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REPLICATION STUDY

Replication and Methodological Evaluation of Industrial Machinery Fleet System Reliability in Kenya

A Multilevel Regression Analysis

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ABSTRACT

Background: Industrial machinery fleet reliability is critical for infrastructure development and economic productivity. Previous studies on system reliability in similar contexts have employed standard regression techniques, which may not adequately account for the hierarchical structure of fleet data, where individual machines are nested within depots and companies.

Purpose and objectives: This study aims to replicate and methodologically evaluate a prior analysis of industrial machinery fleet system reliability. The primary objective is to assess the suitability of a multilevel modelling approach for this context and to verify the robustness of earlier findings concerning key reliability predictors.

Keywords: *Replication study, System reliability, Multilevel modelling, Industrial machinery, Sub-Saharan Africa, Fleet management, Methodological evaluation*

Article Highlights

- Substantial random intercept variance (σ^2=0.18) found at depot level, confirming data clustering.
- Scheduled maintenance adherence shows a 7.2 percentage point increase in machine availability per 100 hours.
- Replication corroborates core maintenance-reliability link but finds attenuated effect size.
- Methodological evaluation demonstrates necessity of multilevel modelling for hierarchical fleet data.

Core Methodological Insight

The significant depot-level variance (95% CI [0.09, 0.31]) validates the multilevel approach, revealing structure that ordinary least squares regression would miss.

This replication provides both methodological validation and context-specific empirical evidence.