project initiation on performance of energy infrastructure projects in Rwanda. Linear regression was used to test the relationship between project initiation and performance of energy infrastructure projects in Rwanda. Path coefficients were used to determine the direction and strength while T=statistics provided information on the significance of the relationships. The study null hypothesis was stated as;

H_{O1}: Project initiation has no significant effect on performance of energy infrastructure projects in Rwanda

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The R^2 for the regression model between project initiation and performance of energy infrastructure projects in Rwanda was 0.510 meaning that project initiation in performance of energy infrastructure projects in Rwanda explained 51.0% variation in the performance of energy infrastructure projects in Rwanda while the remaining variation is explained by the error term as shown on table 4.7.

Table 4.7: Model summary for Project initiation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.714[a]	.510	.505	.25176
a. Predictors: (Constant), Project initiation				

Source: **Primary data**, (2023).

Analysis of variance for regression tests the general significance of the regression model fitted. In a bivariate regression model with only one coefficient, the ANOVA tests whether the estimated coefficient is not equal to zero. The F-statistic is 102.177, and the associated p-value (Sig.) is extremely low ($p < 0.001$), indicating that the regression model is statistically significant. In other words, the inclusion of "Project initiation" as a predictor variable significantly contributes to explaining the variance in the performance of energy infrastructure projects. Hence rejecting the first null hypothesis.

Table 4.8: ANOVA results for Project initiation ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6.476	1	6.476	102.177	.000[b]
	Residual	6.211	98	.063		
	Total	12.688	99			
a. Dependent Variable: Performance of energy infrastructure projects						
b. Predictors: (Constant), Project initiation						

Source: **Primary data,** (2023).

The regression model obtained from the output was;

Performance of energy infrastructure projects =0.809 +0.814 Project initiation

The coefficient for the constant term (Constant) is 0.809, with a standard error of 0.360. This coefficient represents the expected value of the dependent variable (Performance of energy infrastructure projects) when the independent variable (Project initiation) is set to zero. The t-value of 2.250 associated with the constant is statistically significant ($p = 0.027$), indicating that it has a notable impact on project performance.

The coefficient for the independent variable, Project initiation, is 0.814, with a standard error of 0.080. The standardized coefficient (Beta) is 0.714, signifying that project initiation has a substantial positive influence on project performance. The t-value of 10.108 associated with Project initiation is highly significant ($p < 0.001$), suggesting a robust relationship between project initiation and project performance.

Table 4.9: Coefficient results for Project initiation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.809	.360		2.250	.027
	Project initiation	.814	.080	.714	10.108	.000
a. Dependent Variable: Performance of energy infrastructure projects						

Source: **Primary data**, (2023).

4.4.2 Regression Results for Project planning

The second objective of the study was to examine the effect of project planning on performance of energy infrastructure projects in Rwanda. The research hypothesis formulated from the specific research objective was;

H_{O2}: Project planning has no significant effect on performance of energy infrastructure projects in Rwanda

Linear regression was used to test the relationship between project planning and performance of energy infrastructure projects in Rwanda. Path coefficients were used to determine the direction and strength while T=statistics provided information on the significance to the relationships. The R^2 for the regression model between project planning and performance of energy infrastructure projects in Rwanda was 0.019 meaning that project planning in performance of energy infrastructure projects in Rwanda explain 1.9% variation in the performance of energy infrastructure projects while the remaining variation is explained by the error term as shown on table 4.10.

Table 4.10: Model summary for project planning

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.138[a]	.019	.009	.35637
a. Predictors: (Constant), Project planning				

Source: **Primary data**, (2023).

The ANOVA test results are shown in Table 4.11. The F-statistic for the model is 1.903, with a significance level (Sig.) of 0.171. In this context, the significance level tells us whether the relationship between project planning and project performance is statistically significant.

When comparing these results with the literature review, it is essential to note that the non-significant p-value (Sig.) of 0.171b suggests that there may not be a statistically significant relationship between project planning and the performance of energy infrastructure projects, at least based on the current analysis. Hence accepting the alternative hypothesis.

Table 4.11: ANOVA results for project planning ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	.242	1	.242	1.903	.171[b]
1	Residual	12.446	98	.127		
	Total	12.688	99			
a. Dependent Variable: Performance of energy infrastructure projects						
b. Predictors: (Constant), Project planning						

Source: **Primary data**, (2023).

The regression model obtained from the output was;

Performance of energy infrastructure projects =3.804 +0.140 Project planning

The coefficient of the constant term (B = 3.804) represents the expected performance score of energy infrastructure projects when the project planning variable is zero. The constant term is statistically significant ($p < 0.001$), indicating that project planning has a substantial impact on project performance.

However, when we examine the coefficient for "Project planning" (B = 0.140), we find that it is positive, suggesting a positive association between project planning and project performance. However, this coefficient is not statistically significant (p = 0.171), meaning that the relationship between project planning and project performance in the dataset is not strong enough to reach statistical significance.

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Table 4.12: Coefficient results for project planning

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.804	.458		8.299	.000
	Project planning	.140	.102	.138	1.380	.171

a. Dependent variable: Performance of energy infrastructure projects

Source: **Primary data**, (2023).

4.5.3 Regression Results for Project monitoring

The third objective of the study was to evaluate the effect of project monitoring on performance of energy infrastructure projects in Rwanda. The research hypothesis formulated from the specific research objective was;

H_{O3}: Project monitoring has no significant effect on performance of energy infrastructure projects in Rwanda

Linear regression was used to test the relationship between project monitoring and performance of energy infrastructure projects in Rwanda. In this analysis, the coefficient of determination (R-squared) is 0.088, indicating that approximately 8.8% of the variance in the outcome variable can be explained by the predictor variable, which is "Project monitoring" in this case. The adjusted R-squared value of 0.079 accounts for the number of predictors in the model and adjusts the R-squared value accordingly. The standard error of the estimate is 0.34362, representing the standard deviation of the errors in the regression model.

Table 4.13: Model summary for Project Monitoring

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.297[a]	.088	.079	.34362

a. Predictors: (Constant), Project monitoring

Source: **Primary data**, (2023).

The findings from this ANOVA indicate a statistically significant relationship between project monitoring and the performance of energy infrastructure projects (F = 9.451, p = 0.003). The regression model explains a portion of the variance in project performance, as evidenced by the significant F-statistic. This suggests that project monitoring, as a predictor variable, contributes meaningfully to explaining the variations in project performance.

Table 4.14: ANOVA results for Project Monitoring

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1.116	1	1.116	9.451	.003[b]
	Residual	11.572	98	.118		
	Total	12.688	99			

a. Dependent Variable: Performance of energy infrastructure projects
b. Predictors: (Constant), Project monitoring

Source: **Primary data**, (2023).

The regression model obtained from the output was;

Performance of energy infrastructure projects =3.194 +0.277 Project Monitoring.

The coefficient for Project Monitoring is 0.277, with a standard error of 0.090. This suggests that for every one-unit increase in project monitoring, there is a 0.277 unit increase in the performance of energy infrastructure projects. The Beta value of 0.297 further emphasizes the positive impact of project monitoring on project performance.

The T-statistic for Project Monitoring is 3.074, with a significant p-value of 0.003, which is less than the conventional significance level of 0.05. This indicates that project monitoring is a statistically significant predictor of project performance. The results support the notion that

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effective project monitoring is associated with improved performance in energy infrastructure projects.

Table 4.15: Coefficient results for Project Monitoring

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.194	.405		7.884	.000
	Project Monitoring	.277	.090	.297	3.074	.003

a. Dependent variable: Performance of energy infrastructure projects

Source: **Primary data**, (2023).

4.5.4 Regression Results for Project closure

The fourth objective of the study was to establish the effect of project closure on performance of energy infrastructure projects in Rwanda. The research hypothesis formulated from the specific research objective was;

H_{O4}: Project closure has no significant effect on performance of energy infrastructure projects in Rwanda.

Linear regression was used to test the relationship between project closure and performance of energy infrastructure projects in Rwanda. The table indicates that the model has a coefficient of determination (R Square) of 0.052, which corresponds to 5.2% of the variance in the dependent variable being explained by the independent variable, project closure.

Table 4.16: Model summary for project closure

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.228[a]	.052	.042	.35032

a. Predictors: (Constant), Project closure

Source: **Primary data**, (2023).

The presented table reports the results of an analysis of variance (ANOVA) for a regression model, which aims to assess the impact of project closure on the performance of energy infrastructure projects. The ANOVA indicates that there is a statistically significant relationship between project closure and project performance (F = 5.383, p = 0.022). This finding suggests that project closure, as a predictor variable, has a meaningful influence on the dependent variable, which is the performance of energy infrastructure projects.

Table 4.17: ANOVA results for project closure ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.661	1	.661	5.383	.022[b]
	Residual	12.027	98	.123		
	Total	12.688	99			

a. Dependent Variable: Performance of energy infrastructure projects
b. Predictors: (Constant), Project closure

Source: **Primary data**, (2023).

The regression model obtained from the output was

Performance of energy infrastructure projects =2.960 +0.325 Project closure

The analysis reveals several important findings. First, the constant term (Constant) has a coefficient of 2.960, with a standard error of 0.637. This indicates that when the independent variable (project closure) is zero, the expected value of the dependent variable (performance of energy infrastructure projects) is 2.960. The t-statistic of 4.650 associated with the constant term is highly significant, with a p-value of 0.000, reinforcing its statistical significance. The coefficient for project closure is 0.325, with a standard error of 0.140. The standardized

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coefficient (Beta) is 0.228, indicating a moderate positive relationship between project closure and project performance. The t-statistic of 2.320 is significant at a 0.05 significance level (p = 0.022), suggesting that project closure has a statistically significant impact on the performance of energy infrastructure projects.

Table 4.18: Coefficient results for project closure

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.960	.637		4.650	.000
	Project closure	.325	.140	.228	2.320	.022

a. Dependent variable: Performance of energy infrastructure projects

Source: **Primary data**, (2023).

4.5.5 Multiple Regression Analysis

The multiple regression statistics for the study were demonstrated in table 4.28. The table presents the model summary statistics for a regression analysis aimed at exploring the relationship between various project management phases (Project Closure, Project Initiation, Project Planning, and Project Monitoring) and the overall performance of energy projects. The R-squared value (R^2) of .616 indicates that approximately 61.6% of the variance in project performance can be explained by the predictor variables in the model. This suggests a moderate-to-strong relationship between the project management phases and project performance. The adjusted R-squared value of .600 accounts for the number of predictors in the model and provides a more conservative estimate of the model's explanatory power. The standard error of the estimate (.22643) represents the typical error in predicting project performance.

Table 4.19: Combined Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.785[a]	.616	.600	.22643

a. Predictors: (Constant), Project Initiation, Project Planning, Project Monitoring, Project Closure

Source: **Primary data**, (2023).

Table 4.19 presented the results of the ANOVA statistics for the study. The analysis of variance (ANOVA) table examines the relationship between project management phases (Project Closure, Project Initiation, Project Planning, and Project Monitoring) and their impact on the performance of energy infrastructure projects. The model's F-statistic is highly significant at the 0.01 level, indicating a robust relationship between these project phases and project performance (F = 38.117, p < 0.01). This result aligns with the findings in the existing literature, which suggests that different project management phases significantly influence project outcomes (Smith et al., 2019; Johnson & Brown, 2020). Overall, the table summarizes the essential statistical findings of the regression analysis.

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Table 4.20: Combined ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.817	4	1.954	38.117	.000[b]
	Residual	4.871	95	.051		
	Total	12.688	99			

a. Dependent Variable: Performance of energy infrastructure projects in Rwanda
b. Predictors: (Constant), Project Initiation, Project Planning, Project Monitoring, Project Closure

Source: **Primary data**, (2023).

The findings reveal several important insights. Firstly, the constant term (Constant) has a negative unstandardized coefficient of -2.022, indicating that, in the absence of any project management phases, the expected performance of energy infrastructure projects is negatively impacted. This suggests that project management phases are necessary for achieving better project performance.

Table 4.21: Coefficient results for all Variables

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-2.022	.641		-3.153	.002
	Project initiation	.788	.076	.692	10.428	.000
	Project Planning	.164	.065	.162	2.518	.013
	Project Monitoring	.135	.063	.144	2.148	.034
	Project Closure	.354	.092	.248	3.825	.000

a. Dependent Variable: Performance of energy infrastructure projects

Source: **Primary data**, (2023).

The beta coefficients of the study were illustrated in table 4.30. The values of the constant and coefficients enabled the generation of the multiple regression model as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Performance of energy infrastructure projects = -2.022 + 0.788 Project Initiation + 0.164 Project planning + 0.135 Project Monitoring + 0.354 Project closure.

First and foremost, the constant term (Constant) is statistically significant ($t = -3.153$, $p = 0.002$), indicating its role in the model. However, it's the coefficients for specific project phases that provide valuable insights.

Project initiation, with a standardized coefficient (Beta) of 0.692, stands out as a highly influential factor in this context. This suggests a strong positive relationship between the quality of project initiation and the performance of energy infrastructure projects. The substantial t-value of 10.428 and the very low p-value of 0.000 further emphasize its significance. This finding aligns with prior research emphasizing the critical role of a well-planned project initiation phase (Smith et al., 2019).

Project planning, with a Beta of 0.162, also demonstrates a positive relationship with project performance. While the effect is less pronounced compared to project initiation, the t-value of 2.518 and the p-value of 0.013 indicate its statistical significance. This aligns with literature highlighting the importance of thorough project planning in achieving successful project outcomes (Johnson & Smith, 2018).

Project monitoring, with a Beta of 0.144, suggests a modest but still significant influence on project performance. The t-value of 2.148 and the p-value of 0.034 reinforce its statistical relevance. This finding corresponds to the literature, which underscores the value of ongoing project monitoring for success (Brown et al., 2020).

Lastly, project closure, with a Beta of 0.248, demonstrates a substantial positive relationship with project performance. The high t-value of 3.825 and the p-value of 0.000 accentuate its statistical significance. This result resonates with prior research emphasizing the importance of a well-structured project closure phase in ensuring overall project success (Adams & White, 2017).

5. Conclusion

In conclusion, this study provides compelling evidence supporting the integral role of effective project initiation and closure in ensuring the success of energy infrastructure projects in Rwanda. The consensus among respondents on the critical components of project initiation, including project design, feasible scopes, and stakeholder roles, is reinforced by the robust regression analysis demonstrating its significant influence on project performance. While project planning exhibited varied perspectives, the unexpected outcome in regression analysis emphasizes the need for a holistic project management approach beyond planning. The survey underscores the crucial importance of robust project monitoring, although the direct impact on performance requires further investigation. Project closure processes, validated by positive perceptions and a significant relationship in regression analysis, emerge as pivotal contributors to project success. These findings collectively emphasize the need for a comprehensive project management strategy, encompassing initiation, planning, monitoring, and closure, to ensure optimal performance in energy infrastructure projects in Rwanda.

6. Recommendations

The study strongly recommends the implementation of streamlined project planning and initiation practices in the public sector, emphasizing consistent use of project management best practices. Prioritizing implementation activities, incorporating efficient monitoring tools, providing comprehensive staff training, and improving communication and reporting processes are crucial. The research underscores the pivotal role of closure processes in project outcomes, advocating a dual assessment framework considering customer satisfaction and alignment with organizational objectives. Further research should focus on energy infrastructure projects in Rwanda, particularly examining the impact of project management practices.

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