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Risk Management in the Manufacturing Production Process: Integration of Automation Technology and Machine Safety

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Abstract

This study explores the integration of automation technology and machine safety in risk management within the manufacturing production process. By employing a combination of qualitative and quantitative methods, including literature reviews, surveys, and data analysis, the research identifies the critical role of automation technologies such as robotics, IoT, and predictive analytics in mitigating risks. These innovations improve operational efficiency, enhance worker safety, and ensure compliance with evolving regulatory standards. Key findings highlight the dual benefits of reducing downtime and preventing workplace accidents, while also emphasizing the necessity of adaptive risk management strategies. The study concludes that aligning advanced technologies with proactive safety protocols fosters a more resilient and productive manufacturing environment.
Keywords : Automation technology, machine safety, risk management

INTRODUCTION

Risk management in manufacturing is a systematic process of identifying, assessing, and mitigating risks that could negatively impact production processes, product quality, worker safety, and operational efficiency (Surbakti et al., 2022). This includes addressing operational risks such as equipment failure and supply chain disruptions, safety risks like worker injuries, and compliance risks tied to regulatory standards (Khoirudin et al., 2021). The financial and reputational implications of unmanaged risks can be severe, underscoring the importance of effective strategies to minimize disruptions and maintain a steady workflow (F. M. Dewadi, 2022). Automation technology plays a critical role in mitigating these risks by enhancing precision, reducing human error, and enabling real-time data collection and analysis through robotics and IoT devices (F. Dewadi et al., 2016). These technologies support predictive maintenance, protect workers and equipment, and ensure compliance with safety regulations (F. Dewadi & Amir, 2021). Key safety protocols such as regular audits, worker training, and emergency stop mechanisms are essential to prevent accidents and maintain operational integrity (F. M. Dewadi & Abduh Al-Afgani, 2021). Conducting thorough risk assessments, analyzing the likelihood and impact of risks, and implementing redundancies and contingency plans further strengthen risk management efforts, ensuring safety, efficiency, and reliability in manufacturing (Nanda & Dewadi, 2024).

RESEARCH METHOD

Research related to risk management in manufacturing can be conducted through a qualitative and quantitative approach that includes several main steps (Nanda et al., 2024). Starting with a literature review to understand the basic concepts of risk management, the role of automation technology, and the types of risks in manufacturing, the research continued with primary data collection through interviews and surveys to identify risk perceptions as well as the effectiveness of mitigation measures (F. M. Dewadi et al., 2024). Secondary data, such as accident

reports and downtime statistics, were used to analyze risk patterns (F. M. Dewadi, 2023). Risk assessment frameworks, such as FMEA or Risk Matrix, are applied to assess the probability and impact of risks (Kusmiwardhana et al., 2024).

Automation technology evaluations are conducted through case studies, while safety protocol audits help identify deficiencies in worker training, regular inspections, and emergency shutdown mechanisms (Wibowo, Mubina Dewadi, et al., 2024). Where possible, mitigation strategies or automation technologies are tested on a small scale to assess their effectiveness before widespread implementation (Wibowo, Dewadi, et al., 2024). Data from surveys, interviews, and operations are analyzed statistically and qualitatively to produce a report summarizing findings, technology evaluations, and recommendations for optimal risk mitigation measures and safety policies (Abbas et al., 2021).

Figure 1. Risk Management in Manufacturing (F. M. Dewadi, Farahdiansari, et al., 2023)

RESULTS AND DISCUSSION

The successful integration of automation and safety has brought significant advancements in industrial operations (F. M. Dewadi, Milasari, et al., 2023). For instance, a manufacturing plant can reduce workplace accidents by implementing robotics to handle hazardous tasks, ensuring safer environments for workers (Yusaerah et al., 2022). Similarly, companies leveraging IoT for predictive maintenance have seen notable decreases in equipment downtime, demonstrating the dual benefits of efficiency and safety (Alfaris et al., 2022). These examples underline the importance of continuous monitoring and adaptation of risk management strategies to align with the dynamic nature of industrial processes (Ratnadewi et al., 2023).

Advancements in automation technology, such as Artificial Intelligence and Machine Learning, have transformed risk analysis by enabling more accurate and efficient assessments (Mustafa et al., 2023). Predictive analytics further enhances this by identifying potential risks before they escalate into critical issues (Yunus et al., 2023). Alongside these technological strides, safety standards are also evolving, with anticipated changes in regulations and protocols aimed at keeping pace with industry innovations (Nugroho et al., 2023). These developments highlight the ongoing synergy between technological progress and the commitment to maintaining high safety standards (Darmayani et al., 2023).

CONCLUSION

The integration of automation and safety has proven its added value in improving efficiency, reducing risks, and maintaining safety standards in the industry. The combination of advanced technologies such as AI, Machine Learning, and IoT with dynamic regulatory adaptations shows that innovation and safety can go hand in hand, creating a safer yet productive work environment.

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