AFRICAN STRUCTURAL ENGINEERING

CASE STUDY

A Bayesian Hierarchical Model for Evaluating Process-Control System Adoption in Ghana's Structural Engineering Sector (2000–2026)

Kwame Asante[1] | **Ama Serwaa Mensah**[2,3]

1 *Department of Sustainable Systems, University of Ghana, Legon*

2 *University of Ghana, Legon*

3 *Ghana Institute of Management and Public Administration (GIMPA)*

Correspondence: kasante@yahoo.com

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ABSTRACT

Background: The adoption of advanced process-control systems (PCS) in structural engineering is critical for enhancing safety, efficiency, and quality. In many developing economies, however, the rate and drivers of this technological transition are poorly quantified, hindering effective policy and industry strategy.

Purpose and objectives: This case study develops and applies a novel Bayesian hierarchical model to evaluate the adoption rates and key determinants of PCS within the structural engineering sector. It aims to provide a robust, probabilistic assessment of the current adoption landscape and its evolution.

Keywords: *Bayesian hierarchical modelling, process-control systems, structural engineering, Sub-Saharan Africa, technology adoption, developing economies, risk assessment*

Article Highlights

- Firm size shows a strong positive association with PCS adoption (posterior probability: 0.97).
- Bayesian hierarchical model reveals significant regional heterogeneity in adoption rates.
- Adoption driven by firm capacity rather than project-specific factors.
- Framework captures underlying geographical and organisational variances.

Methodological Note

A Bayesian hierarchical logistic regression model was applied to longitudinal data from industry surveys, firm registries, and project documentation (2000–2026).

This study provides a probabilistic assessment of technology adoption patterns in a developing economy context.