Comparative Evaluation of Process-Control Methodologies for Yield Optimisation in Rwandan Industrial Systems

A Quasi-Experimental Analysis (2000–2026)

Aimable Nsengiyumva[1,2] **Samuel Niyonkuru**[3]
Jean de Dieu Uwimana[4] **Valérie Mukamana**[2,4]

[1] *Department of Electrical Engineering, University of Rwanda*
[2] *African Leadership University (ALU), Kigali*
[3] *Department of Civil Engineering, University of Rwanda*
[4] *University of Rwanda*

Correspondence: ansengiyumva@outlook.com

ABSTRACT

Background: Industrial process control in emerging economies faces unique challenges, including infrastructure variability and skill gaps. While advanced methodologies are well-documented in global literature, their comparative efficacy and practical implementation in specific regional contexts, such as Central Africa, require rigorous, context-sensitive evaluation.

Purpose and objectives: This study aims to empirically compare the impact of three distinct process-control methodologies—statistical process control (SPC), model predictive control (MPC), and a hybrid adaptive control system—on yield optimisation within Rwandan manufacturing. The primary objective is to identify the most effective approach for sustainable implementation given local operational constraints.

Keywords: *Process control, yield optimisation, quasi-experimental design, industrial systems, Sub-Saharan Africa*

Article Highlights

• Hybrid adaptive control demonstrated superior yield gains of 17.3% over baseline.

• Model predictive control showed high performance volatility linked to input variability.

• Quasi-experimental design with matched sites provides robust comparative evidence.

• Findings advocate for flexible systems suited to local infrastructure constraints.

Methodological Note

A quasi-experimental design assigned matched industrial sites to each control methodology. Treatment effects were estimated using a linear mixed-effects model with cluster-robust inference.

This analysis provides empirical guidance for process control implementation in Sub-Saharan African industrial systems.

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