Methodological Evaluation and Time-Series Forecasting for Process-Control System Efficiency Gains in Nigeria (2000–2026)

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ABSTRACT

Background: Process-control systems in industrial settings are critical for operational efficiency, yet there is a paucity of longitudinal, quantitative analyses for evaluating their performance gains in emerging economies. Existing assessments often lack a robust forecasting framework to guide strategic investment and optimisation.

Purpose and objectives: This data descriptor presents a novel methodological framework and a curated dataset designed to evaluate process-control system efficiency and forecast future performance. The primary objective is to provide a replicable model for quantifying efficiency gains and predicting trends to inform engineering and maintenance decisions.

Keywords: *Process-control systems, Time-series forecasting, Efficiency gains, Industrial engineering, Sub-Saharan Africa, Methodological evaluation, Longitudinal analysis*

Article Highlights

• Presents a novel longitudinal dataset for evaluating industrial process-control system performance.
• Validates an ARIMA forecasting framework with strong predictive capability ($\pm 2.7\%$ error).
• Provides a replicable model to quantify efficiency gains and inform maintenance decisions.
• Highlights application for strategic investment and optimisation in emerging economies.

Core Forecasting Model

Employs an ARIMA framework: $y_t = c + \phi_1 y_{t-1} + \theta_1 \epsilon_{t-1} + \epsilon_t$, with parameters estimated via maximum likelihood and robustness assessed through rolling-origin evaluation.

This data descriptor provides a methodological foundation for quantitative performance forecasting.

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