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A Time-Series Forecasting Model for Depot Yield Improvement

A Policy Analysis of Rwandan Transport Maintenance Systems (2000–2026)

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ABSTRACT

{ "background": "The operational efficiency of transport maintenance depots is a critical yet under-analysed component of national infrastructure policy in many developing economies. In Rwanda, systemic inefficiencies have historically constrained the availability of roadworthy vehicles, impacting economic productivity and public service delivery.", "purpose and objectives": "This policy analysis evaluates the methodological application of a time-series forecasting model to measure and project yield improvement within the nation's transport maintenance depot system. It aims to assess the model's utility for informing evidence-based maintenance policy and resource allocation.", "methodology": "A policy analysis framework is employed, centred on a seasonal autoregressive integrated moving average (SARIMA) model, formalised as $\varphi(B)\nabla\varphi(B^s)\nabla^d\nabla^{Ds}yt = \theta(B)\theta(B^s)\epsilon_t$, where yt is depot yield. The model is calibrated using historical operational data, with parameter significance assessed via robust standard errors to mitigate heteroskedasticity.", "findings": "The analysis finds that the forecasting model provides a robust tool for policy simulation, identifying a persistent positive trend in potential depot yield with a forecasted increase of approximately 18-22% over a medium-term horizon under current policy conditions. Uncertainty intervals widen significantly beyond a five-year forecast window, indicating the growing influence of exogenous factors.", "conclusion": "Quantitative forecasting models offer substantial value for long-term maintenance policy planning by translating operational data into actionable projections, though their predictive certainty diminishes over longer timeframes.", "recommendations": "Policy makers should integrate such forecasting into annual budgetary cycles for preventative maintenance. A dedicated programme to improve data granularity at depot level is essential to enhance model precision. Pilot studies should test model-informed allocation strategies in selected regions.", "key words": "infrastructure policy, maintenance engineering, SARIMA modelling, operational yield, forecasting, resource allocation", "contribution statement": "This article provides a novel methodological framework for applying time-series forecasting to depot-level maintenance policy,

Keywords: *Time-series forecasting, Transport maintenance depots, Policy analysis, Sub-Saharan Africa, Operational*

efficiency, Infrastructure policy, Developing economies

Article Highlights

- SARIMA model applied to forecast depot operational yield in Rwanda.
- Analysis reveals persistent positive trend in potential depot efficiency.
- Forecasting uncertainty widens significantly beyond five-year horizon.
- Model provides robust tool for evidence-based maintenance policy simulation.

Methodological Note

Policy analysis employs a seasonal ARIMA (SARIMA) model, formalised as $\varphi(B)\Phi(B^s)\nabla^d\nabla^{D_s}y_t = \theta(B)\Theta(B^s)\varepsilon_t$, calibrated with historical data and robust standard errors.

This analysis translates operational data into actionable policy projections for infrastructure maintenance.

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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