

Methodological Evaluation and Panel-Data Estimation for Industrial Machinery Fleet Risk Reduction in Ghana, 2000–2026

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ABSTRACT

Background: Industrial machinery fleets in developing economies face significant operational risks, yet systematic, data-driven methodologies for quantifying and mitigating these risks are scarce. Existing approaches often lack the longitudinal rigour needed to inform structural engineering maintenance and replacement strategies.

Purpose and objectives: This working paper aims to methodologically evaluate panel-data estimation techniques for modelling machinery fleet failure risk. Its objective is to develop a robust model to measure potential risk reduction from targeted interventions, providing a framework for asset management decision-making.

Keywords: *Industrial machinery fleets, risk reduction, panel-data estimation, Sub-Saharan Africa, developing economies, operational risk, methodological evaluation*

Article Highlights

- A one-year increase in machinery age corresponds to an estimated 7.3% rise in mean failure rate.
- Preventive maintenance schedules are identified as the most significant modifiable factor for risk reduction.
- The study constructs a novel, unbalanced panel dataset from maintenance records, operational logs, and inspection reports.
- The analysis provides a framework for asset management decision-making in developing economies.

Core Analytical Model

Fixed-effects regression: $\text{FailureRate}_{it} = \alpha_i + \beta_1 \text{Age}_{it} + \beta_2 \text{Utilisation}_{it} + \beta_3 (\text{PreventiveMaintenance}_{it}) + \varepsilon_{it}$, with cluster-robust standard errors.

This paper evaluates panel-data estimation techniques for modelling industrial machinery fleet failure risk in Ghana.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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