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Replication and Methodological Evaluation of a Difference-in-Differences Model for Industrial Machinery Fleet Reliability in Tanzania

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ABSTRACT

Background: Difference-in-differences (DiD) models are increasingly applied in engineering asset management to evaluate the impact of interventions on system reliability. A prior study proposed a specific DiD framework for assessing maintenance policy changes on heavy machinery fleets, but its methodological robustness and applicability in a sub-Saharan African context required independent verification.

Purpose and objectives: This study aimed to replicate and critically evaluate the methodological application of a published DiD model for analysing industrial machinery fleet reliability. The objective was to assess the model's assumptions, estimation stability, and practical utility within the Tanzanian industrial sector.

Keywords: *Replication study, Difference-in-differences, Engineering asset management, Industrial machinery fleets, Sub-Saharan Africa, System reliability, Methodological evaluation*

Article Highlights

- Direct replication produced a treatment effect estimate (δ=0.18) consistent with the original study
- Methodological evaluation revealed violation of key parallel trends assumption
- Wide confidence intervals indicate substantial estimation uncertainty
- Findings question robustness of DiD application in this specific context

Methodological Insight

The study demonstrates that diagnostic checks for model assumptions—particularly parallel trends—are more critical than point estimates when drawing causal inferences from observational engineering data.

This replication study emphasizes methodological rigor over definitive results.