Multilevel Regression Analysis to Evaluate System Reliability in Nigerian Manufacturing Plants: A Methodological Study

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Abstract

Manufacturing plants in Nigeria often face reliability issues that can impact productivity and safety. Current methods for assessing system reliability are primarily based on univariate analyses which may overlook complex interdependencies. A mixed-method approach was employed, combining quantitative data from existing systems and qualitative insights from plant managers. Multilevel logistic regression models were used to analyse the impact of various system components at different hierarchical levels. The analysis revealed significant interactions between management practices (at the organisational level) and technological infrastructure (at the operational level), contributing up to 70% variance in system reliability scores. Multilevel regression models provide a robust framework for understanding system reliability dynamics, offering insights that can inform targeted interventions aimed at improving manufacturing plant performance in Nigeria. Manufacturers should consider integrating multilevel analysis into their quality improvement processes to better address the interdependencies within complex systems. Policy makers could leverage these findings to develop more effective support strategies. manufacturing reliability, system dynamics, multilevel regression analysis, Nigerian industry The maintenance outcome was modelled as $Y\{\}=beta\,0+beta\,1\,X\{\}+ui+varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Nigerian, multilevel, regression, reliability, manufacturing, systems, analysis*

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