

ADFJ ISSN 2522 - 3186.

African Development Finance Journal

VOLUME 9 (III)

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Geita Zone, Geita, Tanzania*

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Date Received: July 18, 2026

Date Published: September 03, 2026

Effect of Risk Assessment Plan on Completion of Electrical Infrastructure Projects: A Case of TANESCO Geita Zone, Geita, Tanzania

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Abstract

The study assessed the effect of risk assessment plans on the completion of electrical infrastructure projects at TANESCO Geita Zone, Geita, Tanzania. The study employed a quantitative research approach and an explanatory research design. The target population comprised 272 employees at the TANESCO Geita Zone headquarters who were directly involved in or had relevant responsibilities related to electrical infrastructure projects. A census sampling technique was employed, whereby all 272 eligible employees were included in the study. Data were collected using structured questionnaires and analyzed using descriptive statistics, including mean scores and standard deviations, and simple linear regression analysis. The findings revealed that the risk assessment plan had a positive and statistically significant effect on the completion of electrical infrastructure projects ($\beta = 0.62, p < 0.001$). This finding indicates that systematic identification, analysis and evaluation of project risks contribute to improved project completion. The study concludes that effective risk assessment is an important mechanism for anticipating and addressing potential uncertainties that may disrupt electrical infrastructure project implementation. It is recommended that TANESCO management should strengthen systematic risk assessment practices throughout the project life cycle, including regular identification, analysis, evaluation and monitoring of project risks. Project managers should also integrate risk assessment findings into project planning and decision-making to minimize potential delays and enhance the timely completion of electrical infrastructure projects.

Keywords: risk assessment plan, completion of electrical infrastructure projects.

1. INTRODUCTION

Electrical infrastructure projects are critical to economic development because they expand electricity access, improve supply reliability, and support productive activities. In Tanzania, continued investment in generation, transmission and distribution infrastructure has substantially expanded the electricity network. During 2023/24, the national distribution network increased by about 15%, while transmission lines expanded by 9.84%, demonstrating the scale and continuing importance of electrical infrastructure development in the country (EWURA, 2024). However, the expansion of electrical infrastructure also involves complex projects characterized by technical, financial, environmental, procurement and stakeholder uncertainties, making effective risk management essential for achieving planned project completion.

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Risk is particularly important in infrastructure projects because unforeseen events can disrupt planned schedules, increase costs and compromise project performance. A systematic review by Su and Khallaf (2022) found that construction risks are closely associated with project performance, with schedule and cost being among the most frequently examined dimensions of project outcomes. Similarly, Kallowa et al. (2023) found that risk identification, monitoring and prevention significantly influence project success, suggesting that project performance depends not merely on recognizing risks but on establishing systematic mechanisms for responding to them. Thus, a risk assessment plan can be viewed as an important managerial mechanism through which potential risks are identified, analyzed, prioritized and incorporated into project decisions before they develop into events that threaten completion.

The importance of structured risk assessment is further supported by recent construction risk-management research. Khodabakhshian et al. (2023) argue that construction projects are inherently exposed to uncertainty and that inadequate risk-management practices can negatively affect project outcomes. They further note the continuing need for more systematic approaches to risk assessment rather than relying predominantly on experience-based practices. This is particularly relevant to electrical infrastructure projects, where delays in procurement, availability of materials and equipment, technical changes, financing, contractor performance, land-related issues, weather conditions and coordination among multiple stakeholders can interact and produce cumulative delays. Consequently, the effectiveness of a risk assessment plan should be considered not only in terms of whether risks are identified, but also whether assessment results inform timely mitigation and project decision-making.

The Tanzanian electricity sector provides an important context for examining this relationship. TANESCO operates as a vertically integrated state-owned electricity utility, while the rapid expansion of Tanzania's electrical distribution networks has increased the need to install and maintain new infrastructure and equipment (Mbembati & Bakiri, 2023; Twesigye, 2022). This expanding infrastructure environment exposes electrical projects to technical and operational uncertainties, underscoring the importance of systematic risk assessment for achieving planned project completion. The electricity subsector recorded increases in installed capacity, transmission lines, distribution lines and customer connections during 2023/24, indicating a growing portfolio

of infrastructure activities requiring effective project implementation and control (EWURA, 2024). Within this expanding environment, delays in electrical infrastructure projects may have implications beyond individual project budgets because delayed completion can postpone network expansion, service connections and improvements in electricity reliability.

Although international evidence demonstrates a relationship between risk-management practices and project success, empirical evidence specifically examining the effect of risk assessment plans on the completion of electrical infrastructure projects in Tanzania remains limited. Existing Tanzanian evidence has largely examined risk management in other public construction settings. For example, Tuja and Mmari (2025) found that risk identification, risk analysis and regular monitoring were important for the successful completion of public primary-school construction projects in Dodoma Urban District. While this provides useful evidence from the Tanzanian context, school construction differs substantially from electrical infrastructure projects in technical complexity, regulatory requirements, network interdependencies and operational risks. This contextual difference creates a need for sector-specific evidence.

Therefore, this study examines the effect of risk assessment plans on the completion of electrical infrastructure projects at TANESCO Geita Zone, Geita, Tanzania. The study is premised on the argument that systematic assessment of project risks can improve the anticipation and management of uncertainties that otherwise contribute to delays. By focusing specifically on electrical infrastructure projects, the study seeks to contribute context-specific empirical evidence to the project risk-management literature and provide practical insights for strengthening risk assessment and project completion within Tanzania's electricity sector.

2. METHODS

This study employed a quantitative research approach and an explanatory research design to examine the effect of risk assessment plans on the completion of electrical infrastructure projects at TANESCO Geita Zone, Geita, Tanzania. The study was conducted in TANESCO Geita Zone because the area has experienced the implementation of electrical infrastructure projects associated with the agriculture and mining sectors, where project implementation has reportedly encountered various operational and logistical challenges (Katunzi & Mwakapala, 2023). Evidence also

indicates challenges associated with electricity access and infrastructure development in Geita, including logistical constraints and inadequate community engagement (Mshana & Mallya, 2022). Moreover, reported delays in transmission-line expansion projects aimed at connecting remote communities to the national grid suggest the importance of strengthening risk identification and assessment mechanisms during project implementation (Wamba, 2021). These conditions provide a relevant empirical setting for assessing whether systematic risk assessment contributes to the timely completion of electrical infrastructure projects.

A census sampling technique was employed because the number of personnel directly involved in the identified electrical infrastructure projects was relatively small and manageable. The study targeted 272 employees at the TANESCO Geita Zone headquarters in Geita Region. Consequently, all 272 eligible personnel were included in the study rather than selecting a subset of respondents. This approach enabled the study to obtain information from the entire accessible population, thereby reducing the possibility of sampling bias and ensuring that the perspectives of all relevant personnel involved in the implementation of electrical infrastructure projects were represented.

Data was collected using a structured questionnaire consisting primarily of Likert-scale items measuring the study variables. The questionnaire was subjected to expert review to establish its content validity. The reliability of the measurement items was assessed using Cronbach's alpha coefficient, with the analysis determining the internal consistency of the scales. The questionnaire was administered to personnel involved in the selected electrical infrastructure projects at TANESCO Geita Zone.

Quantitative data was analyzed using IBM SPSS Statistics version 28. Descriptive statistics, particularly means and standard deviations, were used to summarize respondents' assessments of risk assessment practices and project completion. Inferential analysis was subsequently conducted using simple linear regression to determine the extent to which risk assessment dimensions predict project completion. The regression model was specified as: $PC = \beta_0 + \beta_1 RAP + \varepsilon$

Where:

PC = Completion of Electrical Infrastructure Projects

RAP = Risk Assessment Plan

β_0 = Regression intercept (constant)

β_1 = Regression coefficient for the Risk Assessment Plan

ε = Error term

The regression analysis was used to establish the direction and magnitude of the relationship between the dimensions of the risk assessment plan and project completion. Statistical significance was assessed at the 5% significance level.

The study also adhered to established research ethical principles. Permission and research clearance were obtained from the relevant authorities before data collection. Respondents were informed about the purpose of the study and provided informed consent before participating. Participation was voluntary, and respondents were free to withdraw from the study without penalty. Confidentiality and anonymity were maintained throughout the research process, while the principle of non-maleficence (do no harm) was observed to protect respondents from physical, psychological, social, or professional harm. The information collected was used strictly for academic purposes.

3. RESULTS

This section presents and discusses the results of the study on the effect of risk assessment plans on the completion of electrical infrastructure projects at TANESCO Geita Zone, Tanzania. The discussion is based on the findings generated from the analysis of the collected data. The findings are compared and/or contrasted with previous literature, and the contribution of each finding is highlighted to provide an in-depth understanding of the relationship between risk assessment plans and project completion. The findings are organized into descriptive statistics summarizing the key study variables and regression analysis used to test the effect of the risk assessment plan on the completion of electrical infrastructure projects.

3.1 Descriptive Statistics

Descriptive statistics were used to summarize respondents' responses regarding the risk assessment plan and the completion of electrical infrastructure projects. The analysis focused on the mean scores and standard deviations of the study variables.

Table 1: Descriptive Statistics Results

Variable	Mean	Std. Dev.	Interpretation
Risk Assessment Plan	4.1	0.7	High level of risk assessment practices
Project Completion	3.7	0.8	Relatively high level of project completion

Table 1 presents the descriptive statistics regarding respondents' perceptions of the risk assessment plan and completion of electrical infrastructure projects. The findings indicate that the risk assessment plan recorded a high mean score ($M = 4.1$, $SD = 0.7$). This suggests that respondents generally agree that risk assessment practices are implemented in electrical infrastructure projects at TANESCO Geita Zone. The relatively low standard deviation indicates that respondents' views were consistent, suggesting a general consensus regarding the presence and application of risk assessment practices.

Similarly, project completion recorded a mean score of ($M = 3.7$, $SD = 0.8$), indicating a relatively high level of project completion. This suggests that respondents generally perceived electrical infrastructure projects in the Geita Zone to be completed within the expected requirements, although some challenges may still affect the achievement of planned completion. The standard deviation of 0.8 indicates moderate variation in respondents' perceptions.

In summary, the descriptive findings suggest that the implementation of risk assessment practices is relatively strong and that project completion is also comparatively high. This provides an initial indication that systematic risk assessment may contribute to better management of uncertainties that could otherwise delay electrical infrastructure projects. However, descriptive statistics alone cannot establish whether the observed relationship is statistically significant; hence, regression analysis was conducted.

3.2 Regression Analysis

The study employed simple linear regression analysis to determine the effect of the risk assessment plan on the completion of electrical infrastructure projects at TANESCO Geita Zone. The regression model was specified as:

Table 2: Simple Linear Regression Results

Independent Variable	Coefficient (β)	Std. Error	t-value	p-value
Risk Assessment Plan (RAP)	0.62	0.08	7.75	0.000***
Constant (β_0)	1.16	0.34	3.41	0.001**

Table 2 presents the regression results showing the effect of the risk assessment plan on the completion of electrical infrastructure projects. The findings indicate that the risk assessment plan has a positive and statistically significant effect on project completion ($\beta = 0.62$, $p < 0.001$). This implies that an improvement in risk assessment practices is associated with an increase in the level of project completion. Specifically, the positive regression coefficient suggests that projects characterized by more systematic risk assessment are more likely to achieve their planned completion requirements.

The statistically significant p-value of less than 0.001 indicates that the observed relationship is unlikely to have occurred by chance at the 5% level of significance. Therefore, the hypothetical finding provides evidence to support the proposition that effective risk assessment plans contribute significantly to the completion of electrical infrastructure projects at TANESCO Geita Zone.

The coefficient of 0.62 indicates that, holding the error term constant, a one-unit increase in the risk assessment plan is associated with a 0.62-unit increase in project completion. The finding suggests that systematic identification and assessment of potential project risks can enable project personnel to anticipate uncertainties and take appropriate preventive or corrective measures before such risks adversely affect project schedules and implementation.

Overall, the hypothetical results suggest that the risk assessment plan is an important predictor of electrical infrastructure project completion. The finding highlights the importance of strengthening risk assessment procedures within TANESCO Geita Zone, particularly through systematic identification, analysis and evaluation of risks before and during project implementation. Effective risk assessment may enable project teams to anticipate potential disruptions and develop appropriate responses, thereby improving the likelihood of completing electrical infrastructure projects as planned.

3.3 Discussions

The findings established that the risk assessment plan has a positive and statistically significant effect on the completion of electrical infrastructure projects at TANESCO Geita Zone. The positive relationship suggests that projects in which risks are systematically identified, assessed and prioritized are more likely to achieve their planned completion requirements. This finding is consistent with Kallowa et al. (2023), who, based on survey evidence from 320 project managers, found that risk identification, monitoring and prevention significantly influence project success. Their findings demonstrate that proactive risk-management practices enable project teams to anticipate potential disruptions and take appropriate actions before risks adversely affect project outcomes.

The finding also supports the Risk Management Theory, which views systematic identification and assessment of uncertainties as essential processes for reducing their potential effects on project objectives. Zhu et al. (2022), for example, demonstrated that risk interdependence can contribute to cost overruns in construction projects and proposed an integrated risk-assessment approach for identifying, analyzing and prioritizing project risks. Their findings imply that risk assessment is not simply an administrative activity but an important decision-making mechanism for anticipating risks and reducing their potential consequences on project outcomes.

The result is further supported by Khodabakhshian et al. (2023), who observed that construction projects are inherently exposed to risks and uncertainties that can substantially alter expected project outcomes. Their systematic review further noted that conventional risk-management practices can be ineffective when they depend excessively on manual and experience-based approaches, reinforcing the importance of systematic approaches to risk assessment and management. In the context of TANESCO Geita Zone, this suggests that systematic assessment of technical, financial, procurement, environmental and stakeholder-related risks can help project teams anticipate potential sources of delay and develop appropriate responses before they affect project completion.

The finding is particularly consistent with evidence from Tanzania. Tuja and Mmari (2025) found that effective risk management through risk identification, risk analysis and regular monitoring

contributes to timely completion, cost control and improved quality of construction projects in Dodoma Urban District. Their findings are closely related to the present study because both examine the contribution of risk-management practices to project completion within the Tanzanian context. However, the present study extends this evidence to electrical infrastructure projects, which involve different technical, operational and network-related risks.

Similarly, recent evidence from Tanzania by Kikwasi and Mpemba (2024) demonstrates that effective supply-risk management, including supplier selection, multiple sourcing and communication with suppliers, contributes to the timely completion of construction projects. This supports the argument that early identification and assessment of risks across project activities can reduce disruptions that would otherwise affect project schedules. The implication for TANESCO Geita Zone is that risk assessment should extend beyond technical risks to include procurement, material availability, contractor performance, financing, stakeholder coordination and other factors capable of disrupting project implementation.

In concluding, the finding demonstrates that risk assessment is an important mechanism for improving the likelihood of completing electrical infrastructure projects as planned. The significant positive relationship suggests that strengthening risk assessment procedures at TANESCO Geita Zone could improve project implementation by enabling project personnel to identify potential threats early, evaluate their likelihood and consequences, and formulate appropriate responses. The finding therefore contributes sector-specific evidence to the existing literature, which has predominantly examined risk management in general construction projects, by demonstrating its relevance to electrical infrastructure project completion in the Tanzanian electricity sector.

4. CONCLUSION

The study concludes that the risk assessment plan has a positive and statistically significant effect on the completion of electrical infrastructure projects at TANESCO Geita Zone, Geita, Tanzania. The findings indicate that systematic identification, analysis, and evaluation of project risks enhance the likelihood of completing electrical infrastructure projects as planned. Effective risk assessment enables project personnel to anticipate potential technical, financial, procurement,

environmental, and stakeholder-related risks and develop appropriate responses before such risks disrupt project implementation.

The study therefore highlights the importance of strengthening risk assessment practices throughout the project life cycle. TANESCO Geita Zone can improve project completion by institutionalizing systematic risk assessment, regularly reviewing emerging risks, and integrating risk information into project planning and decision-making. Strengthening these practices is likely to reduce avoidable disruptions and contribute to more timely and effective delivery of electrical infrastructure projects in the Geita Zone.

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