

# A Panel-Data Methodology for the Cost-Effectiveness Evaluation of Industrial Machinery Fleets in Nigeria

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## ABSTRACT

**Background:** The management of industrial machinery fleets represents a significant capital and operational expenditure for engineering and construction firms in Nigeria. Current evaluation practices often rely on cross-sectional or aggregated financial data, which fail to account for unobserved heterogeneity and dynamic efficiency changes across firms and time.

**Purpose and objectives:** This article presents a novel panel-data methodology to rigorously evaluate the cost-effectiveness of heavy machinery fleets. The objective is to provide a robust analytical framework that isolates the impact of utilisation, maintenance regimes, and fleet composition on total cost of ownership.

**Keywords:** *Panel-data analysis, Cost-effectiveness evaluation, Industrial machinery fleets, Sub-Saharan Africa, Econometric modelling, Asset management, Nigeria*

### Article Highlights

- Introduces a fixed-effects panel regression model for machinery fleet evaluation.
- Controls for unobserved firm heterogeneity and dynamic efficiency changes.
- Reveals non-linear cost escalation from reduced maintenance expenditure.
- Provides framework for causal analysis of total cost of ownership drivers.

### Methodological Contribution

The core specification  $C_{it} = \alpha_i + \beta_1 U_{it} + \beta_2 M_{it} + \beta_3 A_{it} + \gamma Z_{it} + \epsilon_{it}$  isolates causal drivers while accounting for firm-specific fixed effects.

*This study presents an analytical framework, with findings based on simulated data reflecting Nigerian industry conditions.*

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