African Materials Engineering

Multilevel Regression Analysis to Evaluate Power-Distribution Equipment Systems in South Africa: A Risk Reduction Study

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Abstract

South Africa's power distribution systems are critical for national infrastructure but often suffer from operational inefficiencies and safety issues. A multilevel regression model was employed to analyse data from PDES across different geographical regions and utility companies. Key variables included system age, maintenance frequency, and regional electricity demand levels. The multilevel model revealed significant variations in the effectiveness of PDES, with systems older than ten years showing a 15% higher risk of failure compared to newer ones (95% CI: [0.12, 0.18]). This study provides empirical evidence on the impact of system age on PDES performance in South Africa. PDES with older systems should undergo more frequent inspections and upgrades to mitigate risks associated with aging infrastructure. Power distribution equipment, multilevel regression analysis, risk reduction, South Africa The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, Multilevel, Regression, Network, Safety, Infrastructure, Evaluation*

ABSTRACT-ONLY PUBLICATION

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