Methodological Evaluation of Power-Distribution Equipment Systems in South Africa Using Multilevel Regression Analysis for Yield Improvement Studies

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Abstract

Power distribution equipment systems (PDES) play a critical role in South Africa's industrial sector, particularly in enhancing the efficiency of energy supply and demand. A comparative study employing multilevel regression analysis was conducted, utilising data from various industrial sites in South Africa. Data were collected through surveys and site inspections, with a focus on power distribution equipment systems performance metrics. Multilevel regression analysis revealed that the proportion of yield improvement varied significantly across different regions (e.g., urban vs rural), suggesting regional-specific factors influence efficiency. A key finding is that optimal system design can lead to an average yield increase of 15%. The study underscores the importance of tailored PDES systems for achieving maximum performance, highlighting the need for localized engineering solutions in South Africa's energy sector. Policymakers should prioritise regional-specific studies to tailor PDES design and implementation strategies. Industrial stakeholders are encouraged to adopt best practices based on findings from this study. 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, econometrics, efficiency, optimization, productivity*

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