

A Comparative Analysis of Transport Depot Maintenance Systems in Kenya

A Bayesian Hierarchical Model for Reliability Assessment (2000–2026)

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Received: 23 September 2023 | Accepted: 25 November 2023 | Published: 09 January 2024 | DOI:

[10.5281/zenodo.18973059](https://doi.org/10.5281/zenodo.18973059)

ABSTRACT

Background: Maintenance systems for transport depots are critical for operational reliability and safety, yet their comparative performance in developing economies is understudied. Existing reliability assessments often lack the statistical rigour to handle complex, multi-level operational data and inherent uncertainties.

Purpose and objectives: This study aims to methodologically evaluate and compare the reliability of different maintenance systems used in transport depots. The objective is to develop and apply a Bayesian hierarchical model to quantify system reliability and identify key performance drivers.

Keywords: Bayesian hierarchical modelling, reliability engineering, transport depot maintenance, Sub-Saharan Africa, comparative systems analysis, maintenance optimisation

Article Highlights

- Bayesian hierarchical Weibull model quantifies reliability across transport depot systems.
- Depot-level random effects show substantial heterogeneity in operational performance.
- Centralised maintenance demonstrated superior median time-to-failure metrics.
- Framework provides robust inferential tool for comparative systems analysis.

Methodological Insight

The model $T_{ij} \sim \text{Weibull}(\alpha_j, \lambda_{ij})$, $\log(\lambda_{ij}) = \beta X_{ij} + u_j$ explicitly separates covariate effects from depot-level random variation.

This analysis provides a statistically rigorous framework for maintenance system evaluation in developing economies.

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