

ORIGINAL RESEARCH

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

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ABSTRACT

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

Purpose and objectives: This study develops and applies a novel Bayesian hierarchical model to evaluate the adoption rates and key influencing factors of PCS within the civil engineering sector of a West African nation, providing a robust methodological framework for technological diffusion analysis.

Keywords: *Bayesian hierarchical modelling, process-control systems, technology adoption, civil engineering, Sub-Saharan Africa, developing economies, Senegal*

Article Highlights

- Bayesian hierarchical model reveals a 49-percentage-point increase in PCS adoption over 26 years.
- Firm size and public-private partnership engagement show near-certain positive association with adoption.
- Methodology accounts for unobserved heterogeneity across engineering sub-sectors via random effects.
- Findings highlight uneven diffusion, presenting a target for policy and industry intervention.

Methodological Contribution

A novel Bayesian hierarchical logistic model provides a robust framework for analysing technological diffusion in contexts with limited data and sectoral heterogeneity.

This analysis offers a quantitative evidence base for technology policy in developing engineering sectors.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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