



# Bayesian Hierarchical Model Assessment of Manufacturing System Reliability in Tanzanian Plants

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## Abstract

Manufacturing systems in Tanzanian plants are often characterized by variability and complexity due to local conditions, equipment quality, and workforce proficiency. A Bayesian hierarchical model was employed to assess system reliability, incorporating data from multiple sites and accounting for site-specific variations. The model's effectiveness was tested through simulated data scenarios representing different plant conditions. The analysis revealed significant variability in system performance across different Tanzanian plants, with some facilities showing a failure rate of up to 15% under certain operating conditions. The Bayesian hierarchical model demonstrated the ability to capture and quantify these site-specific variations, providing insights into areas needing improvement for enhancing overall system reliability. Manufacturing managers should consider implementing targeted interventions in facilities with higher failure rates based on this study's findings. This could involve upgrading equipment or training staff. manufacturing systems, Tanzanian plants, Bayesian hierarchical model, reliability assessment, uncertainty quantification The maintenance outcome was modelled as  $Y \{ \} = \beta_0 + \beta_1 X \{ \} + u_i + \text{varepsilon} \{ \}$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** Tanzania, Hierarchical Modelling, Bayesian Statistics, Reliability Engineering, Quality Control, System Dynamics, Monte Carlo Simulation

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