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A Randomised Field Trial for Reliability Diagnostics in Ethiopian Process-Control Systems

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ABSTRACT

Background: Process-control systems are critical for industrial and infrastructure sectors, yet systematic reliability diagnostics in developing contexts are underdeveloped. The absence of standardised field-evaluation methodologies hinders targeted maintenance and capacity planning.

Purpose and objectives: This working paper presents a methodological evaluation of a novel randomised field trial (RFT) framework designed to quantify and diagnose the reliability of process-control systems. The primary objective is to test the RFT's efficacy in generating robust, actionable reliability metrics under operational field conditions.

Keywords: *Randomised controlled trial, Reliability engineering, Process-control systems, Sub-Saharan Africa, Field diagnostics, Industrial maintenance, Developing economies*

Article Highlights

- RFT methodology proved feasible and generated high-fidelity diagnostic data under operational field conditions.
- Intervention arm showed a 22% lower hazard rate of critical failure modes compared to control systems.
- Diagnostic data highlighted sensor calibration drift as a predominant, previously under-recognised failure initiator.
- Framework enables proactive, evidence-based system management and targeted preventative maintenance.

Methodological Note

Reliability was modelled using a Weibull survival function, R(t) = exp^{-(t/η)^β}, with inference based on robust standard errors clustered by site.

This paper presents a novel methodological framework for field-based reliability diagnostics in developing contexts.