Maintenance 4.0 vs. Maintenance 5.0: A Modeling and Simulation-Based Comparative Analysis of Performance Metrics

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Abstract. In recent years, the industrial sector has witnessed a profound shift toward the integration of digital technologies across all levels of manufacturing operations. Manufacturers are increasingly adopting digitalization strategies to enhance productivity, efficiency, and decision-making processes, particularly within the field of maintenance. This paper conducts a comparative analysis of Maintenance 4.0 and Maintenance 5.0 by utilizing synthetic data generated through MATLAB simulations. Results show that with the integration of Maintenance 5.0, metrics like Mean Time To Repair (MTTR), Mean Time Between Failure (MTBF), and Overall Equipment Effectiveness (OEE) have been improved compared to Maintenance 4.0. This study contributes to the existing body of literature by providing a comparative analysis through the evaluation of key performance metrics, offering practical insights into their impact on maintenance efficiency and reliability. In addition, the study's limitations are acknowledged, presenting avenues for future research within this field. Lastly, potential directions for further investigation, along with the theoretical contributions and managerial implications of the findings, are thoroughly discussed.

Keywords: Maintenance 5.0, Maintenance 4.0, Industry 5.0, MATLAB, Comparative analysis.