

Multilevel Regression Analysis for Reliability Assessment of Municipal Infrastructure Asset Systems in Rwanda

Emmanuel Habimana¹|Marie Claire Uwimana²|Alice Uwase Kayitesi²
Jean de Dieu Niyonzima²

African Leadership University (ALU), Kigali • University of Rwanda

Correspondence: ehabimana@gmail.com

Received: 17 November 2018 | Accepted: 21 December 2018 | Published: 05 January 2019 | DOI:

[10.5281/zenodo.18968511](https://doi.org/10.5281/zenodo.18968511)

ABSTRACT

Background: Municipal infrastructure asset systems in Rwanda face challenges from rapid urbanisation and constrained maintenance resources. Current reliability assessments often fail to account for the hierarchical nature of asset data, where individual components are nested within larger systems and geographical units.

Purpose and objectives: This study aimed to develop and apply a multilevel regression modelling framework to assess the reliability of municipal infrastructure systems, explicitly accounting for data hierarchy to provide more accurate and actionable insights for asset management.

Keywords: *Municipal infrastructure, Asset management, Reliability assessment, Multilevel regression, Sub-Saharan Africa, Urbanisation, Systems engineering*

Article Highlights

- Multilevel regression reveals 31% of asset reliability variance stems from district-level effects.
- Increased maintenance frequency raises odds of full functionality by 2.4 times.
- Hierarchical data analysis is essential for accurate municipal asset management.
- Framework provides actionable insights for resource allocation in Sub-Saharan Africa.

Methodological Insight

A two-level random intercept logistic model was specified to analyse hierarchical asset data, with parameters estimated via restricted maximum likelihood.

This study demonstrates the critical advantage of hierarchical modelling for infrastructure systems in rapidly urbanizing contexts.

ABSTRACT-ONLY PUBLICATION

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

REQUEST FULL PAPER

 **Email:** info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We
welcome your submissions!**

Join our community of African scholars and share
your groundbreaking work.

 **Submit at:** app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global
Knowledge