

The Implementation of IoT on Supply Chain Management Information System

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Abstract

In the increasingly advanced digital era, the Internet of Things (IoT) has become a key element in industrial transformation, especially in supply chain management information systems. This study aims to explore the implementation of IoT in improving the efficiency and effectiveness of the supply chain in the manufacturing sector. Using a literature review approach, this study identifies various IoT applications, such as sensor networks, Radio Frequency Identification (RFID) technology, and cloud computing that have made significant contributions to real-time data collection, asset tracking, and inventory management. The results of the study indicate that IoT implementation not only improves operational efficiency but also strengthens the competitiveness of companies through automation and artificial intelligence-based data analysis. IoT has been proven to optimize production processes, improve supply chain visibility, and reduce operational costs. However, challenges such as device interoperability, cybersecurity, and resistance to technological change are still major barriers to IoT adoption. This study also highlights the importance of collaboration between IoT solution providers, technology experts, and policy makers to create an ecosystem that supports innovation. The right implementation strategy, accompanied by comprehensive workforce training and a collaborative approach, are needed to maximize the potential of IoT.

Keywords: internet of things, supply chain management, operational efficiency, management information system.

INTRODUCTION

In the ever-evolving digital era, IoT has become one of the main pillars in industrial transformation, including in supply chain management information systems. IoT refers to a network of devices connected to each other via the internet, enabling real-time data collection and exchange (Judijanto et al., 2024). The implementation of IoT in supply chain management not only improves operational efficiency but also provides significant competitiveness for companies in facing increasingly complex global challenges (Wang et al., 2016). Despite the many positive potentials offered by this technology, there is a significant gap in the understanding and adoption of IoT in the industrial sector, especially in Indonesia. Based on previous research, many companies in Indonesia still adhere to traditional manufacturing practices that do not fully utilize modern technologies such as IoT (Judijanto et al., 2024). This creates a gap between the potential that can be achieved with the implementation of IoT and the reality on the ground. Given the importance of innovation in increasing industrial competitiveness, the urgency to research the implementation of IoT in supply chain management information systems is increasingly pressing. This research focuses on how IoT

technology can improve supply chain efficiency and effectiveness, and identifies the challenges faced by companies in adopting this technology.

One of the main challenges faced is the issue of interoperability between different devices and systems. Companies often struggle with the difficulty of integrating various existing technologies, which causes fragmentation in their information systems. In addition, cybersecurity issues are also a major concern, because sensitive data connected to IoT can be the target of attacks that have the potential to harm the company (Judijanto et al., 2024). Therefore, it is important to understand and assess these risks in the context of IoT implementation. Through this study, it is hoped that a clearer understanding will emerge of how IoT can be an enabler in more effective and efficient supply chain management (Judijanto et al., 2024).

In the context of industry 5.0, IoT applications have grown rapidly as a center of innovation in the manufacturing sector and also worldwide. The integration of IoT applications in the manufacturing sector has significant consequences for the sustainability and competitiveness of the economy in Indonesia. IoT technology has a wide variety of applications in the Indonesian manufacturing sector. RFID technology is used in asset tracking and inventory management (Judijanto et al., 2024). Asset tracking systems that yield high-fidelity and instantaneous data concerning asset whereabouts and condition serve as enablers for streamlining supply chain management and operational frameworks in smart manufacturing ecosystems (Bisio et al., 2018). Within these contexts, IoT infrastructure underpins the transformation of inventory oversight, fostering cost efficiency, operational refinement, and heightened component accuracy (Nejad et al., 2015). There is an increasing number of companies incorporating IoT solutions into their activities (Judijanto et al., 2024). The driving factors behind this IoT trend are the desire to improve operational efficiency, increase supply chain visibility, and proactively respond to global technological shifts (Koot et al., 2021). IoT emerges as a transformative agent that facilitates the evolution of traditional industrial settings into smart factories, through the deployment of synchronized networks comprising sensors, actuators, and software that collectively orchestrate the surveillance and refinement of production processes (Soori et al., 2023b).

The present inquiry seeks to interrogate the nuances of IoT application within supply chain management information systems, with an emphasis on elucidating the intricate ways in which this technology can be integrated into daily business practices, as well as to identify the best strategies that companies can adopt to maximize the benefits of IoT. In addition, this study also wants to identify the challenges and obstacles that companies may face when implementing this technology, so that it can provide useful recommendations for stakeholders in the industrial sector. By utilizing IoT technology optimally, it is expected that companies may enhance the operational calibre of their supply chain, thereby cascading positive impacts toward economic growth in the country (Judijanto et al., 2024).

METHOD

This study uses a traditional literature review approach to analyze the implementation of IoT in supply chain management information systems. This method was chosen because of its ability to identify, evaluate, and integrate findings from various relevant studies without using specific applications or software (Toorajipour et al., 2021). The review process is carried out through three main phases, namely planning, implementation, and reporting (Taj et al., 2023). In the planning phase, research questions are formulated and a literature search strategy is developed. A literature search was conducted on leading scientific databases, such as Scopus, IEEE Xplore, and ScienceDirect, using a combination of relevant keywords such as "Internet of Things," "supply chain management," and "information systems" (Shekarian et

al., 2022). Inclusion and exclusion criteria were set to ensure the relevance and quality of the selected articles. These criteria include publications in English, a primary focus on IoT in supply chain management, and publications within the last five years to ensure the timeliness of the information (Mu & Antwi-Afari, 2024). Articles that passed the screening were then analyzed using thematic analysis techniques to identify emerging patterns and themes. The validity of the study was maintained through data triangulation, which is by comparing information from various sources to ensure consistency and accuracy of the findings. The analytical outcomes are articulated through the medium of narratives, tables, and graphs to provide a comprehensive picture of IoT implementation in supply chain management (Perano et al., 2023).

RESULT AND DISCUSSION

Overview of IoT Technology in Indonesian Manufacturing

IoT technology has a wide variety of applications in the Indonesian manufacturing sector. As a basic element, distributed sensor infrastructures materialize as enablers of instantaneous data acquisition and systemic surveillance, while RFID mechanisms are deployed to orchestrate asset localization and streamline inventory governance (Judijanto et al., 2024). Through the transmission of accurate and instantaneous data concerning asset positioning and status, asset tracking systems can be strategically leveraged to refine logistics networks and enhance operational workflows within smart manufacturing environments (Bisio et al., 2018). Smart factories, defined by their pervasive automation and integration of AI, IoT, and robotics, function to refine production systems and systematically enhance operational efficacy, throughput, and output quality (Soori et al., 2023b). Recent advancements in IoT deployment across smart factories signify a pivotal shift toward the digital reconfiguration of manufacturing systems, thereby fostering organizational agility, economic efficiency, and ecological accountability (Wang et al., 2016). IoT-enabled smart factories leverage interconnected devices to streamline and mechanize inventory control systems, resulting in cost minimization, operational refinement, and heightened precision in the production of components (Mashayekhy et al., 2022).

IoT Enterprise Trends

There is an increasing number of companies incorporating IoT solutions into their operations. The driving factors behind this IoT trend are the desire to improve operational efficiency, increase supply chain visibility, and proactively respond to global technological shifts (Judijanto et al., 2024). IoT facilitates the seamless transition from traditional manufacturing paradigms to the smart factory ecosystem by deploying an intricate array of interconnected sensors, devices, and software to meticulously oversee and refine production processes. In enhancing factory-wide visibility, IoT offers comprehensive surveillance, ensuring workplace safety through the identification of latent risks and the rapid alerting of personnel. Additionally, IoT-enabled tracking systems empower suppliers with real-time updates regarding shipments, delivery locations, and schedules, enabling a sophisticated optimization of the supply chain (Soori et al., 2023a).

Implementation Challenges in Indonesian Manufacturing

Despite the high enthusiasm for IoT implementation (Judijanto et al., 2024). The administration and integration of numerous IoT devices present considerable challenges, necessitating both advanced technical knowledge and substantial investment in resources (Abubaker et al., 2017). There are several challenges faced by IoT Companies in Indonesia. Technology challenges, such as interoperability issues and security concerns, remain a hurdle

for seamless IoT integration. Companies struggle with the compatibility of diverse IoT devices and platforms, which often leads to a fragmented ecosystem. Cybersecurity is also a concern that emphasizes the need for robust measures to protect sensitive data and ensure the resilience of IoT networks to potential threats. Inertia associated with traditional manufacturing practices is a significant barrier to the adoption of IoT-driven transformation. To overcome this, a cultural shift is needed within organizations, fostering a mindset that embraces innovation, continuous learning, and adaptability. Policy makers are urged to foster an environment that encourages innovation while providing clear guidelines for IoT implementation in the manufacturing sector (Judijanto et al., 2024).

Impact of IoT Implementation on Operational Efficiency

IoT-based automation integration drives the manufacturing environment to be responsive and agile. In supply chain management practices, it is very clear that there are improvements in logistics, inventory management, and demand forecasting that result in a more resilient and efficient supply chain ecosystem (Judijanto et al., 2024). In the realm of smart manufacturing, the interconnectivity between devices, machinery, and systems serves as a catalyst for enhancing production efficiency, adaptability, and automation. This integration allows for the deployment of IoT devices to monitor and manage key parameters within the production cycle (Lampropoulos et al., 2019). For example, sensors provide real-time data on temperature, humidity, and pressure levels, while interconnected machinery relays ongoing status updates and performance metrics. These data sets are further processed with artificial intelligence and machine learning algorithms to uncover trends and refine manufacturing workflows (Mourtzis et al., 2021). By streamlining processes and minimizing downtime, IoT applications help manufacturers reduce operational costs. Moreover, IoT sensors play a critical role in identifying workplace hazards, promptly alerting workers to avert accidents and safeguard their well-being (Abubaker et al., 2017).

Best Practices and Strategies for Successful IoT Integration

Successful companies embrace collaborative ecosystems involving IoT solution providers, technology experts, and regulatory bodies. Collaboration creates knowledge exchange, problem solving, and co-creation of innovative solutions tailored to specific manufacturing needs. Workforce engagement initiatives ensure that employees embrace technological change and actively contribute to the success of IoT implementation (Judijanto et al., 2024). IoT devices can monitor energy usage across the factory floor and identify areas where energy efficiency can be improved. This can help reduce costs and lower the factory's carbon footprint. IoT devices provide the capability to monitor energy consumption in real-time, revealing areas within the manufacturing process that are ripe for optimization. This capacity aids in reducing energy expenditures while simultaneously promoting sustainability in production (Nigappa & Selvakumar, 2016). More broadly, IoT technology represents a game-changer for energy efficiency in smart factories, offering substantial reductions in energy costs, operational expenses, and environmental impact. Through the strategic use of IoT devices, manufacturers can optimize their energy management practices, reduce operational costs, and contribute to a more sustainable future (Boobalan et al., 2022). The integration of IoT sensors within the smart factory infrastructure enables manufacturers to gather precise data on production activities, thus facilitating real-time decision-making that enhances operational efficiency, increases productivity, and strengthens overall business performance (Soori et al., 2023a).

CONCLUSION

The implementation of IoT in supply chain management information systems has shown enormous potential in transforming industry in Indonesia towards a smarter and more efficient manufacturing era. IoT technology, which includes various devices such as sensor networks, RFID, cloud computing, and artificial intelligence-based data analysis, has been proven to be able to significantly improve operational efficiency, competitiveness, and industrial sustainability. Through the implementation of IoT, companies can automate various processes in the supply chain, monitor data in real-time, and optimize decision-making. This has not only succeeded in reducing production costs, but also increasing accuracy, speed, and flexibility in supply chain management. The problem of interoperability between IoT devices, cybersecurity that is still vulnerable, and resistance to changes in organizational culture are the main obstacles that need to be overcome. In addition, regulations that do not fully support technological innovation are also inhibiting factors in the widespread implementation of IoT. To overcome these challenges, close collaboration between various stakeholders is needed. Companies, technology solution providers, IoT experts, and policy makers need to work together to create an ecosystem that is conducive to the implementation of IoT.

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