TOWARDS SMART WAREHOUSE MANAGEMENT IN VIETNAM: A REVIEW ON AI AND IOT INTEGRATION IN THE LOGISTICS INDUSTRY

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Abstract

Smart warehouse management powered by Artificial Intelligence (AI) and the Internet of Things (IoT) has emerged as an important area of research and application in logistics. This paper conducts a literature review by retrieving data from the Scopus database and performing bibliometric analysis with VOSviewer to identify prominent trends, authors, countries, and research themes. The findings reveal that international studies have mainly focused on four clusters: connectivity infrastructure and big data, automation and robotics, smart device applications, and data-driven decision-making. The study also highlights the benefits, challenges, and research gaps in the implementation of smart warehouses in emerging economies, particularly in Vietnam. Based on these insights, the paper proposes a smart warehouse model together with research directions and policy recommendations to foster the adoption of AI and IoT in warehouse management, thereby enhancing supply chain efficiency and competitiveness in the context of globalization.

Research purpose:
The study aims to analyze global research trends, themes, and gaps in smart warehouse management using AI and IoT technologies and to propose a model and policy recommendations suitable for emerging economies such as Vietnam.

Research motivation:
With the rapid development of AI and IoT, warehouse management is shifting to smarter and more data-driven systems. However, most of the research and applications are concentrated in developed countries, creating a gap in understanding and implementing smart warehouses in developing countries.

Research design, approach, and method:
A systematic literature review was conducted using data retrieved from the Scopus database. Bibliometric analysis was performed with VOSviewer to visualize key research clusters, influential authors, and emerging topics related to AI- and IoT-based warehouse management.

Main findings:
The analysis identified several key research clusters and proposed a smart warehouse model to improve operational efficiency and guide future research and practice.

Practical/managerial implications:
The proposed smart warehouse model and policy recommendations provide guidance for managers and policymakers to adopt AI and IoT technologies effectively, enhance supply chain performance, and strengthen competitiveness in the era of digital transformation.

Keywords: Smart Warehouse, Internet of Things, Artificial Intelligence, Warehouse Management

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1. INTRODUCTION

In the era of the Fourth Industrial Revolution (Industry 4.0), digital transformation is fundamentally reshaping supply chain management, particularly in the logistics sector. Warehouse management, as the central function ensuring the flow of goods, is considered one of the key pillars determining firms' operational capacity and competitive advantage (Zhen & Li, 2022). As a crucial component of the complex logistics system, warehouse management connects storage areas, material flows, production, record keeping, and distribution with the overall economic objectives of the enterprise (Stopka & Ľupták, 2018). Consequently, warehouse operations not only directly influence efficiency but can also become an important source of competitive advantage in today's business environment.

Traditional warehouse systems, which rely heavily on manual or semi-automated processes, are increasingly revealing their limitations. Common issues include inventory inaccuracies, inefficient use of storage space, slow processing speed, and limited forecasting capabilities (Atieh, et al., 2016). These shortcomings are exacerbated by the rapid growth of e-commerce, which demands higher accuracy and flexibility in operations. The strong development of Artificial Intelligence (AI) and the Internet of Things (IoT) has laid the foundation for the emergence of the "smart warehouse" model. AI enables the processing and analysis of large volumes of data to support demand forecasting and optimal decision-making (Divakaran & Chaturvedi, 2024), while IoT provides real-time monitoring and connectivity among warehouse devices (Jarašūnienė, Čižiūnienė, & Čereška, 2023), thereby enhancing transparency and control (Tang, Ho, & Tsui, 2022). The integration of these technologies opens up opportunities for comprehensive automation, fundamentally transforming warehouse management and operations within supply chains.

In practice, the smart warehouse model has become an inevitable trend. According to Grand View Research, the global smart warehouse market was valued at USD 20.95 billion in 2022 and is projected to reach USD 57.97 billion by 2030, with a compound annual growth rate (CAGR) of 14.2% (Grand View Research, 2023). Meanwhile, the Industrial IoT (IIoT) market is forecasted to reach USD 1,693.44 billion by 2030, with a CAGR of 23.3% during 2025–2030 (Grand View Research, 2025). Technologies such as IoT, AI, autonomous robots, warehouse management systems (WMS), and automated guided vehicles (AGVs) have been widely adopted, delivering superior benefits in terms of accuracy, efficiency, cost reduction, and customer service enhancement. Leading corporations such as Amazon, DHL, and Toyota have pioneered the implementation of IoT, AI, autonomous robots, and advanced WMS. Amazon, for instance, currently operates more than 750,000 robots in its fulfillment centers, achieving near-perfect accuracy while significantly reducing labor costs (Khalaf, 2025; Yudiansyah et al., 2020). DHL has deployed RFID technology and IoT sensors to optimize inventory management and demand forecasting (DHL, 2022), whereas Toyota integrates AI with its Just-in-Time model to reduce storage costs and improve production quality. These cases demonstrate that smart warehouses not only provide direct economic benefits but also constitute a strategic factor in enhancing global competitiveness.

In Vietnam, the adoption of smart warehouses remains at an early stage. A report by the Ministry of Industry and Trade (2023) indicates that only about 3% of manufacturing enterprises have reached a mature level of digital transformation, with digital applications in warehouse management accounting for just around 5%. Some large enterprises such as Vinamilk, Samsung, and major e-commerce platforms (Shopee, Lazada, Tiki) have invested in automated warehouse systems integrated with IoT and AI. For example, Vinamilk's smart warehouse, covering an area of 6,000 m², is designed with 17 levels of racks, accommodating more than 27,000 pallets, and operates fully automatically. However, the majority of small and medium-sized enterprises (SMEs) still rely on traditional warehouse management methods due to constraints in capital investment, technological infrastructure, and human resources. This has resulted in a significant gap between Vietnam and global trends.

Beyond Industry 4.0, recent discourse has emphasized the emergence of Industry 5.0, which marks a paradigm shift from the automation-centric focus of Industry 4.0 toward a more human-centric, sustainable, and resilient industrial framework (Verma, 2024; Kaur, Jasmine & Sood, 2025). Industry 5.0 advocates for the integration of advanced digital technologies with human creativity, ethical considerations, and environmental responsibility. In the context of warehouse management, this shift implies that future smart warehouses should not only pursue cost reduction and operational efficiency but also prioritize sustainability, employee well-being, and adaptability to disruptions. Accordingly, the evolution from smart warehouses to human-centered and sustainable warehouse systems represents a critical direction for future research.

From the above analysis, it is evident that smart warehouses based on AI and IoT have become an inevitable trend in the context of international integration and competition and represent one of the key focuses of digital transformation in logistics. Nevertheless, research gaps remain, particularly regarding the consolidation of theoretical foundations, systematization of applications, analysis of benefits and challenges, and identification of future development trends. Accordingly, this paper aims to provide an academic overview of the smart warehouse model driven by AI and IoT, thereby offering insights and recommendations for both research and practical applications in the Vietnamese context. In doing so, this study aims to address the following research questions:

RQ1: How are Artificial Intelligence (AI) and the Internet of Things (IoT) currently applied in the development of smart warehouses globally and within the context of Vietnam?

RQ2: What are the prevailing research trends and existing gaps in the field of AI- and IoT-enabled smart warehouses, as

identified through bibliometric analysis?

RQ3: What conceptual models and practical recommendations can be proposed to support the adoption of smart warehouse systems in Vietnam?

2. LITERATURE REVIEW

2.1 Smart warehouse

A smart warehouse is defined as "leveraging technologies such as the Internet of Things, artificial intelligence, big data analytics, and automation to create a connected environment where data can flow seamlessly between devices, systems, and processes" (Nishar, 2023). Or Jabbar et al (2018) defined it as "a type of warehouse designed to optimize operational performance, while integrating advanced management methods and modern technologies".

Compared to traditional warehouses, smart warehouses are superior in terms of automation, efficiency, and data management. While traditional warehouses mainly rely on manual labor, with inbound–outbound processes and inventory management often being slow and error-prone, smart warehouses employ robots, conveyor systems, and AI/IoT technologies to increase processing speed and accuracy (Yu et al., 2025; Kamali, 2019). In terms of information management, traditional warehouses depend on manual records that are difficult to retrieve, whereas smart warehouses utilize Warehouse Management Systems (WMS) integrated with IoT and AI, enabling real-time data updates and easy analysis (Kamali, 2019). Furthermore, although initial investment costs are high, smart warehouses provide long-term benefits by reducing operational expenses and offering flexible scalability, in contrast to traditional warehouses that are difficult to expand and less adaptable to market fluctuations (Kamali, 2019; Zhao et al., 2025). The main characteristics of smart warehouses include: information connectivity, equipment automation, process integration, and environmental sustainability.

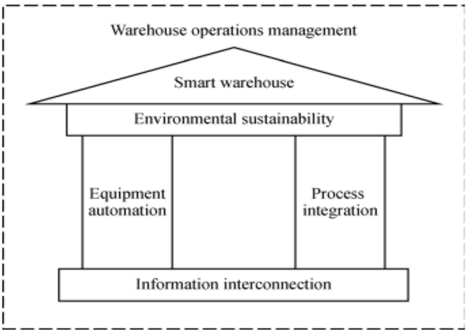

Fig. 1. Structural framework of a smart warehouse

Source: (Zhen & Li, 2022)

Information connectivity: enabled by IoT and wireless networks, allowing real-time monitoring and management of goods, while supporting continuous data sharing to optimize the supply chain (Zhen & Li, 2022; Chopra & Meindl, 2016; Lee et al., 2017).

Equipment automation: automation using robots, AGVs, and conveyor systems enhances monitoring capabilities, optimizes operations, and strengthens competitiveness (Cosma et al., 2025).

Process integration: smart warehouses integrate processes through WMS and ERP systems to ensure synchronized data, eliminate inconsistencies, and improve overall efficiency (Zhen & Li, 2022). Seamless data connectivity across inbound, storage, outbound, and transportation enables timely access to information, reduces response delays (Khan & Abonyi, 2022), and eliminates management gaps, thereby improving overall performance (Hofmann & Rüsch, 2017).

Environmental sustainability: an increasingly important feature, focusing on reducing energy consumption, lowering carbon emissions, and promoting green logistics through energy-efficient technologies and recyclable materials (Dimitrov & Saraceni, 2023).

2.2 Foundational Technologies

The Internet of Things (IoT) is one of the foundational technologies of smart warehouses, establishing a network of interconnected devices that collect, exchange, and analyze real-time data (Ismail, 2019). In warehouse management, IoT enables sensors and monitoring devices to track location, temperature, humidity, and the condition of goods, thereby supporting automated inventory, improving accuracy, and enhancing storage quality, particularly for food and pharmaceuticals (Čolaković et al., 2020). IoT-enabled warehouse management systems (WMS) also increase

productivity, improve picking accuracy, and adapt effectively to the growing complexity of customer orders (Lee et al., 2017). Hence, IoT not only improves operations but also contributes to transforming traditional warehouses into smart warehouses in the Industry 4.0 era (Hamdy, Mostafa, & Elawady, 2018; Lee et al., 2017).

Alongside the Internet of Things, Artificial Intelligence (AI) is recognized as a core technology in the development of smart warehouse models. While IoT serves as the foundation for connectivity and real-time data acquisition, AI is responsible for processing and analyzing this data to generate predictions, support decision-making, and optimize operations. According to Martínez, Rios and Prieto (2020), AI refers to "systems that display intelligent behavior by analyzing their environment and performing actions with some degree of autonomy to achieve specific goals." Key applications of AI in smart warehousing include autonomous mobile robots, robotic arms, and automated guided vehicles (AGVs), which enhance efficiency in picking, material handling, and internal transportation (Sodiya et al., 2024). AI also facilitates predictive maintenance by enabling early detection of equipment failures, thereby minimizing operational disruptions (Hosseinzadeh et al., 2023; Scaife, 2024). Research by Žunić et al. (2018) demonstrated AI's capability to optimize warehouse space and movement flows by calculating and recommending storage layouts that reduce picking time, alleviate congestion, and maximize space utilization. Consequently, the integration of AI into warehouse operations significantly enhances logistics, management, and coordination activities (Pandian, 2019).

3. METHODOLOGY

To achieve the research objectives, this paper adopts a mixed approach combining a literature review and bibliometric analysis. This method ensures both systematic synthesis of theoretical foundations and a quantitative basis for identifying research trends and academic gaps in the field of smart warehouses enabled by AI and IoT.

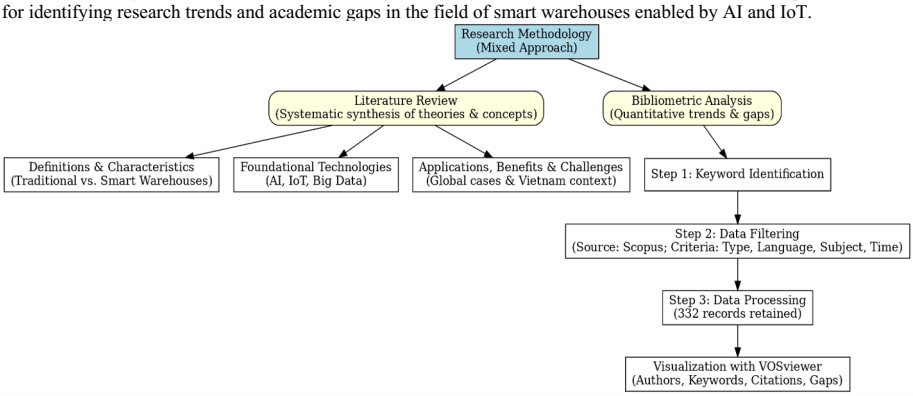

Fig. 2. Research process

The literature review method is employed to systematize relevant concepts, theories, and practical applications. Sources were selected from published academic research, including journal articles, conference proceedings, monographs, and industry reports. The review focuses on three main aspects:

- *Definitions and characteristics of smart warehouses:* synthesizing various conceptualizations from different scholars, highlighting the distinctions between traditional and smart warehouses.
- *Foundational technologies:* analyzing the role of AI, IoT, and Big Data in warehouse management.
- *Applications, benefits, and challenges:* examining global case studies (e.g: Amazon, DHL, Alibaba) as well as the current status of research and implementation in Vietnam.

The literature review not only provides a theoretical foundation for this paper but also helps identify areas for further research, particularly in the Vietnamese context, where the adoption of smart warehouses remains limited.

3.1 Bibliometric analysis

In addition to the literature review, this study employs bibliometric analysis to systematize and visualize the international research landscape on smart warehouses applying AI and IoT. Bibliometric analysis is a widely adopted quantitative method in various scientific fields to identify research trends, main thematic clusters, and collaborative relationships among authors, institutions, and countries.

The data collection process was conducted in three main steps:

(1) *Keyword identification:* ("smart warehous*" OR "intelligent warehous*" OR "automat* warehous*" OR "big data warehous*"OR "warehous* management system*") AND ("AI" OR "artificial intelligence" OR "IoT" OR "Internet of things" OR "big data" OR "data center for warehousing*" OR "automation")

(2) *Data filtering*: Data were retrieved from the Scopus database - one of the most reputable and comprehensive scientific sources. Filtering criteria included: document type (articles and conference papers only), language (English), subject areas (computer science, engineering, management, and logistics) and time frame (2010–2024). The selected time frame reflects the emergence and diffusion of the Industry 4.0 paradigm, which was first introduced in Germany in 2011. Since then, the concepts of IoT, AI and digital transformation in logistics and warehouse management have grown rapidly, making this period particularly relevant for mapping global and Vietnamese research trends.

(3) *Data processing*: After removing duplicates and irrelevant records, a total of 332 documents directly related to the research scope were retained for further analysis.

Using the Scopus dataset, VOSviewer was applied to visualize relationships among authors, keywords, and citations. This tool allows for the identification of influential topics and scholars, while also revealing research gaps concerning the application of AI and IoT in smart warehouse management

3.2 Proposed Smart Warehouse Model Integrating AI and IoT

The bibliometric analysis of Scopus data shows that research on smart warehouses has increased significantly over the past decade, reflecting the growing interest in applying technology to warehouse management. Prominent technologies highlighted in the keyword network include the Internet of Things, Artificial Intelligence, automation, and Warehouse Management Systems. Leading countries in terms of publications and citations include the United States, Germany, China and Japan, with a focus on process optimization, reducing operational costs, and enhancing supply chain efficiency. Overall, these findings are consistent with global trends, in which large enterprises prioritize integrating automation and data analytics to improve inventory accuracy, accelerate order processing, and enhance demand forecasting capabilities. This indicates that smart warehouse research extends beyond technology application toward supply chain integration and intelligent decision-making.

In Vietnam, these findings reveal both challenges and opportunities. First, technological infrastructure and enterprise readiness remain limited, particularly among small and medium-sized enterprises (SMEs), making smart warehouse implementation difficult. The high initial investment required for robots, management software, and IoT systems poses a significant barrier. Second, awareness and managerial capacity regarding new technology adoption are still uneven, leading to fragmented and inconsistent application. Third, the absence of standardization and clear implementation guidelines makes adapting international models to Vietnam less effective.

From this, several research gaps in Vietnam can be identified: most current studies and applications focus on large enterprises, while research on SMEs remains scarce. Specifically, there is a lack of studies assessing the effectiveness of AI and IoT adoption under limited infrastructure conditions, or optimizing inventory and real-time demand forecasting. Furthermore, the development of warehouse management models tailored to industry-specific and enterprise-scale characteristics in Vietnam has not yet been sufficiently addressed.

These findings suggest that, to implement smart warehouses effectively in Vietnam, a phased technology adoption strategy is required balancing cost optimization, infrastructure improvement, and managerial capability enhancement. At the same time, future research should focus on empirical evaluation, measuring the effectiveness of AI, IoT and automation applications, and developing operational standards suited to local conditions. This will not only strengthen the competitiveness of Vietnamese enterprises but also provide a scientific basis for policymaking in supporting digital transformation in logistics.

In this context, the need to develop a smart warehouse model that integrates AI and IoT and is tailored to the practical conditions of SMEs in Vietnam is becoming increasingly essential. The model is designed with flexibility in mind, leveraging real-time data from IoT and predictive processing capabilities from AI, with the goal of optimizing inventory, improving accuracy, and ensuring feasibility under Vietnam's real-world implementation conditions.

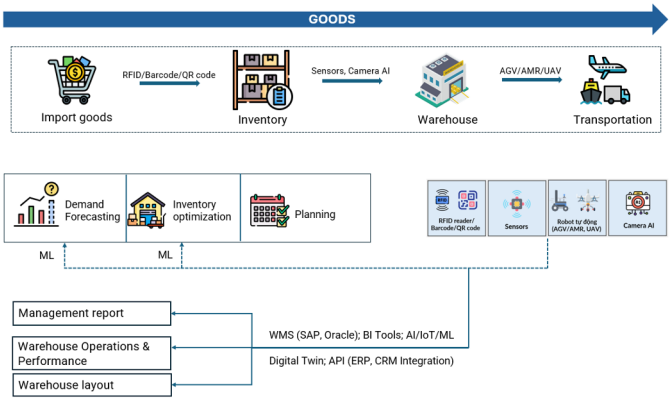

Fig. 3. Proposed Smart Warehouse Model Integrating AI and IoT

Source: Compiled and developed by the authors

The proposed smart warehouse model consists of three layers: physical goods flow, information processing & forecasting, and output. The goods flow layer employs RFID, barcodes, QR codes, IoT sensors, AI-powered cameras, AGV/AMR, and UAVs to monitor, handle, and transport goods efficiently. The information processing layer collects data from these devices, applying AI and Machine Learning to forecast demand, optimize inventory, and plan warehouse operations. The output layer is represented through KPIs, interactive dashboards, and warehouse layout recommendations, thereby enhancing management efficiency and decision-making.

This model establishes a closed-loop data ecosystem that synchronizes AI, IoT, and enterprise management platforms such as ERP and CRM. It is particularly suitable for small and medium-sized enterprises (SMEs) in Vietnam, enabling automation, cost reduction, and improved competitiveness within the broader context of digital transformation.

4. RESULTS AND DISCUSSION

4.1 Research trends by year

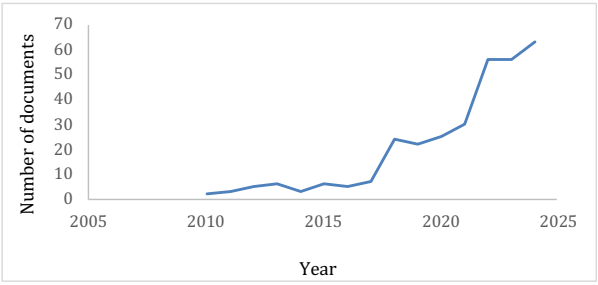

Fig. 4. Research trend chart by year related to smart warehouses applying AI and IoT

Source: Scopus

The analysis in this section is based on an initial dataset of 332 articles retrieved from Scopus (2010 - 2024) using keywords related to smart warehouses, AI and IoT. After removing duplicates and irrelevant records, this dataset formed the basis for trend analysis and cluster visualization.

Specifically, in the period from 2010 to 2016, the number of studies remained modest and grew slowly, reflecting the early stage of academic interest in this field. However, from 2017 onwards particularly during 2018 - 2021, the number of publications began to increase significantly, indicating a notable shift in research orientation and the rapid development of AI and IoT technologies in supply chain and logistics management. Remarkably, since 2022, the chart reveals a sharp surge in the number of published studies. This reflects the strong increase in academic and investment interest under the influence of Industry 4.0, the growing need for warehouse automation, as well as global disruptions such as the COVID-

19 pandemic, which highlighted the critical role of technology in maintaining efficient supply chains.

4.2 Countries interested in the topic

Statistical data (Figure 5) show that China is the absolute leader in smart warehouse research, with 114 publications, 1,335 citations, and the highest level of international collaboration. This confirms China's outstanding position, its strong investment in Industry 4.0, and its central role in the global academic network in this field. Following China, India ranks second with 46 publications, but its academic impact remains limited, with only 339 citations and relatively low levels of international collaboration. This suggests that India's research growth has not yet translated into broad global influence.

In contrast, the United States, despite having only 20 publications, has received 401 citations, reflecting a trend toward producing high-quality, influential research. European countries such as Italy, Germany, France, and Canada also maintain a stable presence in this field, with moderate publication and citation counts, accompanied by relatively strong international collaboration. Notably, several Asian countries including Indonesia, Malaysia, Japan, and Turkey have also begun to participate more actively in smart warehouse research. Particularly remarkable is Australia, which, despite only 7 publications, has achieved 327 citations, demonstrating the high quality and significant influence of its research output. Similarly, the United Kingdom, with 7 publications and 187 citations, also shows an academic contribution that outweighs the volume of its publications.

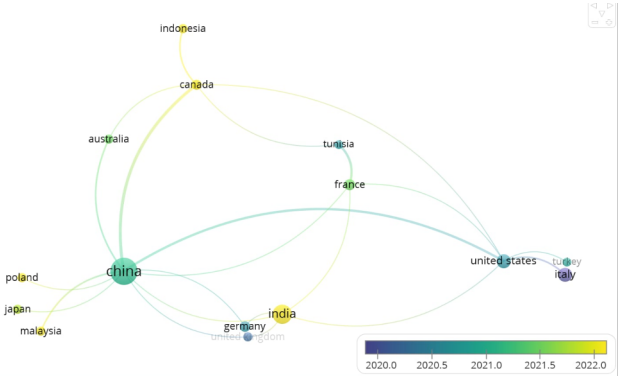

Fig. 5. Leading countries in smart warehouse research

Source: Compiled by the authors

4.3 Research keywords and research trends

After filtering for keywords with a minimum occurrence of 12, the keyword co-occurrence network (Figure 6) visualizes the relationships among concepts extracted from the titles and abstracts of relevant studies on smart warehouse models. The central keyword "warehouses" has the largest node size and is located at the center, illustrating its dominant role in the knowledge network of this field. The remaining keywords are grouped into four main clusters, distinguished by colors (red, yellow, blue, green), each representing a major research trend. The thickness of the connecting lines indicates the strength of co-occurrence between keywords, reflecting the degree of thematic interconnection. Four main clusters can thus be identified, representing four prominent research directions:

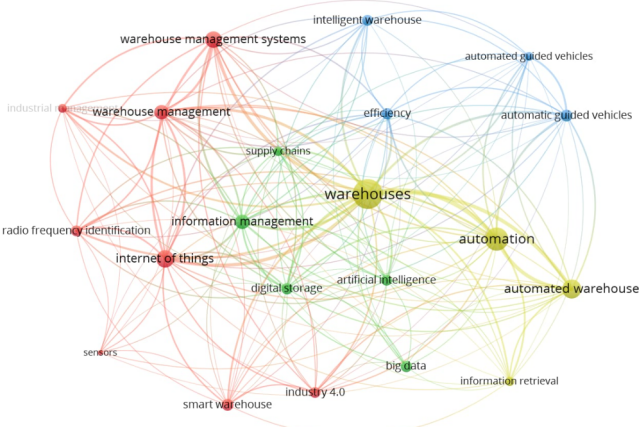

Fig. 6. Visualization of keyword relationships in smart warehouse research

Source: Compiled by the authors

Red cluster: This cluster has a strong infrastructural and system-organizational orientation, centered around keywords such as *"warehouse management systems," "Internet of Things," "radio frequency identification," "smart warehouse," "sensors,"* and *"Industry 4.0."* It reflects the modern research perspective, which no longer views warehouses merely as physical spaces but rather focuses on information architecture and real-time connectivity. The frequent co-occurrence of *"Internet of Things," "radio frequency identification,"* and *"warehouse management"* indicates that Warehouse Management Systems (WMS) are increasingly dependent on data collection and synchronization through sensors, RFID, and IoT to automate monitoring and decision-making. Studies such as Jarašūnienė et al. (2023) and Tang, Ho, & Tsui (2022) highlight the application of these technologies in large-scale supply chain warehouses, ensuring transparency and traceability.

Yellow cluster: Unlike the organizational nature of the red cluster, the yellow cluster emphasizes the automation of operational structures, with keywords such as *"automation," "automated warehouse,"* and *"information retrieval."* This research area focuses on warehouse operational mechanisms and devices, ranging from picking robots and conveyors to automated control systems. It strongly intersects with mechanical engineering, electronics, and automation fields, aiming primarily to minimize human intervention and enhance the speed and accuracy of physical goods flows. Representative studies include Khalaf (2025), which illustrate practical applications of automation in large-scale warehouse operations.

Blue cluster: Highlighted by keywords such as *"automated guided vehicles," "intelligent warehouse,"* and *"efficiency,"* this cluster reflects the application of AGVs/UAVs and intelligent devices to replace human involvement in positioning, picking, and inventory tasks. The repeated emphasis on "efficiency" indicates a shift in research focus from mere technological optimization to comprehensive system performance enhancement. Several studies not only assess the feasibility of AGV/UAV implementation but also provide in-depth evaluations of cost, processing time, and operational flexibility, reflecting the complex and dynamic nature of modern logistics (Yudiansyah et al., 2020).

Green cluster: This cluster represents the strategic and "intelligence" dimension of smart warehouse systems, with keywords such as *"artificial intelligence," "big data," "information management,"* and *"digital storage."* Research in this cluster focuses on leveraging data for warehouse decision-making, ranging from demand forecasting and space allocation to optimizing robot routing and inventory levels. Notably, this cluster connects with all other clusters, underscoring the fact that regardless of how automated or connected warehouses may be, intelligent data-driven decision-making remains the differentiating factor. This is supported by Divakaran & Chaturvedi (2024), which illustrates the importance of intelligent data-driven decision-making across warehouse operations.

Thus, the keyword network highlights four key research directions in the study of smart warehouses today. These trends not only reflect technological advancements in warehousing but also demonstrate the vast potential for improving production and logistics efficiency for enterprises.

5. CONCLUSION

The analysis of the impact AI and IoT reveals that integrating these technologies holds substantial potential for enhancing accuracy, processing speed, and operational flexibility in warehouse management. However, existing models

are predominantly theoretical and tend to be more applicable to large enterprises with established technological infrastructure. In contrast, small and medium-sized enterprises (SMEs) in Vietnam which constitute a significant portion of the national economy, face considerable challenges in implementation.

To refine and improve the feasibility of smart warehouse models for SMEs, this study proposes several future research directions:

To refine and enhance the feasibility of smart warehouse models, particularly for small and medium-sized enterprises (SMEs) in Vietnam, the study proposes the following future directions:

- *Developing a multivariable integrated model:* Incorporating market trends, seasonality, order history and in-warehouse operational data to improve forecasting adaptability.
- *Improving warehouse operations:* Integrating predictive models with warehouse layout redesign, optimizing employee and equipment movement routes, and automating sorting, packing and dispatching through robotics and intelligent navigation systems, thereby increasing overall productivity and reducing labor dependency.
- *Building intuitive decision-support tools:* Embedding analytical results into real-time operational dashboards to enable managers to monitor inventory levels, processing efficiency and risk alerts more effectively.
- *Enhancing managerial capacity:* Providing SMEs with structured guidance on phased technology adoption, change management, and cost-benefit assessment to ensure sustainable and realistic implementation.
- *Policy and institutional support:* Encouraging government and industry bodies to offer incentives, training programs, technology transfer initiatives and pilot projects in industrial zones to reduce barriers to AI and IoT adoption for SMEs.
- *Strategic and sustainable perspective:* Leveraging AI and IoT not only to improve operational efficiency but also to support strategic decision-making, supply chain optimization and alignment with sustainability goals and Industry 4.0 trajectories.

These proposals offer valuable directions for future research in supply chain and logistics management while providing practical insights for SMEs. Specifically, they can help Vietnamese enterprises better understand the benefits, implementation conditions, and challenges associated with adopting smart warehouse systems in production and business operations. The successful realization of these solutions will contribute to optimizing storage and distribution processes, enhancing resource utilization, reducing operational costs, and strengthening competitiveness in the context of global economic integration. Simultaneously, these measures support enterprises in accelerating digital transformation, improving managerial capacity, complying with supportive policies, and pursuing long-term sustainable development objectives.

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