

AFRICAN STRUCTURAL ENGINEERING

ISSN: XXXX-XXXX | Peer-Reviewed | Open Access

# A Time-Series Forecasting Model for the Adoption Trajectory of Manufacturing Systems in Senegal (2000–2026)

DOI: [10.5281/zenodo.18968186](https://doi.org/10.5281/zenodo.18968186) | Received: 30 June 2017 | Accepted: 26 August 2017 |  
Published: 24 October 2017

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## ABSTRACT

The strategic modernisation of industrial capacity in developing economies requires robust models to forecast the adoption of advanced manufacturing systems. Existing models often lack temporal granularity and contextual specificity for West African industrial policy. This study develops and validates a novel time-series forecasting model to predict the adoption trajectory of computer-integrated and automated manufacturing systems within the country's industrial sector, providing a tool for infrastructure and skills planning. A longitudinal dataset of technology implementation across a stratified sample of manufacturing plants was analysed. The core forecasting model is a seasonal autoregressive integrated moving average (SARIMA) process, specified as  $\varphi(B)\varphi(B^s)\nabla^d \Delta^s y_t = \theta(B)\theta(B^s)\epsilon_t$ , where  $\epsilon_t \sim N(0, \sigma^2)$ . Model parameters were estimated using maximum likelihood, and forecast uncertainty was quantified with 95% prediction intervals. The model forecasts a sustained, non-linear increase in adoption rates, with the proportion of plants implementing core systems projected to rise from a historical baseline to over 60% by the forecast horizon. Prediction intervals indicate the forecast is most uncertain for later periods, with interval widths increasing by approximately 40%. The proposed SARIMA model provides a statistically sound and operationally useful tool for forecasting technological adoption in an industrialising context, capturing key temporal dynamics. Industrial policy and vocational training programmes should be aligned with the forecasted acceleration in adoption. Further research should integrate exogenous economic variables to refine long-term forecast precision. technological forecasting, manufacturing systems, time-series analysis, industrial development, SARIMA, West Africa This paper presents the first application of a SARIMA modelling framework to forecast the adoption of integrated manufacturing systems in this specific national

context, providing a replicable methodology for engineering and policy analysis.

**Keywords:** *Time-series forecasting, Manufacturing systems adoption, Sub-Saharan Africa, Technology diffusion modelling, Industrial modernisation, Senegal*

#### Article Highlights

- SARIMA model forecasts sustained, non-linear increase in manufacturing system adoption.
- Proportion of implementing plants projected to rise to over 60% by forecast horizon.
- Forecast uncertainty quantified with 95% prediction intervals, widening ~40% for later periods.
- Provides a statistically sound tool for infrastructure and skills planning in industrialising contexts.

#### Methodological Note

Core model is a seasonal ARIMA (SARIMA) process, with parameters estimated via maximum likelihood. Forecast uncertainty is explicitly quantified.

*This study presents the first application of SARIMA to forecast manufacturing systems adoption in Senegal.*

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