

AFRICAN STRUCTURAL ENGINEERING

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

# Methodological Evaluation and Panel-Data Estimation of Municipal Infrastructure Asset System Efficiency in Uganda, 2000–2026

DOI: [10.5281/zenodo.18967424](https://doi.org/10.5281/zenodo.18967424) | Received: 20 July 2025 | Accepted: 31 August 2025 |

Published: 16 October 2025

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## ABSTRACT

**Background:** Municipal infrastructure asset systems in many developing nations face chronic inefficiencies, yet robust, longitudinal methods for quantifying their operational performance are scarce. Existing evaluations often rely on cross-sectional data, failing to capture dynamic efficiency changes and the impact of management practices over time.

**Purpose and objectives:** This study aims to develop and apply a panel-data econometric framework to evaluate the technical efficiency of municipal infrastructure systems. The objective is to measure longitudinal efficiency gains, identify key determinants of performance, and methodologically advance asset management assessment within an engineering context.

**Keywords:** *Municipal infrastructure, Asset management, Panel-data analysis, Sub-Saharan Africa, Efficiency measurement, Developing economies, Longitudinal study*

### Article Highlights

- Mean technical efficiency score estimated at 0.58, indicating significant systemic improvement potential.
- Panel-data stochastic frontier analysis rejects hypothesis of static efficiency over time.
- Preventative maintenance expenditure ratio emerges as statistically significant performance driver.
- Methodology provides rigorous benchmarking framework for asset management practice.

### Methodological Contribution

Applies stochastic frontier analysis to an unbalanced panel of municipal asset systems, advancing longitudinal efficiency measurement in engineering contexts.

*This study provides an evidence-based framework for tracking infrastructure performance trends.*

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This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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