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A Quasi-Experimental Design for Reliability Assessment in Uganda's Industrial Machinery Fleets

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ABSTRACT

Background: Industrial machinery fleets in developing economies face unique operational challenges, including harsh environmental conditions and inconsistent maintenance regimes, which complicate traditional reliability assessments. Existing methodologies often rely on controlled laboratory data or manufacturer specifications, which do not accurately reflect in-service performance in such contexts.

Purpose and objectives: This article presents a novel quasi-experimental design to empirically evaluate the operational reliability of heavy industrial machinery fleets under real-world conditions. The primary objective is to provide a field-validated methodological framework that quantifies reliability metrics while accounting for contextual operational stressors.

Keywords: *Quasi-experimental design, Reliability engineering, Industrial machinery fleets, Sub-Saharan Africa, Maintenance optimisation, System performance evaluation, Developing economies*

Article Highlights

- Proposes a novel quasi-experimental design for real-world reliability assessment.
- Employs a Weibull proportional hazards model with operational covariates.
- Simulation validates power to detect significant MTBF improvements.
- Provides a methodological bridge for data-scarce industrial contexts.

Methodological Innovation

A non-equivalent group, pre-test/post-test structure stratifies fleet units, with intervention groups receiving a standardised preventive maintenance protocol against control groups.

This article presents a methodological framework, with findings based on simulation validation.