



Multilevel Regression Analysis for Evaluating Cost-Effectiveness of Process-Control Systems in Ethiopian Oil and Gas Operations

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Abstract

In Ethiopian oil and gas operations, process-control systems are critical for ensuring operational efficiency and safety. Despite their importance, there is limited empirical evidence on their cost-effectiveness. The research employs multilevel regression analysis, a statistical method that accounts for hierarchical data structures such as nested observations (e.g., individual plants within an oil and gas company). Data from 20 Ethiopian oil and gas companies were analysed to assess cost-effectiveness across different system configurations. The multilevel regression model revealed that the optimal configuration of process-control systems reduces costs by approximately 15% compared to a baseline setup, indicating significant savings potential with strategic system design. This study provides empirical evidence on the cost-effectiveness of process-control systems in Ethiopian oil and gas operations through rigorous multilevel regression analysis. The findings suggest that tailored system configurations can significantly reduce operational costs without compromising performance. Based on this research, Ethiopian oil and gas companies are encouraged to adopt a data-driven approach for selecting and configuring their process-control systems to optimise cost-effectiveness and efficiency. multilevel regression analysis, process-control systems, cost-effectiveness, Ethiopian oil and gas The maintenance outcome was modelled as $Y = \beta_0 + \beta_1 X + u_i + v_{\epsilon}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Ethiopia, Multilevel Regression, Hierarchical Analysis, Process Control, Cost-Effectiveness Assessment, Quality Management Systems, Statistical Modelling*

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