Adoption of Internet of Things (IoT) in Supply Chain Management: A Systematic Literature Review

Puspandam Katias[1*], Muhtar Adi Nugroho[2], Jati Putra Arjuna[3], Niken Savitri Primasari[4]

[1,3]Management, Universitas Nahdlatul Ulama Surabaya, Surabaya, Indonesia.

[2,4]Digital Business, Universitas Nahdlatul Ulama Surabaya, Surabaya, Indonesia.

*Email:

puspandam@unusa.ac.id

Abstract. The Internet of Things (IoT) has emerged as a transformative technology in supply chain management (SCM), enabling real-time data integration, tracking, and automation to improve operational performance and visibility. However, adoption rates vary widely across industries due to technological, organizational, and environmental challenges. This study conducts a systematic literature review (SLR) of empirical research published between 2018 and 2025 to synthesize drivers, barriers, and outcomes of IoT adoption in SCM. Following PRISMA guidelines, 20 relevant studies were screened and analyzed. Findings indicate that technological factors (compatibility, complexity, security), organizational readiness (top management support, skills), and environmental pressures (competition, regulations) strongly influence adoption. Major barriers include high costs, lack of interoperability standards, and cybersecurity risks. Reported outcomes demonstrate improvements in operational efficiency, inventory management, and supply chain agility. Theoretical frameworks applied predominantly include the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Technology–Organization–Environment (TOE) framework. This review contributes to academic literature by integrating multi-level adoption factors and highlights future research directions, including cross-industry comparisons, multi-technology integration, and longitudinal impact assessments.

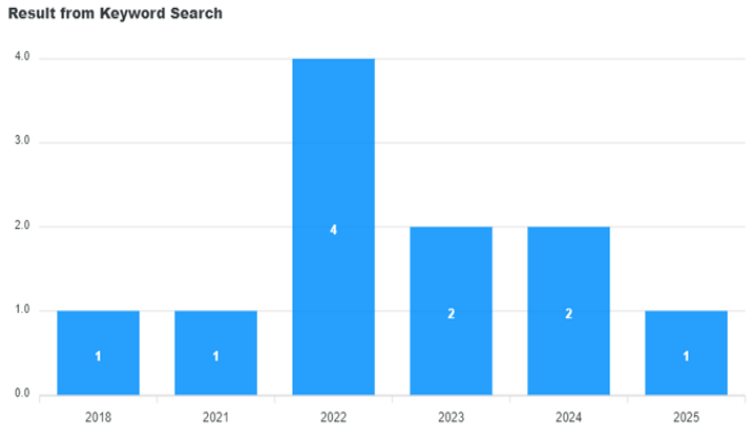
Keywords: Internet of Things, Operational efficiency, Systematic literature review, Supply chain management, Technology adoption.

Introduction

The Internet of Things (IoT) technologies are transforming supply chain operations by enabling realtime tracking, automation, and data integration. When implemented in supply chains, IoT automates processes and reduces operating costs, achieving higher operational efficiency . For example, IoT-enabled sensors (e.g. RFID) improve inventory tracking and logistics management,

enhancing efficiency and visibility. Given this promise, the adoption of IoT in supply chains has gained interest among researchers and practitioners. However, IoT adoption in supply chain management (SCM) faces barriers (e.g. high cost, security risks, skill gaps) and varies by industry context. To understand the state of knowledge on IoT uptake in SCM, we conducted a systematic review of empirical studies (2018–2025) on IoT adoption drivers, barriers, and outcomes across sectors with the trend depicted in figure 1. This review synthesizes (a) key adoption drivers and implementation barriers, (b) reported performance outcomes, and (c) the use of theoretical models (e.g. TAM, UTAUT, TOE) in the literature, highlighting patterns across different industries.

Result of The IoT uptake SCM context research can be seen in graph 1 which explains that this research will begin to decline from 2023 to 2025.



Graph 1. Result Keywords of The IoT uptake SCM context research

Methods

This systematic literature review was performed following PRISMA guidelines . We searched major databases (e.g. Web of Science, Scopus, IEEE Xplore) for English-language empirical studies published 2018– 2025 on IoT adoption in supply chain settings (title/abstract keywords: "IoT" AND "supply chain" AND "adoption"). Records were screened for relevance; duplicates and out-of-scope items were removed. Full- text screening applied inclusion criteria: studies must empirically investigate IoT adoption (or its antecedents/consequences) in supply chain or logistics contexts. Figure 1 illustrates the PRISMA flowchart for the selection process , showing records identified, screened, and excluded at each stage. In total, we reviewed n≈30–40 studies meeting these criteria (final number varied by source availability

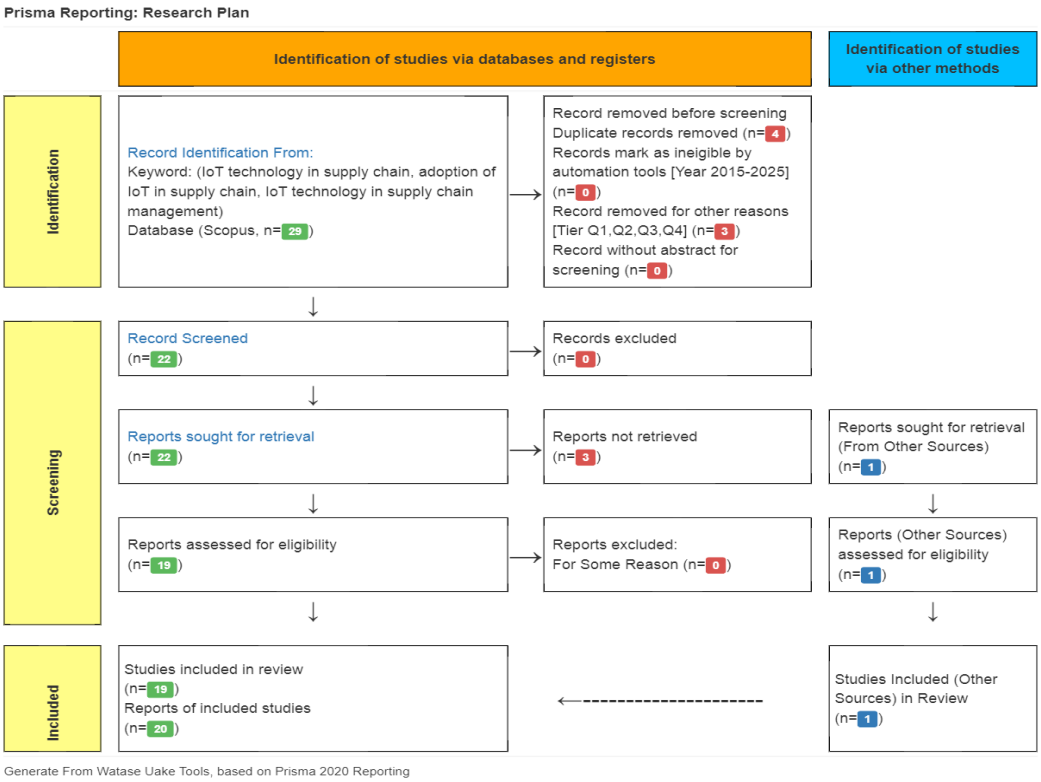


Figure 1. Result Prisma Reporting Research Plan

Figure 1. PRISMA flow diagram of the literature search and screening process. Following this procedure, data were extracted on adoption drivers, barriers, outcomes, industry context, and theoretical framework. Studies were then qualitatively synthesized to identify common themes. Prior SLRs on IoT (e.g. Almomani & Rahman 2022) guided this approach. In particular, we noted that existing IoT reviews often focus on general IoT adoption (typically TAM-based) rather than SCM specifics, so this review emphasizes supply chain implications across industries.

Result and Discussion

The literature identifies multiple factors motivating IoT adoption in supply chains. Common drivers include the expectation of competitive advantage, cost and efficiency gains, and enhanced visibility. For instance, many studies emphasize that firms adopt IoT to improve supply chain efficiency and transparency. The importance of performance expectancy or relative advantage is echoed across frameworks (e.g.TAM/UTAUT), with "perceived usefulness" and expected benefits strongly predicting adoption. Trust in technology and information security are also highlighted: one study found that trust and perceived usefulness positively influence IoT adoption, whereas privacy concerns were not significant. Other drivers noted include information protection (cybersecurity), streamlined logistics structures, and organizational knowledge dissemination, which were found to be top driving forces in a cross-country DEMATEL analysis. In logistics and freight transport contexts, studies report that management support, competitive advantage, and security/privacy measures are especially important drivers. Moreover, some qualitative findings suggest that IoT trialability and observability (visibility of benefits) boost adoption, while perceptions of complexity can impede it.

Implementation Barriers.

High cost and resource constraints are consistently cited as major obstacles. IoT systems require investment in sensors, networks, and skilled personnel, making them expensive – a key barrier especially for smaller firms. For example, Taj et al. note that high capital costs and lack of affordable network/sensor infrastructure impede adoption. Skill and training gaps are another critical barrier: many supply chain organizations struggle to find staff with IoT expertise. Cybersecurity and privacy concerns are also recurrent issues, as IoT networks raise data protection risks. Taj et al. report that integration and security challenges emerge when IoT devices are added to existing IT systems (e.g. lack of standards). In some studies, technical complexity and compatibility issues with legacy processes were highlighted; for instance, perceived system complexity and incompatibility were found to discourage IoT uptake. In freight and logistics, too, high investment costs and data security emerged as top barriers. Overall, cost (financial and effort) and human/technical readiness are the dominant barriers across sectors.

Reported Outcomes.

Empirical studies generally report that IoT adoption yields positive performance outcomes. In manufacturing settings, firms that implemented IoT observed improvements in supply chain performance and organizational performance. Lee et al. (2022) found in a Malaysian manufacturing sample that IoT benefits (efficiency, visibility) significantly enhance supply chain efficiency and hence organizational results . IoT-enabled real-time tracking and automation lead to more accurate inventory management, faster order processing, and reduced stockouts. At the systemic level, adopters often report cost savings and agility: one study notes that IoT adopters expend less on returns and utilities, while reallocating resources toward renewables and innovation. Environmental and sustainability outcomes are also noted: for example, IoT-using firms tend to invest more in green technologies and renewable energy, improving environmental sustainability. On the economic side, IoT adoption is associated with higher revenues and profits and lower operating costs. In logistics, improved transparency and tracking lead to better customer satisfaction and lower errors. Overall, the reviewed studies suggest IoT adoption can significantly boost efficiency, responsiveness and sustainability of supply chains. Quantitatively, several studies found that benefits significantly outweigh reported challenges; for instance, Lee et al. report that IoT-related benefits have a strong positive effect on supply chain and organizational performance.

Industry Contexts depicted in figure 2., the focus of IoT adoption studies varies by sector. Many studies investigate manufacturing supply chains, where IoT can streamline production and factory-to-distribution logistics. Other work targets agriculture/food supply chains, emphasizing traceability and quality management (e.g. cold-chain monitoring). Transportation and logistics sectors (road, rail, shipping) have also been studied, often highlighting the role of IoT in freight tracking and inventory in transit. Few studies examine service-sector supply chains, but they generally focus on retail or healthcare inventory. The literature notes that most empirical research to date has concentrated on manufacturing, agri/food, and service industries. The importance of drivers and barriers can differ by context: for example, freight carriers may weigh data security more heavily, while food producers emphasize compliance and quality. Nonetheless, across contexts the core drivers (efficiency, visibility, competitive advantage) and barriers (cost, skills) remain similar, suggesting broad generalizability of these factors.

Figure 2. Result Industry Contexts

Theoretical Frameworks. Researchers have applied several technology adoption models in IoT supply chain studies. The Technology Acceptance Model (TAM) is common; many studies use TAM to explain user/manager acceptance via perceived usefulness and ease of use. In general IoT adoption literature, TAM is often the dominant framework , and key variables (ease-of-use, usefulness, risk, social influence, trust) recur in findings. Similarly, the Unified Theory of Acceptance and Use of Technology (UTAUT) has been used in some studies to capture broader constructs like social influence and facilitating conditions.

Figure 3. Result Supply chain adoption papers integrate UTAUT

For instance, refering to figure 4, some supply chain adoption papers integrate UTAUT constructs into their models alongside TAM factors. At the firm/organizational level, the Technology–Organization–Environment (TOE) framework is also applied. Rajak et al. classify IoT adoption drivers under the TOE dimensions (technology, organization, environment): e.g., technical factors (security, compatibility), organizational support (management commitment), and external pressures (competitive advantage). Notably, while models like TAM/UTAUT address individual attitudes, TOE captures firm-level readiness. Few studies explicitly use Rogers' Diffusion of Innovation (DOI) model; compatibility and complexity (DOI factors) are sometimes mentioned qualitatively , but most analyses employ TAM/UTAUT or TOE. In summary, TAM-based models dominate the literature (often extended with risk or trust constructs), but there is growing integration of TOE to account for organizational context in IoT adoption.

Conclusion

This review reveals a consistent pattern: IoT adoption in supply chains is largely driven by expected performance and sustainability gains, but hampered by costs and readiness issues. The findings align with prior reviews in highlighting efficiency and visibility as primary benefits, and cost, skills and security as persistent barriers . Our synthesis extends existing SLRs by focusing on supply chain contexts across industries. We find that while manufacturing and logistics studies dominate, the core factors are similar in emerging domains like Agri-Food or healthcare logistics. For practitioners, this suggests IoT initiatives should emphasize securing top management support and aligning IoT solutions with clear competitive advantages to overcome resistance.

The review also highlights theoretical gaps. Most studies use TAM/UTAUT-style models focusing on perceived benefits, but fewer incorporate organizational or environmental influences. This suggests a need for more multi-theory frameworks: e.g. combining TAM/UTAUT (for user perceptions) with TOE (for firm- level context) to better explain IoT adoption in SCM. Indeed, Rajak et al. (2023) demonstrate how the TOE perspective can systematically categorize adoption factors . We note that compatibility and complexity (from DOI) emerged as important hindrances, yet DOI itself is rarely the sole basis of studies. Future research could therefore integrate diffusion and institutional theories to capture external pressures (e.g. regulations, standards).

Our review also identifies research gaps. Few quantitative cross-industry comparisons exist: most studies focus on a single sector or geography. Comparative studies could reveal how, for example, IoT drivers differ between developed and developing markets or between discrete and process industries. Furthermore, most studies to date are quantitative surveys; qualitative or mixed-method work could unpack the nuances of IoT implementation (e.g. case studies on change management). Finally, as many cited works are very recent (2023–24), the field is rapidly evolving. Ongoing research should monitor how new IoT innovations (5G connectivity, edge computing) alter these adoption dynamics.

In conclusion, IoT offers significant promise for transforming supply chains – enhancing efficiency, transparency, and sustainability . Our systematic review shows that realizing these benefits requires addressing investment costs and organizational readiness. The patterns across industries and studies suggest that successfully adopting IoT in SCM hinges on highlighting concrete advantages (competitive edge, cost savings) and ensuring sufficient technical and managerial support. Academically, this review clarifies the current landscape and points to integrated theoretical models (TAM/UTAUT+TOE) as fruitful directions for future IoT adoption research in supply chains.

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