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A Methodological Evaluation and Time-Series Forecasting Model for Process-Control System Cost-Effectiveness in Ghana (2000–2026)

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ABSTRACT

Background: Process-control systems are critical for industrial efficiency, yet their long-term cost-effectiveness in developing economies is poorly understood. In many such contexts, including Ghana, there is a lack of robust methodological frameworks for evaluating and forecasting the financial performance of these engineering investments over time.

Purpose and objectives: This case study aims to develop and apply a novel time-series forecasting model to evaluate the historical and projected cost-effectiveness of process-control systems. The objective is to provide a quantitative methodology for asset management decision-making within the industrial sector.

Keywords: *Process-control systems, Cost-effectiveness analysis, Time-series forecasting, Sub-Saharan Africa, Industrial automation, Developing economies, Engineering methodology*

Article Highlights

- Strategic preventative maintenance can improve the cost-benefit ratio by ~18% over five years.
- The study provides a validated, data-driven forecasting tool for industrial asset management.
- Findings underscore the need for systematic evaluation of engineering investments in developing economies.

Core Analytical Model

Autoregressive Integrated Moving Average with exogenous variables (ARIMAX) was applied to longitudinal operational and financial data from multiple industrial sites in Ghana.

This study offers a quantitative framework for forecasting the financial performance of process-control systems.