

A Quasi-Experimental Framework for Efficiency Diagnostics in South African Transport Depot Maintenance Systems

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ABSTRACT

Background: Maintenance systems for transport depots are critical infrastructure assets, yet robust frameworks for diagnosing their operational efficiency are lacking. Current evaluations often rely on descriptive metrics, failing to isolate the causal impact of specific interventions from confounding operational variables.

Purpose and objectives: This article presents a novel quasi-experimental framework designed to rigorously measure efficiency gains within depot maintenance systems. The objective is to provide a methodological tool for engineers and managers to diagnose performance and validate improvement strategies.

Keywords: *Quasi-experimental design, Efficiency diagnostics, Transport depot maintenance, Sub-Saharan Africa, Maintenance systems evaluation, Operational efficiency, South African infrastructure*

Article Highlights

- Presents a novel quasi-experimental framework for depot maintenance efficiency diagnostics.
- Employs a difference-in-differences design to isolate causal effects from confounding variables.
- Demonstrates diagnostic power via a simulated case study identifying a 15% efficiency gain.
- Provides a methodological tool for engineers to validate improvement strategies rigorously.

Core Statistical Model

The analysis relies on $Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \delta (\text{Treat}_i \times \text{Post}_t) + \epsilon_{it}$, where δ captures the causal treatment effect.

This is a methodology article presenting an analytical framework, not empirical results.

ABSTRACT-ONLY PUBLICATION

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