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A Systematic Literature Review of ERP and RFID Implementation in Supply Chain Management

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Abstract

The integration of Enterprise Resource Planning (ERP) and Radio Frequency Identification (RFID) in Supply Chain Management (SCM) significantly enhances supply chain efficiency and effectiveness. ERP systems enable companies to optimize inventory and production management, while RFID technology facilitates precise tracking of products and raw materials, thereby improving production process efficiency. This research aims to systematically review the existing literature on implementing ERP and RFID technologies in SCM and their interconnected roles. Utilizing the Systematic Literature Review (SLR) methodology, the study highlights the crucial impact of ERP and RFID on supply chain performance efficiency. The findings indicate that ERP implementation in SCM offers numerous benefits, which is vital in boosting company efficiency, effectiveness, and overall performance. Additionally, integrating ERP and RFID with technologies like blockchain and cloud computing can further optimize supply chain management processes, providing even greater advantages.

Keywords: Enterprise Resource Planning, Radio Frequency Identification, Supply chain Management, Systematic Literature Review

1 Introduction

Industry 4.0 brings concepts that focus on the automation of systems, processes, digitalization, and exchange in the industrial world, aiming to achieve smart factories that can reduce lead times in response to customer demand, cope with unexpected events, and increase productivity in the system. Industry 4.0 enforces fundamental changes in the manufacturing processes of today's companies. Integrating digitalization and the Internet into the manufacturing process leads to the global transformation of the manufacturing industry (Paksoy et al., 2021). Supply chain management (SCM) is almost all companies' most important business process. To integrate all supply chain actors, SCM uses processes and technologies that have continued to evolve over the years (Hader et al., 2020). There are very important technological advances to improve supply chain processes, for example, ERP and RFID technology. Two technologies that can be utilized in supply chain management are radio frequency identification (RFID) and enterprise resource planning (ERP).

Integrating ERP into supply chain management facilitates improved coordination between the supply chain and different departments within an organization (Koh et al. 2014). Information technology plays a vital role in shaping a competitive business strategy and is considered an essential component. Enterprise resource planning (ERP) is a form of information technology that provides a framework for reorganizing business processes (Acar et al. 2017).

Enterprise resource planning systems bring together information across all parts of the organization, both internal and external, for a smoother flow of information. It can be one fully integrated system, several partially integrated systems, or many best-in-class systems, depending on the wants and needs of the organization (Trivedi et al. 2018). Enterprise resource planning systems enhance and improve data sharing. Factors that hinder production can also be identified easily through ERP systems. The availability of information provided by ERP enables better decision-making in terms of production processes, inventory control, and many other aspects (Koh et al. 2014). ERP systems used effectively will provide current, vital information for decision-making. The role of accounting has also become easier due to the timely availability of financial information in the supply chain, thus making the accounting process easier. Supply chain management practices can be carried out more efficiently and profitably (Sawahir and Roshan, 2021).

RFID (Radio Frequency Identification) is an emerging technology that uses radiofrequency electromagnetic fields to facilitate the contactless and wireless data transmission required for automatic identification and tracking of tags attached to various items (Raki, 2014). This technology enables unique identification of objects and seamless tracking throughout their lifecycle. RFID tags, which are equipped with microchips and antennas, can be attached to various objects, such as products, assets, or even living organisms, enabling efficient monitoring and management in various applications including supply chain management, inventory control, asset tracking, and access control systems. By leveraging RFID technology, organizations can increase operational efficiency, improve inventory accuracy, streamline processes, and improve overall visibility and control over their assets and resources. RFID is built on the software and hardware platform of wireless sensor networks and the detailed design of the business processes of logistics supply chain management systems (Pan and Liu, 2021).RFID technology is widely used in the company's field or inventory section (supply). Value creation stems from the conversion of data resources through enterprise technology, and RFID emerges as a capability that yields substantial advantages for knowledge management systems, thereby enhancing the supply chain. The adoption of RFID by enterprises represents targeted resource investments to bolster capabilities and improve the overall supply chain (Reyes and Worthington, 2015). We can encourage people to actively control every area of the logistics supply chain by combining wireless sensor networks and RFID technologies with the model for managing the logistics supply chain. This strategy intends to raise the logistics supply chain management standard, lower logistics-related expenses and security oversight, and ultimately provide customers with secure and superior logistics products. Future developments in logistics will mostly be driven by incorporating cutting-edge information technologies, such as RFID and wireless sensor networks, into supply chain management practices. Its relevance stems from its ability to propel the growth of supply chain management logistics (Pan and Liu, 2021).

Integrating an ERP system into a business represents a potent strategy for enhancing operational efficiency and augmenting organizational efficacy (Surung et al., 2020). As Linda et al. (2022) indicated, ERP exerts a direct and favorable influence on supply chain management (SCM), positively impacting organizational performance. Combining ERP with SCM practices can elevate a company's competitiveness and overall performance (Ince et al., 2013). Numerous studies focusing on Radio-Frequency Identification (RFID) in SCM underscore its substantial contributions to a company's knowledge management system, a pivotal pathway to enhancing supply chain performance (Reyes and Worthington, 2015). The synergy of ERP and RFID within SCM holds promise for enhancing supply chain efficiency and effectiveness. ERP enables companies to optimize inventory and production management, while RFID facilitates product and raw material tracking, thereby enhancing production process efficiency and effectiveness. Leveraging electronic solutions such as RFID and ERP can enhance supply chain integration, a fundamental SCM practice. Collaboration among supply chain stakeholders ensures the smooth and productive flow of goods, capital, and information across the entire network of suppliers, manufacturers, distributors, and customers. The overarching objective is to maximize benefits for the entire supply chain ecosystem (Oghazi et al., 2018).

This study focuses on ERP and RFID, which can contribute to the supply chain process. This article aims to systematically review the literature on implementing ERP and RFID technologies in supply chain management and the integration between them. To achieve this goal, three sub-research questions (SRQs) are formulated and discussed specifically, namely: (1) ERP system implementation in SCM; (2) RFID system implementation in SCM; and (3) integration between ERP and RFID systems in SCM. In addition, this study will also present the development or evolution related to research trends on the topic of ERP and RFID system implementation in SCM using bibliometric analysis.

Additionally, this research aims to thoroughly examine the utilization of ERP and RFID systems within the supply chain management domain. The study is anticipated to provide a comprehensive and in-depth review of how these systems are employed, their effectiveness, and their impact on various aspects of supply chain management. This study will uncover trends, influencing factors, benefits, and drawbacks in implementing these technologies by analyzing many relevant scientific articles. Using the SLR (Systematic Literature Review) method in this study will update the existing knowledge on this topic. By covering the latest articles, this study will provide

up-to-date information on the latest research results, new ideas, and innovations in using ERP and RFID technologies in SCM. In an ever-evolving world, knowledge updates are essential to staying relevant and effective in the dynamic SCM industry. In addition, the analysis from this study will provide valuable insights for organizations planning to adopt these technologies and help them make better decisions in improving SCM performance. This article includes the following sections: literature review that explains each variable; research methodology that discusses a systematic review of the selected articles; identification and description of results; and discussion and conclusion.

2 Literature Review

2.1 Enterprise Resource Planning (ERP)

ERP stands for Enterprise Resource Planning, a useful tool for managing various business processes in an integrated manner in one unit, including marketing, production, purchasing, and accounting. ERP can also store all transactions made by the company in a database that the company can access and provides tools for management information reporting (Chandra et al., 2022). According to Maulana and Paryogo (2020), the ERP system is a system that supports business processes by providing real-time information that is integrated between functional divisions of the company. An enterprise resource planning (ERP) system is a valuable tool for integrating information from various organizational departments and consolidating data into a unified database.

The database can be stored locally if the ERP system is implemented within the company's physical location or cloud-based if the ERP system is implemented externally, outside the company's infrastructure (Surung et al., 2020). Roshan (2021) asserts that enterprise systems, commonly called ERP (Enterprise Resource Planning) systems, are software solutions that integrate various functions, including financial management, accounting, human resources, customer relations, supply chain, manufacturing, marketing, sales, and distribution. Their main purpose is synchronizing information exchange and facilitating efficient organizational coordination and collaboration. These ERP systems support repetitive and continuous business processes, such as supply chain management, order management, and general payment transactions..

According to Amadi-Echendu (2023), ERP (Enterprise Resource Planning) is a module or application that can fundamentally change an organization's business operations. It is a software system specifically designed to integrate various business processes within an organization. ERP modules or applications cover many functions, including financial management, human resource management, inventory management, production management, logistics management, and more.

When various companies face a number of organizationally independent information systems, they usually face the accumulation of large amounts of non-standardized information across different departments, functions, and business processes throughout the company that cannot be transferred due to their heterogeneous formats (Oghazi, 2009). For this reason, various companies use ERP systems to link information from different segments of the organization with each other to facilitate proper and timely delivery, improve customer satisfaction, and reduce costs (Tsai et al., 2007). Using ERP, an organization can combine various aspects of its business into one integrated platform, enabling seamless data exchange between different departments and improving operational coordination and efficiency. In addition, the implementation of ERP in companies has many benefits. By implementing ERP, companies are able to increase their productivity by reducing expenses and increasing revenue (Izzati & Najwa, 2018).

2.2 Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) is an innovative technology with great potential to enhance transparency and efficiency in supply chains (Desingh et al., 2021). With RFID, every object can have an embedded label containing a microchip and a radio device emitting signals. This label, often called the "tag," is affixed to each pallet before shipment from the store. Its purpose is to facilitate the company's identification and monitoring of each object's status.

RFID technology enables real-time data collection and processing, enhancing the effectiveness of inventory identification, tracking, and tracing processes within the supply chain. This can improve efficiency and create sustainable competitive advantages through product quality assurance (Liang et al., 2021). In efforts to enhance efficiency in business supply chains, companies have opted to adopt RFID technology and provide the latest training in accounting to support its implementation

With the use of RFID, companies can gain better visibility into production, reduce operational costs, mitigate losses due to theft, optimize their ever-changing business processes, and accurately record them. Additionally, the

use of RFID technology can enhance inventory management by enabling precise data collection on raw materials from suppliers, warehouse storage, and distribution of finished products throughout the supply chain. RFID technology can optimize supply chain logistics by coordinating demand with supply and swiftly identifying process bottlenecks (Chanchaichujit et al., 2020).

RFID (Radio Frequency Identification) is an advancement from barcode technology, offering more sophisticated capabilities in providing detailed information about a product. Unlike barcodes that require direct line-of-sight scanning, RFID can be read from a distance without needing direct line-of-sight, enabling faster and more efficient processing (Kurniawan, 2015; Jules, 2006). RFID technology consists of readers and tags that identify objects using radio waves. Tags receive information from objects and transmit it to readers. RFID facilitates the automation of continuous replenishment and vendor-managed inventory. Tags are used to identify and track objects, while readers gather information from the tags and send it to servers for analysis through software interfaces. These tags consist of an IC chip and an antenna and go through an assembly process (Unhelkar et al., 2022). Meanwhile, two frequency types are used in RFID systems: high frequency and low frequency. High frequency is used for active tags transmitting data over long distances. On the other hand, low frequency is used for passive tags that can transmit data over short distances due to power obtained from electromagnetic waves (Tritularsih & Sutopo, 2018). Thus, selecting the appropriate frequency aligns with the RFID system's needs and applications.

According to Savino et al. (2018), RFID technology appears quite simple in its concept. Information is stored in RFID tags placed on objects or integrated into smart cards. These tags can be accessed via radio signals, which compatible RFID readers read. The data read is then displayed on a screen for further use. Subsequently, this data can be automatically sent to an Information Technology (IT) system for further processing.

2.3 Supply Chain Management (SCM)

Supply chain management is a highly significant business process for every company today. Supply chain management connects consumer needs with suppliers through a network of channels consisting of various subprocesses. Therefore, companies need to implement information technology to enhance SCM performance. Information technology can potentially improve the performance of production distribution systems within the supply chain (Linda et al., 2022). Tarigan et al. (2021) further explain that supply chain management (SCM) is an approach aimed at achieving seamless integration and efficiency improvement among various organizations involved in the supply chain. These organizations include suppliers, manufacturers, distributors, retailers, and customers. The term "supply chain" encompasses various broad and complex operations involving production and distribution activities from suppliers and manufacturers to distributors and ultimately reaching end consumers (Cuadra et al., 2022).

Supply chain management involves six main functions in managing the flow of goods. The first function is procurement, which involves collecting purchasing data of products and materials from suppliers. The second function is transportation and logistics, focusing on managing material movement and delivering products to customers. The third function is production scheduling, which involves creating models to schedule purchases and production of goods or maintaining safe inventory levels to optimize warehouse capacity, enhance accuracy, and reduce costs. The fourth function is manufacturing, which involves overseeing the production process, including estimating production times and ensuring supervision at each stage. The fifth function is quality control, which involves maintenance and inspection of production facilities to minimize production delays and is typically carried out by larger companies or factories (Surung et al., 2020).

Effective supply chain management requires improving customer service and operational efficiency within the supply chain. Good customer service means orders are consistently fulfilled, deliveries are made on time, and there are minimal product returns. Internal efficiency means companies reap good returns on their investments and find ways to reduce operational and selling costs. Hugos (2024) in his book states that companies in the supply chain need to make good and appropriate decisions in five aspects, as follows:

1. Production: Determining the desired products for the market, their quantity, and production timing, and creating production schedules that consider factory capacity, division of labor, quality control, and equipment maintenance.
2. Inventory: Deciding on the type and quantity of inventory to be held at each stage of the supply chain to address uncertainties, considering storage costs, establishing optimal inventory levels, and reorder points.
3. Location: Selecting the most cost-efficient location for production facilities and inventory storage and deciding whether to use existing facilities or build new ones will determine the product distribution path to end consumers.

4. Transportation: Choosing the appropriate mode of transportation to move inventory between supply chain locations, considering speed, cost, and uncertainty, and determining when to use specific transportation modes.
5. Information: Gathering and sharing timely and accurate data to enhance coordination and decision-making related to production, inventory location, and transportation.

Decisions made in supply chain management regarding these five aspects will determine a company's capability and effectiveness. In competing in the market, a company's strategy heavily relies on the effectiveness of its supply chain. An optimized supply chain for low costs suits companies aiming to serve mass markets and compete based on price, while a supply chain optimized for responsiveness suits companies focusing on customer service and convenience. Thus, a company's identity and capabilities are influenced by its supply chain and the markets it serves. Technological advancements have had a significant impact on supply chain management. With technological progress, supply chain management has evolved from manual processes to complex digital systems-supported processes. Digital supply chains utilize advanced technology to maximize supply and demand choices and interdependence between them. Digital technology has transformed business operations, consumer habits, and relationships within the economic sectors. Mobile internet and social networks contribute to the culture of being always online, hyperconnectivity in the global digital economy, and collecting vast amounts of user information (Mohsen, 2023).

One significant technological development in supply chain management is implementing Enterprise Resource Planning (ERP) systems and frequency identification (RFID) technology. This implementation has become an integral part of technology-driven supply chain management transformation. By adopting ERP and RFID, companies can enhance visibility and transparency in the supply chain, identify bottlenecks, and respond to market changes more quickly and accurately. Thus, ERP and RFID implementation become crucial steps in enhancing efficiency and resilience in supply chain management in this digital era.

3 Research Method

This study adopts the Systematic Literature Review (SLR) methodology to address the primary research question concerning the potential improvements in the effectiveness and efficiency of supply chain management through the implementation of ERP and RFID systems. This rigorous approach is employed to systematically review and analyze existing literature, providing a comprehensive understanding of the subject matter and facilitating evidence-based insights into the impact of ERP and RFID systems on supply chain management. This involves collecting, evaluating, and synthesizing relevant information related to a particular topic or issue from various literature sources. It follows the five stages or phases Denyer and Tranfield (2009) described in conducting SLR.

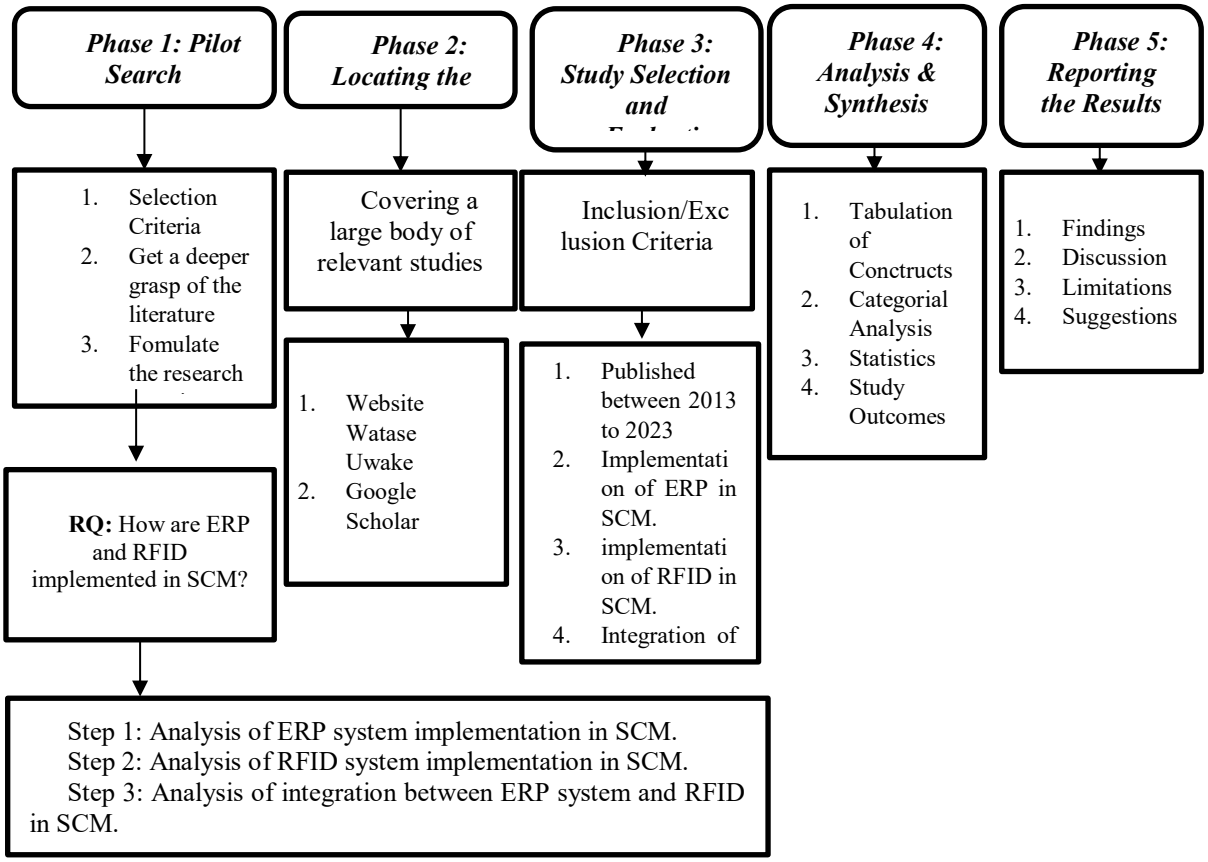


Figure 1. Systematic literature review research process

Phase 1: Pilot Search and the Research Question

The pilot search and research question are the first steps in the SLR research method. The literature search used the Watase Uake database (a journal search site indexed by Scopus) and Google Scholar, with predetermined keywords as shown in Table 1. The search was conducted with specific search strings to find contributions relevant to the research topic. Articles were obtained based on title searches and predetermined keywords. The primary objective of this literature search is to address the main research question concerning the implementation of ERP and RFID systems in supply chain management. To ensure a comprehensive response, the research question is further divided into three sub-research questions: (SRQ 1) Analyzing the implementation of ERP in supply chain management. (SRQ 2) Analyzing the implementation of RFID in supply chain management. (SRQ 3) Analyzing the integration of ERP and RFID in supply chain management. Examining these sub-questions enables a detailed understanding of how ERP and RFID systems are utilized within supply chain management.

Table 1. Search Protocol for Selected Literature Sources

Database	*Article parts Searched*	*Keyword*	*Time Span*
Watase Uake	Title, Keyword	ERP in *Supply chain Management* RFID in *Supply chain Management*	2013 - 2023
Google Scholar	Title, Keyword	ERP in *Supply chain Management* RFID in *Supply chain Management*	

Source: Data Processed in 2023

Phase 2: Locating the studies

The locating the studies stage is used to find relevant articles through the use of appropriate search databases. In this study, two databases that provide broad access to literature related to the research statement, namely Watase Uake and Google Scholar, were used with predefined keywords. The search protocols used to explore the individual databases in the two databases are the same. For example, for the search in Watase Uake, the search was applied to the title section, and for Google Scholar, the search also included the title section.

Phase 3: Study Selection and Evaluation

The study selection and evaluation phase is the stage in the research process where the literature that has been found is chosen and assessed. The objective of this phase is to select relevant and high-quality literature. The literature that has been selected from the study discovery phase is then read, examined in more detail, and evaluated based on the predetermined research topic. According to the literature search results, 96 relevant articles were found. Subsequently, each article was evaluated using predetermined exclusion and inclusion criteria. One of the criteria employed was the publication period between 2013 and 2023. During this stage, the elimination of articles that did not meet the criteria was carried out three times. First, duplicate articles between two keywords were eliminated, resulting in one article. Second, 44 articles published outside the period of 2013–2023 were excluded. Lastly, two articles that did not have Q1, Q2, Q3, or Q4 rankings in the Scopus database were eliminated. Following that, a screening stage involved two eliminations. The first elimination was performed manually to ensure the presence of related keywords in the title and abstract of the article, as a result, 21 articles were excluded from the analysis due to not meeting the specified criteria. The second elimination was applied to articles that lacked available data (6 articles). At the final analysis stage, 20 articles were selected that met the criteria and passed the elimination stage. However, since the number of articles obtained from Watase Uake was limited, 20 additional articles were included from other sources, such as Google Scholar, to achieve this study's desired number of articles. Consequently, a total of 40 articles were acquired to be utilized in this study.

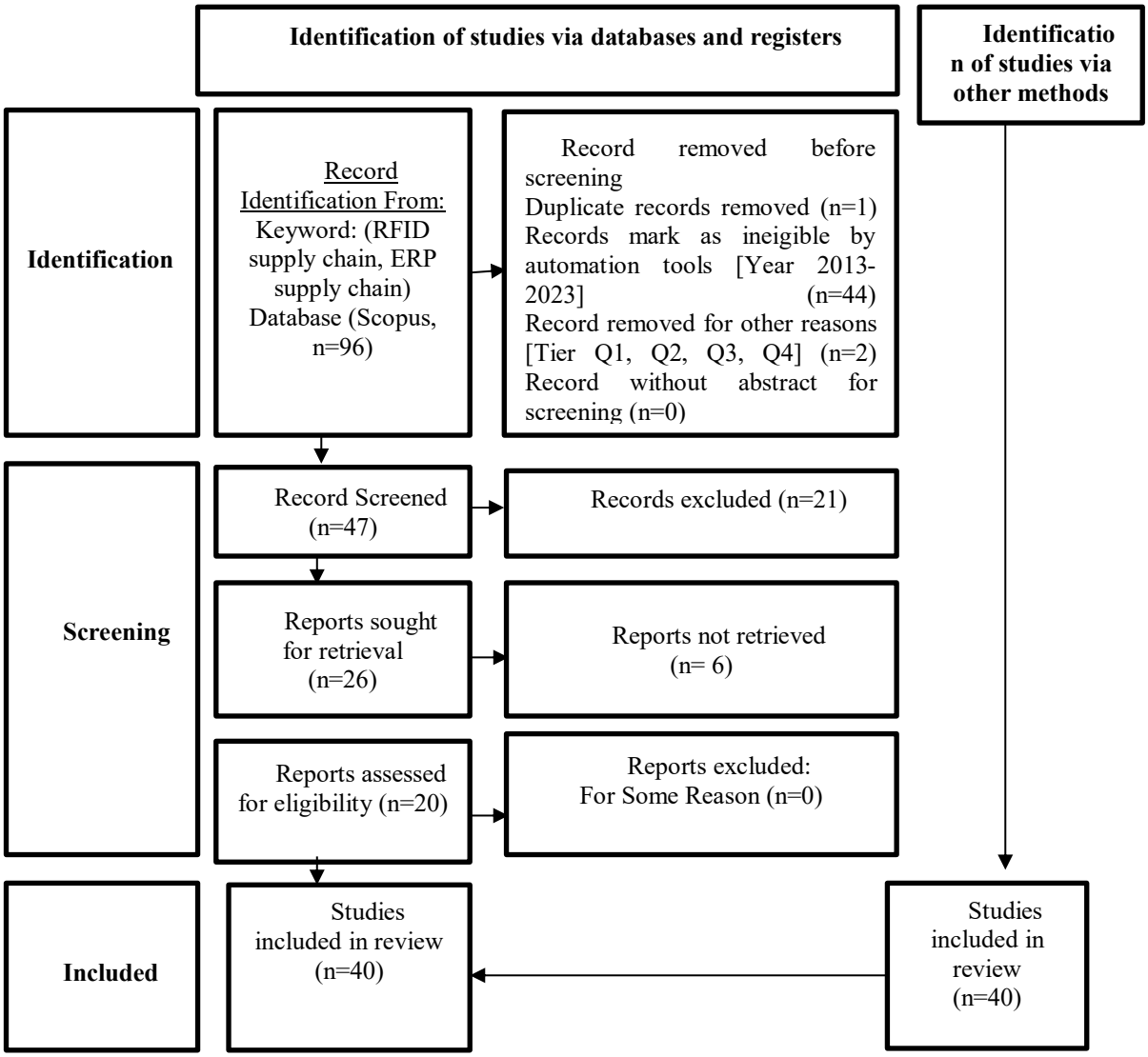


Figure 2, Prism literature review
Source: Data processed in Watase uake website 2023

Phase 4: Analysis and Synthesis

In this phase, the 40 selected articles were analyzed, and the extracted data was synthesized to identify factors and patterns related to implementing ERP and RFID in supply chain management. This analysis aims to understand the implementation of ERP and RFID systems in improving the effectiveness and efficiency of SCM processes, as well as the factors that influence the successful implementation of these two systems in SCM and their integration to create more efficient and effective SCM. In addition, a bibliometric analysis was conducted to determine the evolutionary trends related to this topic by paying attention to several important points, such as: (1) The number of articles published in the last 10 years (2) The distribution of articles by journal database (3) The distribution of articles by country.

Phase 5: Reporting the Results

The research findings are communicated using tables, statistics, and discussions, following a methodology akin to that utilized by Toorajipour et al. (2021). This approach encompasses presenting thorough details regarding the search strategy, criteria for study inclusion or exclusion, selecting relevant studies, quality evaluation, data extraction, and synthesis of findings.

The analysis results are subsequently reported in a comprehensive and systematic manner, either in the form of a scientific article or a detailed report. This comprehensive presentation offers an in-depth overview of the implementation of RFID and ERP systems in supply chain management.

4 Result and Discussion

4.1 *Classification of Articles by Keyword*

Table 2. Classification of Articles

No	Topic/Keyword	Researcher's Name (Year)
1.	ERP in SCM	Ince *et al.* (2013), Jenatabadi *et al.* (2013), Srinivasan, *et al.* (2014), Koh *et al.* (2014), Almahamid *et al.* (2015), Handoko, *et al.* (2015), Poranki, *et al.* (2017), Li *et al.* (2017), Alawamleh *et al.* (2018), Trivedi, *et al.* (2018), Pattanayak *et al.* (2019), Hader *et al.* (2020), Surung *et al.* (2020), Khan *et al.* (2020), Li and Wu (2021), Pirmanta *et al.* (2021), Tarigan *et al.* (2021), Sawahir and Roshan (2021), Lukyanova *et al.* (2022), Haddudm and Khare (2022), Linda *et al.* (2022), Santoso, *et al.* (2022)
2.	RFID in SCM	Costa *et al.* (2013). Tsai *et al.* (2013), Barge *et al.* (2014). Raki (2014), Reyes and Worthington (2015), Virgilio and Milicchio (2015), Moon *et al.* (2018), Savino *et al.* (2018), Zhang *et al.* (2018), Mateen *et al.* (2019), Desingh *et al.* (2021), Pan and Liu (2021).
3.	Integration of ERP and RFID in SCM	Oghazi *et al.* (2018), Zelbst, *et al.* (2019), Sidhu *et al.* (2020), Varialle, *et al.* (2021).

According to the information presented in Table 2, the articles have been categorized into three groups according to their relevant topics or keywords. Out of the total, 24 articles focus on discussing ERP in supply chain management, followed by 12 articles that delve into RFID in supply chain management. Furthermore, only four articles specifically address the integration of ERP and RFID in the context of supply chain management. This data indicates that the topic of integrating ERP and RFID in SCM is relatively limited compared to the other two topics.

4.2 *Bibliometric Analysis*

Next, the bibliometric analysis results will be presented to examine the trends and evolution of research related to this topic by providing graphical representations of the distribution of articles published per year, per country, and per journal database from all the articles published in the past 10 years (2013–2023). The publication of scientific articles on ERP and RFID in supply chain management between 2013 and 2023 demonstrates a fluctuation in the yearly trend, with some years experiencing an increase in publications while others witnessing a decline. Research productivity provides an overview of the contributions made by institutions or individuals to research activities. Research productivity is measured by research output, and one of the research outputs is publication.

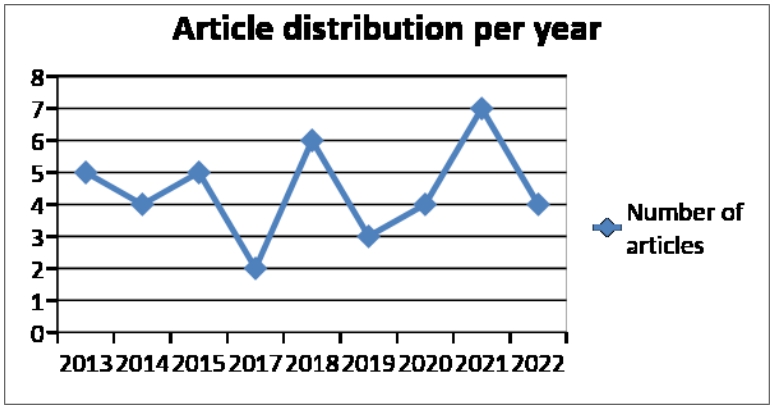


Figure 3. Distribution Chart by Year of Publication
Source: Data processed in 2023

The analysis of 40 articles shows that the number of publications began to increase in 2015. It can be seen that in 2015, compared to 2014, it increased from 4 to 5 articles. From Figure 3, it can be seen that the peak of research productivity and publications is seen in 2021 when it reaches 7 articles, but in 2022, the number of articles published decreases to 4 articles. Data for 2022 is still possible to increase. It is expected that the publication of articles on ERP and RFID in supply chain management in 2023 will increase when compared to 2022 so as to increase the literature on this topic.

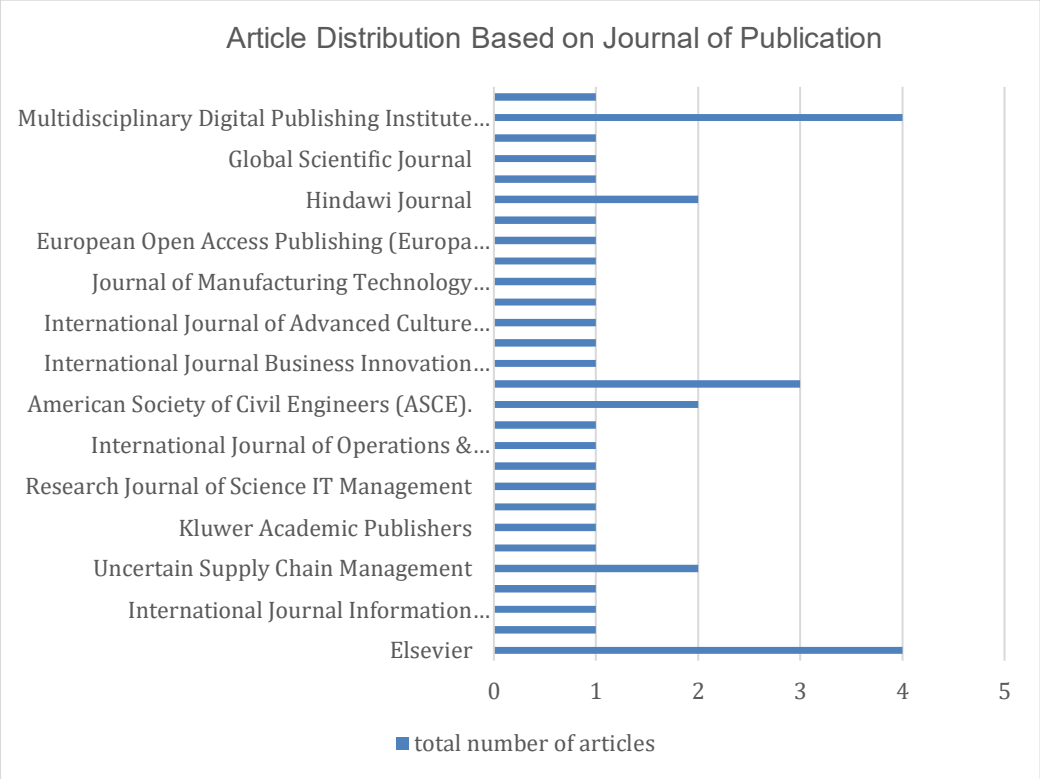


Figure 4. Graph of Article Distribution by Publication Journal Database
Source: Data processed in 2023

The development of publications on the implementation of ERP and RFID in supply chain management, as presented in Figure 4, shows that 29 journal publications have published articles on the implementation of ERP and RFID in supply chain management. Journal publications from MDPI and Elsevier make the highest contributions with 4 articles each, followed by IEEE, which published 3 articles. Most other journal publishers only published one article related to this topic. This indicates significant interest and research in implementing ERP and RFID in supply chain management, with a diverse range of information sources available to researchers and practitioners in this field.

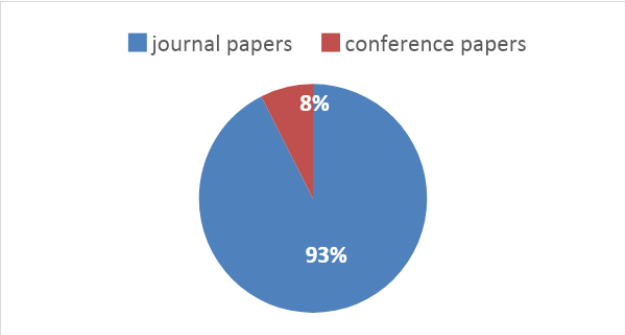


Figure 5. Distribution by Article Type
Source: Data processed in 2023

Based on Figure 5, in terms of the distribution of article types, it can be observed that 92% of the articles used in this research are sourced from scientific journals, while 8% are from conference proceedings. This indicates that most research conducted in this domain is predominantly published in scientific journals. This fact highlights a strong interest and focus on research and knowledge dissemination regarding implementing ERP and RFID in supply chain management.

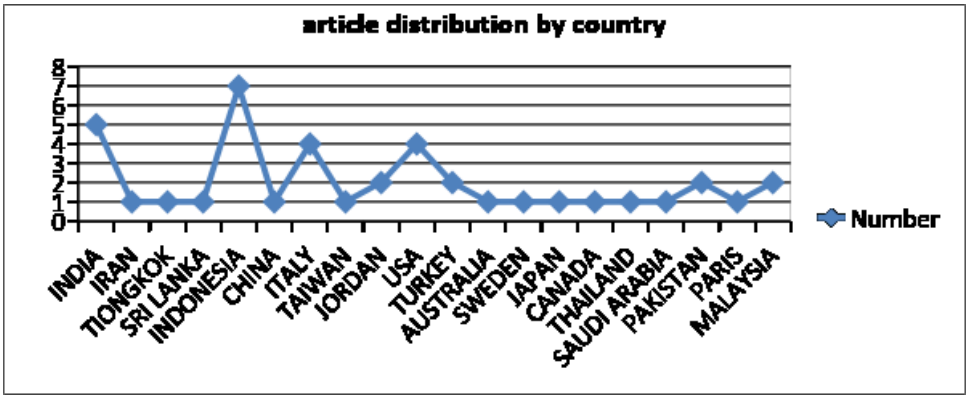


Figure 6. Country article distribution graphic
Source: Data processed in 2023

The development of publications on the topic of enterprise resource planning and radio frequency identification implementation in supply chain management is presented in graphical form in Figure 6, which shows a total of 20 countries that contribute to the publication of articles on the topic of enterprise resource planning and radio frequency identification implementation in supply chain management. Based on the data acquired, the researcher found that Indonesia is in first place as the country that discusses this topic the most, with 7 articles, followed by India, Italy, and the USA, which obtained 5, 4, and 4 articles, respectively. So it can be concluded that research on this topic has spread worldwide and not only been centered on one continent in the last 10 years. This is shown by the emergence of several countries from the continents of Asia, America, Europe, and Australia. However, none of the articles came from countries on the African continent.

SRQ 1: The Implementation of ERP Systems in Supply Chain Management (SCM)

Supply chain management and enterprise resource planning (ERP) are considered crucial investments in corporate information technology, as highlighted by Jenatabadi et al. (2013). ERP systems effectively replace outdated and incompatible logistics methods by centralizing all information within a single database, as Lukyanova et al. (2022) noted. Surung et al. (2020) emphasize that ERP encompasses various functional areas, including Marketing and Sales (M/S), Accounting and Finance (AF), Supply Chain Management (SCM), and Human Resources (HR). Moreover, the interconnectedness of each department within an ERP system's supply chain highlights the reliance on preceding links to provide essential information for subsequent links (Sawahir and Roshan (2021).

There is a critical requirement for information integration across the supply chain and proper enterprise resource planning. The supply chain assumes a critical role in enhancing the efficiency of managing different inputs, while enterprise resource planning (ERP) endeavors to enhance resource efficiency as a whole, thereby reducing production and operational costs (Poranki et al., 2015). Implementing ERP in supply chain management enables businesses to gain a competitive advantage by improving the flow of process information across functional systems that connect suppliers, manufacturers, distributors, and even end users. This integration facilitates the seamless exchange of data and enhances overall efficiency throughout the supply chain, leading to improved competitiveness in the market (Handoko et al., 2015).

ERP has several technologies that are able to integrate with SCM, which helps the supply chain process. One of the technologies or features in the ERP system is blockchain. The integration between ERP and blockchain is able to provide positive synergies for the continuity of the supply chain process (SCM). The blockchain feature in ERP's implementation in SCM can enable users to operate all types of transactions safely and transparently (Hader et al. 2020). Not only blockchain, ERP systems also have a technology called cloud computing, which, when applied to SCM, is able to provide the visibility needed for effective decision-making and reduce redundant or duplicate information systems (Srinivasan and Dey 2013). In ensuring the sustainability of a company, the integration between ERP and supply chain management can enable companies to more effectively communicate

corporate values and culture to customers as well as suppliers so that companies are able to build sustainable business relationships (Chandra et al., 2022). Linda et al. (2022) suggest that combining ERP and SCM can affect organizational performance.

ERP is a breakthrough technology to integrate various fields or divisions within a company to create and improve effectiveness and efficiency in the company's operational activities. The adoption of ERP into supply chain management is able to provide positive synergies in the supply chain process by channeling information to functional systems, which will ultimately be addressed to suppliers and customers. ERP also consists of several features that can increase the transparency of transactions, increase visibility in decision-making, and minimize error rates, so its implementation will affect company performance. It is valuable for stakeholders to improve ERP implementation in each company's business process and execute SCM practices to maintain relationships between suppliers and customers.

1) ERP implementation success factors in SCM

The successful implementation of an ERP system in a firm aids in providing an overview of the processes and resources involved in the company's functioning. (Koh et al. 2014). By implementing an ERP system, an entity is able to improve its overall efficiency and optimize resource utilization. In order to effectively respond to changes in the business environment, it is crucial for management to ensure seamless integration of all ERP systems throughout the supply value chain in support of supply chain management (SCM) processes. This integration enables the real-time flow of data and information, ensuring smooth operations and adaptability to dynamic market conditions (Almahamid and Hourani 2015). ERP must be fully utilized so that organizations can feel and benefit from the application of ERP in SCM; therefore, companies must have managers who are qualified to manage ERP systems (Acar et al. 2017). Before implementing ERP, organizations need to prepare themselves by building an appropriate technology infrastructure and an organizational structure that supports a mindset appropriate to the level of organizational change involved (Li et al. 2017).

One of the determining factors for the success of ERP implementation in SCM is also influenced by management's preparation of competent resources to manage ERP. Where in the process, top management must have a commitment to hold training sessions arranged for employees, and sufficient funds are allocated for the implementation process as well as unexpected features that may need to be done (Alawamaleh et al. 2018). Top management commitment is also considered as a significant factor in the successful adoption of an ERP system. If management considers making their ERP systems and solutions as flexible as possible and maximizing effectiveness, this will allow the ERP system to expand its benefits to the company or organization (Trivedi et al. 2018). Thus, the determining factor in the successful implementation of ERP technology is influenced by how ready management is to transition company activities to an integrated ERP system. Due to the complexity of ERP implementation, management must prepare human resources competent in managing ERP for supply chain management. Organizations must also maximize the adoption of ERP systems by paying attention to the right technological infrastructure so that it will create a system that is also able to maximize effectiveness in the entire supply chain process.

2) The benefits of ERP implementation in SCM

The implementation of ERP systems in SCM is able to minimize supply chain process delays, increase efficiency, reduce SCM costs, improve procurement processes, and help organizations predict (Khan et al. 2020). ERP systems will also help organizations set their inventory targets effectively, contribute to better customizing products and services, and reduce supply chain complexity (Koh et al. 2014). In the research of Handoko et al. (2015), ERP implementation in SCM is able to minimize errors in the process; by reducing production costs, companies can gain a competitive advantage in cost leadership and enhance overall company performance. Not only that, ERP is also able to provide deep insight into business processes so as to provide information to management as a consideration in decision-making (Pattanayak et al. 2019). This is also supported by a statement from Ince et al. (2013) that successfully implementing and integrating ERP systems and SCM ERP practices assist in planning, decision-making, implementation, and enhancing company performance.

Thus, implementing ERP into the supply chain provides many benefits in improving efficiency and effectiveness, such as speeding up process times, minimizing costs, and reducing the risk of errors. Not only does ERP provide benefits in the supply chain process, but it can also provide benefits in decision-making by interested parties. In general, all the benefits obtained from implementing ERP into SCM will provide positive synergies for company performance.

3) The role of ERP systems in the SCM process

A key factor in improving the effectiveness and efficiency of the supply chain is enterprise resource planning. Integrating various organizational resource information is the main goal of ERP in order to increase operational performance, create business partner synergies, and satisfy consumer needs (Ince et al., 2013). ERP is crucial in boosting productivity and motivating companies to adopt it in their operations. Effective supply chain management relies on information sharing, necessitating the integration of processes across various organizations within the supply chain. ERP plays a crucial role in supporting system integration across various entities and process integration inside an organization. (Srinivasan and Dey, 2013). In the real world of corporate logistics, adopting ERP holds substantial value in the supply chain enterprises' logistics information management system, successfully increasing customer satisfaction.

In the environmental accounting scope of green supply chain management, ERP implementation plays a role in showing data about the environmental impact of the entire supply chain so that people in the company are able to realize the consequences of their activities on the environment (Kandananond, 2014). Currently, Indonesia has a global contribution to secondary pollution, so the government is examining businesses that provide ecologically beneficial goods. With well-established ERP systems, this circumstance enables industrial organizations to undertake green supply chain management (Tarigan et al., 2021). Research by Santoso et al. (2022) states that adopting ERP technology in GSCM practises can improve company operational performance and increase public awareness of the environment. The results of research by Pirmanta et al. (2021) show that ERP sustainability can influence the supply chain's external integration with an impact on information quality. This shows that throughout scientific development, ERP not only helps the efficiency and effectiveness of the company but also contributes to the scope of the company's social environment.

In general, ERP systems facilitate the integration of operational processes within the organization, including those in the supply chain, to improve productivity. More specifically, in the field of environmental accounting, ERP plays a role in increasing organizational awareness of environmental issues by providing information related to the impact that the organization has on its environment. This can be a strong trigger or consideration factor for organizations to immediately adopt an ERP system, seeing how environmental issues are currently noteworthy in supporting a company's sustainability.

SRQ 2: The Implementation of RFID in Supply Chain Management

RFID technology utilizes radio waves to detect and monitor objects equipped with RFID tags (Zhang et al., 2018). Its distinct characteristics, including the ability to provide unique product identification, seamless communication, and real-time data availability, significantly contribute to supply chain operations. Through RFID, precise and efficient tracking of individual items across the entire supply chain becomes possible due to the unique identification assigned to each product. The seamless communication capability of RFID enables instant and reliable data exchange between various stakeholders involved in the supply chain network. Moreover, the real-time data availability offered by RFID empowers businesses to make well-timed and well-informed decisions, optimize inventory management, enhance product visibility, and ultimately enhance overall operational efficiency. Furthermore, RFID technology facilitates precise inventory management and monitoring processes, increasing operational efficiency, reducing human errors, and enhancing visibility and transparency throughout the supply chain (Zhang et al., 2018). Virgilio and Milicchio (2015) found that there are two main approaches to RFID data processing in the supply chain. The first approach is real-time processing of the data stream. In this approach, data cleaning techniques such as SMURF adaptive filters address irregularities caused by RFID tag reading inaccuracies. The second approach involves storing RFID data in a data warehouse and performing multidimensional analysis. RFID data is collected, compressed, and stored in a data warehouse for more comprehensive analysis (Virgilio & Milicchio, 2015).

Implementing RFID technology in the supply chain can significantly enhance transaction efficiency and reduce overall operational costs for companies. Research by Reyes et al. (2015) and Moon (2018) demonstrates these benefits. One primary advantage of RFID technology is its capacity to identify and track products throughout the supply chain precisely. According to Savino et al. (2018), installing RFID antennas at various locations or shelves helps monitor product locations at different stages in the supply chain. This enables companies to gain better visibility into product movements, streamline inventory control, and boost overall operational efficiency. Additionally, RFID technology helps mitigate manual errors within the supply chain. Mateen (2019) notes that by using tags, receivers, and wireless waves, RFID combined with Electronic Product Code (EPC) can reduce human errors in sectors such as production, distribution, trade, logistics, and security. Integrating RFID technology in the supply chain can lead to increased transaction cost efficiency, lower operational expenses, improved product

visibility, simplified inventory management, and fewer manual errors. Consequently, RFID is considered a promising solution for enhancing the performance and efficiency of a company's supply chain.

RFID technology in food product supply chain management can also provide benefits. RFID sensors in the food industry supply chain can help control the temperature of food products. This is confirmed by the findings of Costa et al. (2014) in their research, who found that by integrating temperature sensors into RFID tags, product temperature information can be collected and monitored in real time during their journey through the supply chain. This allows companies to monitor and control product temperatures more effectively, ensure optimal product safety and quality, and identify potential problems or damage at inappropriate temperatures. Therefore, using RFID technology with temperature sensors enables companies to ensure that proper temperature conditions are maintained throughout the product's journey, thus maintaining the quality and freshness of food products. Barge et al. (2014) found that the benefits of implementing RFID systems in the dairy supply chain, particularly in the electronic identification of single-matured cheese wheel products, would help improve traceability and reduce the risk of misidentification. Cheese can be individually identified and tracked with high identification capabilities, thus ensuring better product quality. This helps to improve traceability, reduce the risk of misidentification, and ensure better product quality.

In addition to the numerous benefits of using RFID in supply chain management—such as process optimization, increased transaction cost efficiency, and reduced overall operational costs—there are some drawbacks associated with RFID implementation. For instance, RFID tags can be difficult to detect in bright sunlight due to radio wave interference. Additionally, placing tagged objects too closely can lead to inaccurate readings. Sidhu et al. (2020) also found that RFID tags can become unreadable when exposed to certain materials or environmental conditions. Despite these challenges, ongoing advancements in RFID technology are addressing many of these issues. For example, utilizing different frequencies or incorporating additional technologies like sensors and improved safeguards can enhance the performance and reliability of RFID systems in supply chain management.

SRQ 3: The Integration of ERP and RFID in Supply Chain Management

Enterprise Resource Planning (ERP) is a robust software system designed to integrate and manage various business functions, including finance, inventory management, production, sales, and human resources. Conversely, Radio Frequency Identification (RFID) uses radio waves to identify and track items via electronic tags attached to these objects (Oghazi, 2018). In the modern global market, companies must operate in a highly coordinated and customized manner to sustain their competitive edge. According to Oghazi (2018), companies engaged in supply chain collaboration strive to integrate their internal processes and functions to boost their competitive performance. This integration is intended to streamline operations, enhance efficiency, and optimize overall performance within the supply chain ecosystem. Essentially, merging ERP and RFID in supply chain management (SCM) provides companies with improved visibility, better decision-making capabilities, enhanced operational efficiency, optimized use of technology, and a higher level of accuracy and responsiveness in addressing supply chain challenges and opportunities.

Along with the passage of time, technological developments have begun to increase, which provide many benefits to their users, for example, with the existence of the IoT. In their study, Sidhu et al. (2020) highlighted the continued evolution of the Internet of Things (IoT) over the past few years. The IoT ecosystem has been enriched with new technologies and protocols that aim to improve accessibility, cost-effectiveness, energy efficiency, and, most importantly, security. Researchers have provided a conceptual demonstration of integrating Radio Frequency Identification (RFID) and Wireless Sensor Network (WSN) technologies for an efficient supply chain management system. In addition, Savino et al. (2018) also found that supply chains with SCOR-integrated RFID systems allow for improved real-time information sharing between partners, reducing total lead time and operating costs. Therefore, integrating ERP and RFID in supply chain management (SCM) can contribute to reducing operational costs and enhancing overall efficiency. With better inventory visibility and accurate monitoring, companies can avoid unnecessary inventory, reduce high inventory costs, and improve inventory turnover. In addition, the automation process generated by this integration can also reduce human errors and the time required in operational processes.

The problem sometimes faced in applying ERP technology is the data input that is still done manually. This data entry process often experiences delays during data entry, and on the other hand, an inventory check is held at the finished goods warehouse to adjust the inventory in the system (Tarigan, 2004). This is due to many possibilities, including the influence of humans, who cannot be expected to perform at a constant data input speed every time. Thus, the role of a manager is very important in overcoming this. According to the explanation provided by Zelbst et al. (2019), managers should prioritize the utilization of RFID, IoT, and blockchain technologies and realize the importance of building integrated and interconnected technology systems to facilitate

timely decision-making. Similarly, in their study, Variale et al. (2021) also emphasized the substantial benefits of blockchain in reducing manual operations and increasing operational speed. The order entry process begins when a retailer initiates an order request with a manufacturer. Therefore, technologies such as RFID, IoT, and blockchain can play an important role in minimizing the manual data input process.

The emergence of these technologies can provide good benefits for companies in their supply chains. Oghazi et al. (2018) describe the advantages associated with technologies such as ERP and RFID, highlighting their important role in supply chain management. The integration of operational information is made possible by employing RFID tags, which enable inventory tracking as it is manufactured and shipped across the supply chain. Simultaneously, ERP systems facilitate the transmission of inventory-related information throughout the entire chain. Furthermore, strategic information, such as sales data, can be accessed by all stakeholders at different levels within the supply chain through ERP systems. This helps avoid manipulation of demand information and the occurrence of the bullwhip effect. By integrating ERP and RFID in SCM, companies can gain benefits in more accurate inventory management, where RFID allows companies to track and identify goods in real-time automatically. This information can be directly integrated with the inventory module in the ERP system, allowing the company to have better visibility over its existing inventory. This can help avoid shortages or excess inventory that can disrupt the flow of the supply chain.

So the conclusion is that integrating ERP and RFID in supply chain management can provide many benefits for companies and users of these technologies. As described above, there are several benefits to integrating ERP and RFID in SCM, namely: 1) more accurate inventory management, 2) better tracking and management, and 3) reduced costs and increased efficiency.

Conclusion

This research shows that ERP implementation in SCM has various advantages and plays an important role in improving the company's efficiency, effectiveness, and overall performance. Integrating technologies such as blockchain and cloud computing can also provide additional benefits for optimizing SCM processes. In addition, the application of RFID in SCM can significantly improve traceability, reduce costs, and improve product quality. Integrating ERP and RFID in SCM provides significant benefits to companies, including more accurate inventory management, better tracking and management, reduced costs, and improved efficiency. With this integration, companies can have better visibility into inventory, avoid shortages or excess inventory, and improve inventory turnover. RFID technology enables high-quality individualized product tracking, while ERP systems enable the integration of operational and strategic information in the supply chain.

Like any other research, our study has some limitations. This is especially the case with our database of relevant published articles. The coverage of selected journals relevant to this research topic is limited to a handful of cases. In addition, articles that discuss the integration between ERP and RFID in SCM are lacking, so researchers lack information about these cases. Our research is also limited to the databases used; this research only uses two databases as a medium for searching their articles. For management, this article can be a consideration to start adopting ERP and RFID technology in the organization to improve the efficiency and performance of supply chain management operations by looking at the benefits of implementing these two technologies in SCM. Managers can also utilize the results of various studies and the literature referenced in our article. For future research, this article can be used as literature that supports research topics related to the implementation of ERP and RFID in SCM by further expanding their discussion topics on the integration of ERP and RFID in SCM to avoid the lack of articles obtained due to the narrow topic or keywords used in the search database. In addition, future researchers are expected to increase the number of databases used in searching for their articles.

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