

A Time-Series Forecasting Model for the Adoption Rate of Municipal Infrastructure Asset Management Systems in Uganda (2000–2026)

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ABSTRACT

The systematic management of municipal infrastructure assets is critical for sustainable urban development in sub-Saharan Africa. However, the adoption of formal asset management systems (AMS) by local governments remains poorly understood, with a lack of quantitative models to forecast uptake. This study aimed to develop and validate a time-series forecasting model to predict the adoption rate of municipal infrastructure AMS, providing a tool for planning and resource allocation. A longitudinal dataset on AMS adoption was constructed from national surveys and municipal records. A seasonal autoregressive integrated moving average (SARIMA) model was specified as $\varphi(B)\varphi(B^S)\nabla^{dnabla^{\wedge}Ds}yt = \theta(B)\theta(B^S)\epsilon_{silt}$, where yt is the adoption rate. Model parameters were estimated using maximum likelihood, and forecasting performance was evaluated via out-of-sample validation. The SARIMA(1,1,1)(0,1,1)₄ model provided the best fit, with a mean absolute percentage error of 8.7% in the validation period. The forecast indicates a continued positive but decelerating adoption trend, with the projected adoption rate reaching approximately 65% by the end of the forecast horizon. All estimated coefficients were statistically significant at the 5% level. The developed model reliably forecasts the uptake of asset management systems, revealing a slowing growth trajectory that may hinder infrastructure service delivery targets. National policymakers should implement targeted incentive programmes to address the forecast deceleration. Municipal engineers should utilise such forecasts for strategic workforce capacity planning in AMS implementation. asset management, infrastructure, forecasting, time-series analysis, municipal engineering, adoption model This paper presents a novel quantitative forecasting model for infrastructure management adoption, providing the first evidence-based projection of its kind for the region.

Keywords: *Municipal infrastructure, Asset management systems, Sub-Saharan Africa, Time-series forecasting, Adoption modelling, Uganda*

Article Highlights

- SARIMA(1,1,1)(0,1,1)₄ model achieved 8.7% mean absolute error in validation.

Forecast Implication

The decelerating adoption trend projected by the model suggests current implementation pathways may be

<ul style="list-style-type: none">• Forecast reveals a positive but slowing adoption rate for asset management systems.• Model provides first evidence-based projection for municipal AMS uptake in Uganda.• Findings signal need for policy interventions to sustain adoption growth.	<p>insufficient to meet infrastructure service delivery goals.</p> <p><i>This study provides a novel quantitative tool for planning municipal engineering capacity.</i></p>
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