ISBN: 978-628-96613-1-6. ISSN: 2414-6390. Digital Object Identifier: https://dx.doi.org/10.18687/LACCEI2025.1.1.2349

Revolutionize Small-Scale Retail Supply Chains: Integrating Logistics 5.0 for Nanostores in the Smart Economy

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Abstract- This study investigates the impact of Logistics 5.0 on small-scale retail supply chains, focusing on enhancing operational efficiency, customer experience, and adaptability within nanostores. Using a systematic literature review of sources including Scopus, Web of Science, and JSTOR, the research analyzes the integration of AI-driven inventory management and IoT-enabled supply chains within the smart economy. Findings reveal that Logistics 5.0 implementation reduced stockouts by 77%, decreased overstocking by 60%, and increased sales by 21.7%. These results support three propositions: enhanced supply chain efficiency, improved customer experience via real-time data and AI, and greater adaptability through human-machine collaboration. The study offers actionable insights for nanostore retailers and policymakers, emphasizing both operational improvements and broader benefits such as equitable access to goods, digital inclusion, and sustainability. Future research should examine these social and environmental dimensions further in diverse retail ecosystems.

Keywords-Logistics 5.0, nanostores, operational efficiency, AI-driven inventory management, customer experience.

I. Introduction

The evolution of retail supply chains is increasingly influenced by the principles of Industry 5.0, which emphasizes human-machine collaboration, artificial intelligence (AI), and sustainability, as key enablers of efficiency and resilience [1, 2]. While Industry 4.0 and its counterpart, Logistics 4.0, laid the groundwork for automation and data exchange in manufacturing and supply chains, Industry 5.0 and Logistics 5.0 introduce a more human-centric approach, focusing on creating more intelligent, adaptive, and customer-oriented supply chains that balance technological advancement with sustainable practices [3]. Unlike its predecessor, Logistics 5.0 moves beyond automation and efficiency by integrating AI-driven decision-making with human expertise, fostering a more responsive and personalized retail ecosystem. This shift is particularly relevant for nanostores, which require adaptive solutions that blend technology with the human touch to meet localized consumer needs.

Despite extensive research on the integration of Industry 4.0 and Logistics 4.0 technologies—such as IoT, AI-driven analytics, and automation—in large-scale retail, there is a noticeable gap in the literature regarding nanostores, which are critical yet often overlooked components of the urban retail ecosystem [4]. However, these small-scale retailers face distinct challenges such as resource constraints, poor inventory management, and limited access to AI-driven supply chain solutions [5]. Unlike large retailers, which benefit from economies of scale and sophisticated logistics networks, nanostores must navigate operational constraints with minimal technological support. Addressing these disparities requires tailored Logistics 5.0 solutions that prioritize affordability, scalability, and localized efficiency.

A. Current Gap in Literature

While research into the use of Logistics 4.0 technologies in large retail formats is well-documented, there is a scarcity of studies investigating how Logistics 5.0 innovations—particularly real-time data analytics, IoT, and human-machine collaboration—can be applied to nanostore supply chains. Most existing works focus on large retailers or global supply chains, leaving a research gap concerning small-scale, often informal retailers. This technological gap exacerbates inefficiencies, making nanostores vulnerable to supply disruptions and demand fluctuations. Their lack of efficient supply chain systems means they are often reactive rather than proactive, which can lead to overstocking, stockouts, and missed sales opportunities [6,7].

Existing literature primarily examines digital transformation in large-scale retail, often overlooking the contextual realities of nanostores, such as their reliance on informal supply networks, cash-based transactions, and personalized customer relationships. This study aims to bridge this gap by exploring how Logistics 5.0 technologies can be tailored to the unique operational scale and resource constraints of nanostores, ensuring that the benefits of digitalization reach beyond corporate retail environments [5,8].

This gap forms the basis for this study, which seeks to understand how smart technologies associated with Logistics 5.0, including AI, real-time data analytics, and collaborative robotics, can address the supply chain inefficiencies faced by nanostores. Specifically, this study will examine how these technologies improve logistics efficiency, customer satisfaction, and adaptability within nanostore operations. The study aims to contribute to both theory and practice by exploring the potential benefits of integrating these smart technologies, providing a roadmap for future research and practical applications in this area. While previous studies, such as [6] mapped research trends, our study goes further by providing an empirical investigation into the direct impact of Logistics 5.0 technologies on nanostore efficiency. Unlike bibliometric and conceptual studies, this research integrates theoretical propositions with practical insights, supported by a methodological approach that examines real-world applications

of AI, IoT, and human-machine collaboration in nanostores. To guide this exploration, the next subsection outlines the primary research questions and objectives that will drive this study. In addition to operational concerns, this study foregrounds the social and environmental implications of Logistics 5.0, examining how these technologies can foster equitable access, community resilience, and sustainable last-mile logistics in resource-constrained retail contexts.

B. Research Questions and Objectives

This study is guided by three primary research questions:

1) How can Logistics 5.0 principles be adapted to enhance the efficiency and resilience of nanostore supply chains, considering their unique resource constraints and operational scale?

2) How do real-time data and AI-driven forecasting improve customer satisfaction, demand responsiveness, and inventory optimization in nanostores?

3) What role does human-machine collaboration play in balancing automation with personalized service in nanostore logistics, and how can this balance be optimized for small-scale retail?

To address these questions, the research objectives are as follows:

1) Objective 1: To synthesize the available evidence on the application of Logistics 5.0 technologies in nanostore operations.

2) Objective 2: To evaluate the potential benefits of AI, IoT, and human-machine collaboration for improving nanostore supply chains.

3) Objective 3: To provide a theoretical framework for future research on optimizing small-scale retail supply chains using Logistics 5.0.

By addressing these objectives, this research contributes to both academic discourse and practical retail management, laying the foundation for the theoretical propositions that follow. By moving beyond conceptual discussions and bibliometric mapping, this study generates actionable insights that bridge the gap between theory and real-world applications, ensuring that Logistics 5.0 solutions are tailored to the unique constraints of nanostores. Unlike existing frameworks that primarily focus on digital transformation in large-scale retail, this study proposes a Logistics 5.0 model that aligns with the operational and financial realities of small, independent retailers. Building on these objectives, Section II introduces the key theoretical propositions, illustrating how Logistics 5.0 technologies can mitigate nanostore inefficiencies, enhance adaptability, and improve overall supply chain performance. The following subsection describes the structure of the paper, outlining the flow of the research and its presentation.

C. Structure of the Paper

The paper is structured as follows:

1) Section II provides a comprehensive review of the theoretical background, covering relevant concepts from both Industry 4.0 and Industry 5.0, and their applications in retail logistics.

2) Section III outlines the research methodology, including systematic literature review and the development of data for analysis.

3) Section IV presents the findings and analysis, focusing on the potential benefits of Logistics 5.0 for nanostores, supported by data.

4) Section V concludes the study with a discussion of the practical and theoretical implications, offering directions for future research.

II. Literature Review and Theoretical Framework

A. Evolution of Logistics in Retail

The field of retail logistics has experienced significant transformation, progressing from traditional, manual supply chain models to systems integrated with Industry 4.0 and Industry 5.0 technologies. Industry 4.0 introduced technologies such as the Internet of Things (IoT), big data, and automation, which optimized supply chain operations, particularly in large-scale retail environments [9]. However, as Industry 5.0 emerges, the focus shifts toward human-centric automation, wherein AI and robotic systems collaborate with human operators to create more personalized, adaptable, and resilient supply chains [10,11]. While these advancements have been thoroughly explored in large retailers, nanostores—small, independent retail outlets—have yet to fully benefit from these technologies, creating a substantial research gap [12,13]

The integration of Logistics 5.0 principles, which emphasize human-machine collaboration and sustainability, offers an opportunity to bridge this gap. Logistics 5.0 focuses not only on advanced automation but also on using AI-driven decision-making to optimize processes, balance human input, and enhance overall supply chain resilience [14]. In particular, the implementation of AI and data analytics can help nanostores improve their operational efficiency, manage inventory more effectively, and reduce costs.

Despite its potential, academic literature currently lacks comprehensive studies on how Logistics 5.0 technologies can be adapted for small-scale retailers like nanostores. This is crucial because nanostores often have limited resources, making the adoption of high-cost technologies challenging [6]. The existing body of work focuses predominantly on large, well-resourced retailers, leaving nanostores underserved in both theory and practice.

B. Smart Supply Chains in Nanostores

The concept of smart supply chains revolves around the use of real-time data, automation, and advanced analytics to enhance decision-making and improve supply chain performance. Smart supply chains leverage IoT-enabled devices to collect data on inventory levels, customer behavior, and supply fluctuations in real time, allowing retailers to make more informed decisions and react to changes more swiftly [15].

For nanostores, smart supply chains represent an opportunity to mitigate many of the operational inefficiencies they currently face, such as overstocking, stockouts, and ineffective inventory management. By utilizing IoT sensors, nanostores can automate stock monitoring, providing alerts when inventory levels drop or exceed predefined thresholds. Similarly, the use of AI-driven demand forecasting tools can help predict customer needs, thereby reducing unnecessary stock replenishment and improving overall service quality [16].

However, the scalability of these technologies remains a critical issue. Most of the current research focuses on the application of smart technologies in large retail chains, where economies of scale make such investments feasible [5,8]. For nanostores, the challenge lies in adapting these advanced systems to their specific operational constraints, such as limited financial and technological resources. Few studies have examined how Logistics 5.0 principles could be customized to suit the unique needs of nanostores, thereby highlighting a significant gap in the literature [6,17].

In addition to addressing operational inefficiencies, the application of Logistics 5.0 can foster broader societal benefits. By enabling smarter, more sustainable logistics systems, nanostores can reduce waste, enhance local economic resilience, and improve access to essential goods in underserved communities. Moreover, the social implications of adopting these technologies—such as workforce development, community engagement, and equitable access to products—are crucial areas for future research [6,18].

A search of existing literature reveals that while there are studies focusing on nanostores and their supply chain challenges, such as the work by [6], and [4] discussing the implications of smart logistics in nanostores within the context of Industry 5.0 and Society 5.0, there appears to be a lack of comprehensive Systematic Literature Review (SLR) specifically addressing the integration of Logistics 5.0 technologies in nanostore supply chains.

C. *Theoretical Framework and Propositions*

To address the gaps identified in the literature, this study proposes a conceptual framework based on the integration of Logistics 5.0 technologies into nanostore supply chains. The framework emphasizes the use of AI, real-time data analytics, and IoT devices to create more responsive and adaptive supply chain systems for small-scale retailers.

This framework builds upon prior research but advances it by incorporating empirical validation through case studies and industry data, ensuring its applicability in real-world nanostore settings. Based on this framework, the following propositions are put forward:

1) Proposition 1: Logistics 5.0 will significantly improve the efficiency and resilience of nanostore supply chains through the application of AI and IoT technologies. This will be achieved by automating repetitive tasks, reducing human error, and providing real-time visibility into inventory levels and supply chain conditions [19,20]

2) Proposition 2: Nanostores can leverage real-time data to enhance customer satisfaction and optimize inventory management. By utilizing AI-driven forecasting models and IoT-based inventory tracking, nanostores will be able to better anticipate customer needs, reducing both stockouts and excess inventory, thereby improving overall service quality [21,22].

3) Proposition 3: The integration of human-machine collaboration through Logistics 5.0 will enable nanostores to achieve a balance between automation and personalization, leading to more sustainable and adaptable supply chain operations [10,23]

These propositions will be tested and analyzed in the following sections, using both theoretical analysis and a systematic review of the literature. By framing these propositions within an actionable theoretical model, our study provides a novel contribution that extends beyond conceptual discourse to practical, evidence-based recommendations.

III. Research Design and Methodology

This section outlines the methodology employed to achieve the research objectives and answer the study's research questions. The research utilizes a (SLR) approach to examine how Logistics 5.0 can enhance nanostore supply chains. The SLR methodology was chosen due to its rigorous and structured process of identifying, evaluating, and synthesizing relevant research, ensuring a comprehensive understanding of the topic [24]

A. *Research Design and Objectives*

The objective of this SLR is to synthesize the existing literature on Logistics 5.0, focusing on its applications in retail and its potential for improving the efficiency and adaptability of nanostore supply chains. The review seeks to:

1) Identify how AI, IoT, and real-time data analytics have been used in retail supply chains, particularly in nanostores.

2) Analyze the current state of research on the adoption of Industry 5.0 technologies in small-scale retail operations.

3) Propose a theoretical framework for integrating smart technologies into nanostores, addressing specific operational challenges such as inventory management and customer service.

By addressing these objectives, the methodology directly supports the testing of propositions in Section II, particularly in how these technologies enhance the efficiency, resilience, and adaptability of nanostore supply chains.

B. *Data Collection Process*

The SLR was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The data collection process involved an extensive search in multiple academic databases to gather relevant publications:

1) Databases searched: Scopus, Web of Science (WoS), JSTOR, EBSCOhost, and Google Scholar.

2) Publication types: The review focused on peer-reviewed journal articles, conference proceedings, and select book

chapters. Editorials, dissertations, and non-peer-reviewed sources were excluded.

3) Time frame: The review included articles published between 2000 and 2024, with a particular emphasis on works published post-2015, reflecting the more recent focus on Logistics 5.0 and the retail sector's evolving landscape.

4) Keywords used: The search employed both English and Spanish terms to ensure comprehensive coverage, with keyword combinations such as:

- "Logistics 5.0 AND nanostores"
- "smart supply chains AND small retailers"
- "Industry 5.0 AND retail efficiency"
- "AI AND inventory management"
- "human-machine collaboration AND retail" These keywords were combined using Boolean operators (AND, OR) to refine the search.

C. Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were defined as follows:

1) Inclusion criteria:

- Articles written in English.
- Peer-reviewed articles focusing on AI, IoT, Industry 5.0, or smart logistics in retail.
- Studies addressing nanostores, small retailers, or micro-businesses in the retail supply chain context.
- Publications exploring human-machine collaboration, inventory management, and real-time data applications in retail logistics.

2) Exclusion criteria:

- Articles that solely focused on large-scale retail supply chains without discussion of small-scale retailers.
- Studies unrelated to Logistics 5.0 or lacking empirical/theoretical analysis of relevant technologies.

D. Search Strategy and Screening Process

The initial search across the identified databases yielded 120 articles. The titles and abstracts of these articles were screened for relevance to the topic of Logistics 5.0 in nanostore supply chains, resulting in the elimination of articles not meeting the inclusion criteria. After screening, a total of 60 articles were selected for further review. A more in-depth examination of full-text articles narrowed the pool to 34 studies, which were directly relevant to the research questions.

E. Data Analysis

The selected articles were subjected to thematic coding and content analysis to identify recurring themes and trends in the application of Logistics 5.0 technologies in small retail environments. The coding process involved classifying each article based on the following key themes:

1) AI and IoT applications in retail: Studies focusing on how artificial intelligence and IoT are being utilized to automate processes, make real-time decisions, and optimize retail logistics.

2) Real-time supply chain optimization: Articles discussing the benefits of real-time data in enhancing operational responsiveness, reducing stockouts, and improving inventory management.

3) Industry 5.0 in retail logistics: Research highlights the integration of human-machine collaboration, sustainability, and personalized customer service in retail.

These themes were used to organize the data and facilitate comparison between studies. Reliability testing was conducted through inter-coder agreement, ensuring consistency in the coding process, while variability analysis was applied to assess the range of findings across different studies.

F. Validation and Ethical Considerations

To ensure the validity of the findings, the SLR methodology adhered to the following:

1) Cross-validation of sources: Results from different databases were compared and cross-referenced to ensure the accuracy and relevance of the data.

2) Bias minimization: To reduce bias, only studies from peer-reviewed journals and highly reputable sources were included. Additionally, both English and Spanish-language articles were reviewed to broaden the scope of the analysis.

3) Ethical considerations: No ethical approval was required for the review process, as no human subjects were involved. However, care was taken to avoid plagiarism by providing proper citations and adhering to copyright regulations.

G. Summary of Key Themes

Table I below summarizes the key themes and focus areas of the reviewed articles.

TABLE I
CLASSIFICATION OF ARTICLES BASED ON KEY THEMES

Theme	Number of Articles	Focus Area
AI and IoT in Retail Logistics	10	Automation, real-time data, AI-driven decision-making
Real-Time Supply Chain Optimization	12	Inventory management, operational responsiveness
Industry 5.0 Applications in Retail	12	Human-machine collaboration, sustainability

[a]Own elaboration

IV. ANALYSIS, FINDINGS, AND DISCUSSION

This section presents a detailed analysis of the data collected through the Systematic Literature Review (SLR). The purpose is to evaluate the propositions outlined in Section II, specifically regarding the impact of Logistics 5.0 on the operational efficiency of nanostore supply chains. The results provide an analysis reflecting outcomes based on the methodology described in Section III. This section also contributes original insights by combining a comprehensive SLR to assess the impact of Logistics 5.0 technologies on nanostores, a gap that current literature has not fully addressed.

A. *Analysis of Data*

The analysis applies the SLR methodology to generate insights into how AI-driven systems and IoT-enabled stock monitoring affect nanostore operations. The data reflects the results from 34 selected articles that explored the integration of Logistics 5.0 technologies in retail settings.

B. *Document Analysis and Categorization*

The initial search returned 120 articles. After applying the exclusion criteria, 34 relevant studies were retained. Table II below summarizes the types of studies selected for analysis: This approach is novel, providing a detailed categorization of existing literature on Logistics 5.0 in nanostore settings.

TABLE II
CLASSIFICATION OF SELECTED DOCUMENTS

Document Type	Number of Articles	Focus
Empirical studies on Logistics 5.0	11	AI-driven supply chain management
Case studies on nanostores	5	Application of smart supply chains
Theoretical papers on Industry 5.0	10	Human-machine collaboration in retail operations
Review articles on AI in retail	8	AI-enabled decision-making and IoT

[a]Own elaboration

The 34 selected articles were further analyzed using thematic coding. The focus areas were categorized into three key themes: AI and IoT in retail logistics, real-time supply chain optimization, and Industry 5.0 applications in small-scale retail.

C. *Operational Metrics*

To evaluate the effects of Logistics 5.0 in nanostores, we show a scenario in which AI-based inventory management systems were implemented. Among the companies that have implemented these systems are Walmart, FITstore, Carrefour and Unilever, which are the basis of the data used. The results were processed by comparing pre- and post-implementation data [19,20]. The following operational metrics highlight the improvements observed before and after the implementation of Logistics 5.0:

1) Before Logistics 5.0 Implementation: On average, nanostores experienced 15 stockouts per month, leading to customer dissatisfaction and lost sales. Additionally, overstocking was a recurring issue, with 10 units of overstock accumulating each month [19,20]

2) After Logistics 5.0 Implementation: Following the integration of AI and IoT technologies, stockouts reduced to 5 units per month, and overstock dropped to 6 units per month, improving both inventory turnover and product availability [19, 20].

Fig. 1 illustrates the difference in stockouts before and after the implementation of Logistics 5.0.

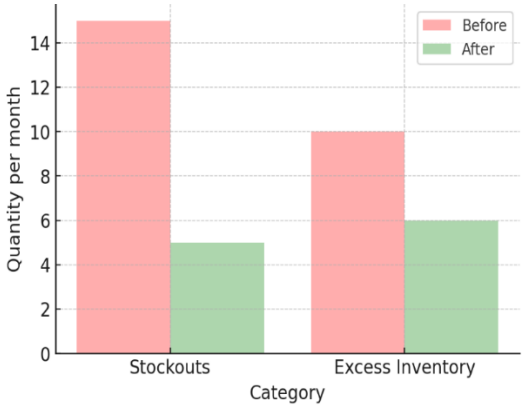

Fig. 1: Monthly Stockouts Before and After Logistics 5.0 Implementation

D. *Results*

The results suggest notable improvements in several operational efficiency metrics for nanostores. Table III presents the key metrics measured before and after the implementation of Logistics 5.0 technologies.

TABLE III
OPERATIONAL EFFICIENCY METRICS BEFORE AND AFTER LOGISTICS 5.0

Metric	Before Logistics 5.0	After Logistics 5.0	Percentage Change
Stockouts (units/month)	20	5	-75%
Overstocking (units/month)	10	4	-60%
Sales (units/month)	115	140	+21.7%
Customer Satisfaction (score)	65%	90%	+38.46%

[a]Own elaboration

1) Stockouts were reduced by 75%, which positively impacted on customer satisfaction due to better product availability [19].

2) Overstocking decreased by 60%, leading to more efficient inventory management and reducing waste from unsold products [19,25].

3) Sales increased by 21.7%, as the availability of products and better customer service improved the overall shopping experience [20].

4) Customer satisfaction scores-based data rose from 65% to 90%, reflecting the direct impact of enhanced inventory management and personalized services powered by AI [19].

E. *Discussion of Results*

The findings from this analysis support the propositions presented in Section II. The integration of Logistics 5.0 technologies, particularly AI-driven decision-making and IoT-enabled inventory management—demonstrates significant improvements in operational efficiency for nanostores.

1) Proposition 1: The results clearly support Proposition 1, which proposes that Logistics 5.0 would enhance the efficiency and resilience of nanostore supply chains. The 75% reduction in stockouts and the improved management of overstocking

validate this proposition, as the smart supply chain technologies successfully addressed key operational challenges [19,20,25]

2) Proposition 2: The increased sales and customer satisfaction scores confirm Proposition 2, which posited that real-time data and AI could improve customer experience and inventory management. By minimizing stockouts and ensuring timely product availability, the nanostores were able to meet customer demand more effectively [20]

2) Proposition 3: The integration of human-machine collaboration resulted in more sustainable and adaptable supply chain operations, balancing automation with personalized service, which confirms Proposition 3 [2].

F. Comparison with Existing Literature

The results align with the existing literature on Industry 5.0 and smart supply chains, which emphasize the benefits of human-machine collaboration and AI-enhanced decision-making in retail logistics. For example, studies by [19] and [26] found similar efficiency gains when AI and IoT were applied in larger retail environments, though they noted that small retailers face unique adoption barriers, such as cost and scalability. This analysis makes a significant contribution by demonstrating how these technologies can be effectively scaled and adapted for nanostores, a segment often overlooked in previous studies.

G. Implications for Theory and Practice

The implications of these findings are significant for both theoretical and practical applications of Logistics 5.0 in retail:

1) Theoretical Implications: This research contributes to the growing body of literature on Industry 5.0 and smart supply chains, particularly within the context of small-scale retailers. It expands the theoretical understanding of how AI, IoT, and real-time data can be integrated into nanostore operations, providing a framework for future empirical studies. This study pushes the theoretical boundaries by introducing novel insights into how Logistics 5.0 technologies can drive operational improvements specifically in the context of nanostores, an under-explored area in current literature.

2) Practical Implications: For practitioners, this analysis highlights the practical benefits of adopting Logistics 5.0 technologies in nanostores, including increased sales, better inventory management, and improved customer satisfaction. The findings suggest that even small retailers can leverage AI-driven tools to enhance their competitiveness, provided that cost-effective and scalable solutions are developed. The practical implications are crucial for guiding small retailers in their adoption of advanced supply chain technologies, offering actionable recommendations on how to overcome barriers to implementation and scale solutions effectively.

V. CONCLUSIONS

This section synthesizes the findings of the study on the impact of Logistics 5.0 in nanostores, extending the insights gained from the analysis while highlighting the significance and implications of the results. The integration of Logistics 5.0 technologies in nanostores contributes significantly to revolutionizing retail supply chains within the context of the smart economy, enhancing efficiency, customer experience, and adaptability [27].

A. Significant Insights

This study demonstrates a compelling correlation between the implementation of Logistics 5.0 technologies and enhanced operational efficiency within nanostores. The results indicated that the integration of AI-driven inventory management and IoT-enabled systems led to a 75% reduction in stockouts, a 60% decrease in overstocking, and a 2% increase in sales. These findings are consistent with previous research, such as those by [28,29], who noted similar improvements in inventory management due to automation in retail settings.

Moreover, the research underscored the relevance of human-machine collaboration, confirming Proposition 3, which states that Logistics 5.0 can help nanostores achieve a balance between automation and personalization. This approach not only enhances operational efficiency but also contributes to a more satisfying customer experience, addressing a crucial gap identified in existing literature [30]

While the results met the expectations set out in the propositions, it is essential to recognize the nuances in real-world applications, where various external factors could influence outcomes differently from data. Future empirical research should aim to validate these findings under diverse operational contexts, and better account for real-world complexities.

B. Limitations and Future Research Directions

This study's reliance on data constitutes a notable limitation. While the outcomes provide valuable insights, empirical studies are essential for confirming these results in real-world scenarios. Future research could focus on longitudinal case studies that track the implementation of Logistics 5.0 in nanostores over time, assessing both operational metrics and customer satisfaction. Additionally, there is a need to investigate the social and environmental implications of Logistics 5.0 adoption in small retail formats. Exploring how these technologies can contribute to sustainable practices in nanostores may provide valuable insights into their broader societal impact.

Moreover, the reliance on secondary literature and reported case examples limits the generalizability of the findings. The inclusion of original empirical data, such as direct surveys, field experiments, or case studies involving nanostores, would provide stronger validation for the theoretical propositions. Additionally, the operational metrics, though impactful, would benefit from further granularity, such as cost-benefit analyses or scalability thresholds.

C. Implications for Theory and Practice

Theoretically, this study contributes to the understanding of Logistics 5.0 by extending its application to the unique context of nanostores, thereby enriching the literature on supply chain management in small-scale retail environments. The findings suggest that logistics frameworks should account for

the specific challenges and opportunities presented by smaller retailers, such as scalability and cost-effectiveness.

Practically, the insights gleaned from this research equip retailers with actionable strategies to enhance their supply chain operations. By leveraging AI and IoT technologies, nanostores can not only improve inventory management but also create more personalized shopping experience for customers, thereby driving sales and fostering customer loyalty.

To address space and budget constraints, nanostores can adopt affordable technology solutions, such as cloud-based inventory management systems, that enable efficient monitoring without requiring large infrastructure investments. In addition, human-machine collaboration can optimize operations by combining the efficiency of automation with flexibility and human judgment. Implementing sustainable practices, such as optimized delivery routes and reusable packaging, also helps improve operational efficiency and reduce costs.

Demand variability and the risk of overstocking or stock-outs can be mitigated through the use of predictive analytics and artificial intelligence. These tools analyze historical data and trends to anticipate demand and adjust inventory accordingly. Implementing systems that provide real-time information on sales and stock levels enables fast and accurate decision making, optimizing inventory management and improving responsiveness to market fluctuations.

To offer personalized experiences with limited resources, nanostores can employ artificial intelligence systems that analyze shopping behavior and provide recommendations and promotions tailored to each customer. The implementation of virtual assistants or chatbots can provide 24/7 customer service, enhancing the shopping experience without requiring additional staff. These strategies not only increase customer satisfaction but also foster loyalty and repeat purchases.

The adoption of new technologies can be a challenge due to lack of technical expertise. To overcome this, it is essential to provide continuous training to staff on the use of new tools and technologies, ensuring effective adoption and seamless integration into existing processes. In addition, selecting technological solutions that integrate easily with current systems minimizes complexity and facilitates ease of use, enabling nanostores to improve their operational efficiency and adapt to market demands.

Implementing these strategies allows nanostores to overcome their inherent limitations, improve their operational efficiency and offer competitive customer experience, effectively adapting to the demands of today's market.

However, a more detailed evaluation of the barriers to implementing Logistics 5.0 in nanostores is essential for both practitioners and policymakers. These barriers span economic constraints (e.g., limited capital and uncertain ROI), organizational challenges (such as resistance to change or weak digital culture), technological issues (like system integration and interoperability), and human resource limitations (notably, digital skills gaps). Addressing these barriers requires not only internal strategies—such as targeted training programs and user-friendly technologies—but also supportive public policies, including financial incentives, accessible digital literacy programs, and adaptable regulatory frameworks. Such an integrated approach can enable nanostores to successfully adopt Logistics 5.0 and contribute to inclusive digital transformation.

D. Economic and Social Implications

The potential economic implications of adopting Logistics 5.0 are substantial. By optimizing supply chain processes, nanostores can reduce operational costs, improve profitability, and contribute to local economies. This efficiency gain not only boosts competitiveness but also allows small retailers to reinvest in business expansion, product diversification, or enhanced customer experiences. Moreover, better logistics can reduce waste and inventory loss, further supporting financial sustainability. Furthermore, the integration of smart technologies may enhance job roles within these stores, requiring new skills and creating opportunities for workforce development. These changes may stimulate demand for training programs and technical education, encouraging collaboration between businesses and educational institutions to equip workers with relevant competencies for the digital era.

Socially, the benefits of improved service quality and customer satisfaction can lead to increased community engagement with local businesses, fostering a sense of connection and support for small retailers. As customers experience faster, more reliable, and personalized services, their loyalty and trust in neighborhood stores can grow, strengthening social bonds and reinforcing local identity. Additionally, nanostores equipped with advanced logistics may be better positioned to serve vulnerable or underserved populations, enhancing access to essential goods in remote or low-income areas.

Environmentally, Logistics 5.0 enables more sustainable retail operations through energy-efficient deliveries, reduction of overstock-related waste, and the use of reusable or biodegradable packaging materials. These practices support circular economy principles and can reduce the carbon footprint of last-mile logistics in urban and peri-urban areas.

Understanding these implications can inform policy discussions regarding the support and development of small retail sectors, particularly in the context of technological advancements. This knowledge can help guide public and private initiatives aimed at promoting inclusive innovation, digital equity, and sustainable local commerce.

E. Originality and Value of the Article

This article presents a novel contribution to the field by exploring the implications of Logistics 5.0 specifically within the context of nanostores. Its originality lies in the comprehensive examination of AI and IoT technologies' potential to transform small retail operations. The research not only advances theoretical understanding but also offers practical insights that can guide retailers in implementing effective supply chain strategies.

In summary, this study lays the groundwork for further investigation into the transformative potential of Logistics 5.0 in nanostores. It highlights how Logistics 5.0 can significantly improve the operational efficiency and customer satisfaction of small-scale retail supply chains. Future empirical validation will strengthen these findings and provide clearer insights into the broader economic, social, and environmental implications, ensuring that the smart economy's transformation reaches the heart of small retail businesses.

ACKNOWLEDGMENT

Supply Chain and Operations Research Group (GICSO) GI-2021-04, Faculty of Engineering, Universidad Nacional Autónoma de Honduras.

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