Journal of Renewable Engineering
E-ISSN : 3046-7624
https://ejournal-nawalaedu.com/index.php/jore
Vol.3.No.2 April 2026
DOI : https://doi.org/10.62872/ej870708

Systematic Literature Review: The Implementation of Smart Manufacturing to Enhance Production Process Efficiency

Taryana
[1] Politeknik Penerbangan Indonesia Curug, Indonesia

Email: taryana@ppicurug.ac.id

Received: March 08, 2025   Revised : April 12, 2026
Accepted: April 20, 2026   Published: April 24, 2026

ABSTRACK — *The emergence of smart manufacturing in the Industry 4.0 era has transformed traditional production systems into interconnected, data-driven environments aimed at enhancing efficiency and flexibility. However, conventional manufacturing systems continue to face challenges such as planning errors, bottlenecks, machine downtime, and limited technological integration. This study aims to systematically analyze the implementation of smart manufacturing technologies in improving production process efficiency. The research employs a systematic literature review (SLR) with a qualitative approach, utilizing secondary data from peer-reviewed journals and academic publications. Data collection follows structured stages of identification, screening, eligibility, and inclusion, while data analysis is conducted through thematic and content analysis to identify patterns, technologies, and efficiency outcomes. The findings reveal that key technologies such as Cyber-Physical Systems (CPS), Internet of Things (IoT), Artificial Intelligence (AI), big data analytics, and digital twins significantly contribute to improving production efficiency through real-time monitoring, predictive maintenance, and optimized decision-making. These technologies effectively reduce downtime, minimize waste, and enhance overall system performance. In conclusion, smart manufacturing represents a transformative approach that addresses inefficiencies in conventional systems and supports sustainable industrial development through integrated and intelligent production processes.*

Keywords: *Smart Manufacturing, Industry 4.0, Production Efficiency, Internet Of Things, Artificial Intelligence*

INTRODUCTION

The rapid advancement of digital technologies in the era of *Industry 4.0* has significantly transformed the landscape of manufacturing systems, giving rise to the concept of *smart manufacturing*. This paradigm shift is characterized by the integration of advanced technologies such as *Cyber-Physical Systems (CPS)*, *Internet of Things (IoT)*, *Artificial Intelligence (AI)*, *Big Data Analytics*, and cloud computing into production environments. These technologies enable manufacturing systems to become highly interconnected, data-driven, and capable of autonomous decision-making in real time. As a result, smart manufacturing is widely recognized as a key driver for improving production efficiency, flexibility, and customization in modern industries. Empirical studies indicate that smart factory frameworks can significantly reduce response times, enhance productivity, and improve data exchange and system autonomy, thereby optimizing overall operational performance (Ryalat et al., 2023; Ryalat et al., 2024). Furthermore, IoT-enabled systems support predictive maintenance, energy monitoring, supply chain optimization, and workplace safety, which collectively contribute to more efficient and sustainable production processes (Soori et al., 2023; Fatima et al., 2022; Andronie et al., 2021).

Despite these technological advancements, many manufacturing systems particularly in developing and transitional economies—continue to rely on conventional production models that face persistent inefficiencies. Traditional manufacturing systems are often characterized by fragmented processes, limited technological integration, and reactive decision-making approaches. These limitations result in a range of operational challenges, including planning errors, production bottlenecks, material delays, and inefficient resource utilization. Studies have shown that such inefficiencies lead to increased production costs, longer lead times, and reduced competitiveness in global markets (Fitriadi & Ayob, 2023; Jebbor et al., 2023; Kozinski et al., 2023). Moreover, common bottlenecks such as machine downtime, workforce constraints, variability in process control, and suboptimal facility layouts further exacerbate inefficiency within conventional systems (Das, 2024; Lai et al., 2021; Ongbali et al., 2021). These challenges highlight the urgent need for innovative solutions that can enhance production efficiency and support the transition toward more advanced manufacturing paradigms.

In response to these limitations, smart manufacturing offers a comprehensive solution by enabling real-time monitoring, predictive analytics, and automated control of production processes. Technologies such as AI and deep learning facilitate predictive maintenance, defect detection, and intelligent production planning, thereby reducing downtime and improving product quality (Soori et al., 2023; Ryalat et al., 2024; Chukwunweike et al., 2024). Similarly, the concept of *digital twins*—virtual representations of physical systems—allows manufacturers to simulate, monitor, and optimize production processes in a virtual environment before implementing changes in the physical system (Karic et al., 2025; Huang et al., 2021). These capabilities enable organizations to move from reactive to proactive decision-making, ultimately enhancing efficiency and reducing operational risks. However, the successful implementation of smart manufacturing requires not only technological adoption but also organizational readiness, strategic planning, and integration across the entire production lifecycle.

Notwithstanding the growing body of research on smart manufacturing, there remains a lack of comprehensive and structured understanding of how these technologies collectively contribute to production efficiency. Existing studies often focus on specific technologies or isolated applications, such as IoT-based monitoring or AI-driven analytics, without providing an integrated perspective on their combined impact. While several systematic reviews have attempted to synthesize knowledge on smart factories and Industry 4.0 technologies, they often emphasize technological advancements rather than their practical implications for production efficiency across different stages of the manufacturing lifecycle (Ryalat et al., 2023; Soori et al., 2023; Singh et al., 2022). Furthermore, there is limited attention to the interrelationship between technological integration, operational efficiency, and sustainability, particularly in the context of transitioning from Industry 4.0 to Industry 5.0 (Karic et al., 2025; Andronie et al., 2021).

Another critical gap in the literature lies in the absence of unified frameworks that guide the implementation of smart manufacturing in a systematic and scalable manner. While previous studies highlight the potential benefits of CPS, IoT, and AI, they often lack clear guidelines on how these technologies can be effectively integrated into existing manufacturing systems. Additionally, issues related to energy efficiency, environmental sustainability, and social implications are frequently treated as secondary considerations rather than integral components of smart manufacturing systems (Ryalat et al., 2024; Yuan et al., 2024). This fragmentation of knowledge creates challenges for practitioners and policymakers who seek to implement smart manufacturing solutions in real-world contexts. Therefore, there is a pressing need for a systematic literature review that not only synthesizes existing research but also identifies critical success factors, implementation frameworks, and research gaps.

The novelty of this study lies in its integrative approach to examining smart manufacturing as a holistic system that encompasses technological, operational, and strategic dimensions. Unlike previous studies that focus on individual technologies or specific applications, this research aims to provide a comprehensive synthesis of how smart manufacturing technologies interact to enhance production efficiency. By analyzing the roles of CPS, IoT, AI, and digital twins within a unified framework, this study contributes to a deeper understanding of the mechanisms through which smart manufacturing improves efficiency. Moreover, this research emphasizes the importance of lifecycle integration—covering design, production, logistics, and services—as well as sustainability considerations, thereby addressing key gaps identified in existing literature (Singh et al., 2022; Karic et al., 2025; Andronie et al., 2021).

In addition, this study highlights the significance of transitioning from Industry 4.0 to Industry 5.0, where human-centric approaches, sustainability, and resilience become central to manufacturing systems. While Industry 4.0 focuses on automation and digitalization, Industry 5.0 emphasizes collaboration between humans and intelligent machines, as well as the integration of social and environmental considerations into production processes (Fatima et al., 2022; Sarkar et al., 2024). This shift underscores the need for a more comprehensive understanding of smart manufacturing that goes beyond efficiency and productivity to include broader societal impacts. By incorporating these perspectives, the present study offers a more forward-looking analysis of smart manufacturing and its potential to transform industrial systems.

Based on the foregoing discussion, the primary objective of this study is to systematically analyze the implementation of smart manufacturing technologies in enhancing production process efficiency by synthesizing existing literature, identifying key technologies and mechanisms, and evaluating their impact on operational performance. Through this objective, the study seeks to provide a structured and evidence-based understanding of smart manufacturing, thereby contributing to both academic discourse and practical applications in the field of industrial engineering and manufacturing management.

METHOD

This study adopts a systematic literature review (SLR) approach with a qualitative research design to comprehensively examine the implementation of smart manufacturing in enhancing production process efficiency. The research relies on secondary data sources, consisting of peer-reviewed journal articles, conference proceedings, and reputable academic publications related to Industry 4.0, smart manufacturing technologies, and production efficiency. The data collection process follows a structured and transparent procedure, including identification, screening, eligibility, and inclusion stages. Relevant literature is identified through major academic databases such as Scopus, Web of Science, and Google Scholar using predefined keywords, including “smart manufacturing,” “Industry 4.0,” “production efficiency,” “IoT,” “CPS,” “AI,” and “digital twin.” Inclusion criteria are applied to select studies published within a recent time frame, written in English, and directly مرتبط with the research topic, while exclusion criteria eliminate irrelevant, duplicate, or low-quality sources. This systematic approach ensures the reliability, validity, and comprehensiveness of the collected data.

The data analysis employs a combination of thematic analysis and content analysis to synthesize findings from the selected literature. Thematic analysis is used to identify recurring themes, patterns, and relationships related to key technologies, implementation strategies, and their impact on production efficiency. Meanwhile, content analysis enables the categorization and interpretation of data based on predefined variables such as types of technologies (e.g., IoT, CPS, AI), application areas, and efficiency outcomes. The analysis process involves data coding, classification, comparison, and synthesis to generate meaningful insights and conceptual frameworks. Additionally, a comparative analytical approach is applied to examine similarities and differences across studies, allowing for the identification of best practices, critical success factors, and research gaps. Through this integrated analytical framework, the study provides a structured and in-depth understanding of how smart manufacturing contributes to improving production process efficiency.

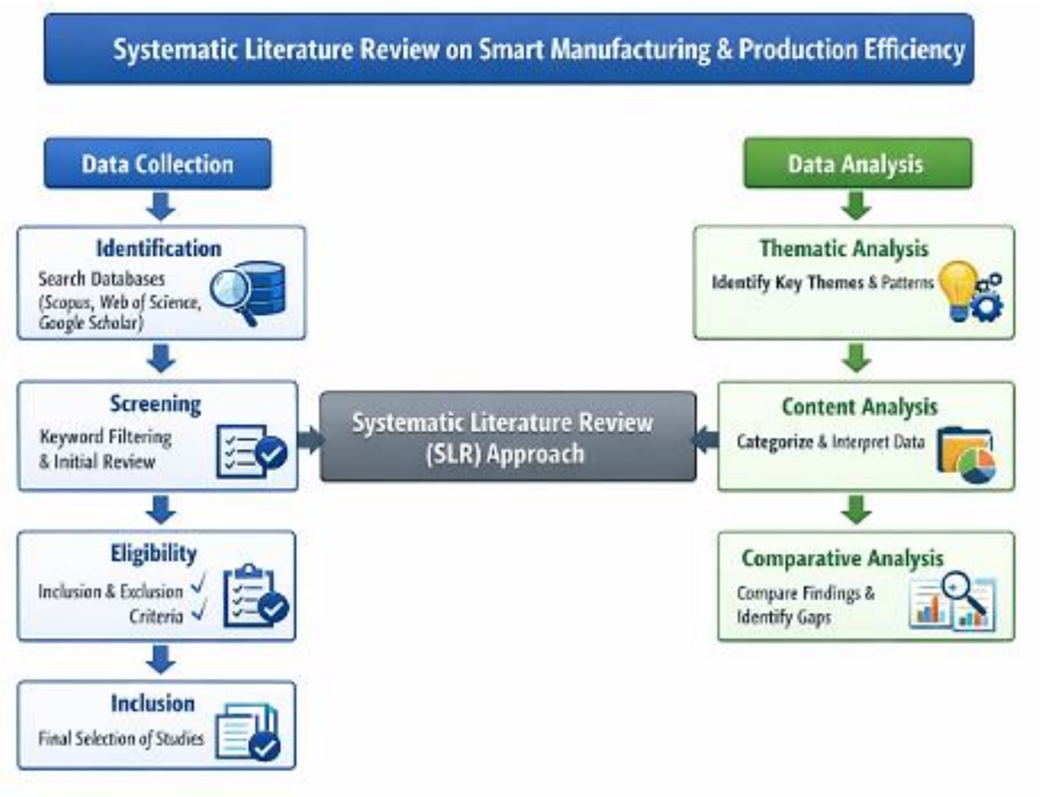

Figure 1. Diagram Conceptual Research

RESULTS AND DISCUSSION

Based on the systematic literature review and thematic analysis conducted, this study identifies key patterns regarding the implementation of smart manufacturing technologies and their impact on production process efficiency. The findings are synthesized to illustrate the relationship between core technologies, their functional roles, and measurable efficiency outcomes in manufacturing systems.

Table 1. Smart Manufacturing Technologies and Their Impact on Production Process Efficiency

No	Technology	Main Function in Manufacturing	Impact on Production Efficiency	Supporting Studies
1	Cyber-Physical Systems (CPS)	Integration of physical machines with digital systems	Real-time monitoring, improved coordination, reduced delays	(Ryalat et al., 2023; Singh et al., 2022; Karic et al., 2025)
2	Internet of Things (IoT)	Data collection and connectivity between devices	Predictive maintenance, reduced downtime, optimized resource use	(Soori et al., 2023; Fatima et al., 2022; Andronie et al., 2021)
3	Artificial Intelligence (AI)	Data-driven decision-making and automation	Improved production planning, defect detection, process optimization	(Ryalat et al., 2024; Chukwunweike et al., 2024; Huang et al., 2021)
4	Big Data Analytics	Processing and analyzing large-scale production data	Enhanced decision accuracy, demand forecasting, efficiency improvement	(Soori et al., 2023; Singh et al., 2022)

5	Digital Twin	Virtual simulation of physical production systems	Process optimization, reduced trial-and-error, faster innovation cycles	(Karic et al., 2025; Huang et al., 2021; Andronie et al., 2021)
6	Cloud Computing	Data storage and system integration across platforms	Increased scalability, real-time access, improved collaboration	(Andronie et al., 2021; Fatima et al., 2022)
7	Smart Sensors	Real-time data acquisition from machines and environments	Increased accuracy, early fault detection, reduced operational risks	(Soori et al., 2023; Ryalat et al., 2023)

The interpretation of the table indicates that smart manufacturing technologies contribute significantly to improving production process efficiency through interconnected and data-driven systems. Technologies such as CPS and IoT enable real-time monitoring and seamless communication between machines, which reduces delays and enhances coordination. Meanwhile, AI and big data analytics support predictive and optimized decision-making, allowing manufacturers to minimize errors, reduce downtime, and improve product quality. The use of digital twins further enhances efficiency by enabling virtual simulations that reduce the need for costly physical trials. Overall, the integration of these technologies creates a synergistic effect that transforms traditional manufacturing systems into intelligent, adaptive, and highly efficient production environments. This confirms that the successful implementation of smart manufacturing is not dependent on a single technology, but rather on the strategic integration of multiple technologies within a unified system.

Discussion

The findings of this study, derived from a systematic literature review and synthesized in the results table, provide a comprehensive understanding of how smart manufacturing technologies contribute to enhancing production process efficiency within the framework of Industry 4.0. In line with the research objective—to systematically analyze the implementation of smart manufacturing technologies in improving production efficiency—this discussion highlights that smart manufacturing represents not merely a technological upgrade but a fundamental transformation of production systems. It integrates physical processes with digital intelligence, enabling real-time, data-driven, and autonomous decision-making that addresses long-standing inefficiencies in conventional manufacturing systems.

At the core of this transformation is the emergence of interconnected technologies such as Cyber-Physical Systems (CPS), Internet of Things (IoT), Artificial Intelligence (AI), big data analytics, and digital twins. These technologies collectively enable the creation of smart factories that are capable of real-time monitoring, adaptive control, and predictive optimization. As identified in the findings table, CPS and IoT play a foundational role by connecting physical equipment with digital systems, allowing continuous data exchange and system integration. This connectivity enables manufacturers to monitor production processes in real time, detect anomalies, and respond to disruptions more effectively. Empirical studies confirm that such integration significantly reduces response time and improves coordination across production units, thereby minimizing delays and inefficiencies (Ryalat et al., 2023; Singh et al., 2022; Karic et al., 2025).

Furthermore, IoT-based systems enhance production efficiency through predictive maintenance, which reduces machine downtime—a critical bottleneck in traditional manufacturing systems. By collecting and analyzing sensor data, manufacturers can anticipate equipment failures and perform maintenance proactively, rather than reactively. This shift from reactive to predictive maintenance not only reduces downtime but also extends equipment lifespan and improves overall system reliability (Soori et al., 2023; Fatima et al., 2022; Andronie et al., 2021). In conventional systems, machine breakdowns often lead to production interruptions, increased costs, and delayed deliveries. Therefore, the integration of IoT and CPS directly addresses one of the most persistent challenges identified in traditional manufacturing environments.

In addition to connectivity and monitoring, Artificial Intelligence (AI) and big data analytics significantly enhance decision-making processes in smart manufacturing systems. The findings indicate that AI enables predictive modeling, defect detection, and intelligent production planning, which contribute to higher efficiency and product quality. Through machine learning algorithms, production systems can analyze large volumes of data to identify patterns, optimize workflows, and improve forecasting accuracy. This capability is particularly important in addressing planning errors and coordination issues commonly found in conventional manufacturing systems (Ryalat et al., 2024; Chukwunweike et al., 2024; Huang et al., 2021). For instance, AI-driven scheduling systems can dynamically adjust production plans based on real-time data, reducing bottlenecks and ensuring optimal resource utilization.

Moreover, big data analytics supports strategic decision-making by providing insights into production performance, demand trends, and supply chain dynamics. This allows manufacturers to optimize inventory levels, reduce material waste, and improve production planning. In traditional systems, limited data availability and fragmented information often lead to inefficiencies and suboptimal decision-making. By contrast, data-driven approaches enable more accurate and timely decisions, thereby enhancing overall operational efficiency (Soori et al., 2023; Singh et al., 2022). The integration of AI and big data thus represents a critical advancement in overcoming the limitations of conventional manufacturing systems.

Another key technology highlighted in the findings is the digital twin, which serves as a virtual representation of physical production systems. Digital twins enable manufacturers to simulate, monitor, and optimize production processes in a virtual environment before implementing changes in the physical system. This capability reduces the need for costly trial-and-error approaches and accelerates innovation cycles. Studies show that digital twin technology improves process optimization, enhances system flexibility, and reduces operational risks by allowing manufacturers to test different scenarios and identify optimal solutions (Karic et al., 2025; Huang et al., 2021; Andronie et al., 2021). In the context of conventional manufacturing challenges—such as layout inefficiencies and process variability—digital twins provide a powerful tool for continuous improvement and system optimization.

Despite these advantages, the transition from conventional manufacturing to smart manufacturing is not without challenges. The literature consistently highlights that traditional manufacturing systems face persistent issues such as planning errors, coordination inefficiencies, material delays, and limited technological integration. These challenges result in increased production costs, longer lead times, and reduced competitiveness (Fitriadi & Ayob, 2023; Jebbor et al., 2023; Kozinski et al., 2023). Common bottlenecks, including machine downtime, workforce limitations, and variability in process control, further exacerbate inefficiency in traditional systems (Das, 2024; Lai et al., 2021; Ongbali et al., 2021). While smart manufacturing technologies offer solutions to these problems, their implementation requires significant investment, organizational change, and technical expertise.

In this context, the role of systematic literature reviews becomes particularly important. As identified in the findings, existing reviews provide valuable insights into the development and application of smart manufacturing technologies, yet they often lack integration across different stages of the manufacturing lifecycle. Many studies focus on specific technologies—such as IoT or AI—without considering how these technologies interact within a comprehensive system. This fragmentation of knowledge creates challenges for practitioners seeking to implement smart manufacturing solutions in a coordinated and effective manner (Ryalat et al., 2023; Soori et al., 2023; Singh et al., 2022).

Systematic literature reviews address this gap by synthesizing existing research, identifying key trends, and highlighting critical success factors for implementation. They provide a structured framework for understanding the relationships between technologies, processes, and outcomes, thereby facilitating more informed decision-making. For example, integrated reviews emphasize the importance of lifecycle perspectives that encompass design, production, logistics, and services, ensuring that smart manufacturing systems are aligned with overall organizational objectives (Singh et al., 2022; Karic et al., 2025; Andronie et al., 2021). This holistic approach is essential for achieving sustainable and scalable improvements in production efficiency.

Another important dimension highlighted in the literature is sustainability. Smart manufacturing technologies not only improve efficiency but also contribute to environmental and social sustainability by optimizing energy consumption, reducing waste, and enhancing resource utilization. Studies indicate that the integration of sustainability considerations into smart manufacturing systems is critical for achieving long-term competitiveness and resilience (Ryalat et al., 2024; Yuan et al., 2024; Huang et al., 2021). However, sustainability is often treated as a secondary objective rather than a core component of smart manufacturing strategies. Systematic reviews play a crucial role in highlighting the importance of sustainability and promoting its integration into manufacturing practices.

Furthermore, the transition from Industry 4.0 to Industry 5.0 introduces new challenges and opportunities for smart manufacturing. While Industry 4.0 focuses on automation and digitalization, Industry 5.0 emphasizes human-centric approaches, collaboration between humans and machines, and the integration of social and environmental considerations. This shift requires new frameworks and critical success factors that go beyond technological adoption to include organizational culture, workforce development, and ethical considerations (Fatima et al., 2022; Sarkar et al., 2024). Systematic literature reviews are essential for identifying these emerging trends and guiding future research and practice.

In relation to the research objective, the findings confirm that smart manufacturing technologies significantly enhance production process efficiency by addressing key challenges associated with conventional manufacturing systems. The integration of CPS, IoT, AI, big data, and digital twins enables real-time monitoring, predictive maintenance, intelligent decision-making, and process optimization. These capabilities reduce downtime, minimize waste, improve product quality, and enhance overall system performance. At the same time, the study highlights that the successful implementation of smart manufacturing requires a comprehensive and integrated approach that considers technological, organizational, and strategic factors.

In conclusion, this discussion demonstrates that smart manufacturing represents a transformative paradigm that redefines production systems in the Industry 4.0 era. By leveraging advanced technologies and data-driven approaches, it provides effective solutions to the inefficiencies of conventional manufacturing systems. However, the complexity of these technologies necessitates systematic and structured approaches to implementation, as well as continued research to address emerging challenges and opportunities. Through the integration of technological innovation, sustainability, and human-centric principles, smart manufacturing has the potential to drive the next generation of industrial development and significantly enhance production efficiency.

CONCLUSION

In conclusion, this study confirms that the implementation of smart manufacturing technologies within the Industry 4.0 framework significantly enhances production process efficiency by transforming conventional manufacturing systems into integrated, data-driven, and adaptive environments. Through the synergistic use of Cyber-Physical Systems (CPS), Internet of Things (IoT), Artificial Intelligence (AI), big data analytics, and digital twin technologies, manufacturers are able to achieve real-time monitoring, predictive maintenance, optimized decision-making, and continuous process improvement. These capabilities effectively address persistent challenges in traditional manufacturing, such as planning errors, bottlenecks, machine downtime, and inefficient resource utilization. Furthermore, the study highlights that the success of smart manufacturing implementation depends on a holistic and systematic approach that integrates technological, organizational, and strategic dimensions. Therefore, smart manufacturing not only improves operational efficiency but also serves as a critical pathway for sustainable and competitive industrial development in the evolving landscape of Industry 4.0 and beyond.

REFERENCES

(2021). Internet of Things-based real-time production logistics, sustainable industrial value creation, and artificial intelligence-driven big data analytics in cyber-physical smart manufacturing systems. *Economics, Management, and Financial Markets*. https://doi.org/10.22381/emfm16120215

Andronie, M., Lăzăroiu, G., Iatagan, M., Hurloiu, I., & Dijmarescu, I. (2021). Sustainable cyber-physical production systems in big data-driven smart urban economy: A systematic literature review. *Sustainability, 13*, 751. https://doi.org/10.3390/su13020751

Andronie, M., Lăzăroiu, G., Iatagan, M., Uță, C., Ștefănescu, R., & Cocoșatu, M. (2021). Artificial intelligence-based decision-making algorithms, internet of things sensing networks, and deep learning-assisted smart process management in cyber-physical production systems. *Electronics*. https://doi.org/10.3390/electronics10202497

Chukwunweike, J., Anang, A., Adeniran, A., & Dike, J. (2024). Enhancing manufacturing efficiency and quality through automation and deep learning: Addressing redundancy, defects, vibration analysis, and material strength optimization. *World Journal of Advanced Research and Reviews*. https://doi.org/10.30574/wjarr.2024.23.3.2800

Das, P. (2024). Data-driven system to analyze potential constraints on manufacturing cycle time. *International Journal for Multidisciplinary Research*. https://doi.org/10.36948/ijfmr.2024.v06i05.25422

Fatima, Z., Tanveer, M., Waseemullah, W., Zardari, S., Naz, L., Khadim, H., Ahmed, N., & Tahir, M. (2022). Production plant and warehouse automation with IoT and Industry 5.0. *Applied Sciences*. https://doi.org/10.3390/app12042053

Fitriadi, F., & Ayob, A. (2023). Optimizing traditional shipyard industry: Enhancing manufacturing cycle efficiency for enhanced production process performance. *International Journal of Industrial Engineering, Technology & Operations Management*. https://doi.org/10.62157/ijietom.v1i1.15

Huang, Z., Shen, Y., Li, J., Fey, M., & Brecher, C. (2021). A survey on AI-driven digital twins in Industry 4.0: Smart manufacturing and advanced robotics. *Sensors, 21*. https://doi.org/10.3390/s21196340

Jebbor, I., Benmamoun, Z., & Hachimi, H. (2023). Optimizing manufacturing cycles to improve production: Application in the traditional shipyard industry. *Processes*. https://doi.org/10.3390/pr11113136

Karic, H., Schilberg, D., & Arockiadoss, A. (2025). Smart factory and Industry 4.0: A survey on advancements, technologies, methods and perspectives of digital transformation in manufacturing. *AHFE International*. https://doi.org/10.54941/ahfe1006444

Kozinski, O., Kotyrba, M., & Volná, E. (2023). Improving the production efficiency based on algorithmization of the planning process. *Applied System Innovation*. https://doi.org/10.3390/asi6050077

Lai, X., Shui, H., Ding, D., & Ni, J. (2021). Data-driven dynamic bottleneck detection in complex manufacturing systems. *Journal of Manufacturing Systems*. https://doi.org/10.1016/j.jmsy.2021.07.016

Ongbali, S., Afolalu, S., Oyedepo, S., Aworinde, A., & Fajobi, M. (2021). A study on the factors causing bottleneck problems in the manufacturing industry using principal component analysis. *Heliyon, 7*. https://doi.org/10.1016/j.heliyon.2021.e07020

Phan, H. (2025). Driving process efficiency in manufacturing with cutting-edge industrial engineering approach. *Journal of Recent Activities in Production*. https://doi.org/10.46610/jorap.2025.v10i01.003

Ryalat, M., Elmoaqet, H., & Alfaouri, M. (2023). Design of a smart factory based on cyber-physical systems and internet of things towards Industry 4.0. *Applied Sciences*. https://doi.org/10.3390/app13042156

Ryalat, M., Franco, E., Elmoaqet, H., Almtireen, N., & Al-Refai, G. (2024). The integration of advanced mechatronic systems into Industry 4.0 for smart manufacturing. *Sustainability*. https://doi.org/10.3390/su16198504

Sarkar, B., Shardeo, V., Dwivedi, A., & Pamucar, D. (2024). Digital transition from Industry 4.0 to Industry 5.0 in smart manufacturing: A framework for sustainable future. *Technology in Society*. https://doi.org/10.1016/j.techsoc.2024.102649

Singh, A., Madaan, G., Hr, S., & Kumar, A. (2022). Smart manufacturing systems: A futuristics roadmap towards application of Industry 4.0 technologies. *International Journal of Computer Integrated Manufacturing, 36*, 411–428. https://doi.org/10.1080/0951192x.2022.2090607

Soori, M., Arezoo, B., & Dastres, R. (2023). Internet of things for smart factories in Industry 4.0: A review. *Internet of Things and Cyber-Physical Systems*. https://doi.org/10.1016/j.iotcps.2023.04.006

Yuan, Y., Na, H., Chen, C., Qiu, Z., Sun, J., Zhang, L., Du, T., & Yang, Y. (2024). Status, challenges, and prospects of energy efficiency improvement methods in steel production: A multi-perspective review. *Energy*. https://doi.org/10.1016/j.energy.2024.132047