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COMPARATIVE STUDY

Comparative Evaluation of Process-Control System Methodologies for Efficiency Gains in South Africa

A Quasi-Experimental Design

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ABSTRACT

Background: Process-control systems are critical for operational efficiency in capital-intensive industries, yet there is a paucity of rigorous, field-based evaluations comparing the efficacy of different methodological approaches within the local industrial context.

Purpose and objectives: This study aims to empirically compare the efficiency gains delivered by three distinct process-control system methodologies—model predictive control, statistical process control, and a rule-based heuristic system—within operational industrial plants.

Keywords: *Process-control systems, Efficiency gains, Quasi-experimental design, South Africa, Comparative evaluation, Industrial automation*

Article Highlights

- Quasi-experimental design implemented across three matched manufacturing sites.
- Model predictive control demonstrated superior performance with 17.3% efficiency gain.
- Primary mechanism was reduced energy consumption during transient operational states.
- Findings provide first comparative field evidence from South African industrial context.

Methodological Note

Treatment effect estimated using difference-in-differences model with cluster-robust standard errors, measuring efficiency via normalised output-per-unit-energy metric.

This study offers practical evidence for industrial practitioners considering process-control system implementations.