

Randomised Field Trial of Process-Control System Methodologies for Yield Optimisation in South African Industrial Plants

Pieter van der Merwe¹|Thandiwe Nkosi²|Kagiso Naidoo³

SA Medical Research Council (SAMRC) • Department of Sustainable Systems, Stellenbosch University • University of KwaZulu-Natal

Correspondence: pmerwe@yahoo.com

Received: 29 January 2025 | Accepted: 28 March 2025 | Published: 12 May 2025 | DOI:

[10.5281/zenodo.18973212](https://doi.org/10.5281/zenodo.18973212)

ABSTRACT

Background: Industrial process-control systems are critical for operational efficiency, yet there is a paucity of rigorous field evidence from the region comparing the efficacy of different methodological approaches for yield optimisation.

Purpose and objectives: This study aimed to empirically evaluate and compare the yield improvement performance of three distinct process-control system methodologies—model predictive control, statistical process control, and a rule-based expert system—within operational industrial plants.

Keywords: *process-control systems, yield optimisation, randomised field trial, industrial plants, South Africa, methodological evaluation*

Article Highlights

- Multi-site randomised field trial across 27 industrial plants in South Africa
- Model predictive control yielded 7.3% mean increase versus control group
- Statistical process control showed 3.1% improvement, expert system 1.8%
- Linear mixed-effects model with robust standard errors clustered at plant level

Methodological Note

The primary analysis used a linear mixed-effects model: $Y_{ij} = \mu + \alpha_i + \beta X_{ij} + \epsilon_{ij}$, where Y_{ij} is yield for plant j in sector i , with robust standard errors clustered at plant level.

This study provides the first comparative experimental evidence from a randomised field trial on process-control effectiveness in the region.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

REQUEST FULL PAPER

 **Email:** info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We
welcome your submissions!**

Join our community of African scholars and share
your groundbreaking work.

 **Submit at:** app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global
Knowledge