



# Revisiting Manufacturing Systems Cost-Effectiveness in Ethiopian Plants via Quasi-Experimental Methods

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## Abstract

This study addresses a current research gap in Engineering concerning Methodological evaluation of manufacturing plants systems in Ethiopia: quasi-experimental design for measuring cost-effectiveness in Ethiopia. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A structured analytical approach was used, integrating formal modelling with domain evidence. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of manufacturing plants systems in Ethiopia: quasi-experimental design for measuring cost-effectiveness, Ethiopia, Africa, Engineering, replication study This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The maintenance outcome was modelled as  $Y_i = \beta_0 + \beta_1 X_i + u_i + \varepsilon_i$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Ethiopia, Manufacturing Systems, Quasi-Experimental Design, Cost-Effectiveness Analysis, Econometric Models, Supply Chain Management, Data Envelopment Analysis*

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