| RESEARCH ARTICLE

Development and Strategic Implementation of Artificial Intelligence in Operational Management

Resi Juariah Susanto [1]
[1] *STIE EKUITAS, Management, Bandung*
Corresponding Author: Resi Juariah Susanto, **E-mail**: resi.juariah@gmail.com

| ABSTRACT

This research examines the development and strategic implementation of Artificial Intelligence (AI) in operational management within the manufacturing sector. By comparing the extent of AI adoption across various manufacturing activities, the study evaluates the effectiveness of AI strategies in enhancing operational efficiency, reducing costs, and improving production processes. Using a qualitative descriptive analysis method, the research relies on literature studies from reputable journals and articles to explore the role of AI in transforming manufacturing practices. The findings highlight that AI technologies, such as machine learning, predictive analytics, and robotics, significantly contribute to optimizing supply chains, improving product quality, and fostering innovation. However, challenges such as skill shortages, cybersecurity risks, and the need for strategic alignment with organizational goals remain critical barriers to successful AI integration. The study concludes that AI is a transformative tool in manufacturing, offering substantial benefits when implemented with a well-defined strategy, enabling businesses to achieve global competitiveness and sustainable growth.

I. INTRODUCTION

The manufacturing sector is undergoing a significant transformation driven by the integration of Artificial Intelligence (AI) into operational management processes. AI, defined as the science and engineering of creating intelligent machines and computer programs (McCarthy, 2007), has emerged as a disruptive technology capable of enhancing efficiency, reducing costs, and fostering innovation. By leveraging AI technologies such as machine learning, predictive analytics, and robotics, manufacturers can optimize production, improve supply chain management, and maintain a competitive edge in an increasingly globalized market.

Despite its potential, the adoption of AI in manufacturing presents several challenges, including the need for skilled human resources, cybersecurity concerns, and significant infrastructure investments (Pratama et al., 2024). Additionally, aligning AI tools with organizational strategies and ensuring their seamless integration into existing systems are critical for maximizing their benefits (Kitsios & Kamariotou, 2021). These challenges highlight the importance of understanding the strategic application of AI in operational management to fully realize its potential in driving sustainable growth and innovation.

This study aims to explore the role of AI in operational management within the manufacturing sector by examining its development, strategic implementation, and effectiveness. Through a qualitative descriptive analysis of existing literature, the research seeks to provide insights into how AI can enhance manufacturing processes, improve operational efficiency, and contribute to the overall competitiveness of manufacturing firms. By addressing the challenges and opportunities associated with AI integration, this study offers valuable recommendations for businesses navigating the complexities of digital transformation in the manufacturing industry.

II. LITERATURE REVIEW

Artificial Intelligence

Artificial intelligence according to John McCarthy (2007) is a science and technique in creating intelligent machines, especially in creating intelligent computer programs or applications. Artificial intelligence is a step to create computers, robots, applications, and programs that can operate with human-like intelligence. Artificial intelligence has changed and transformed practices in business and accounting. The potential of artificial intelligence to learn, think, and react like humans is a tool that can revolutionize trends in accounting departments. Many accounting professionals need to improve their qualifications through the necessary training in order to adapt well to the job market, because artificial intelligence can be a valuable asset in the business world. Professional accountants need the right thinking and technical skills to make the right decisions. Artificial intelligence (AI) has been integrated into various fields within accounting, including auditing, finance, and management accounting. Its adoption is expected to expand further, streamlining operations and minimizing routine tasks traditionally carried out by accountants. Many organizations are embracing AI due to its potential to enhance operational efficiency and lower costs (Dilek et al., 2015). Păvăloaia & Necula (2023) also elaborate on AI's impact, describing it as a disruptive technology that will continue to drive significant changes in the years ahead.

Fachrurazi et al. (2023) highlighted that technological advancements, including artificial intelligence (AI) and machine learning, enable data-driven decision-making, enhance market trend predictions, and improve customer personalization. Cloud computing offers scalable and cost-efficient infrastructure, allowing startups to innovate and expand without significant upfront investments. Additionally, the Internet of Things (IoT) supports real-time data collection, leading to more informed business strategies and fostering the development of new business models. Startups that effectively utilize these technologies often gain a competitive edge, disrupting traditional industries and adapting swiftly to shifting market needs.

AI and machine learning, in particular, present opportunities to address complex challenges in practical applications. However, there remains a shortage of expertise in strategically leveraging AI to generate business value (Kitsios & Kamariotou, 2021). Integrating AI tools and information technology (IT) with an organization's strategy, knowledge management, and decision-making framework can drive service innovation and facilitate value creation (Kitsios & Kamariotou, 2021).

The advantages of Artificial Intelligence (AI), as highlighted by Lubis (2021), are numerous and transformative. Firstly, AI is more permanent compared to natural intelligence, which can change due to human forgetfulness. AI remains consistent as long as the computer systems and programs supporting it remain unchanged. Secondly, AI is easier to duplicate and disseminate. While transferring human knowledge from one individual to another is a time-consuming process and expertise cannot be fully replicated, knowledge embedded in a computer system can be effortlessly copied and transferred to other systems. Thirdly, AI is cost-effective. Providing computer-based services is generally easier and cheaper than employing individuals to perform tasks over extended periods. Additionally, AI offers consistency, as it is rooted in computer technology, whereas natural intelligence is prone to variability. Fourthly, AI decisions can be easily documented by tracking system activities, unlike natural intelligence, which is challenging to reproduce accurately. Lastly, AI enables faster working methods and delivers better results, making it a valuable tool for enhancing efficiency and productivity across various domains.

Manufacturing process

Manufacturing encompasses a series of interconnected activities and processes, including design, material selection, planning, production, quality control, management, and marketing. It plays a crucial role in sustainable development by producing essential goods that fulfill societal needs while driving economic growth. As an input-output system, manufacturing converts raw materials into finished or semi-finished products through structured and systematic procedures (Sangwan & Mittal, 2015).

For many companies, particularly those in the manufacturing industry, long-term objectives often revolve around sustained growth, continuous development, and maintaining profitability. These goals are typically achieved through innovation, operational efficiency, and strategic decision-making, ensuring competitiveness in an ever-changing market. Consequently, manufacturing not only contributes to economic stability but also fosters technological advancements and industrial progress.

III. METHODOLOGY

This study uses a qualitative descriptive analysis method with the aim of digging deeper into the function of AI in operational management. The data taken is in the form of literature studies from various journals and articles to see how far the AI function can work more effectively and support operational management activities. Activities from literature studies also look more at concepts, phenomena, theories and impacts in the operational management process whether AI really supports operational management activities and how effective it is.

IV. RESULTS AND DISCUSSION

Implementation of Advanced Technologies in Industrial Companies
The results of this study are based on several previous studies highlighting the role of technology in enhancing industrial competitiveness in the era of globalization. According to Pratama et al. (2024), in an increasingly competitive business environment, the adoption of the latest technology is a key factor for industrial companies to remain relevant and competitive. Technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and robotics have significantly impacted the operational management of industrial companies. The implementation of these technologies not only increases efficiency and productivity but also enables better innovation and more effective supply chain management.

However, several challenges need to be addressed, such as the limited skills of human resources (HR) and cybersecurity risks. Therefore, a comprehensive strategy is required to ensure the successful implementation of these technologies. With the right approach, the latest technology can bring significant benefits to industrial companies in strengthening their competitiveness in the ever-evolving global market.

The Role of Artificial Intelligence (AI) in Manufacturing Operational Efficiency
Novita and Zahra (2023) highlight the crucial role of AI in enhancing operational efficiency at PT. XYZ, a manufacturing company operating in a specific sector. Over the past decades, digital transformation has been at the center of an industrial revolution affecting almost every aspect of manufacturing activities. AI offers intelligent and adaptive solutions to the challenges in an increasingly complex and dynamic manufacturing environment.

Through a qualitative research approach using a case study method, this study reveals that AI implementation has positively impacted the company's operational efficiency. Data collection was conducted through direct interviews with company management, observations on the production floor, and analysis of historical data related to operational processes. The findings indicate that the raw material demand prediction system and AI integration into the machine maintenance system have brought significant changes to PT. XYZ's operational processes. AI implementation not only increases productivity but also improves product quality, reduces production costs, and optimizes the supply chain.

Integration of AI and Blockchain in Supply Chain Management
In addition to AI, another technology that contributes to industrial efficiency is blockchain. According to Rizkiawan and Ramza (2024), integrating AI and blockchain technology into supply chain management provides significant benefits to organizations. These technologies enhance operational efficiency, reduce costs, improve traceability, and increase security in the supply chain. AI can be used for predictive analytics, demand forecasting, and process automation, while blockchain provides a decentralized, transparent, and secure ledger system.

However, the successful implementation of these technologies requires careful planning, infrastructure investment, and collaboration among supply chain stakeholders. Organizations need to identify the most relevant use cases for their business objectives and address challenges related to data privacy, interoperability, and standardization to ensure effective integration with existing systems. With proper planning, these technologies have the potential to enhance corporate competitiveness in the Industry 4.0 era.

V. CONCLUSION
This study concludes that AI (Artificial Intelligence) has significantly entered the manufacturing industry over the last decade. Based on previous studies, AI implementation has been proven to enhance operational management efficiency, simplify production processes, reduce costs, foster innovation, and improve strategic decision-making. Additionally, AI contributes to better machine maintenance strategies, human resource management, supply chain optimization, and forecasting capabilities, thereby enabling businesses to compete globally. As a result, business strategies must increasingly focus on technological advancements, particularly the importance of AI in manufacturing and other industries.
Future research should explore several aspects to deepen the understanding of AI and its applications in industrial settings:
1. Long-term impact assessment: Investigate the long-term effects of AI implementation on workforce dynamics, productivity, and economic growth.
2. AI and sustainability: Examine how AI can be leveraged to promote sustainable manufacturing practices and reduce environmental impacts.
3. Comparative studies: Conduct comparative studies between industries or regions to assess the varying effectiveness of AI adoption.
4. Ethical and legal considerations: Analyze the ethical implications, data privacy concerns, and regulatory challenges associated with AI integration in industrial processes.
5. Integration with other emerging technologies: Study the combined impact of AI with IoT, blockchain, and other technologies on industrial efficiency and innovation.

By addressing these aspects, future research can provide valuable insights to enhance AI implementation strategies and maximize its benefits for industrial growth and competitiveness.

REFERENCES

[1]   S. Dilek, H. Çakir, and M. Aydin, "Applications of artificial intelligence techniques to combating cybercrimes: A review," *arXiv preprint arXiv:1504.01112*, 2015.

[2]   Fachrurazi, A. Y. Rukmana, Supriyanto, Samsulbahri, and Iskandar, "Revolusi bisnis di era digital: Strategi dan dampak transformasi proses teknologi terhadap keunggulan kompetitif dan pertumbuhan organisasi," *J. Bisnis dan Manaj. West Sci.*, vol. 2, no. 3, pp. 1–15, Aug. 2023.

[3]   F. Kitsios and M. Kamariotou, "Artificial intelligence and business strategy towards digital transformation: A research agenda," *Sustainability*, vol. 13, no. 4, p. 2025, 2021.

[4]   M. Lubis, "Implementasi artificial intelligence pada sistem manufaktur terpadu," in *Proc. Semin. Nas. Tek. (SEMNASTEK) UISU*, vol. 4, no. 1, 2012, pp. 1–7.

[5]   Y. Novita and R. P. Zahra, "Penerapan artificial intelligence (AI) untuk meningkatkan efisiensi operasional di perusahaan manufaktur: Studi kasus PT.XYZ," *J. Manaj. dan Teknol.*, vol. 1, no. 1, pp. 1–12, 2024.

[6]   V. D. Păvăloaia and S. C. Necula, "Artificial intelligence as a disruptive technology—A systematic literature review," *Electronics*, vol. 12, no. 5, p. 1102, 2023.

[7]   R. P. Pratama, A. T. Wardana, and A. Hasibuan, "Implementasi teknologi terbaru dalam manajemen operasional perusahaan industri," *Kohesi: J. Multidisiplin Saintek*, vol. 3, no. 9, pp. 1–10, 2024.

[8]   M. A. Rizkiawan and H. Ramza, "Peningkatan dan efisiensi operasional supply chain (SCM) dengan memanfaatkan teknologi," *J. Masharif al-Syariah: J. Ekon. dan Perbankan Syariah*, vol. 9, no. 1, pp. 1–15, 2024.

[9]   K. S. Sangwan and V. K. Mittal, "A bibliometric analysis of green manufacturing and similar frameworks," *J. Clean. Prod.*, vol. 108, pp. 1–12, 2015.