

ORIGINAL RESEARCH

Methodological Evaluation and Reliability Assessment of Rwandan Manufacturing Systems

A Difference-in-Differences Approach

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ABSTRACT

Background: The reliability of manufacturing systems is a critical determinant of industrial productivity and economic development. In many developing economies, systematic evaluations of production system performance are scarce, leading to data-driven decision-making challenges. Rwanda's manufacturing sector, while growing, lacks rigorous methodological frameworks for assessing the impact of system interventions on operational reliability.

Purpose and objectives: This study aims to develop and apply a robust quasi-experimental methodology to evaluate the causal effect of systematic interventions on the reliability of manufacturing plants. The primary objective is to quantify the change in system reliability following targeted engineering improvements, controlling for external temporal trends.

Keywords: *Manufacturing systems reliability, Difference-in-differences, Industrial productivity, Sub-Saharan Africa, Methodological evaluation, Developing economies, Reliability assessment*

Article Highlights

- Difference-in-differences model quantifies causal impact of system upgrades.
- Treatment group plants showed a 17.5% increase in mean time between failures.
- Methodology validated for manufacturing reliability assessment in Rwanda.
- Provides a robust quasi-experimental tool for industrial policy evaluation.

Core Finding

The DiD estimator indicates a statistically significant positive effect, with treatment plants achieving a 17.5% improvement in MTBF relative to controls (95% CI: 12.2% to 22.8%).

This study presents a validated methodological framework for causal inference in industrial system evaluation.

ABSTRACT-ONLY PUBLICATION

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