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A Bayesian Hierarchical Model for Evaluating Process-Control System Adoption in Ghana's Industrial Sector

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ABSTRACT

Background: The adoption of advanced process-control systems is critical for enhancing industrial efficiency and productivity. In many developing economies, however, systematic evaluation of the factors influencing this adoption is lacking, hindering targeted interventions and policy formulation.

Purpose and objectives: This paper develops and applies a novel Bayesian hierarchical model to quantify the adoption rates of process-control systems within the nation's industrial sector and to identify the key technical and organisational determinants driving this uptake.

Keywords: *Bayesian hierarchical modelling, process-control systems, technology adoption, Sub-Saharan Africa, industrial sector, developing economies*

Article Highlights

- Overall adoption probability of process-control systems is low at 0.23
- Significant sector-level variability with food processing leading adoption
- Firm size and technical training investment are strongest predictors
- Bayesian framework captures multi-level variability better than traditional methods

Methodological Innovation

Uses Bayesian hierarchical logistic regression with Hamiltonian Monte Carlo estimation to model sector-level and firm-level determinants simultaneously.

Provides evidence-based recommendations for sector-specific industrial policy in developing economies.