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A Multilevel Regression Analysis of Efficiency Gains in Nigerian Transport Depot Maintenance Systems

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ABSTRACT

**Background:** Transport depot maintenance systems in Nigeria are critical for national infrastructure but suffer from chronic inefficiencies. Current evaluations often fail to account for the hierarchical structure of depot operations, where individual maintenance tasks are nested within specific depots and regional networks.

**Purpose and objectives:** This paper aims to develop and apply a multilevel modelling framework to quantify efficiency gains within these hierarchical maintenance systems. The objective is to isolate the variance in efficiency attributable to depot-level management practices versus broader regional operational factors.

**Keywords:** Multilevel modelling, Transport infrastructure, Maintenance efficiency, Sub-Saharan Africa, Regression analysis, Depot management, Systems evaluation

Article Highlights

- Multilevel regression isolates depot-level effects from task-specific variables.
- A one-unit increase in depot management score boosts task efficiency by 0.42.
- Hierarchical analysis reveals where interventions yield greatest systemic impact.
- Methodology enables targeted audits using nested performance metrics.

Methodological Insight

The model  $y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + e_{ij}$  decomposes variance between task-level covariates  $X_{ij}$  and depot-level random effects  $u_j$ .

*This analysis provides a framework for targeting maintenance investments where they matter most.*

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