CASE STUDY

A Quasi-Experimental Design for Reliability Diagnostics in Senegalese Manufacturing Systems

A Case Study

Aminata Ndiaye[1]|**Ibrahima Sarr**[2,3]
Mamadou Diop[4,5]

[1] *Institut Pasteur de Dakar*
[2] *Department of Civil Engineering, Council for the Development of Social Science Research in Africa (CODESRIA), Dakar*
[3] *Université Gaston Berger (UGB), Saint-Louis*
[4] *Department of Civil Engineering, Université Gaston Berger (UGB), Saint-Louis*
[5] *Department of Sustainable Systems, Institut Pasteur de Dakar*

Correspondence: andiaye@gmail.com

ABSTRACT

Background: Manufacturing systems in developing economies often operate under unique constraints, including intermittent power supply and variable maintenance regimes, which challenge conventional reliability engineering models. Existing diagnostic frameworks, largely developed for stable industrial contexts, lack validation in such environments, creating a knowledge gap in predictive maintenance strategies for these regions.

Purpose and objectives: This case study aimed to develop and evaluate a quasi-experimental design for conducting reliability diagnostics within the specific operational context of Senegalese manufacturing. The primary objective was to measure the causal impact of scheduled preventive interventions on system mean time between failures (MTBF).

Keywords: *Quasi-experimental design, Reliability diagnostics, Manufacturing systems, Sub-Saharan Africa, Predictive maintenance, Industrial engineering, Developing economies*

Article Highlights

• Quasi-experimental design isolates causal impact of maintenance in non-laboratory industrial settings.

• 34% MTBF improvement observed in treatment group versus control under Senegalese operational constraints.

• Weibull model indicates shift from wear-out to random failure pattern post-intervention.

• Provides a validated diagnostic framework for reliability engineering in developing economies.

Methodological Insight

A longitudinal, non-equivalent control group design was implemented across two production lines in a Dakar plant, using a Weibull proportional hazards model for reliability analysis with robust, clustered inference.

This case study offers a practical framework for reliability diagnostics where randomized controlled trials are not feasible.

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