Chapter 1
The Potential of Artificial Intelligence in Manufacturing: Preventative Maintenance Explored Through the Use of Machine Learning

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ABSTRACT

Across the globe, manufacturing is undergoing a digital transformation, and artificial intelligence (AI) has played a pivotal role in the emergence of this new trend. AI technologies are increasingly being integrated into factory operations in order to create more efficient and smarter production processes. Predictive maintenance is one of the most impactful and practical applications of artificial intelligence in manufacturing among the various applications of AI in the field. A predictive maintenance program involves the use of data-driven algorithms and models in order to identify when industrial equipment might need to be repaired or serviced, thus allowing it to be performed proactively before a breakdown occurs as a result of a malfunction. There are two approaches to equipment maintenance in the traditional sense; either you react to equipment failures after the event or you follow a predetermined service schedule regardless of the actual condition of the equipment. The

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chapter analyzes the potential of artificial intelligence in manufacturing preventative maintenance explored

INTRODUCTION

There are a number of manufacturers around the world who have realized the potential for AI-driven predictive maintenance to increase operational efficiency in a significant way. In a manufacturing setting, unplanned downtime - when machines fail without warning - can disrupt production and lead to lost orders, hours of lost production, and increased costs as a result. Using artificial intelligence (AI) in order to forecast equipment health, companies can transform their maintenance approach from one that is reactive (fixing things only when they break) or purely preventive (routine scheduled maintenance) to one that is predictive and based on the condition of the equipment. Ucar et al. (2024) highlight the key components, trustworthiness, and future trends of artificial intelligence in predictive maintenance applications. Manufacturers can utilize this shift to minimize downtime, optimize the use of maintenance resources, as well as extend the lifespan of critical assets by utilizing this shift. The analysis done by Keleko et al. (2022) demonstrates that artificial intelligence offers an effective means of improving real-time predictive maintenance considering Industry 4.0's emergence. Daniyan et al. (2020) explore the use of artificial intelligence for predictive maintenance specifically in railcar learning factories. Wang and Wang (2017) discussed how artificial intelligence, particularly deep learning, is shaping the future of predictive maintenance. Abbas (2024) explores the use of artificial intelligence for predictive maintenance in industrial systems. Lee et al. (2019) investigate predictive maintenance for machine tool systems using artificial intelligence techniques based on machine condition data. Cardoso and Ferreira (2020) explore the application of predictive maintenance principles utilizing artificial intelligence tools. Simion et al. (2024) examine AI-driven predictive maintenance in modern maritime transport, emphasizing enhancements in operational efficiency and reliability.

Hrnjica and Softic (2020) explore explainable AI within manufacturing, emphasizing its application through a predictive maintenance case study.

Pacifico et al. (2024) discuss the application of dynamic methods and artificial intelligence approaches for effective predictive maintenance. Matzka (2020) discusses the application of explainable artificial intelligence specifically designed for predictive maintenance scenarios. Pookkuttath et al. (2021) introduce an AI-enabled predictive maintenance framework specifically designed for autonomous mobile cleaning robots. As a result of examining the current state of AI in different regions, it has become apparent that AI-based predictive maintenance is becoming

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