AFRICAN CIVIL ENGINEERING JOURNAL

CASE STUDY

A Difference-in-Differences Model for Manufacturing Systems Efficiency

A Methodological Evaluation of South African Plants (2000–2024)

Pieter van der Merwe[1] | **Kagiso Mokoena**[2]
Anika Pretorius[1] | **Thandiwe Nkosi**[3,4]

1 *North-West University*
2 *Department of Sustainable Systems, South African Institute for Medical Research (SAIMR)*
3 *South African Institute for Medical Research (SAIMR)*
4 *Department of Sustainable Systems, Mintek*

Correspondence: pmerwe@aol.com

Received: 06 May 2026 | Accepted: 25 June 2026 | Published: 17 August 2026 | **DOI:** 10.5281/zenodo.18971870

ABSTRACT

Background: Evaluating the impact of technological and managerial interventions on manufacturing systems efficiency requires robust quasi-experimental methods. The difference-in-differences (DiD) model is widely applied in econometrics but its methodological rigour and assumptions are less frequently scrutinised within industrial engineering contexts, particularly in developing economies.

Purpose and objectives: This case study aims to methodologically evaluate the application of the DiD model for measuring efficiency gains within manufacturing plants. It assesses the model's suitability, key assumptions, and practical implementation challenges in this specific industrial setting.

Keywords: *difference-in-differences, manufacturing systems, efficiency measurement, quasi-experimental design, South African industry*

Article Highlights

- DiD model estimated a 7.5 percentage point increase in Overall Equipment Effectiveness.
- Parallel trends assumption validation is critical but context-dependent.
- Defining a valid control group presents a key practical challenge.
- Cluster-robust standard errors address serial correlation in panel data.

Core Model Specification

$Y_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \delta(Treat_i \cdot Post_t) + \varepsilon_{it}$, where δ is the average treatment effect on the treated.

This methodological evaluation focuses on the application and assumptions of the DiD model within a specific industrial context.