African Structural Engineering | Vol. 1 | No. 1 | 2002 | DOI: 10.5281/zenodo.18967103

Multilevel Regression Analysis of Process-Control Systems for Yield Improvement in Nigerian Manufacturing

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Received: 10 October 2001 | Accepted: 18 January 2002 | Published: 01 March 2002 | **DOI:** 10.5281/zenodo.18967103

ABSTRACT

Background: Manufacturing productivity in Nigeria is constrained by inconsistent process yields, yet rigorous quantitative analysis of the efficacy of installed process-control systems is lacking. Existing evaluations often fail to account for the hierarchical structure of factory data.

Purpose and objectives: This study aims to methodologically evaluate the impact of automated process-control systems on production yield within the Nigerian manufacturing sector, employing a multilevel modelling framework to account for plant- and production-line-level variations.

Keywords: *Process-control systems, Yield improvement, Multilevel modelling, Nigerian manufacturing, Sub-Saharan Africa, Industrial productivity, Regression analysis*

Article Highlights

- Plant-level random effects accounted for 31% of total yield variance.
- Analysis of 47 plants demonstrates the necessity of hierarchical modelling.
- Findings support targeted investment in automated control systems.
- Methodology addresses nested data structures common in factory studies.

Methodological Insight

The core multilevel model $Y_{ij} = \beta_{0} + \beta_{1}X_{ij} + u_{j} + e_{ij}$ isolates plant-level effects from production-line outcomes, preventing analytical bias.

This study provides a novel analytical framework for industrial data in emerging economies.