



# Methodological Evaluation of Manufacturing Plant Systems in Rwanda Using Quasi-Experimental Design for Risk Reduction Measurement

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### Abstract

Manufacturing plants in Rwanda face various operational risks that can hinder productivity and economic growth. A methodological evaluation is crucial to understand these risks and implement effective risk reduction strategies. A quasi-experimental design was employed to analyse data from ten randomly selected manufacturing plants across different sectors. Statistical models were used to estimate the effects of identified risk factors on plant performance using regression analysis with robust standard errors. Regression analysis revealed that operational inefficiencies, such as equipment malfunctions and supply chain disruptions, significantly impact productivity. Specifically, equipment malfunctions accounted for a 15% reduction in production output, indicating their substantial influence. The quasi-experimental design proved effective in measuring the effects of risk factors on manufacturing plant performance. This methodological approach offers a robust framework for future risk assessment and mitigation strategies in Rwanda's manufacturing sector. Based on the findings, it is recommended that manufacturers implement preventive maintenance schedules and enhance supply chain management to mitigate operational risks effectively. Model estimation used  $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sumiell}(y_i, f\theta(\xi)) + \lambda \operatorname{Vert}\theta\operatorname{rVert}^2$ , with performance evaluated using out-of-sample error.

**Keywords:** African geography, manufacturing systems, quasi-experimental design, risk assessment, econometric analysis, spatial econometrics, resource allocation

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