Journal of Posthumanism
2025
Volume: 5, No: 3, pp. 409–437
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i3.746

Reviewing the Integration of RFID and IoT in Supply Chain Management: Enhancing Efficiency and Visibility

Md Abdullah Al Mahmud[1], Md Zikar Hossan[2], Anamika Tiwari[3], Rabeya Khatoon[4], Sadia Sharmin[5], Md Saddam Hosain[6], Jannatul Ferdousmou[7]

Abstract

Supply Chain Management (SCM) increasingly relies on advanced technologies like Internet of Things (IoT) and Radio Frequency Identification (RFID) to enhance operational efficiency and decision-making processes. These technologies enable the integration of data, information, products, and physical objects throughout the supply chain, automating and optimizing business processes. IoT applications have revolutionized SCM by enabling smart objects that enhance intelligence and automation capabilities. The convergence of RFID with IoT, termed RFID-IoT, aims to develop automated sensing systems that are seamless, interoperable, and highly secure. This integration facilitates real-time tracking and monitoring of goods, improving supply chain visibility and responsiveness. The systematic review of current literature underscores RFID-IoT's potential to significantly enhance SCM by maximizing productivity, minimizing costs, and meeting customer requirements more effectively. However, challenges such as integration complexities and security issues remain critical areas for further research and development. Future advancements in RFID-IoT technologies promise to further streamline SCM processes across product manufacturing, shipping, distribution, inventory management, and retail, fostering a more efficient and resilient supply chain ecosystem.

Keywords: *Supply Chain Management, Internet of Things, Radio Frequency Identification, Product Manufacturing, Inventory Management, Retail.*

Introduction

Supply Chain Management (SCM) is a systematic process overseeing the flow of operations from acquiring raw materials from suppliers to manufacturing products and distributing them to retailers for delivery to end customers. The primary goal of SCM, as illustrated in Figure 1, is to ensure that the right item is delivered to the right customer at the right price, in the right condition, at the right place and time, and in the right quantity (Khan et al., 2022; Lu & Navas, 2021; Varriale et al., 2021).

[1] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States, Email: abdullahalmahmud4248@gmail.com, (Corresponding Author)
[2] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States
[3] Department of Information Technology, Westcliff University, 17877 Von Karman Ave 4th Floor, Irvine, CA 92614, United States.
[4] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States.
[5] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States.
[6] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States.
[7] Department of Business Administration, International American University, 3440 Wilshire Blvd STE 1000, Los Angeles, CA 90010, United States

However, achieving this ideal condition is challenging due to real supply chain problems such as delivery delays, overstocking, and stockouts (Ye et al., 2023). Over time, supply chains have become riskier, more complex, and costlier, counteracting the primary objectives of efficiency and cost-effectiveness. To tackle these growing challenges, integrating information and communication technology (ICT) into SCM has become essential (Reece et al., 2022). Traditional management methods are no longer sufficient to maintain efficiency and cost-effectiveness amidst increasing complexity, risk, and cost. By leveraging advanced technologies such as smart tools, analytics, and business intelligence, firms can create intelligent and integrated infrastructures that streamline operations from raw material acquisition to end-customer delivery (Aljabhan, 2022). This technological convergence enables real-time data communication and precise coordination across the supply chain, enhancing the ability to deliver the right product to the right customer at the right time and place. Consequently, businesses can better manage inventory levels, reduce the likelihood of stock outs and overstocking, and mitigate delivery delays, thus achieving the fundamental goals of SCM (Wu et al., 2022).

Figure 1. Supply chain management concept (Khan et al., 2022).

One prominent technology driving this transformation is RFID. Although RFID has been in existence for some time, recent advancements have made it more accessible and effective, significantly impacting SCM practices. RFID technology offers a robust solution for sensing, detecting, identifying, tracking, and monitoring objects throughout the supply chain (Costa et al., 2013; Konovalenko & Ludwig, 2019). By bridging the physical and digital realms, RFID provides a seamless connection between tangible products and their digital records, facilitating more accurate and efficient management of inventory and assets (Cao & Zhang, 2016). RFID is more affordable and capable of reading several tags at once than other Automatic Identification and Data Capture (AIDC) systems like Optical Character Recognition (OCR)(Haque et al., 2015). By using RFID in event analysis inside SCM, companies can now rapidly spot process deviations and improve operations, guaranteeing more effective and smooth workflows. As a result, RFID has become a critical component in modern SCM, helping companies gain a competitive edge in an increasingly globalized and competitive market.

The advancements in RFID technology, particularly its integration with the Internet of Things (IoT), have revolutionized various sectors by addressing the limitations of traditional wired solutions. IoT constitutes Wireless Sensor Networks (WSN), which integrate multiple small and intelligent sensors over extensive areas for applications in retail, healthcare, agriculture, and military surveillance

(Butun et al., 2012; De Donno et al., 2014; Shih & Wang, 2016; Srbinovska et al., 2015). Standard and interoperable communication protocols are used by this dynamic global network infrastructure to smoothly combine real and virtual things (Alwadi et al., 2017). RFID-IoT is the term used to connect tagged things inside the Internet of Things network using protocols like Tag Talk Only (TTO) and Reader Talk First (RTF) (A. Poad & Ismail, 2018). Improving production, sales, storage, shipping, installation, property monitoring, positioning services, and environmental detection, this innovation provides new operational solutions throughout the supply chain (Chen et al., 2020; Gu, 2017; Urbano et al., 2020). Consequently, the evolution of RFID-IoT is poised to significantly impact the revolution of SCM, driving improvements in operational processes and cost reductions.

By offering visibility of information, traceability of goods, reliability, flexibility, and adaptability, RFID-IoT technologies improve supply chain management. By ensuring that every step of the SCM process is linked, this pervasive interconnectivity guarantees the accurate delivery of items at the right time, in the right amount, and to the right places (Xu, 2011). Research highlights the importance of information sharing in improving coordination among organizations within the supply chain, resulting in more efficient management. By enabling real-time data exchange and seamless communication, RFID-IoT technologies facilitate better coordination among manufacturers, retailers, and suppliers, leading to optimized operations and reduced costs. This enhanced collaboration and improved information flow ultimately contribute to a more responsive and resilient supply chain ecosystem, capable of adapting to changing market demands and conditions (Di Mauro et al., 2020; Lyons * et al., 2005; M. A. R. C. Rakibul Hasan, Fatema Tuz Johora, Md Wali Ullah, Md Abdul Barek Saju, 2024).

Research Motivation and Objective

In recent years, the integration of RFID and IoT technologies within SCM has seen significant expansion, driven by a compelling need to streamline operations, reduce costs, and enhance overall efficiency (Maheshwari et al., 2021; M. A. A. M. Rakibul Hasan, Syeda Farjana Farabi, Jahanara Akter, Fatema Tuz Johora, 2024; Raut et al., 2021; Raza, 2022). Despite substantial advancements, existing literature predominantly focuses on either RFID or IoT individually, lacking a comprehensive review that systematically addresses their combined impact on SCM (Caro & Sadr, 2019; Fatema Tuz Johora & Mahmud, 2024; Manavalan & Jayakrishna, 2019). By means of an extensive systematic evaluation, this work seeks to close this gap by highlighting the efficiency, connectivity, flexibility, and adaptability of RFID-IoT applications in SCM. It critically evaluates their efficacy in optimizing task assignments, workforce management, machine and vehicle utilization, as well as minimizing time and resource costs. Furthermore, it examines their interoperability across various SCM components such as raw materials, products, pallets, and containers, while assessing scalability in marketing strategies and data accuracy. Moreover, the paper explores the compatibility of RFID-IoT systems with real-time data updates and security standards, crucial for ensuring seamless integration into modern supply chain environments.

Looking ahead, this review not only consolidates the current state-of-the-art but also identifies key challenges faced by existing RFID-IoT implementations in SCM. By addressing these challenges, such as technological integration hurdles and security concerns, the paper provides a foundation for future research directions. It discusses potential avenues for enhancing RFID-IoT systems in SCM, emphasizing innovation in technology adoption and integration strategies. Ultimately, this paper aims to serve as a comprehensive resource for both academics and practitioners, offering insights into the evolving landscape of RFID-IoT technology and its transformative potential within supply chain management practices.

Paper Outline

This paper is structured as follows: Section II begins with a concise overview of RFID and IoT technologies, highlighting their integration for application in Supply Chain Management (SCM). Section III outlines the systematic review methodology used for implementation. Section IV comprehensively surveys RFID-IoT solutions in SCM, addressing each stage of the supply chain while also examining the associated challenges. Additionally, Section IV discusses current issues encountered at each SCM stage. Section V focuses on the present challenges and section VI presents future potential of RFID-IoT technologies. Finally, the concluding section offers summary remarks and outlines avenues for future research.

Theoretical Background

IoT for Supply chain Management

Kevin Ashton introduced the term "Internet of Things" in 1999, aiming to bridge the gap between RFID technology and the Internet, revolutionizing data collection and management without direct human intervention (Ashton, 2009). Today, the concept of IoT extends far beyond its origins, facilitating interconnectedness among various technologies with profound implications, particularly in supply chain management (Atzori et al., 2010; Bogataj et al., 2017; Rakibul Hasan). The challenges within supply chains, such as delivery efficiency, continuous monitoring, and collaborative partnerships (Ben-Daya et al., 2019), find potential solutions through IoT's network of internet-connected physical objects. This infrastructure enables stakeholders to achieve greater transparency and visibility by monitoring variables like temperature, location, humidity, and other critical parameters in real-time (Miorandi et al., 2012).

Furthermore, IoT integration promises significant reductions in waste and costs across supply chains (Mathaba et al., 2017; Verdouw et al., 2013). Technologically, IoT relies on foundational elements such as RFID and GPS, enabling seamless data transmission to the internet for analysis and decision-making (Lee et al., 2018). Its applications span diverse sectors, including agriculture and healthcare, where tracking and monitoring of goods and services play pivotal roles in ensuring quality and safety (Jabin et al., 2024; S. F. F. Rakibul Hasan, Md Kamruzzaman , Md Khokan BHUYAN , Sadia Islam Nilima , Atia Shahana 2024; Yan, 2017). Despite these advancements, widespread adoption of IoT in supply chains faces persistent challenges, including security vulnerabilities, lack of standards, interoperability issues, and limitations in hardware and software (Birkel & Hartmann, 2019). These complexities necessitate robust solutions to enhance data security and privacy protections to foster widespread adoption (Lin et al., 2017; Md Abdullah Al Mahmud, 2024; Shahana et al., 2024).

From a business perspective, trust emerges as a critical factor influencing the adoption of IoT technologies. Stakeholders must navigate concerns around data privacy, particularly as IoT generates vast amounts of private data. Addressing these privacy challenges requires robust security mechanisms, with blockchain technology emerging as a potential solution due to its decentralized nature and enhanced data management capabilities in emergency scenarios (Khan & Salah, 2018). However, centralized databases remain vulnerable to cyber-attacks, underscoring the need for secure data exchange protocols between organizations. These challenges highlight the tension between the ideal of a transparent global supply chain and the practicalities of implementing secure and efficient IoT infrastructures.

RFID for Supply chain Management

RFID technology has garnered significant attention across diverse sectors such as defense, healthcare, transportation, and agriculture due to its versatile applications (Chen et al., 2010; Gope et al., 2018; Ibrahim, 2018). At its core, RFID comprises three essential components: the reader (or transceiver), antenna, and tag. Utilizing Radio Frequency (RF) waves, RFID systems activate and power tags, which then respond by transmitting stored information back to the reader. Tags, whether passive or active, play crucial roles based on their power requirements and functionality. Passive tags, powered by RF energy from readers, offer cost-effective deployment for tracking multiple objects simultaneously. In contrast, active tags, equipped with their power source, provide longer reading ranges and continuous real-time data, albeit with a limited lifespan (Chen et al., 2020).

The versatility of RFID lies in its ability to monitor dynamic changes in state, position, and attributes of tagged objects effectively. Passive tags, due to their energy-efficient design, facilitate economical deployment across various applications, minimizing operational costs and maintenance efforts (Chen et al., 2020). Furthermore, RFID systems ensure high reliability in detection and identification tasks, significantly reducing the probability of missing or failure detection. This reliability enhances system efficiency and ease of implementation, supporting seamless integration into existing operational workflows.

In practical terms, RFID systems offer several distinct advantages. They enable "place and go" scenarios, where tagged items can be swiftly identified and tracked without manual intervention, streamlining logistics and inventory management processes. Moreover, the ability to read multiple tags simultaneously enhances operational efficiency in environments requiring rapid and accurate data capture. Overall, RFID technology continues to evolve as a robust solution for enhancing traceability, security, and efficiency across a wide range of industries and applications. The RFID technology is categorised based on the frequency of operation and the types of applications it can handle (See Table 1).

RFID frequency range of functionality	RFID properties	RFID frequencies	Read range	Transmission rate	Applications
Low Frequency (LF) 30–300 kHz	Passive	125–134 kHz	Short	Slow	Retail counting and manual warehouse
High Frequency (HF) 3–30 MHz	Passive	13.56 MHz	Medium	Medium	Computerized object tracking
Ultra-High Frequency (UHF) 300 MHz-3 GHz	Passive	433 MHz and 865–956 MHz and 2.45 GHz	Long	Fast	Monitoring and updating logistics changes for several sites
Microwave 2–30 GHz	Active	2.45–5.8 GHz	Very Long	Very Fast	Observation in real time of workers, assets, and works in progress (WIP)

Table 1. Rfid Features, Frequency Ranges, And Scm Implementations (Tan & Sidhu, 2022)

RFID-IoT for Supply chain Management

RFID technology, in conjunction with IoT, represents a transformative force in creating interconnected networks of physical objects capable of exchanging real-time data. IoT allows for easy tracking of item location, statuses, motions, and operations because it is a dynamic global network in which every physical and virtual asset is uniquely recognized (Alwadi et al., 2017). This integration facilitates remote accessibility to devices, empowering them to communicate autonomously and make intelligent decisions based on sensor inputs from other machines. The IoT architecture typically comprises three primary layers: the perception layer for data collection from RFID tags and various sensors, the network layer for transmitting this data, and the application layer for analyzing and visualizing collected information within supply chain management (SCM) systems (dos Santos & Dias Canedo, 2019). Five different layered architectures are required for an IoT system to interface with business or management models (Khan et al., 2012). The perception, network, middleware, application, and business layers make up the five layers of the architecture (see Figure 2).

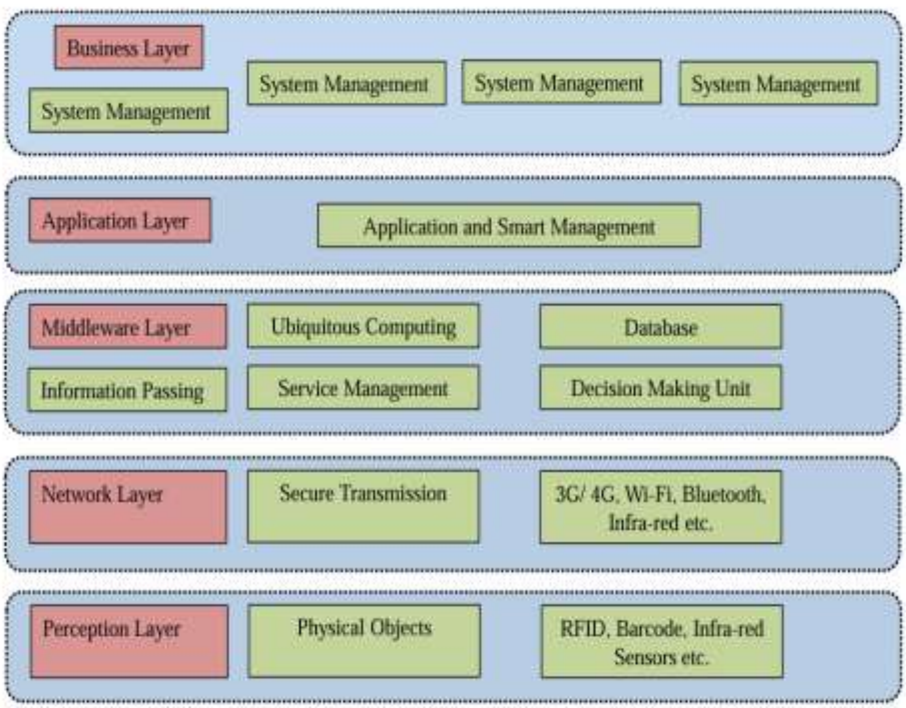

Figure 2. RFID-IoT layered architecture (Tan & Sidhu, 2022).

In SCM applications, RFID and IoT enable the automatic identification and monitoring of objects, stocks, equipment, and even workers, capturing real-time data to track processes such as production starts and finishes. This capability enhances operational efficiency by providing detailed insights into inventory management, resource allocation, and quality assurance (Qu et al., 2019). By leveraging RFID and IoT technologies, businesses can optimize production timelines and costs throughout the supply chain, from manufacturing to retail. This integration not only ensures transparency in product tracking but also enhances brand protection and customer satisfaction through verified traceability of every ingredient and production stage.

Review Approach

To reduce the impact of reviewer biases and reveal the characteristics and structure of research domains concerning RFID-IoT applications in SCM, this study meticulously selected relevant literature. We started by searching for RFID, IoT, and Supply Chain Management-related terms; we made sure to exclude any results from white papers, theses, chapters in books, or websites. We considered only research articles that were published in English during the last ten years and were directly related to the issue. After then, the papers were sorted into four groups: retail management, product manufacturing management, inventory management, and shipping and distribution management. After carefully reviewing recent research, the author settled on this classification scheme. In order to find characteristics and trends in the field of supply chain management, all of the chosen publications were carefully reviewed. The study was further bolstered by the inclusion of a couple of more articles. This study's article selection approach is shown in Figure 3.

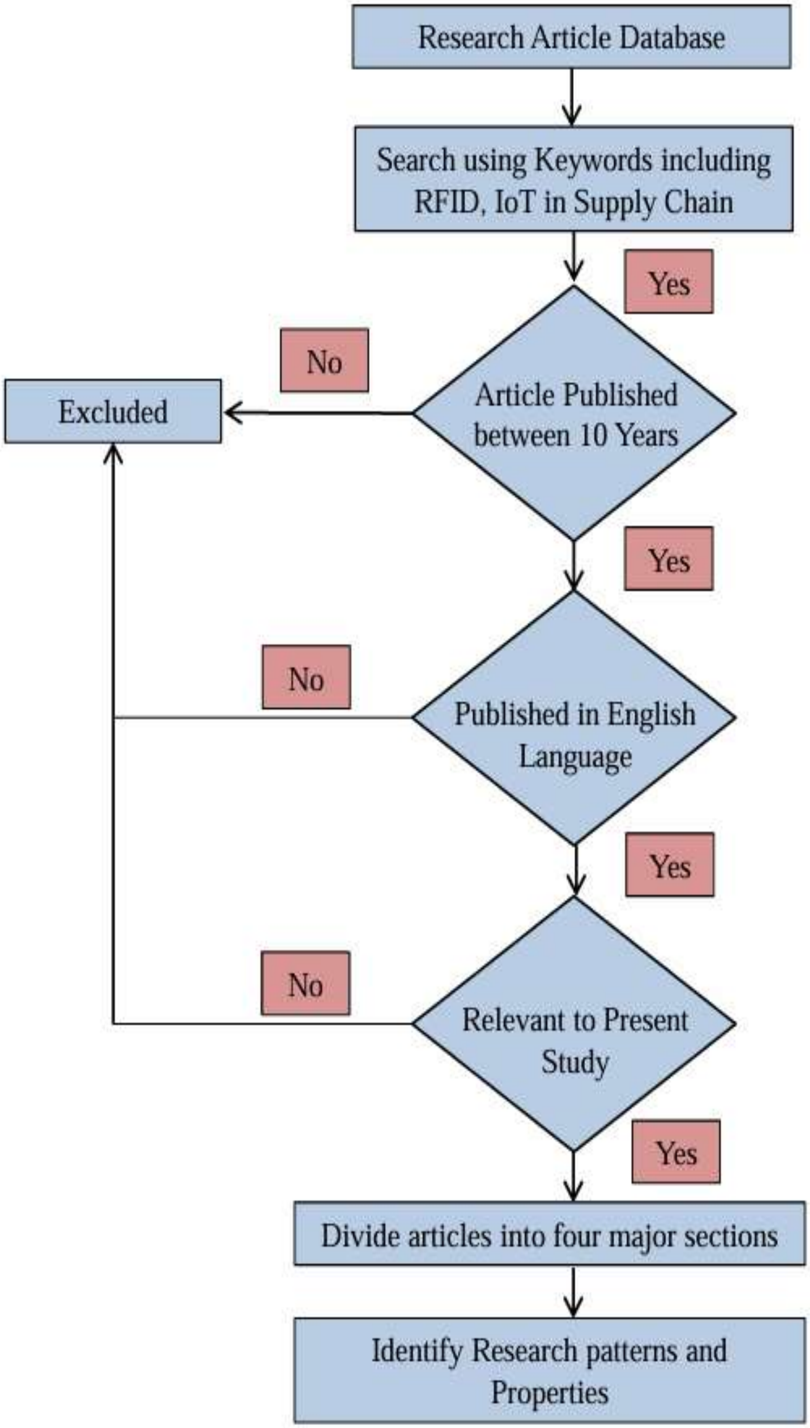

Figure 3. Existing literature review methodology.

Findings

Manufacturing, shipping and distribution, inventory, and retail are just a few areas that benefit greatly from RFID-IoT technology' automatic product identification, ubiquitous networking, and real-time data transfer. Figure 4 shows how these steps incorporating RFID-IoT into the supply chain fill a need that has been identified in previous research. These studies tend to ignore the importance of product shipping and distribution in the supply chain, which causes problems with classification, as well as increased costs and risks (Sarac et al., 2010). The deployment of RFID-IoT technologies aids in reducing product costs, improving product quality, optimizing processes, and facilitating communication and services among multiple parties. Analytical modelling, simulation, case studies, experiments, and return on investment evaluations were among the methods used by Wan et al. (2017) to examine the effects of RFID-IoT. The purpose of this work is to bring attention to the important contributions of scholarly articles in four main areas: methodology, design, and applications in the supply chain. These categories are based on an exhaustive survey of RFID-IoT literature

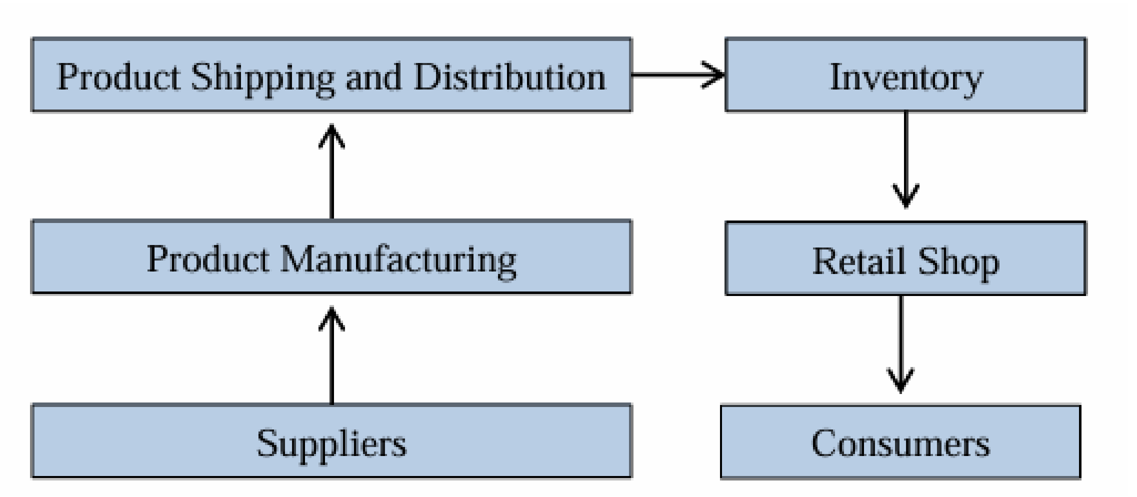

Figure 4. Stages of RFID-IoT method in SCM.

Product Manufacturing Management

In order to succeed in today's market, manufacturers have come to realize that they must change their processes and way of thinking as an organization. This is especially true when it comes to tracking and controlling the flow of raw materials. Technology, particularly the Internet of Things (IoT) and sensory wireless networks like radio frequency identification (RFID), can greatly facilitate this transition. Making sure the proper material gets to the right place on shelves is a complex operation, but these technologies make it possible to identify and track goods or objects in real-time, simplifying the process. In addition to lowering the incidence of human mistake and the need for a big workforce—a factor that contributes to high turnover rates—RFID-IoT technology improves labor efficiency and cost-effectiveness in production. There are three key areas where RFID-IoT excels: managing products and resources, operations, and information. Product and resource management can benefit from RFID-IoT by better monitoring products, machinery, and employees, as well as by discovering where resources come from. It helps operational managers to precisely predict when jobs will be finished by providing real-time status updates. With RFID-IoT, data analysis for decision-support tools becomes more easier in the realm of information management. The technology's benefits can be better understood by stakeholders from a variety of angles, depending on their individual requirements, if they are grouped into these three areas.

Applications of Product Manufacturing Management

An new active shopfloor material handling solution was proposed by Gope et al. (2018) that utilizes real-time navigation and several manufacturing data sources. To optimize movement activities, this system employs a novel allocation technique. It also focuses on reducing transportation costs and features an intelligent tram with sensing and automation capabilities. In a data-driven, real-time Internet of Things (IoT) setting, active RFID sensing technology improves the flow of process for dynamic material handling operations, leading to more efficient bulk tracing and tracking. Transport expenses for large-scale manufacturing can be reduced thanks to the system's optimization of tasks based on time, cost, quality, distance, priority, and volume, which minimizes human handling errors. Better energy efficiency and lower costs are the goals of the cognitive computing solution for advanced material handling, which features a high-performance cloud-based system with various mapping and localization algorithms, notification services, and decision-making procedures (Segura Velandia et al., 2016) . This system proves to be better than the old ways of delivery. To further address processing faults and product recalls, RFID and IoT technologies are employed to monitor and control the assembly of automobile components. To monitor the assembly and production of crankshafts, Doinea et al. (2015) investigated the adaptability and interoperability of radio frequency identification systems. The optimized reader antenna architecture and low-cost UHF RFID passive tag performed admirably in metal environments and were easily adaptable to additional vehicle components. The integrated IoT system provides a more economical substitute for conventional camera-based systems by collecting real-time data from many operations and transmitting it to a factory-based server.

In the realm of manufacturing, the quality and safety of materials used are paramount, and consumers increasingly demand transparency regarding these materials. This includes detailed information about ingredient descriptions, quantities, and any non-compatible substances, including their chemical compositions. Li et al. (2017) introduced a food safety management system designed to monitor the entire food production process using data from raw materials, such as organic fertilizers and seeds, as well as the growth environment. This system leverages IoT sensors and RFID tags to collect identification data, which is then streamed to a data center for real-time traceability. This automated and effective approach significantly enhances product quality visibility and ensures safety, surpassing traditional methods like barcode technology. Additionally, the combination of RFID and QR technology, as proposed in (Wang et al., 2016), offers a cost-effective solution for large-scale manufacturing by enabling real-time tracking and tracing of prepackaged food. This system not only counts numbers but also detects excessive additives, unhealthy ingredient portions, and expiration dates, with validation and alert mechanisms to promptly address any food quality or safety issues. Through these advancements, the transparency of ingredient usage and the integrity of the food processing ecosystem are substantially improved, reassuring consumers about the safety and accuracy of the product labeling.

Particularly in settings where a wide variety of items are made at the same time on a common assembly line, work schedules have a major influence on production efficiency. Achieving optimal productivity requires careful planning of all available resources, including but not limited to machinery, tasks, personnel, and supplies. Industrial Petri Net (MPN), developed by Zhang, Zhang, Wang, et al. (2015), is an Internet of Things (IoT) solution that uses intelligent tool agents linked to RFID-tagged industrial products in real time. Through simulation tests, this strategy improves workflow efficiency and addresses schedule search stagnation by enhancing the MPN model with the Ant Colony Optimization (ACO) metaheuristic method. A related study by Shen et al. (2006) also suggested an IoMT architecture for collecting data in real-time from different parts of a manufacturing process. This framework allows for two-way communication across machine, enterprise, and manufacturing layers, integrating data from employees, substances, activities, and equipment. It is crucial to have real-time production scheduling in ubiquitous manufacturing environments. In their demonstration of real-time scheduling using RFID, Zigbee, and the Internet of Things, Wan et al. (2017) used multi-agent systems. The authors proposed four agent models for optimizing production management in simulated scenarios: machine, capability evaluation, real-time scheduling, and process monitor.

Utilizing radio frequency identification (RFID) and the internet of things (IoT), Chen et al. (2020) presented a novel approach to system structure and layout for the semiconductor production sector. They propose using Manufacturing Execution Systems (MES) to collect RFID data directly into a centralized database, bypassing the traditional use of RFID memory (EEPROM). This approach significantly mitigates the risks associated with data reading and updating failures. By altering the manufacturing operation flow, this design enhances the quality and efficiency of data reading, aligning well with the characteristics of IoT while reducing costs. However, while RFID-IoT technology addresses the challenges of rapid data reading and updating, the proposed solution necessitates that the collected data be formatted into smaller sizes to optimize performance.

Challenges Faced in Product Manufacturing Management

Because of the quick changes brought about by technology, the industrial industry is encountering enormous difficulties. Materials, complicated assembly jobs, agile manufacturing processes, product quality, and worker productivity have all been the subject of much written about when it comes to the creation of modern production systems. Regardless, the ever-changing nature of manufacturing resources is ignored in a lot of studies, which restricts their usefulness to theoretical contexts or controlled lab environments. Battery life, operational frequency, size, practicality, and accuracy are all important real-world considerations that need to be thoroughly verified (Zhang, Zhang, Du, et al., 2015). Problems with system design, scalability, compatibility, and decision-making processes also slow down technology adoption in manufacturing. While software consultants do their best to base system designs on manufacturers' main requirements, there are additional hurdles to overcome when integrating with preexisting systems such as MES and production scheduling software. Database administration, data input from batch and real-time processing, and connection bandwidth are all areas that might need some optimization to cut down on latency and downtime. Unanticipated obstacles cause many of the suggested solutions to fail in real-world implementations, even though they work fine in simulations. To construct predictive models, such those employing machine learning, to give business insights and help decision-making, it is essential for consultants and domain experts to communicate effectively and gather, analyze, and apply relevant data. According to the literature, these concerns are outlined in Table 2.

Reference	Objective	Problem
(Zhang et al., 2014)	Distribution of manufactured goods	Particularly in the realm of agile software and hardware, the integration of the suggested solution with the current system (i.e., production scheduling system or MES) is crucial. It is possible to optimize the system architecture

		even further. Expensive solution, particularly for widespread implementation. Additional real-world instances should be used to further evaluate the system's scalability and compatibility.
(Segura Velandia et al., 2016)	Distribution duties in manufacturing	The cloud does not yet completely utilize. The suggested and integrated answer using the current setup (i.e. example, a system for scheduling production or management information systems (MES), especially in the context of lightweight software , system compatibility and scalability should be tested with additional real-life scenarios, as well as hardware technologies.
(Doinea et al., 2015)	Motor vehicle component, crankshaft	The implementation cost is increased due to the necessity to customize the RFID solution. The solution's compatibility with the current setup, especially in the case of agile software and hardware. Products, processes, and employees are the only areas that can be considered in conventional Business Intelligence (BI) studies. The proposed solution does not incorporate domain expert knowledge. The solution is expensive, particularly when implemented on a wide scale. It is possible to optimize the system architecture even further. Additional real-life instances should be used to further assess the system's scalability and compatibility.
(Li et al., 2017)	Food	The autonomous sensor structure's needs must be considered while tailoring an RFID solution. Data about redundancy. The processing of large amounts of data causes system lag. It is possible to optimize the system architecture even further. This solution does not take into account domain experts' insights. Deploying the solution on a wide scale can be quite expensive.
(Wang et al., 2016)	Pre-process food	The safety of the system has to be beefed up. Processing massive data causes system lag. There is room for improvement in the system architecture. There has to be an improvement in the decision-making process. The approach can be somewhat pricey, particularly when used on a wide scale. It would be wise to test the system's compatibility and scalability with additional real-world scenarios.

(Zhang, Zhang, Wang, et al., 2015)	Process of manufacturing	There is a restriction on the breadth of dynamic events. Adding more Internet of Things devices is a good idea. Delays in the system caused by processing huge data. Additional real-life instances should be used to further assess the system's scalability and compatibility.

Table 2. Overview of the Problems in the Management of Product Manufacture.

Shipping and Distribution Management

In today's competitive landscape, effective shipping and distribution management is indispensable for companies seeking enhanced competitiveness and profitability. By efficiently managing the movement and storage of products from source to end-user, organizations can streamline operations and reduce costs. However, the traditional challenges of coordination among multiple stakeholders, including manufacturers, transporters, storekeepers, and consumers, often lead to inefficiencies and fragmentation. Leveraging technologies like RFID and IoT offers a transformative solution. These technologies enable seamless connectivity across all parties within a unified platform, facilitating real-time access to critical information such as location updates during product transfers. This transparency enhances planning and readiness for receiving or dispatching shipments, thereby optimizing processes and lowering distribution costs, even in scenarios involving customized products or mass orders.

Application of Shipping and Distribution Management

Finding major gaps in procedures like identification, tracking, real-time data streaming, operational compatibility, and resource management, the literature delves further into automation in shipping and distribution applications. Product delivery and arrival times have been significantly affected by these inadequacies, which has reduced overall process efficiency. The goal of the public logistic system suggested by Wu et al. (2012) is to improve cooperation between businesses by making asset and status information more transparent and easy to see. By utilizing RFID sensors and the IoT for real-time asset information, this revolutionary approach presents a new revenue model for industrial parks. To optimize processes like check-in/out, real-time routing, vehicle status monitoring, and resource utilization, it is crucial to have excellent asset and service tracing, especially for numerous stakeholders like manufacturers. Flexible, easily deployable, and XML-based data sharing is prioritized in the system's infrastructure design. In addition, the integration of many technologies such as RFID, WSN, cloud computing, and the Internet of Things has the potential to alleviate the problems associated with water-based logistics by improving communication and visibility in real-time and by eliminating the delays caused by traditional methods of exchanging data from vessels equipped with automatic identification systems (AIS).

In shipping and distribution, rescheduling is a typical problem that causes inefficiencies including squandered vehicle loading capacity and loading task mistakes. Liu et al. (2019) offered a solution to this problem by combining IoT technologies with RFID tags, readers, sensors, and actuators to gather accurate data in real-time from various sources. To optimize routes and schedule vehicles efficiently, this framework allows for real-time information on traffic, road conditions, logistical resources, and new job requests. A software dashboard can display data in real-time, enabling adjustments to be made on the fly according to driver preferences and operational requirements. Optimal routing services allow this approach to maximize vehicle utilization while decreasing resource wastage, especially in the area of fuel usage. Furthermore, supply chain management is aided by a scheduling and routing network model that makes use of RFID and GPS. This model allows for the real-time monitoring and adjustment of schedules and routes, ultimately leading to an improvement in logistical efficiency (Ding et al., 2018).

Transparency in transportation between businesses is crucial for improving the dependability of logistics services, according to Gnimpieba et al. (2015). They suggest a system that uses RFID and the internet of things to implement IPTD, or integrated production and transportation task dispatching, and RTSM, or real-time transportation status monitoring. To further optimise IPTD and minimise transportation and manufacturing expenses, better teaching-learning based optimisation (TLBO) is employed. In order to keep an eye on tasks and their status in real-time, this method incorporates transportation and production data. It provides decision-support tools for managing orders and production schedules. Being a Web-based application (WebAPP), the system guarantees independence, scalability, and simple reconfiguration. It also analyses workloads, machine status, and previous task data to enable dynamic decision-making for transportation jobs across enterprises. With the use of cloud-based technologies like RFID, the Internet of Things (IoT), GPS/GPRS, and Google Cloud Platform (GCP), this all-inclusive solution ensures performance and scalability by efficiently sharing information and managing databases (Pal & Kant, 2018).

Alfian et al. (2020) conducted a comprehensive review exploring the potential of sensor-based infrastructure, specifically RFID-IoT systems, to mitigate food waste and maintain the freshness of perishable goods throughout the supply chain. Their study emphasizes the integration of centralized data collection and analytics via cloud computing, which facilitates real-time monitoring and management of food products. Utilizing machine learning, particularly XGBoost, the authors developed a model to track product movements such as shipping and receiving, enhancing traceability and ensuring quality control by monitoring factors like humidity and temperature. Alfian et al. (2017) further proposed a multilayer perceptron neural network to handle missing sensor data, crucial for maintaining food safety standards, particularly for sensitive products like kimchi. This integrated approach not only improves logistical efficiency but also enhances overall food quality management through innovative technological solutions.

Challenges Faced in Shipping and Distribution Management

Being crucial mediators between suppliers, manufacturers, retailers, and consumers, shipping and distribution provide numerous issues within the supply chain. The current body of research highlights numerous important uses, including task monitoring, scheduling, route optimization, real-time vehicle tracking, and food quality verification. However, connectivity problems in rural locations make continuous data input even more complicated due to the transient nature of maritime conditions. Thinking about things like ROI, development costs, scalability, and long-term viability is crucial when implementing these technologies and it also requires stakeholders to work together. Traditional cost-minimization tactics are giving way to more holistic approaches that aim to maximize overall profitability across the supply chain, but a definitive support mechanism for shipping and distribution management is still hard to come by. Achieving comprehensive integration across varied stakeholder requirements for effective communication, coordination, and administration from manufacturing facilities to distribution centers to retail outlets is no easy feat. Table 3 details all of the obstacles.

Reference	Objective	Problem
(Wu et al., 2012)	Transportation in supply hub	A company's acceptance of this idea is gradual. Adding more Internet of Things devices is a good idea. Delays in

		the system caused by processing huge data. Since the internet does not reach many regions, the deployment work becomes more complex. Changing development and deployment to accommodate different stakeholders' needs is difficult. System security should be tightened, particularly when dealing with several platforms. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Liu et al., 2019)	Inland shipping	Because there are still many places that do not have access to the internet, the deployment task is challenging. Changing development and deployment to accommodate different stakeholders' needs is difficult. System security should be tightened, particularly when dealing with several platforms. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Ding et al., 2018; Lam & Ip, 2019)	Schedule and Transportation route optimization	Achieving effective management requires optimizing the distribution of resources. A plethora of platforms is a hallmark of complex systems. It is possible to optimize the system architecture even further. Changing development and deployment to accommodate different stakeholders' needs is difficult. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Gnimpieba et al., 2015)	Production and Transportation tasks	When there are a lot of platforms, system complexity increases. Changing development and deployment to accommodate different stakeholders' needs is difficult. System security should be tightened, particularly when dealing with several platforms. Delays in the system caused by processing huge data. It is possible to optimize the system architecture even further. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Pal & Kant, 2018)	Pallet and Container transportation	Optimization, coordination, and service quality are three areas where workflow management can be improved. There ought to be decision-making processes. Complex systems, in particular, comprise a wide variety of platforms. Processing massive data causes system lag. It would be helpful to include a real-world example.
(Alfian et al., 2020)	Fresh food transportation	The acquired data is not reliable since real-world logistic activities are very dense and dynamic. Modules with errors. Cellular reception is spotty because of the unreliability of the internet. Dealing with several platforms adds complexity to the system. Because it incorporates so many different platforms, system security should be beefed up.

		It is possible to optimize the system architecture even further.
(Alfian et al., 2017)	Perishable food transportation	The incorrect identification may result from inaccurate readings. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility. Readers, tags, and IoT sensors should all have their security tightened. It is possible to optimize the system architecture even further.
(Qu et al., 2016)	Perishable food transportation	Particularly in reader, tags, and IoT sensor, system security has to be beefed up. It is possible to optimize the system architecture even further. The system's scalability and compatibility need additional testing with actual users.
(Urbano et al., 2020)	Fruits transportation	The amount of data that can be stored in memory is currently insufficient. A warning system is not being suggested. A complicated system, in particular, will involve several platforms. It makes sense to strengthen system security, particularly when dealing with many platforms. A system for making decisions ought to be laid forth.

Table 3. Overview of the Problems in the Management of Shipping and Distribution.

Inventory Management

Effective inventory tracking is critical for modern supply chains, serving as a linchpin for business success. It encompasses receiving, storing, processing orders, and fulfilling customer demands promptly. The primary goals include optimizing inventory and operational costs while maintaining responsive customer service. Traditionally challenged by heavy workloads and diverse product demands, inventory management has seen significant improvements with RFID-IoT innovations. These technologies facilitate precise product tracking, equipment maintenance scheduling, space optimization, environmental monitoring, and streamlined workforce management, enhancing overall efficiency and profitability in supply chain operations.

Application of Inventory Management

Managing real-time sensory data within warehouses, optimizing space utilization based on fluctuating product needs, and efficiently storing products have all put inventory management in the spotlight. Novel approaches to these problems have recently emerged as a result of technological progress. For instance, a low-cost system for passive RFID tag detection, identification, and monitoring has been developed by researchers. It uses a Raspberry Pi as the central server and NodeMcu with ESP8266-12e Wi-Fi modules. This approach minimizes interference and reduces maintenance costs while integrating seamlessly with cloud-based IoT platforms for real-time monitoring and dynamic operational adjustments in both internal and external warehouse environments. By replacing traditional manual methods with cloud-based resource management, these systems enhance forklift utilization, shipment efficiency, and overall inventory space utilization rates. Moreover, safety and compliance in product storage are ensured through sophisticated class-based categorization and compatibility rules, preventing hazardous incidents by segregating chemically incompatible products (Abdel-Basset et al., 2018). These advancements underscore the critical role of RFID and IoT integration in transforming inventory management, optimizing logistical processes, and meeting the demands of dynamic supply chains efficiently.

The importance of inventory management, particularly concerning Returnable Transport Items (RTI), is underscored in the literature (Zhang, Zhang, Du, et al., 2015). This paper introduces a robust RFID-IoT peer-to-peer system designed for managing packaged gas cylinders, offering benefits such as reduced cycle times, scalable capacity expansion, automation, and lower costs associated with asset loss. The proposed solution aims to achieve three primary objectives: first, to accurately identify each cylinder with detailed information including testing schedules and delivery dates; second, to ensure precise tracking of cylinder locations to prevent misplacement and loss; and third, to assess cylinder condition through environmental and internal evaluations, thereby providing valuable data for both operational and customer insights. Utilizing RFID and IoT technologies, this system addresses the comprehensive management of reusable containers within the supply chain, optimizing resource recovery and enhancing efficiency through real-time tracking of utilization rates, status updates, return times, and quantities (Zhang et al., 2014). Simulation studies validate the solution's cost-effectiveness and reliability over the long term, crucially supporting its adoption across multiple industries seeking sustainable and efficient inventory management solutions.

In their research, Anandhi et al. (2019) introduced a comprehensive framework leveraging RFID and IoT technologies via a dedicated website to enhance secure and intelligent inventory management. This framework emphasizes product identification, traceability, and transparency of information, aiming to reduce time and costs while improving customer satisfaction. By analyzing cause-effect relationships among criteria such as dependability, service, network, and privacy through a correlation matrix, the study prioritizes requirements effectively. Addressing security concerns, a previous study proposed an end-to-end authentication protocol to mitigate risks in RFID-based inventory systems (Tejesh & Neeraja, 2018). This protocol ensures mutual authentication between tag-reader, reader-cloud server, user-reader, and user-cloud server, enhancing item availability and security without the computational intensity of traditional encryption methods. The use of session keys during authentication further optimizes computational and communication costs, making the system suitable for tracking objects in transit as well.

Challenges Faced in Inventory Management

Effective inventory management systems play a crucial role in navigating the unpredictable supply dynamics of products. However, contemporary challenges arise from fluctuating customer preferences, posing complexities in inventory planning strategies. Recent literature underscores the integration of advanced analytics models to forecast demand, yet real-time data remains underutilized, hindering precise forecasting capabilities. This gap persists in both qualitative and quantitative analyses, influencing adoption rates among small to medium enterprises (SMEs). Additionally, some entities opt for on-premises servers and databases due to policy restrictions and reliance on legacy technologies, thereby escalating costs and impeding innovative solutions deployment. These multifaceted issues underscore the need for comprehensive solutions to foster continuous sectoral development. Table 4 details all of the obstacles.

Reference	Objective	Problem
(Yang et al., 2018)	Inventory management	A company's acceptance of this idea is gradual. Adding more Internet of Things devices is a good idea. Delays in the system caused by processing huge data. Since the internet does not reach many regions, the deployment work becomes more complex. Changing development and deployment to accommodate different stakeholders'

		needs is difficult. System security should be tightened, particularly when dealing with several platforms. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Trab et al., 2018)	Dynamic inventory tasks	Because there are still many places that do not have access to the internet, the deployment task is challenging. Changing development and deployment to accommodate different stakeholders' needs is difficult. System security should be tightened, particularly when dealing with several platforms. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Zhou et al., 2017)	Product storing and space utilizing	Achieving effective management requires optimizing the distribution of resources. A plethora of platforms is a hallmark of complex systems. It is possible to optimize the system architecture even further. Changing development and deployment to accommodate different stakeholders' needs is difficult. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Paul et al., 2019)	Dynamic inventory environment	When there are a lot of platforms, system complexity increases. Changing development and deployment to accommodate different stakeholders' needs is difficult. System security should be tightened, particularly when dealing with several platforms. Delays in the system caused by processing huge data. It is possible to optimize the system architecture even further. Included should be decision-making mechanisms. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility.
(Abdel-Basset et al., 2018)	Space utilization in smart inventory management	Optimization, coordination, and service quality are three areas where workflow management can be improved. There ought to be decision-making processes. Complex systems, in particular, comprise a wide variety of platforms. Processing massive data causes system lag. It would be helpful to include a real-world example.
(Zhang, Zhang, Du, et al., 2015)	Explosive product inventory management	The acquired data is not reliable since real-world logistic activities are very dense and dynamic. Modules with errors. Cellular reception is spotty because of the unreliability of the internet. Dealing with several platforms adds complexity to the system. Because it incorporates so many different platforms, system security should be beefed up. It is possible to optimize the system architecture even further.

(Kalange et al., 2017)	Returned item management	The incorrect identification may result from inaccurate readings. Additional real-life scenarios should be used to evaluate the system's scalability and compatibility. Readers, tags, and IoT sensors should all have their security tightened. It is possible to optimize the system architecture even further.
(Anandhi et al., 2019)	Secure inventory management	Particularly in reader, tags, and IoT sensor, system security has to be beefed up. It is possible to optimize the system architecture even further. The system's scalability and compatibility need additional testing with actual users.
(Tejesh & Neeraja, 2018)	Inventory data security	The amount of data that can be stored in memory is currently insufficient. A warning system is not being suggested. A complicated system, in particular, will involve several platforms. It makes sense to strengthen system security, particularly when dealing with many platforms. A system for making decisions ought to be laid forth.

Table 4. Overview of the Problems in the Management of Inventory.

Retail Management

The introduction of smart devices such as smartphones and tablets has greatly changed the retail business and the way customers purchase. Retailers successfully connect their businesses with end-users by automating product searches according to customer preferences. Improving customer satisfaction and product visibility are two primary goals of effective retail management. Other objectives include optimising profit margins and reducing operating costs. Among these responsibilities is the capacity to manage a wide range of products, keep them in stock, and respond to changing demand patterns. The importance of keeping products clean and in good condition has been highlighted by the current COVID-19 pandemic; thus, there is a pressing need for retail solutions that strike a good compromise between hygiene regulations and operational efficiency.

Application of inventory management

RFID and IoT technologies have catalyzed significant advancements in retail management, addressing critical challenges through enhanced connectivity and data integration. These technologies empower retailers to streamline operations and elevate customer experiences by ensuring efficient product tracking and seamless information dissemination. By tagging products with RFID, essential data such as availability, pricing, expiration dates, and nutritional information can be instantly relayed to consumers via IoT-connected mobile applications. This real-time access not only enhances shopping convenience but also facilitates personalized marketing strategies and informed decision-making based on detailed consumer behavior insights. Studies utilizing RFID, NFC, and IoT-enabled systems further augment customer engagement by analyzing shopping patterns and preferences. Such insights enable retailers to proactively customize product offerings and optimize store layouts, ultimately fostering a more tailored and satisfying shopping experience for consumers.

Hester and Tentzeris (2016) advocate for an advanced information application system architecture tailored to optimize every facet of the fresh food supply chain, including shipment planning, transport logistics, and real-time product tracking. This integrated approach not only ensures the efficient monitoring of perishable items but also significantly enhances customer satisfaction by providing timely updates on product availability, thereby minimizing booking cancellations. Concurrently, advancements in RFID technology, such as the Van-Atta reflectarray structures and screen-printed UHF RFID tags developed by Sharif et al. (2019) and subsequent studies, address inherent hardware limitations and reduce implementation costs in large retail environments. These innovations not only extend the range and reliability of RFID systems but also enhance their suitability for diverse retail applications, including those with metallic infrastructure like refrigerators and shelves. By leveraging these advancements, retailers can achieve cost-effective, eco-friendly solutions that improve operational efficiency while meeting stringent food safety and sustainability standards, thereby paving the way for future IoT-driven advancements in retail management.

In recent RFID-IoT applications, ensuring secure and robust authentication protocols between RFID readers and tags is paramount beyond traditional hardware research (Bardaki et al., 2012). This pioneering work introduces an ultra-lightweight protocol utilizing basic bitwise XOR and left-rotation logical operations for mutual authentication. Emphasizing minimal computation, storage, and communication overhead, the protocol addresses critical concerns including data confidentiality, integrity, and resistance to various attacks, while safeguarding RFID tag anonymity and preventing tracking. Such advancements are crucial in retail management, where shops are highly vulnerable within the supply chain management (SCM) ecosystem. By instilling consumer confidence in networked RFID-IoT systems, this innovation not only enhances operational efficiency but also supports dynamic pricing and promotional strategies (Lim et al., 2013). This approach focuses on perishable items, leveraging RFID-enabled functionalities to monitor in-store product quantity, sales volume, expiration dates, and replenishment needs. By optimizing RFID tag and antenna placements based on product categories and employing robust IoT data pipelines, retailers can achieve enhanced supply chain visibility and foster effective collaboration with suppliers, ultimately improving supply-demand dynamics in volatile markets.

Challenges Faced in Inventory Management

Retail management is increasingly leveraging RFID and IoT technologies to revolutionize customer shopping experiences. By focusing on item-level tagging and real-time data streaming, retailers are optimizing both operational efficiency and financial performance. These innovations address longstanding challenges in traditional retail settings, such as item location difficulties, out-of-stock issues, inadequate sales assistance, and lengthy checkout processes. The integration of RFID enables enhanced inventory visibility, leading to better stock management and reduced instances of product unavailability. Moreover, IoT capabilities facilitate live data analytics, offering insights into customer behavior and preferences in real-time. However, while these advancements promise significant benefits, challenges remain in ensuring RFID tag readability, accuracy, and data security across diverse retail environments. Future developments should prioritize scalability and compatibility to maximize the technology's effectiveness across various retail applications, fostering continuous innovation and improved decision-making tools in the industry. Table 5 details all of the obstacles.

Reference	Objective	Problem
(Chan et al., 2018)	Retail shop application	Limited availability of real-time data. Improvements could be made to the security and reliability of data. There has to be a way to make decisions. The system's compatibility has to be tested with additional real-life scenarios.

(Choi et al., 2015)	Customer behavior in the retail shop	It is essential to frequently update the rules of the fuzzy interference engine. The use of human reasoning and knowledge is essential. Limited availability of real-time data. Improvements could be made to the security and reliability of data. There needs to be a system in place for making decisions. The system's compatibility and scalability need additional testing with real-world circumstances.
(Hester & Tentzeris, 2016)	Food retail shop	Customer unwillingness to divulge personal details. Improvements could be made to the security and reliability of data. The financial and ROI effects on existing business strategies are unclear.
(Sharif et al., 2019)	RFID design in retail management	There needs to be more research on readability accuracy, computation of the new RFID design's lifespan, addition of middleware components (such as a buffer mechanism), inclusion of decision-making mechanisms, and further evaluation of the system's scalability and compatibility with more real-life scenarios.
(Bardaki et al., 2012)	RFID authentication protocol in retail management	It is recommended that the suggested method incorporate further quantitative analyses. Include the system infrastructure. Included should be decision-making mechanisms. The system's compatibility and scalability need additional testing with real-world circumstances.
(Lim et al., 2013)	Dynamic pricing and promotion strategy	A personalized RFID-enabled service that boosts the percentage of legibility. It is important to evaluate the development and infrastructure expenses. Add a middleware component, like a buffer mechanism. Included should be decision-making mechanisms. The system's compatibility and scalability need additional testing with real-world circumstances.

Table 5. Overview of the Problems in the Management of Retail.

Current Challenges

The adoption of IoT within supply chains is impeded by a range of financial and environmental challenges. One major barrier is the high cost of smart technologies like RFID, which limits their penetration into the broader market. Additionally, the development and deployment of control software systems tailored for IoT processes are costly and complex, posing significant hurdles to widespread implementation. Despite these challenges, a partial solution has been found by leveraging mobile devices to interface with IoT transducers, enhancing versatility and availability in deployment (Yang et al., 2022).

From an environmental perspective, outdated sensor and actuator designs contribute to electronic waste accumulation, exacerbating sustainability concerns (Akid et al., 2021; Awan et al., 2021; Uddin et al., 2012). This contrasts with the increasing adoption of multifunctional smartphones in consumer markets, which incorporate greener technologies and functionalities (Aditto et al., 2023; Tan & Sidhu, 2022). Efforts aimed at addressing these environmental challenges are crucial for advancing IoT technologies across various industries. By investing in innovative sensor designs and promoting sustainable practices, the IoT sector can mitigate its environmental footprint and drive broader adoption. These advancements are pivotal for realizing the full potential of IoT in transforming everyday life and business operations.

Future Directions

RFID-IoT technology has evolved significantly, offering transformative potential in SCM. It addresses critical needs such as real-time tracking, data transparency, and operational efficiency across various SCM stages. Despite its promise, widespread adoption faces challenges. Integrating RFID with IoT and cloud technologies, though beneficial, requires careful consideration of scalability and feasibility. Current literature emphasizes closed-loop systems but overlooks scalability issues and the maturity of machine learning applications in SCM implementation.

The COVID-19 pandemic underscored the importance of agile SCM practices, prompting increased investments in technologies like RFID, IoT, and cloud computing. Companies adapted by enhancing inventory visibility and operational efficiency to meet shifting consumer demands and minimize human interaction. The integration of 5G with RFID-IoT technologies further enhances SCM capabilities, enabling real-time monitoring and agile responses in manufacturing, warehousing, and transportation. However, challenges remain, such as managing complex networks and ensuring data reliability amidst higher device densities. As these technologies advance, they hold the potential to transform SCM into autonomous, self-adaptive systems capable of real-time decision-making and operational control without human intervention.

Conclusions

In order to better understand how SCM might benefit from RFID and the IoT, this research provides a thorough literature analysis on the topic. It delves into the history of RFID and the Internet of Things, highlighting how both have developed over time and how they might work together to improve supply chain management. Production, transportation, inventory management, and store operations are the four pillars upon which the article rests. Its principal goal is to promote the use of RFID-IoT to solve real-world problems and to function as a guide for researchers and practitioners alike.

Several gaps in the current literature are highlighted by the review:

- RFID technology's uses, problems, and obstacles have been the subject of numerous studies that do not address the integration of the Internet of Things.

- Because of worries about implementation costs, efficacy, interoperability, scalability, and compatibility, there is a noticeable dearth of research on supply chain management using RFID-IoT.

- Most previous research has ignored the Internet of Things (IoT) in favour of RFID, which fails to take system dynamics into account.

- Research often overlooks the essential SCM changes that will be required for RFID-IoT implementations in the future.

In addition to outlining the authors' views on the recognized difficulties and suggested solutions, the paper offers comprehensive insights into various RFID-IoT application domains. Through the examination of potential remedies, the unique difficulties encountered by each domain of application are assessed. To encourage researchers in academia and business to focus on fundamental RFID-IoT applications and create ground-breaking solutions to revolutionize the supply chain management sector, the paper finishes by describing broad difficulties and suggesting future research directions.

Funding

This research received no external funding.

Data Availability Statement

Data will be available on suitable demand.

Acknowledgements

The authors would like to be grateful to the Department of Business Administration, Westcliff University, California 90020, USA.

Conflicts of Interest

The authors declare no conflict of interest.

References

A. Poad, F., & Ismail, W. (2018). Performance analysis of tags collection time on a new architecture of 2.4 GHz embedded active RFID system for indoor and outdoor tracking and monitoring applications based on IEEE 802.15. 4 standard. Wireless Personal Communications, 98, 1941-1954. https://doi.org/https://doi.org/10.1007/s11277-017-4955-z

Abdel-Basset, M., Manogaran, G., & Mohamed, M. (2018). Internet of Things (IoT) and its impact on supply chain: A framework for building smart, secure and efficient systems. Future Generation Computer Systems, 86(9), 614-628. https://doi.org/10.1016/j.future.2018.04.051

Aditto, F. S., Sobuz, M. H. R., Saha, A., Jabin, J. A., Kabbo, M. K. I., Hasan, N. M. S., & Islam, S. (2023). Fresh, mechanical and microstructural behaviour of high-strength self-compacting concrete using supplementary cementitious materials. Case Studies in Construction Materials, 19, e02395. https://doi.org/10.1016/j.cscm.2023.e02395

Akid, A. S. M., Shah, S. M. A., Sobuz, M. D. H. R., Tam, V. W. Y., & Anik, S. H. (2021). Combined influence of waste steel fibre and fly ash on rheological and mechanical performance of fibre-reinforced concrete. Australian Journal of Civil Engineering, 19(2), 208-224. https://doi.org/10.1080/14488353.2020.1857927

Alfian, G., Rhee, J., Ahn, H., Lee, J., Farooq, U., Ijaz, M. F., & Syaekhoni, M. A. (2017). Integration of RFID, wireless sensor networks, and data mining in an e-pedigree food traceability system. Journal of Food Engineering, 212, 65-75. https://doi.org/https://doi.org/10.1016/j.jfoodeng.2017.05.008

Alfian, G., Syafrudin, M., Farooq, U., Ma'arif, M. R., Syaekhoni, M. A., Fitriyani, N. L., Lee, J., & Rhee, J. (2020). Improving efficiency of RFID-based traceability system for perishable food by utilizing IoT sensors and machine learning model. Food Control, 110, 107016. https://doi.org/https://doi.org/10.1016/j.foodcont.2019.107016

Aljabhan, B. (2022). A Comprehensive Analysis on the Adoption of IoT with Logistics and Supply Chain Management. 2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA),
doi: 10.1109/ICCSEA54677.2022.9936196.

Alwadi, A., Gawanmeh, A., Parvin, S., & Al-Karaki, J. N. (2017). Smart solutions for RFID based inventory management systems: A survey. Scalable Computing: Practice and Experience, 18(4), 347-360. https://doi.org/10.12694/scpe.v18i4.1333

Anandhi, S., Anitha, R., & Sureshkumar, V. (2019). IoT enabled RFID authentication and secure object tracking system for smart logistics. Wireless Personal Communications, 104, 543-560.

https://doi.org/https://doi.org/10.1007/s11277-018-6033-6

Ashton, K. (2009). That 'internet of things' thing. RFID journal, 22(7), 97-114.

Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. Computer Networks, 54(15), 2787-2805. https://doi.org/https://doi.org/10.1016/j.comnet.2010.05.010

Awan, S., Ahmed, S., Ullah, F., Nawaz, A., Khan, A., Uddin, M. I., Alharbi, A., Alosaimi, W., & Alyami, H. (2021). IoT with blockchain: A futuristic approach in agriculture and food supply chain. Wireless communications and mobile computing, 2021(1), 5580179. https://doi.org/10.1155/2021/5580179

Bardaki, C., Kourouthanassis, P., & Pramatari, K. (2012). Deploying RFID-Enabled Services in the Retail Supply Chain: Lessons Learned toward the Internet of Things. Information Systems Management, 29(3), 233-245. https://doi.org/10.1080/10580530.2012.687317

Ben-Daya, M., Hassini, E., & Bahroun, Z. (2019). Internet of things and supply chain management: a literature review. International Journal of Production Research, 57(15-16), 4719-4742. https://doi.org/10.1080/00207543.2017.1402140

Birkel, H. S., & Hartmann, E. (2019). Impact of IoT challenges and risks for SCM. Supply Chain Management: An International Journal, 24(1), 39-61. https://doi.org/10.1108/SCM-03-2018-0142

Bogataj, D., Bogataj, M., & Hudoklin, D. (2017). Reprint of "Mitigating risks of perishable products in the cyber-physical systems based on the extended MRP model". International Journal of Production Economics, 194, 113-125. https://doi.org/https://doi.org/10.1016/j.ijpe.2017.11.004

Butun, I., Wang, Y., Lee, Y. s., & Sankar, R. (2012). Intrusion prevention with two–level user authentication in heterogeneous wireless sensor networks. International Journal of Security and Networks, 7(2), 107-121. https://doi.org/https://doi.org/10.1504/IJSN.2012.050027

Cao, J., & Zhang, S. (2016). Research and design of RFID-based equipment incident management system for industry 4.0. 2016 4th International Conference on Electrical & Electronics Engineering and Computer Science (ICEEECS 2016), 10.2991/iceeecs-16.2016.172

Caro, F., & Sadr, R. (2019). The Internet of Things (IoT) in retail: Bridging supply and demand. Business Horizons, 62(1), 47-54. https://doi.org/https://doi.org/10.1016/j.bushor.2018.08.002

Chan, C. O., Lau, H. C., & Fan, Y. (2018). IoT data acquisition in fashion retail application: Fuzzy logic approach. 2018 International Conference on Artificial Intelligence and Big Data (ICAIBD), DOI: 10.1109/ICAIBD.2018.8396166

Chen, H., Zhu, Y., & Hu, K. (2010). Multi-colony bacteria foraging optimization with cell-to-cell communication for RFID network planning. Applied Soft Computing, 10(2), 539-547. https://doi.org/https://doi.org/10.1016/j.asoc.2009.08.023

Chen, Y.-Q., Zhou, B., Zhang, M., & Chen, C.-M. (2020). Using IoT technology for computer-integrated manufacturing systems in the semiconductor industry. Applied Soft Computing, 89, 106065. https://doi.org/https://doi.org/10.1016/j.asoc.2020.106065

Choi, S. H., Yang, Y. X., Yang, B., & Cheung, H. H. (2015). Item-level RFID for enhancement of customer shopping experience in apparel retail. Computers in Industry, 71, 10-23. https://doi.org/https://doi.org/10.1016/j.compind.2015.03.003

Costa, C., Antonucci, F., Pallottino, F., Aguzzi, J., Sarriá, D., & Menesatti, P. (2013). A review on agri-food supply chain traceability by means of RFID technology. Food and bioprocess technology, 6, 353-366. https://doi.org/https://doi.org/10.1007/s11947-012-0958-7

De Donno, D., Stefanizzi, M. L., Catarinucci, L., Mainetti, L., Patrono, L., & Tarricone, L. (2014). Integrating passive UHF RFID tags with WSN nodes: Challenges and opportunities. Journal of Communications Software and Systems, 10(2), 99-106.

Di Mauro, C., Ancarani, A., Schupp, F., & Crocco, G. (2020). Risk aversion in the supply chain: Evidence from replenishment decisions. Journal of Purchasing and Supply Management, 26(4), 100646. https://doi.org/https://doi.org/10.1016/j.pursup.2020.100646

Ding, K., Jiang, P., & Su, S. (2018). RFID-enabled social manufacturing system for inter-enterprise monitoring and dispatching of integrated production and transportation tasks. Robotics and Computer-Integrated Manufacturing, 49, 120-133. https://doi.org/https://doi.org/10.1016/j.rcim.2017.06.009

Doinea, M., Boja, C., Batagan, L., Toma, C., & Popa, M. (2015). Internet of things based systems for food safety management. Informatica Economica, 19(1), 87.

dos Santos, Y. L., & Dias Canedo, E. (2019). On the design and implementation of an IoT based architecture for reading ultra high frequency tags. Information, 10(2), 41. https://doi.org/ 10.3390/info10020041

Fatema Tuz Johora, R. H., Sayeda Farjana Farabi Jahanara Akter, & Mahmud, M. A. A. (2024). AI-POWERED FRAUD DETECTION IN BANKING: SAFEGUARDING FINANCIAL TRANSACTIONS. The American Journal of Management and Economics Innovations 6(06), 8–22. https://doi.org/https://doi.org/10.37547/tajmei/Volume06Issue06-02

Gnimpieba, Z. D. R., Nait-Sidi-Moh, A., Durand, D., & Fortin, J. (2015). Using Internet of Things Technologies for a Collaborative Supply Chain: Application to Tracking of Pallets and Containers. Procedia Computer Science, 56, 550-557. https://doi.org/https://doi.org/10.1016/j.procs.2015.07.251

Gope, P., Amin, R., Hafizul Islam, S. K., Kumar, N., & Bhalla, V. K. (2018). Lightweight and privacy-preserving RFID authentication scheme for distributed IoT infrastructure with secure localization services for smart city environment. Future Generation Computer Systems, 83, 629-637. https://doi.org/https://doi.org/10.1016/j.future.2017.06.023

Gu, C. (2017). Fast discrepancy identification for RFID-enabled IoT networks. Ieee Access, 6, 6194-6204. https://doi.org/10.1109/ACCESS.2017.2785810

Haque, S. A., Rahman, M., & Aziz, S. M. (2015). Sensor anomaly detection in wireless sensor networks for healthcare. Sensors, 15(4), 8764-8786. https://doi.org/10.3390/s150408764

Hester, J. G., & Tentzeris, M. M. (2016). Inkjet-printed flexible mm-wave Van-Atta reflectarrays: A solution for ultralong-range dense multitag and multisensing chipless RFID implementations for IoT smart skins. IEEE Transactions on Microwave Theory and Techniques, 64(12), 4763-4773. DOI: 10.1109/TMTT.2016.2623790

Ibrahim, G. T. (2018). Simple, Low-cost IoT/UHF RFID-based Lab equipment identification and tracking system. 2018 ASEE Annual Conference & Exposition, DOI 10.18260/1-2--30963

Jabin, J. A., Khondoker, M. T. H., Sobuz, M. H. R., & Aditto, F. S. (2024). High-temperature effect on the mechanical behavior of recycled fiber-reinforced concrete containing volcanic pumice powder: An experimental assessment combined with machine learning (ML)-based prediction. Construction and Building Materials, 418, 135362. https://doi.org/https://doi.org/10.1016/j.conbuildmat.2024.135362

Kalange, S. H., Kadam, D. A., Mokal, A. B., & Patil, A. A. (2017). Smart retailing using IOT. International Research Journal of Engineering and Technology (IRJET), 4(11), 263-268.

Khan, M. A., & Salah, K. (2018). IoT security: Review, blockchain solutions, and open challenges. Future Generation Computer Systems, 82, 395-411. https://doi.org/https://doi.org/10.1016/j.future.2017.11.022

Khan, R., Khan, S. U., Zaheer, R., & Khan, S. (2012). Future internet: the internet of things architecture, possible applications and key challenges. 2012 10th international conference on frontiers of information technology,
DOI: 10.1109/FIT.2012.53

Khan, Y., Su'ud, M. B. M., Alam, M. M., Ahmad, S. F., Ahmad, A. Y. B., & Khan, N. (2022). Application of internet of things (iot) in sustainable supply chain management. Sustainability, 15(1), 694. https://doi.org/10.3390/su15010694

Konovalenko, I., & Ludwig, A. (2019). Event processing in supply chain management – The status quo and research outlook. Computers in Industry, 105, 229-249. https://doi.org/https://doi.org/10.1016/j.compind.2018.12.009

Lam, C., & Ip, W. (2019). An integrated logistics routing and scheduling network model with RFID-GPS data for supply chain management. Wireless Personal Communications, 105, 803-817 https://doi.org/10.1007/s11277-019-06122-6.

Lee, C. K. M., Lv, Y., Ng, K. K. H., Ho, W., & Choy, K. L. (2018). Design and application of Internet of things-based warehouse management system for smart logistics. International Journal of Production Research, 56(8), 2753-2768. https://doi.org/10.1080/00207543.2017.1394592

Li, Z., Liu, G., Liu, L., Lai, X., & Xu, G. (2017). IoT-based tracking and tracing platform for prepackaged food supply chain. Industrial Management & Data Systems, 117(9), 1906-1916. https://doi.org/https://doi.org/10.1108/IMDS-11-2016-0489

Lim, M. K., Bahr, W., & Leung, S. C. H. (2013). RFID in the warehouse: A literature analysis (1995–2010) of its applications, benefits, challenges and future trends. International Journal of Production Economics, 145(1), 409-430. https://doi.org/https://doi.org/10.1016/j.ijpe.2013.05.006

Lin, J., Yu, W., Zhang, N., Yang, X., Zhang, H., & Zhao, W. (2017). A survey on internet of things: Architecture, enabling technologies, security and privacy, and applications. IEEE Internet of Things Journal, 4(5), 1125-1142. DOI: 10.1109/JIOT.2017.2683200

Liu, S., Zhang, Y., Liu, Y., Wang, L., & Wang, X. V. (2019). An 'Internet of Things' enabled dynamic optimization method for smart vehicles and logistics tasks. Journal of Cleaner Production, 215, 806-820. https://doi.org/https://doi.org/10.1016/j.jclepro.2018.12.254

Lu, L., & Navas, J. (2021). Advertising and quality improving strategies in a supply chain when facing potential crises. European Journal of Operational Research, 288(3), 839-851. https://doi.org/https://doi.org/10.1016/j.ejor.2020.06.026

Lyons *, A. C., Coronado Mondragon, A. E., Bremang, A., Kehoe, D. F., & Coleman, J. (2005). Prototyping an information system's requirements architecture for customer-driven, supply-chain operations. International Journal of Production Research, 43(20), 4289-4319. https://doi.org/10.1080/00207540500142365

Maheshwari, S., Gautam, P., & Jaggi, C. K. (2021). Role of Big Data Analytics in supply chain management: current trends and future perspectives. International Journal of Production Research, 59(6), 1875-1900. https://doi.org/10.1080/00207543.2020.1793011

Manavalan, E., & Jayakrishna, K. (2019). A review of Internet of Things (IoT) embedded sustainable supply chain for industry 4.0 requirements. Computers & Industrial Engineering, 127, 925-953. https://doi.org/https://doi.org/10.1016/j.cie.2018.11.030

Mathaba, S., Adigun, M., Oladosu, J., & Oki, O. (2017). On the use of the Internet of Things and Web 2.0 in inventory management. Journal of Intelligent & Fuzzy Systems, 32(4), 3091-3101. https://doi.org/10.3233/JIFS-169252

Md Abdullah Al Mahmud, M. A. H., Md Abdul Barek Saju, Md Wali Ullah, Rakibul Hasan, and G. Suzer. (2024). INFORMATION TECHNOLOGY FOR THE NEXT FUTURE WORLD: ADOPTION OF IT FOR SOCIAL AND ECONOMIC GROWTH: PART II. International Journal of Innovative Research in Technology, 10, 742-747.

Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of things: Vision, applications and research challenges. Ad Hoc Networks, 10(7), 1497-1516. https://doi.org/https://doi.org/10.1016/j.adhoc.2012.02.016

Pal, A., & Kant, K. (2018). IoT-based sensing and communications infrastructure for the fresh food supply chain. Computer, 51(2), 76-80. https://doi.org/10.1109/MC.2018.1451665

Paul, S., Chatterjee, A., & Guha, D. (2019). Study of smart inventory management system based on the internet of things (IOT). International Journal on Recent Trends in Business and Tourism (IJRTBT), 3(3), 27-34.

Qu, S., Zhou, Y., Zhang, Y., Wahab, M. I. M., Zhang, G., & Ye, Y. (2019). Optimal strategy for a green supply chain considering shipping policy and default risk. Computers & Industrial Engineering, 131, 172-186. https://doi.org/https://doi.org/10.1016/j.cie.2019.03.042

Qu, T., Lei, S., Wang, Z., Nie, D., Chen, X., & Huang, G. Q. (2016). IoT-based real-time production logistics synchronization system under smart cloud manufacturing. The International Journal of Advanced Manufacturing Technology, 84, 147-164. https://doi.org/10.1007/s00170-015-7220-1

Rakibul Hasan, M. A. A. M., Syeda Farjana Farabi, Jahanara Akter, Fatema Tuz Johora. (2024). Unsheltered: Navigating California's Homelessness Crisis. Sociology Study Vol. 14(May-June), No. 3, 143-156. https://doi.org/DOI:10.17265/2159-5526/2024.03.002

Rakibul Hasan, M. A. R. C., Fatema Tuz Johora, Md Wali Ullah, Md Abdul Barek Saju. (2024). Driving Growth: The Integral Role of Small Businesses in the U.S. Economic Landscape. American Journal of Industrial and Business Management, 14, 852-868. https://doi.org/10.4236/ajibm.2024.146043

Rakibul Hasan, S. F. F., Md Kamruzzaman , Md Khokan BHUYAN , Sadia Islam Nilima , Atia Shahana (2024). AI-Driven Strategies for Reducing Deforestation. The American Journal of Engineering and Technology, 6(06), 6–20. https://doi.org/https://doi.org/10.37547/tajet/Volume06Issue06-02

Rakibul Hasan, S. F. F., Md Kamruzzaman, Md Khokan BHUYAN , Sadia Islam Nilima , Atia Shahana AI-Driven Strategies for Reducing Deforestation. The American Journal of Engineering and Technology, 6(06), 6–20. https://doi.org/https://doi.org/10.37547/tajet/Volume06Issue06-02

Raut, R. D., Mangla, S. K., Narwane, V. S., Dora, M., & Liu, M. (2021). Big Data Analytics as a mediator in Lean, Agile, Resilient, and Green (LARG) practices effects on sustainable supply chains. Transportation Research Part E: Logistics and Transportation Review, 145, 102170. https://doi.org/https://doi.org/10.1016/j.tre.2020.102170

Raza, S. A. (2022). A systematic literature review of RFID in supply chain management. Journal of Enterprise Information Management, 35(2), 617-649. https://doi.org/10.1108/JEIM-08-2020-0322

Reece, E. M., Davis, M. J., Abu-Ghname, A., Castanon, J. M., Voris, M., Hoxworth, R., Winocour, S., & Buchanan, E. P. (2022). Working smarter, not harder: using data-driven strategies to generate front-end cost savings through price negotiation and supply chain optimization. Plastic and reconstructive surgery, 149(6), 1488-1497. https://doi.org/10.1097/PRS.0000000000009121

Sarac, A., Absi, N., & Dauzère-Pérès, S. (2010). A literature review on the impact of RFID technologies on supply chain management. International Journal of Production Economics, 128(1), 77-95. https://doi.org/https://doi.org/10.1016/j.ijpe.2010.07.039

Segura Velandia, D. M., Kaur, N., Whittow, W. G., Conway, P. P., & West, A. A. (2016). Towards industrial internet of things: Crankshaft monitoring, traceability and tracking using RFID. Robotics and Computer-Integrated Manufacturing, 41, 66-77. https://doi.org/https://doi.org/10.1016/j.rcim.2016.02.004

Shahana, A., Hasan, R., Farabi, S. F., Akter, J., Al Mahmud, M. A., Johora, F. T., & Suzer, G. (2024). AI-Driven Cybersecurity: Balancing Advancements and Safeguards. Journal of Computer Science and Technology Studies, 6(2), 76-85. https://doi.org/ https://doi.org/10.32996/jcsts.2024.6.2.9

Sharif, A., Ouyang, J., Yang, F., Chattha, H. T., Imran, M. A., Alomainy, A., & Abbasi, Q. H. (2019). Low-cost inkjet-printed UHF RFID tag-based system for internet of things applications using characteristic modes. IEEE Internet of Things Journal, 6(2), 3962-3975. DOI: 10.1109/JIOT.2019.2893677

Shen, W., Wang, L., & Hao, Q. (2006). Agent-based distributed manufacturing process planning and scheduling: a state-of-the-art survey. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), 36(4), 563-577. https://doi.org/10.1109/TSMCC.2006.874022

Shih, C.-W., & Wang, C.-H. (2016). Integrating wireless sensor networks with statistical quality control to develop a cold chain system in food industries. Computer Standards & Interfaces, 45, 62-78. https://doi.org/https://doi.org/10.1016/j.csi.2015.12.004

Srbinovska, M., Gavrovski, C., Dimcev, V., Krkoleva, A., & Borozan, V. (2015). Environmental parameters monitoring in precision agriculture using wireless sensor networks. Journal of Cleaner Production, 88, 297-307. https://doi.org/https://doi.org/10.1016/j.jclepro.2014.04.036

Tan, W. C., & Sidhu, M. S. (2022). Review of RFID and IoT integration in supply chain management. Operations Research Perspectives, 9, 100229. https://doi.org/https://doi.org/10.1016/j.orp.2022.100229

Tejesh, B. S. S., & Neeraja, S. (2018). Warehouse inventory management system using IoT and open source framework. Alexandria Engineering Journal, 57(4), 3817-3823. https://doi.org/https://doi.org/10.1016/j.aej.2018.02.003

Trab, S., Bajic, E., Zouinkhi, A., Abdelkrim, M. N., & Chekir, H. (2018). RFID IoT-enabled warehouse for safety management using product class-based storage and potential fields methods. International Journal of Embedded Systems, 10(1), 71-88. DOI: 10.1109/JIOT.2019.2893677

Uddin, M. A., Jameel, M., Sobuz, H. R., Hasan, N. M. S., Islam, M. S., & Amanat, K. M. (2012). The effect of curing time on compressive strength of composite cement concrete. Applied Mechanics and Materials, 204, 4105-4109. https://doi.org/10.4028/www.scientific.net/AMM.204-208.4105

Urbano, O., Perles, A., Pedraza, C., Rubio-Arraez, S., Castelló, M. L., Ortola, M. D., & Mercado, R. (2020). Cost-effective implementation of a temperature traceability system based on smart RFID tags and IoT services. Sensors, 20(4), 1163. https://doi.org/10.3390/s20041163

Varriale, V., Cammarano, A., Michelino, F., & Caputo, M. (2021). Sustainable supply chains with blockchain, IoT and RFID: A simulation on order management. Sustainability, 13(11), 6372. https://doi.org/https://doi.org/10.3390/su13116372

Verdouw, C. N., Beulens, A. J. M., & van der Vorst, J. G. A. J. (2013). Virtualisation of floricultural supply chains: A review from an Internet of Things perspective. Computers and Electronics in Agriculture, 99, 160-175. https://doi.org/https://doi.org/10.1016/j.compag.2013.09.006

Wan, J., Tang, S., Hua, Q., Li, D., Liu, C., & Lloret, J. (2017). Context-aware cloud robotics for material handling in cognitive industrial Internet of Things. IEEE Internet of Things Journal, 5(4), 2272-2281. https://doi.org/10.1109/JIOT.2017.2728722

Wang, M., Zhong, R. Y., Dai, Q., & Huang, G. Q. (2016). A MPN-based scheduling model for IoT-enabled hybrid flow shop manufacturing. Advanced Engineering Informatics, 30(4), 728-736. https://doi.org/https://doi.org/10.1016/j.aei.2016.09.006

Wu, H., Chen, X., Hu, Q., Shi, C., & Mo, J. (2012). Novel design of inland shipping management information system based on WSN and Internet-of-things. TransNav, International Journal on Marine Navigation and Safety od Sea Transportation, 6(3), 307-313.

Wu, H., Shen, Y., Tömösközi, M., Nguyen, G. T., & Fitzek, F. H. (2022). Demonstration of In-Network Audio Processing for Low-Latency Anomaly Detection in Smart Factories. 2022 IEEE 19th Annual Consumer Communications & Networking Conference (CCNC), DOI: 10.1109/CCNC49033.2022.9700506

Xu, L. D. (2011). Information architecture for supply chain quality management. International Journal of Production Research, 49(1), 183-198. https://doi.org/10.1080/00207543.2010.508944

Yan, R. (2017). Optimization approach for increasing revenue of perishable product supply chain with the Internet of Things. Industrial Management & Data Systems, 117(4), 729-741.

https://doi.org/10.1108/IMDS-07-2016-0297

Yang, K., Duan, T., Feng, J., & Mishra, A. R. (2022). Internet of things challenges of sustainable supply chain management in the manufacturing sector using an integrated q-Rung Orthopair Fuzzy-CRITIC-VIKOR method. Journal of Enterprise Information Management, 35(4/5), 1011-1039. https://doi.org/10.1108/JEIM-06-2021-0261

Yang, T., Fu, C., Liu, X., Pei, J., Liu, L., & Pardalos, P. M. (2018). Closed-loop supply chain inventory management with recovery information of reusable containers. Journal of Combinatorial Optimization, 35, 266-292. https://doi.org/https://doi.org/10.1007/s10878-015-9987-2

Ye, Y., Hung Lau, K., & Teo, L. (2023). Transforming supply chains for a new competitive market alignment – a case study of Chinese fashion apparel companies. International Journal of Logistics Research and Applications, 26(3), 365-397. https://doi.org/10.1080/13675567.2021.1951690

Zhang, Y., Huang, G. Q., Sun, S., & Yang, T. (2014). Multi-agent based real-time production scheduling method for radio frequency identification enabled ubiquitous shopfloor environment. Computers & Industrial Engineering, 76, 89-97. https://doi.org/https://doi.org/10.1016/j.cie.2014.07.011

Zhang, Y., Zhang, G., Du, W., Wang, J., Ali, E., & Sun, S. (2015). An optimization method for shopfloor material handling based on real-time and multi-source manufacturing data. International Journal of Production Economics, 165, 282-292. https://doi.org/https://doi.org/10.1016/j.ijpe.2014.12.029

Zhang, Y., Zhang, G., Wang, J., Sun, S., Si, S., & Yang, T. (2015). Real-time information capturing and integration framework of the internet of manufacturing things. International Journal of Computer Integrated Manufacturing, 28(8), 811-822. https://doi.org/10.1080/0951192X.2014.900874

Zhou, W., Piramuthu, S., Chu, F., & Chu, C. (2017). RFID-enabled flexible warehousing. Decision Support Systems, 98, 99-112. https://doi.org/https://doi.org/10.1016/j.dss.2017.05.002