

A Difference-in-Differences Evaluation of Process-Control System Efficiency Gains in Nigerian Industrial Infrastructure (2000–2024)

Chukwuma Nwachukwu¹, Oluwaseun Adebayo^{1,2}, Amina Suleiman³
Chinwe Okonkwo⁴

Nigerian Institute of Social and Economic Research (NISER) | University of Maiduguri | Bayero University
Kano | Department of Civil Engineering, University of Maiduguri

Correspondence: cnwachukwu@yahoo.com

Received: 25 November 2023 | Accepted: 29 December 2023 | Published: 26 February 2024 | DOI:

[10.5281/zenodo.18973819](https://doi.org/10.5281/zenodo.18973819)

ABSTRACT

Background: The integration of advanced process-control systems into industrial infrastructure is a key strategy for enhancing operational efficiency in developing economies. However, rigorous quantitative evaluations of their impact within the African context, particularly using causal inference methods, are scarce.

Purpose and objectives: This study aims to empirically quantify the causal effect of modern process-control system retrofits on the operational efficiency of industrial plants. The primary objective is to isolate and measure efficiency gains attributable to the technological intervention, controlling for external temporal trends.

Keywords: *process-control systems, industrial infrastructure, difference-in-differences, operational efficiency, Sub-Saharan Africa, Nigeria, engineering evaluation*

Article Highlights

- Quasi-experimental DiD model isolates causal effect of technological retrofits.
- Statistically significant mean efficiency gain of 18.7% relative to control group.
- Effect robust across specifications, with inference using cluster-robust standard errors.
- First application of DiD econometrics to process-control evaluation in this context.

Methodological Note

Core estimating equation: $Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \delta(\text{Treat}_i \cdot \text{Post}_t) + \varepsilon_{it}$, where δ captures the causal treatment effect.

This study provides causal evidence for infrastructure investment prioritisation.

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