African Manufacturing Engineering

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

Siyavhuza Mkhize[1], **Mampho Modise**[2,3]

[1] Department of Mechanical Engineering, South African Institute for Medical Research (SAIMR)

[2] Department of Sustainable Systems, Vaal University of Technology (VUT)

[3] Department of Sustainable Systems, South African Institute for Medical Research (SAIMR)

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

Correspondence: smkhize@outlook.com

DOI: 10.5281/zenodo.18829101

Author notes

Siyavhuza Mkhize is affiliated with Department of Mechanical Engineering, South African Institute for Medical Research (SAIMR) and focuses on Engineering research in Africa.

Mampho Modise is affiliated with Department of Sustainable Systems, Vaal University of Technology (VUT) and focuses on Engineering research in Africa.

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 $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

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