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Methodological Evaluation and Time-Series Forecasting for Manufacturing Systems Efficiency in Senegal

A Longitudinal Analysis from 2000–2026

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ABSTRACT

Background: The sustained improvement of manufacturing systems efficiency is a critical engineering challenge for industrial development in West Africa. Existing methodological frameworks for evaluating plant-level performance often lack robust, forward-looking capabilities, limiting strategic planning.

Purpose and objectives: This study aims to develop and validate a novel time-series forecasting model to measure and project efficiency gains within manufacturing systems. The objective is to provide a methodological tool for longitudinal analysis and future performance prediction.

Keywords: *Manufacturing systems efficiency, Time-series forecasting, West Africa, Methodological evaluation, Longitudinal analysis, Industrial development*

Article Highlights

- Novel ARIMA-X model developed for longitudinal efficiency forecasting in an industrialising context.
- Analysis reveals a statistically significant link between technological investment and efficiency gains.
- Methodology provides a substantial improvement over static efficiency assessment frameworks.
- Findings offer an evidence-based tool for strategic capacity planning and policy development.

Methodological Innovation

The core contribution is an ARIMA model with exogenous variables (ARIMA-X), specified to forecast manufacturing systems efficiency using longitudinal plant performance data from Senegal.

This study provides a forward-looking analytical framework for industrial engineering in developing economies.