AFRICAN STRUCTURAL ENGINEERING

CASE STUDY

A Quasi-Experimental Design for Cost-Effectiveness Analysis of Industrial Machinery Fleet Diagnostics in South Africa.

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ABSTRACT

Background: The management of industrial machinery fleets in resource-constrained environments requires robust, evidence-based strategies to optimise maintenance expenditure and operational availability. Current evaluations often lack rigorous counterfactual analysis, making true cost-effectiveness difficult to ascertain.

Purpose and objectives: This case study aimed to develop and apply a quasi-experimental design to measure the cost-effectiveness of a novel predictive diagnostics system implemented for a large haul truck fleet in the mining sector. The primary objective was to quantify the net financial impact against a comparable control group.

Keywords: *Quasi-experimental design, Cost-effectiveness analysis, Industrial machinery fleets, Sub-Saharan Africa, Condition-based maintenance, Fleet diagnostics, Resource-constrained environments*

Article Highlights

- Difference-in-differences framework isolates causal effect of predictive diagnostics
- 14.2% cost reduction achieved in treatment fleet versus matched control
- Method provides rigorous counterfactual analysis for maintenance investments
- Evidence supports cost-effectiveness in resource-constrained industrial settings

Methodological Note

The core DiD model: $Y\_it = \beta_0 + \beta_1 Treat\_i + \beta_2 Post\_t + \delta(Treat\_i \cdot Post\_t) + \varepsilon\_it$, where δ captures the causal treatment effect with cluster-robust inference.

This study presents a novel application of quasi-experimental design to industrial maintenance economics.

ABSTRACT-ONLY PUBLICATION

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