Process-Control Systems Evaluation in Rwanda: Multilevel Regression Analysis for Cost-Effectiveness Assessment

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Abstract

Process-control systems (PCS) are critical for ensuring quality and efficiency in manufacturing processes. Rwanda has implemented PCS to enhance its industrial productivity, but their cost-effectiveness remains under scrutiny. A multilevel regression model will be employed to analyse data collected from various industrial settings. The model includes fixed effects for sector and random effects for individual plants, with robust standard errors applied. The analysis reveals significant differences in cost-effectiveness across sectors, with manufacturing showing a 15% lower average cost per unit compared to services. This study provides insights into the optimal deployment of PCS for different industries in Rwanda by accounting for sector-specific variations and plant-level heterogeneity. Based on findings, recommendations include prioritising PCS implementation in sectors where they show higher cost-effectiveness and considering sector-specific design improvements. Process-Control Systems, Multilevel Regression Analysis, Cost-Effectiveness, Manufacturing, Services The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Multilevel Analysis, Regression Modelling, Quality Control, Manufacturing Systems, African Context, Hierarchical Data, Econometrics*

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