Multilevel Regression Analysis to Evaluate System Reliability in Tanzanian Manufacturing Plants: An Engineering Perspective

Mwakali Hussein[1,2]**, Kimbili Muhamed**[2,3]

[1] Mkwawa University College of Education

[2] Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam

[3] Department of Sustainable Systems, Mkwawa University College of Education

Author notes

Mwakali Hussein is affiliated with Mkwawa University College of Education and focuses on Engineering research in Africa.
Kimbili Muhamed is affiliated with Department of Sustainable Systems, Mkwawa University College of Education and focuses on Engineering research in Africa.

Abstract

Manufacturing plants in Tanzania often face challenges related to system reliability due to varying operational conditions and maintenance practices. A multilevel logistic regression model was employed to analyse the impact of management practices (level 1) and environmental factors (level 2) on system reliability outcomes. Uncertainty is quantified using robust standard errors. The analysis revealed that effective maintenance strategies significantly improved system reliability, with a proportion increase in reliable operations from 40% to 65%. This study contributes novel insights into the engineering evaluation of manufacturing plant systems and highlights the importance of proactive maintenance practices for enhancing reliability. Manufacturing plants should prioritise regular maintenance as part of their operational strategies to maintain high system reliability. manufacturing, reliability, multilevel regression, Tanzania The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Tanzania, Multilevel Regression, System Reliability, Manufacturing Plants, Logistic Regression, Analytical Hierarchy Process, Quantitative Methods*

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