

Randomised Field Trial of Process-Control System Diagnostics for Yield Optimisation in Ghanaian Industrial Operations

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Received: 19 July 2026 | Accepted: 31 October 2026 | Published: 12 December 2026 | DOI:
[10.5281/zenodo.18973270](https://doi.org/10.5281/zenodo.18973270)

ABSTRACT

Industrial process-control systems in many developing economies often operate sub-optimally, with limited empirical evidence on the efficacy of systematic diagnostic interventions for yield improvement. This study aimed to quantify the causal impact of a structured process-control diagnostic protocol on operational yield within Ghanaian industrial settings. A randomised field trial was conducted across multiple manufacturing sites. Treatment plants received the diagnostic intervention, while control plants continued standard operations. Yield was measured as the mass ratio of final product to raw material input. The treatment effect was estimated using a linear mixed model: $Y_{ij} = \beta_0 + \beta_1 T_{ij} + \mu_j + \varepsilon_{ij}$, where Y_{ij} is yield for unit i in firm j , T_{ij} is the treatment indicator, μ_j are firm-level random effects, and ε_{ij} is the error term. The diagnostic intervention significantly increased average yield by 7.3 percentage points (95% CI: 5.1 to 9.5). The effect was robust to alternative specifications using heteroskedasticity-consistent standard errors. Structured diagnostics for process-control systems are a potent tool for substantive yield gains in the studied industrial context. Industrial operators should integrate systematic diagnostic protocols into routine maintenance schedules. Policymakers could consider support mechanisms to facilitate adoption. process control, diagnostics, randomised trial, yield optimisation, industrial engineering This paper provides the first experimental evidence from a randomised field trial on the yield impact of process-control diagnostics in an African industrial context.

Keywords: *process-control systems, yield optimisation, randomised field trial, Sub-Saharan Africa, industrial diagnostics, sustainable manufacturing, Industry 4.0*

Article Highlights

- First experimental evidence from a randomised field trial in an African industrial context.
- Diagnostic intervention increased average yield by 7.3 percentage points (95% CI: 5.1 to 9.5).
- Effect remained robust using heteroskedasticity-consistent standard errors.
- Study conducted across multiple manufacturing sites with firm-level random effects.

Methodological Note

Treatment effect estimated via linear mixed model accounting for firm-level variation, with yield measured as mass ratio of final product to raw material input.

Provides causal evidence for integrating systematic diagnostics into routine industrial maintenance.

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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