

Methodological Evaluation and Multilevel Regression Analysis of Manufacturing System Reliability in Ethiopia

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ABSTRACT

Background: The reliability of manufacturing systems is a critical determinant of industrial productivity and economic development. In many developing economies, systematic evaluations of these systems, particularly within operational plants, are scarce, leading to a lack of context-specific empirical evidence for improvement.

Purpose and objectives: This study aims to methodologically evaluate the reliability of manufacturing systems within operational plants and to develop a robust analytical model for identifying the key operational and organisational factors influencing system reliability.

Keywords: *Manufacturing systems, System reliability, Multilevel modelling, Sub-Saharan Africa, Industrial development, Regression analysis, Methodological evaluation*

Article Highlights

- Multilevel modelling reveals greater reliability variance between production lines than within them.
- Preventive maintenance adherence is a significant, quantifiable predictor of system MTBF.
- The study provides a context-specific analytical framework for Sub-Saharan African manufacturing.
- Findings prioritise organisational practices over equipment-specific variables for intervention.

Core Analytical Model

A two-level hierarchical linear model was specified with equipment nested within production lines to analyse $\log(\text{MTBF})$, accounting for both within-line and between-line variance.

This study offers a methodological framework for evaluating industrial system reliability in developing economies.



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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