

Methodological Evaluation of Power-Distribution Equipment Systems in South Africa

A Panel-Data Estimation for Risk Reduction (2000–2026)

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ABSTRACT

Background: The reliability of power-distribution networks is critical for national infrastructure. In South Africa, ageing equipment and operational challenges have heightened the risk of systemic failures, necessitating a robust, data-driven methodology for evaluating equipment performance and prioritising interventions.

Purpose and objectives: This case study aims to develop and apply a panel-data estimation model to methodologically evaluate the performance of key power-distribution equipment systems. The primary objective is to quantify risk reduction associated with targeted maintenance and replacement strategies.

Keywords: *Power-distribution networks, Panel-data estimation, Risk reduction, South Africa, Infrastructure reliability, Asset management, Grid resilience*

Article Highlights

- Panel-data model quantifies failure risk for ageing distribution equipment.
- Identifies critical 15–25 year age bracket for targeted interventions.
- Demonstrates shift from reactive to predictive asset management.
- Provides a data-led framework for prioritising infrastructure investment.

Core Methodology

Fixed-effects panel model using utility records for three equipment classes across multiple municipalities, with inference based on robust standard errors clustered at the municipal level.

This study applies econometric panel-data analysis to infrastructure asset management.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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