

# 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.*

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