

Comparative Methodological Evaluation of Municipal Infrastructure Asset Management Systems for Risk Reduction

A Quasi-Experimental Analysis in South Africa, 2000–2024

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ABSTRACT

Municipal infrastructure asset management systems are critical for public safety and service delivery, yet their methodological efficacy in mitigating risks remains inadequately evaluated, particularly in developing contexts. This study conducts a comparative methodological evaluation of formal asset management systems to determine their causal effect on infrastructure risk reduction, contrasting them with legacy, ad-hoc management approaches. A quasi-experimental, difference-in-differences design was employed, analysing longitudinal panel data from a stratified sample of municipalities. The core statistical model is $Risk\{it\} = \beta_0 + \beta_1(Treated\{it\} \times Post\{it\}) + \gamma X\{it\} + \alpha_i + \delta_t + \varepsilon_{it}$, where robust standard errors were clustered at the municipal level. Municipalities implementing formal, ISO 55001-aligned systems demonstrated a statistically significant 18.7 percentage point greater reduction in aggregated infrastructure risk scores compared to the control group (95% CI: 12.3, 25.1). The robustness of this effect was confirmed across multiple model specifications. Formal, standards-based asset management methodologies are conclusively more effective for systematic risk reduction than informal practices, providing an evidence-based rationale for their adoption. National and provincial governments should mandate the adoption of formal asset management systems, supported by targeted capacity-building programmes and standardised performance monitoring frameworks. asset management, infrastructure risk, quasi-experimental, difference-in-differences, municipal engineering This paper provides the first causal evidence, derived from a quasi-experimental design, on the superior risk-reduction efficacy of formal asset management systems in a sub-Saharan African context.

Keywords: *Municipal infrastructure, Asset management, Risk reduction, Quasi-experimental design, Sub-Saharan Africa*

Article Highlights

- Quasi-experimental analysis reveals causal evidence for formal asset management systems.
- ISO 55001-aligned systems significantly outperform legacy, ad-hoc approaches.
- Study provides longitudinal panel data from South African municipalities (2000–2024).
- Findings support policy mandates for standardised asset management frameworks.

Core Finding

A difference-in-differences model shows a statistically significant 18.7 pp greater risk reduction (95% CI: 12.3, 25.1) for municipalities implementing formal asset management systems.

This study offers the first causal evidence from a sub-Saharan African context on this critical engineering policy issue.

ABSTRACT-ONLY PUBLICATION

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