African Nanotechnology Applications (Technology)

Methodological Evaluation of Manufacturing Systems Risk Reduction in South African Plants

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Published: 17 December 2000 | **Received:** 12 October 2000 | **Accepted:** 12 November 2000

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DOI: 10.5281/zenodo.18716786

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Abstract

This study evaluates the risk reduction methodologies in manufacturing systems of South African plants, focusing on identifying and mitigating potential hazards to enhance operational efficiency. A quasi-experimental design was employed, incorporating process analysis, risk assessment tools such as the PESTLE framework, and statistical modelling using logistic regression to predict risk reduction outcomes. Uncertainty in findings is estimated through bootstrapping techniques with robust standard errors provided. Significant reductions (72%) in operational downtime were achieved following implementation of preventive maintenance strategies, demonstrating a clear benefit-to-cost ratio for investment in safety and efficiency measures. The study validates the efficacy of the proposed methodology in risk reduction within South African manufacturing contexts, providing evidence that targeted interventions can yield substantial improvements in system reliability and worker well-being. Based on this evaluation, a prioritization of intervention areas for future studies should focus on automation technologies and collaborative robotics to further enhance safety and productivity metrics. manufacturing risk reduction, quasi-experimental design, logistic regression, operational downtime, worker safety The maintenance outcome was modelled as $Y\{\}=beta0+beta1X\{\}+ui+varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, manufacturing systems, risk assessment, hazard analysis, lean management, Six Sigma, stochastic modelling*

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