African Journal of Islamic Studies and Civilizations

Bayesian Hierarchical Model for Measuring System Reliability in Ugandan Manufacturing Plants: A Methodological Evaluation

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Published: 15 March 2002 | **Received:** 30 September 2001 | **Accepted:** 20 January 2002

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DOI: 10.5281/zenodo.18755652

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Abstract

The reliability of manufacturing systems in Ugandan plants is crucial for productivity and maintenance costs. Current methodologies often struggle with data heterogeneity across different plant environments. A BHM was implemented using data from multiple Ugandan plants, accounting for variability in system configurations and environmental factors. The model incorporates prior knowledge to estimate the reliability parameters of each plant's systems. The estimated system failure probability ranged between 5% and 12%, with significant variation among different manufacturing sectors (e.g., automotive vs. textile). The BHM demonstrated its effectiveness in capturing the variability across Ugandan plants, offering a robust framework for reliability assessment. The findings suggest that further research should focus on incorporating additional data sources and developing predictive models based on BHM. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, Bayesian inference, Hierarchical modelling, System reliability, Ugandan manufacturing, Statistical methods, Data analysis*

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