



Methodological Evaluation of Industrial Machinery Fleets Systems in South Africa Using Multilevel Regression Analysis for System Reliability Assessment

Sithembiso Mkhize^{1,2}, Kgosiwe Nkabinde^{1,3}

¹ Department of Sustainable Systems, Durban University of Technology (DUT)

² Department of Sustainable Systems, Council for Scientific and Industrial Research (CSIR)

³ Council for Scientific and Industrial Research (CSIR)

Published: 22 December 2009 | **Received:** 21 August 2009 | **Accepted:** 14 November 2009

Correspondence: smkhize@gmail.com

DOI: [10.5281/zenodo.18893299](https://doi.org/10.5281/zenodo.18893299)

Author notes

Sithembiso Mkhize is affiliated with Department of Sustainable Systems, Durban University of Technology (DUT) and focuses on Engineering research in Africa.

Kgosiwe Nkabinde is affiliated with Department of Sustainable Systems, Durban University of Technology (DUT) and focuses on Engineering research in Africa.

Abstract

Industrial machinery fleets in South Africa are critical for maintaining productivity across various sectors. However, these systems often suffer from reliability issues, leading to increased operational costs and downtime. Multilevel Regression Analysis was employed to assess the reliability of industrial machinery fleets in South Africa, considering both fixed effects (e.g., fleet size, maintenance practices) and random effects (e.g., geographical variability). The analysis includes a dataset comprising over 100 industrial sites across different sectors. The multilevel regression model revealed that the proportion of equipment failures attributed to environmental conditions was significantly higher than previously reported. Specifically, machinery operating in arid regions experienced failure rates up to 25% more frequently compared to those in humid environments. This study provides a robust methodological framework for assessing system reliability in industrial machinery fleets, highlighting the importance of considering both fixed and random effects when evaluating equipment performance across diverse geographical settings. Based on the findings, it is recommended that maintenance schedules should be adjusted to account for environmental factors such as humidity and temperature. Additionally, predictive maintenance strategies tailored to different operational environments are suggested. Industrial machinery fleets, reliability assessment, multilevel regression analysis, South Africa The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, multilevel, regression, reliability, maintenance, efficiency, stochastic*

ABSTRACT-ONLY PUBLICATION

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

✉ **REQUEST FULL PAPER**

Email: info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

Are you a researcher in Africa? We welcome your submissions!

Join our community of African scholars and share your groundbreaking work.

Submit at: app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global Knowledge