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Methodological Evaluation of Manufacturing Plant Systems Efficiency Gains in South Africa: A Randomized Field Trial Approach

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Abstract

This study addresses a current research gap in Engineering concerning Methodological evaluation of manufacturing plants systems in South Africa: randomized field trial for measuring efficiency gains in South Africa. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A mixed-methods design was used, combining survey and interview data collected over the study period. 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 manufacturing plants systems in South Africa: randomized field trial for measuring efficiency gains, South Africa, Africa, Engineering, original research This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, econometrics, stochastic frontier, randomized control trial, productivity, operations management, regression analysis*

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