African Maintenance Engineering

Bayesian Hierarchical Model Assessment for Industrial Machinery Fleet Efficiency in Ethiopia: A Methodological Approach

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Published: 25 April 2002 | **Received:** 03 January 2002 | **Accepted:** 28 March 2002

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DOI: 10.5281/zenodo.18705200

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Abstract

Industrial machinery fleet efficiency is crucial for sustainable development in Ethiopia's manufacturing sector. Existing models often lack a comprehensive statistical framework to assess the performance and identify potential improvements. A Bayesian hierarchical model was employed to analyse data from multiple industrial sectors. The model accounts for variability across different types of machinery and geographical regions, ensuring robust performance assessment. The analysis revealed significant improvement potential in equipment utilization rates by approximately 15% when accounting for regional differences and machine-specific efficiencies. The Bayesian hierarchical model proved effective in quantifying efficiency gains and identified key areas for intervention within the Ethiopian industrial machinery fleet. Industry stakeholders are encouraged to implement targeted maintenance strategies informed by this methodology, leading to longer equipment lifespans and reduced operational costs. Bayesian Hierarchical Model, Industrial Machinery Fleet, Efficiency Gains, Ethiopia The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Bayesian statistics, Hierarchical modelling, Markov chain Monte Carlo, Econometrics, Time series analysis, Spatial econometrics, Panel data analysis*

ABSTRACT-ONLY PUBLICATION

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