



Methodological Evaluation of Transport Maintenance Depot Systems in South Africa Using Multilevel Regression Analysis for Risk Reduction Assessment

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Published: 13 June 2006 | **Received:** 12 February 2006 | **Accepted:** 03 May 2006

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DOI: [10.5281/zenodo.18829101](https://doi.org/10.5281/zenodo.18829101)

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Abstract

This study addresses a current research gap in Engineering concerning Methodological evaluation of transport maintenance depots systems in South Africa: multilevel regression analysis for measuring risk reduction in South Africa. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A structured analytical approach was used, integrating formal modelling with domain evidence. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of transport maintenance depots systems in South Africa: multilevel regression analysis for measuring risk reduction, South Africa, Africa, Engineering, methodology paper This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The maintenance outcome was modelled as $Y_i = \beta_0 + \beta_1 X_i + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, regression, multilevel, nested, longitudinal, variance, reliability*

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