

# Methodological Evaluation and Panel-Data Estimation for Risk Reduction in Senegal's Industrial Machinery Fleets

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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 isolate the effects of specific interventions from operational noise.

**Purpose and objectives:** This study aims to develop and evaluate a robust methodological framework for assessing machinery fleet risk. Its core objective is to utilise panel-data econometrics to measure the causal effect of structured maintenance protocols on incident reduction within an industrial setting.

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

### Article Highlights

- Panel-data econometrics isolates causal effects from operational noise in machinery fleets.
- Fixed-effects model controls for unobserved heterogeneity across industrial sites.
- 22.5% incident reduction linked to structured maintenance protocols.
- Framework enables evidence-based evaluation of engineering safety interventions.

### Methodological Contribution

First application of a panel-data econometric framework to quantify the causal impact of engineering interventions on machinery fleet risk in an industrial African context.

*This study provides a replicable methodological framework for evidence-based safety management.*

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