



# Methodological Evaluation of Manufacturing Plant Systems in Rwanda: Panel Data Estimation for System Reliability Assessment

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### Abstract

This study evaluates manufacturing plant systems in Rwanda, focusing on reliability assessment through panel data estimation. Panel data analysis was employed to assess system reliability across different manufacturing plants. The study utilised a mixed-effects model for estimating system performance. A significant proportion ( $p=0.02$ ) of manufacturing systems showed variability in their operational effectiveness, with some exhibiting higher reliability than others. The findings suggest that system reliability is influenced by both technological and managerial factors in Rwandan manufacturing environments. Further research should focus on implementing robust maintenance strategies to enhance overall system performance. Manufacturing systems, panel data analysis, reliability assessment, mixed-effects model Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_{i=1}^n (y_i - f(\theta(\xi)))^2 + \lambda \operatorname{Vert} \theta \operatorname{Vert} \}^2$ , with performance evaluated using out-of-sample error.

**Keywords:** Sub-Saharan, Africa, Econometric, Time-Series, Panel-Data, Stochastic, System-Reliability

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