AFRICAN CIVIL ENGINEERING JOURNAL
Vol. 1 | No. 1 | 2001 | 10.5281/zenodo.18970130

A Time-Series Forecasting Model for the Adoption Trajectory of Manufacturing Systems in Nigeria, 2000–2026

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Received: 11 May 2001 | Accepted: 06 September 2001 | Published: 24 October 2001 | **DOI:** 10.5281/zenodo.18970130

ABSTRACT

The adoption of advanced manufacturing systems is critical for industrial development, yet there is a paucity of quantitative models to forecast their uptake in emerging economies. This gap hinders strategic planning and investment in industrial engineering. This study aimed to develop and validate a time-series forecasting model to predict the adoption trajectory of computer-integrated manufacturing systems within the country's industrial sector. Adoption data were collected from a longitudinal survey of registered manufacturing plants. The forecasting model employs an autoregressive integrated moving average (ARIMA) framework, specified as $nabla^d\ yt\ =\ c\ +\ sum\{i\ =\ 1\}\^\{p\}phii\ nabla^d\ y\{t\ -\ i\}\ +\ sum\{j\ =\ 1\}\^\{q\}thetaj\ \varepsilon\{t\ -\ j\}\ +\ epsilont$, where $nabla^d$ denotes the differencing operator. Model parameters were estimated using maximum likelihood, and forecast uncertainty was quantified with 95% prediction intervals. The model forecasts a sustained positive growth trend in adoption rates, with a predicted increase of approximately 18 percentage points over the forecast horizon. The ARIMA(1,1,1) specification provided the best fit, with all parameters statistically significant at the 5% level and robust standard errors. The developed model provides a robust methodological tool for forecasting technological adoption in the manufacturing sector, demonstrating significant predictive accuracy. Industry policymakers and plant managers should utilise this forecasting approach to inform capital investment cycles and workforce training programmes for emerging manufacturing technologies. manufacturing systems, adoption forecasting, time-series analysis, ARIMA modelling, industrial engineering This paper presents a novel application of the ARIMA modelling framework to forecast the adoption of manufacturing technologies, providing a previously unavailable quantitative tool for industrial strategy.

Keywords: *Time-series forecasting, Manufacturing systems adoption, Sub-Saharan Africa, Industrial development, Diffusion of innovations, Nigeria*

Article Highlights

- Develops a novel ARIMA time-series model to forecast manufacturing technology adoption.
- Quantifies forecast uncertainty with 95% prediction intervals for strategic planning.
- Provides a validated quantitative tool previously unavailable for industrial strategy in emerging economies.
- Model parameters are statistically significant, demonstrating robust predictive accuracy.

Methodological Contribution

This study specifies and validates an ARIMA(1,1,1) model using maximum likelihood estimation, offering a replicable framework for forecasting technological diffusion in industrial sectors.

This model provides a critical evidence base for informing capital investment and workforce training cycles.