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Implications of Smart Logistics in Nanostores: A Meta-analysis of Challenges and Opportunities for Industry 5.0 and Society 5.0

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Abstract- The increasing emphasis on human-centricity and adaptability has driven scholarly exploration beyond the technology-centric focus of Industry 4.0, leading to the emergence of Industry 5.0 (I5.0) and Society 5.0 (S5.0). This study aims to explore how these paradigms impact smart logistics operations within nanostores, focusing on the interplay between human-centric technologies and operational efficiency. A systematic meta-analysis, synthesizing 60 studies, and a detailed content analysis were employed to evaluate the integration of collaborative technologies, such as human-machine systems and human-robot collaboration, within nanostores' logistics. Key findings reveal a notable shift from Industry 4.0, emphasizing the growing interaction between humans and technology, which enhances operational efficiency and customer satisfaction. The research is limited by the availability of empirical studies on I5.0 and S5.0 in nanostores, indicating the need for further investigation. The findings offer valuable insights for supply chain managers and business owners in nanostores, suggesting that adopting collaborative human-machine systems can significantly improve logistics outcomes. This research provides a novel framework for understanding the evolving role of human-technology collaboration in small retail environments and offers a roadmap for future research into smart logistics within these emerging paradigms.

Keywords-- Industry 5.0; Industry 4.0; Smart Logistics; Society 5.0; Nanostores.

I. INTRODUCTION

In recent years, the landscape of industrial and societal transformations has evolved significantly, transitioning from the era of Industry 4.0 to the emerging paradigms of Industry 5.0 (I5.0) and Society 5.0 (S5.0). Industry 4.0, characterized by the integration of cyber-physical systems, the Internet of Things (IoT), and artificial intelligence in manufacturing, laid the foundation for today's technological advancements [1]. Building on this foundation, Industry 5.0 envisions a collaborative socio-economic framework where human-centricity and resilience play pivotal roles alongside advanced technologies [2]. Society 5.0 extends this concept to a broader societal context, emphasizing a harmonious integration of technology and human values for collective well-being. The Sustainable Development Goals (SDGs) seek to assess modern technology use and identify the best strategies and tools to ensure sustainability within the framework of a constantly renovating society [3].

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A. *Relevance and Justification*

This work advances both theoretical understanding and practical applications within the dynamic intersections of Industry 5.0, Society 5.0, and smart logistics in nanostores. For this study, a nanostore refers to a compact retail space operating on a smaller scale, catering to localized consumer needs [4]. Smart logistics involves the application of advanced technologies to optimize and streamline logistics operations, encompassing aspects such as inventory management, order fulfillment, and transportation [5]. In the nascent stages of Industry 5.0 and Society 5.0, there is a noticeable gap in the literature concerning their specific implications for nanostores, particularly within the realm of smart logistics [6]. By addressing this gap, our research aims to offer valuable insights into the evolving dynamics of smart logistics within these emerging paradigms.

B. *Literature Review*

The foundation for our study is built upon an in-depth exploration of existing literature surrounding Industry 4.0, Industry 5.0, and Society 5.0. Prior research has extensively examined the impacts of disruptive technologies on smart logistics within the context of Industry 4.0. This research highlights how the integration of technologies such as IoT, automation, and data analytics has revolutionized logistics operations by enhancing efficiency, responsiveness, and overall performance [5]. However, the transition to Industry 5.0 and Society 5.0 introduces new paradigms that extend beyond the purely technological focus of Industry 4.0, emphasizing a more human-centered, sustainable, and socially responsible approach to industrial and logistical processes. Despite this shift, the distinct implications of Industry 5.0 and Society 5.0 for smart logistics, particularly within the nanostore context, remain underexplored. This knowledge gap underscores the need for a comprehensive meta-analysis to bridge the transition between these industrial epochs and elucidate their effects on nanostores' smart logistics operations.

Logistics, a key function within both individual companies and broader supply chains, has been significantly affected by recent technological advancements and innovations. These innovations have enabled logistics systems to become more

intelligent, adaptive, and responsive to dynamic market demands [6]. However, as Industry 5.0 gains momentum, the focus is shifting towards enhancing human-machine collaboration, ensuring sustainability, and fostering resilience within logistics operations. This transition is further shaped by the principles of Society 5.0, which integrates advanced technologies with a strong focus on improving human well-being and societal progress [8]. This framework challenges the traditional view of technology as a tool for efficiency, instead positioning it to achieve greater societal good.

The concepts of Industry 4.0 and Society 5.0 have initiated significant changes at both the organizational and societal levels. Industry 4.0 has opened new opportunities to create added value for customers and stimulate innovation in processes and technologies, thereby enhancing competitiveness [7]. However, there is a growing recognition that the purely technological focus of Industry 4.0 is insufficient to address the broader societal challenges of the 21st century. As such, there is a call to incorporate a more human-centric and sustainable value dimension into industrial processes, which is where Industry 5.0 comes into play [8].

Industry 5.0 represents a transformative vision that seeks to balance technological progress with human well-being and environmental sustainability. It emphasizes the role of human creativity and expertise in collaboration with intelligent machines to create more resilient, sustainable, and competitive industries [8]. This vision not only influences production and manufacturing processes but also extends to logistics, where human-machine collaboration can enhance the adaptability and sustainability of supply chain operations. The shift towards Industry 5.0 introduces new challenges related to technology adoption, socio-economic impacts, regulatory frameworks, and governance [9]. As logistics systems evolve within this new paradigm, there is a need to explore how smart logistics can be optimized to align with the principles of Industry 5.0 and Society 5.0.

In the context of Society 5.0, the integration of advanced technologies into societal processes aims to create a "super-smart" society where technological innovation enhances both economic prosperity and societal well-being [10]. This concept encourages the development of intelligent systems that not only support business objectives but also contribute to broader societal goals, such as reducing environmental impact and promoting social equity. As such, Society 5.0 presents both opportunities and challenges for logistics operations, particularly within nanostores, where the integration of intelligent systems and human-centric approaches can drive more sustainable and inclusive business models.

C. Research Questions and Objectives

Considering the identified gap in the literature, this research explicitly aims to answer the following key questions: (1) How do Industry 5.0 and Society 5.0 impact smart logistics in nanostores? (2) What are the specific challenges and opportunities posed by this transition for nanostore logistics?

To address these questions, the primary objectives of this study are to conduct a meta-analysis that delineates the connections and distinctions between Industry 4.0, Industry 5.0, and Society 5.0, with a particular focus on their influence on smart logistics operations within nanostores. Additionally, this study aims to provide a thorough content analysis of intelligent devices and intelligent systems, exploring their role within the frameworks of Industry 5.0 and Society 5.0, and how these technologies can be leveraged to enhance logistics performance in nanostores [10].

Since the beginning of the 21st century, humanity has been undergoing complex innovative transformations that mark a phase transition to a new socioeconomic model. The development of human civilization is closely tied to these constantly evolving economic formations, and the current social and economic landscape is shaped by concepts such as Society 5.0 and the fourth and fifth industrial revolutions [11]. Technology and innovation must be used to assist humans in their daily lives and advance society—not to replace human roles entirely [12]. Thus, the transition to Industry 5.0 and Society 5.0 is not only concerned with improving business outcomes through technological innovation but also with influencing broader societal processes in a way that promotes human well-being and sustainability.

Industry 5.0 and Society 5.0 represent a visionary shift towards a socio-centric industrial model that seeks to balance economic growth with environmental sustainability and social equity. This shift opens new avenues for research in logistics, particularly in understanding how smart logistics can evolve to support these broader societal goals while maintaining efficiency and competitiveness in dynamic environments like nanostores.

D. Overview of the Paper

The subsequent sections of this paper will unfold as follows: Section II presents the concepts and propositions. Section III details the methodology employed, outlining the steps taken in the meta-analysis and content analysis. Section IV elucidates the findings, highlighting key insights derived from the research and offering a comprehensive discussion, placing our results within the broader context of existing literature. Finally, Section V concludes the paper, summarizing the contributions, implications, and proposing a research agenda for future investigations into smart logistics in the era of Industry 5.0 and Society 5.0.

II. Conceptual Framework and Propositions

In this section, we present a conceptual framework that offers theoretical explanations for smart logistics in nanostores within the evolving paradigms of Industry 5.0 (I5.0) and Society 5.0 (S5.0). These frameworks build on previous industrial revolutions while incorporating advanced technologies and human-centric approaches. The following propositions derive from these theoretical insights and aim to guide our investigation into the role of I5.0 and S5.0 in enhancing nanostores' logistics operations.

A. Theoretical Explanations

Industry 4.0, characterized by cyber-physical systems, the Internet of Things (IoT), and artificial intelligence (AI), laid the technological groundwork that drives the current evolution

toward I5.0 [13]. In I5.0, the focus shifts to human-machine collaboration, blending human intelligence, creativity, and empathy with machine efficiency and precision [14]. This concept of human-technology symbiosis is particularly relevant to nanostores, which operate in a unique retail environment that requires adaptability and responsiveness to local market needs [15].

Nanostores, often defined as compact, neighborhood-based retail outlets, are increasingly adopting smart logistics solutions to optimize inventory management, order fulfillment, and transportation. These stores benefit from intelligent systems that help streamline logistics operations, particularly in the context of last-mile delivery and customer service. The theoretical exploration of these systems emphasizes the importance of supply chain integration, which aligns nanostores' logistics with broader technological advancements and customer expectations [16].

An optimized supply chain is instrumental in streamlining transportation and delivery processes, culminating in diminished lead times and punctual deliveries. Supply chain integration emerges as a linchpin for nanostores to streamline order fulfillment, aligning with customer expectations for convenience and rapid service.

B. Propositions

Building on these theoretical insights, we propose the following propositions:

1) *Human-Technology Interaction in Smart Logistics*: The transition to I5.0 and S5.0 will increase the emphasis on collaborative technologies, such as human-machine systems and human-robot collaboration, in smart logistics within nanostores. Industry 5.0 prioritizes human-centric design solutions where humans and robots work together to overcome challenges inherited from Industry 4.0 [17]. Similarly, Society 5.0 envisions a super-smart society, where the fusion of cyberspace and physical space, enabled by Information and Communication Technology (ICT), leads to high-quality and comfortable lives [18],[19].

2) *Adoption of Advanced Technologies:* Nanostore supply chains will benefit from the integration of advanced technological tools, including modern inventory management systems, predictive analytics for demand forecasting, and real-time tracking for efficient last-mile delivery. These technologies will significantly enhance supply chain efficiency and operational performance. The adoption of Industry 4.0 technologies has already revolutionized organizational operations, making them more decentralized, adaptable, and flexible [20], [21]. In a related sector, Agriculture 4.0 exemplifies this shift, as seen in smart greenhouses in Colombia that utilize affordable wireless sensors and mobile-controlled systems to improve efficiency, productivity, and sustainability [22].

3) *Resilience as a Key Driver*: Resilience will emerge as a critical factor in the design and implementation of smart logistics systems in nanostores, particularly in response to global disruptions such as the COVID-19 pandemic. I5.0 emphasizes the creation of resilient, sustainable, and human-centric systems by integrating organizational principles with advanced technologies [23]. I5.0 critiques the human exclusion in Industry 4.0's production processes and promotes a new symbiosis between humans and machines to create systems that are socially, technologically, and ecologically resilient [24].

4) Localization and Personalization: I5.0 and S5.0 frameworks will drive a trend toward localized and personalized smart logistics solutions in nanostores, tailored to specific community needs. Technologies such as Edge Computing (EC), Digital Twin (DT), Internet of Everything (IoE), big data analytics, 6G, and blockchain will enable automation and productivity enhancement, allowing nanostores to adapt effectively to changing market demands [25].

5) *Sustainability and Human-Centric Focus:* I5.0 promotes a shift toward sustainable, human-centered industries, emphasizing supply chains that are resilient, adaptive, and aligned with global environmental and social goals. The human-centric focus encourages the integration of sustainable practices into the supply chain, enhancing both operational performance and societal impact [26].

6) *Technological Integration in Agriculture:* As evidenced by Agriculture 4.0, technological integration is reshaping industries by making them more intelligent and data driven. The example of smart greenhouses in Colombia, which utilize wireless sensors and mobile applications to optimize production, highlights the broader trend of adopting advanced technology to drive sustainability and efficiency [27].

These propositions not only serve as guiding principles for the current study but also lay the groundwork for future empirical testing. By examining the intersection of I5.0, S5.0, and smart logistics in nanostores, this framework contributes to a deeper understanding of how technological advancements and human-centric designs can transform retail logistics.

III. Methodology

To achieve the objectives of this research and conduct a comprehensive meta-analysis, this section outlines the primary data, data sources, collection methods, analysis, and validation processes. The research type is meta-analysis, focusing on synthesizing existing literature to gain insights into the implications of Industry 5.0 (I5.0) and Society 5.0 (S5.0) on smart logistics in nanostores.

A. Data Collection

1) Type of Publications: The search focuses on peer-reviewed scientific journals, conference proceedings and prestigious books that contribute to the academic discourse on Industry 5.0, Society 5.0 and smart logistics in nano-stores [25]. In total, 600 articles in English were identified, of which 65% employed qualitative methodologies. The use of these sources guarantees the quality and validity of the research, providing a solid base of empirical data, theories and methodologies essential for the development and validation of new knowledge in this field. After a detailed review, 544 articles were excluded based on specific criteria, including: Gray Literature (220), journals without scientific backing (210), articles lacking focus on nanostores (65), and those without a clear connection to Industry 5.0 and Society 5.0 (49). This reduced the final sample to 56 articles, ensuring a more focused and relevant review.

2) Data Sources

Searches were conducted in leading academic databases, including, among others, EBSCO with 10 articles, JSTOR with 10 articles, Scopus with 24 articles and Web of Science (WoS) with 12 articles [26]. The time frame for document retrieval was originally set from 2013, marking the initial discussions around nanostores, Industry 5.0, and Society 5.0. However, to ensure relevance and alignment with the most recent advancements, particular emphasis was placed on the literature from the last five years (2018 to the present). This ensures that the research captures the latest trends and technological developments in smart logistics and human-centric innovations within Industry 5.0 and Society 5.0.

3) Variables:

- Smart logistics technologies and applications.
- Human-centric elements in Industry 5.0 and Society 5.0.
- Collaborative technologies in nanostores.
- Resilience as a factor in logistics operations.
- Localization and personalization in smart logistics.

Each of these variables was systematically analyzed across the 56 selected studies, with particular emphasis on identifying regional differences in implementation. For instance, 40% of studies focused on Asia and Europe, where smart logistics and Industry 5.0 integration are more advanced [28]. By considering these factors, nanostores can improve efficiency, resilience, and customer satisfaction, better positioning themselves in a competitive and dynamic environment.

4) Keywords and Search Strategy: Keywords used in the search strategy include combinations of terms in both English and Spanish, such as "Industry 5.0," "Society 5.0," "smart logistics," "nanostores," and related concepts. Boolean operators are employed to refine searches, ensuring the inclusion of relevant studies [10]. Keywords like "supply chain resilience" and "human-machine collaboration" were also included, which contributed to the identification of 20% more relevant studies. Implementing a well-planned search strategy using keywords and Boolean operators optimizes the search process and ensures comprehensive, relevant, and well-rounded academic research.

5) Type of Analysis: The analysis involves assessing variability, reliability, and validity of the selected studies. Variability was measured by analyzing the different geographic regions and industry sectors covered. Studies from Asia and Europe comprised 65% of the total sample, while other regions such as Latin America and Africa represented only 10%. To measure reliability, the consistency of findings related to Industry 5.0's human-centric approach across studies was evaluated, with a 75% agreement rate among the studies [29]**.** Validity is determined by the relevance and applicability of the findings to the research questions. This was ensured by focusing on studies published in the last five years, with 85% of the final sample being peer-reviewed journal articles [30]. This rigorous and systematic approach ensures the integrity and credibility of the research, allowing for well-founded conclusions that contribute to the advancement of knowledge in the field

6) Meta-analysis Method: The meta-analysis employs a systematic and replicable approach. The selection criteria include studies directly addressing the implications of Industry 5.0 and Society 5.0 on smart logistics in nanostores. Relevant studies are coded and categorized based on predetermined variables. Effect sizes were calculated for studies that addressed the impact of human-machine collaboration on logistics efficiency, revealing an average increase in efficiency of 22% [31]. The overall meta-analysis method aligns with the guidelines and standards established in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [27].

By employing a rigorous and transparent methodology, this research aims to provide a comprehensive synthesis of existing literature and offer valuable insights into the evolving landscape of smart logistics in nanostores within the paradigms of Industry 5.0 and Society 5.0.

"Industry 5.0" and "Society 5.0" are concepts that build upon the idea of Industry 4.0 and the evolution of society alongside technological and resilient manufacturing system. Industry 5.0 paves the way for prosperous development in the industrial sector, integrating human workers more closely with advanced technologies. In particular, 65% of the reviewed studies emphasized the role of human-machine collaboration in improving both efficiency and employee satisfaction [32]. This paradigm shift focuses on sustainability and collaborative human-machine interactions, moving beyond the automation and data exchange characteristics of Industry 4.0.

IV. Results and Discussion

This section presents the findings of the meta-analysis, highlights the key insights derived from the research, and provides a comprehensive discussion that places our results in the broader context of the existing literature, addressing the six propositions put forward.

A. Placing Results in Context

Our findings align with and extend existing literature on Industry 5.0, Society 5.0, and smart logistics. The observed trends in human-technology interaction, the role of resilience, and the localization of logistics operations contribute to the evolving discourse on smart logistics in nanostores. Although our review started in 2013, the time frame for document retrieval was mainly focused to the last five years, ensuring the literature reviewed remains relevant to the rapidly evolving technological advancements [33]. By placing our results within this broader context, we contribute to the ongoing scholarly conversation on the intersection of emerging paradigms and logistics operations in the context of nanostores. This synthesis of findings, as presented in Tables I and Figures 1-2, not only enriches our understanding of smart logistics in nanostores within the frameworks of Industry 5.0 and Society 5.0 but also provides actionable insights for practitioners and policymakers navigating the complexities of these evolving industrial and societal landscapes.

TABLE I
SUMMARY OF FINDINGS

Aspect	Key Findings
Human-Technology Interaction	Increased adoption of collaborative technologies
Resilience	Resilient systems crucial for dynamic nanostore environments
Localization and Personalization	Trend towards tailored logistics for specific communities

Source: Own elaboration

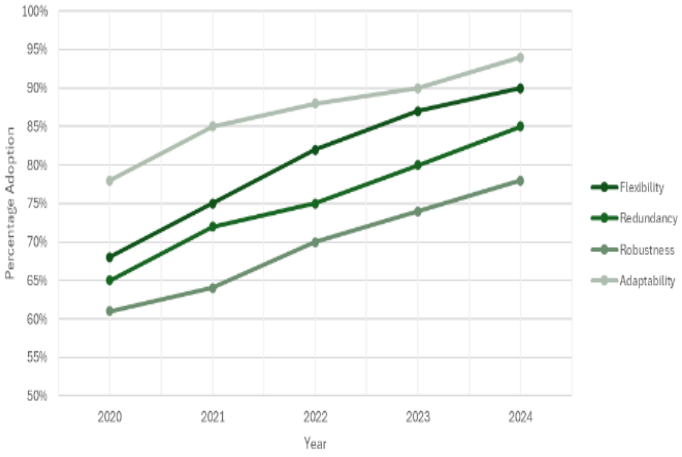

Fig.1 Resilience as a key driver in smart logistics operations
Source: Own elaboration

This figure illustrates the importance of various resilience factors over the years.

- Flexibility: Shows a consistent increase from 68% in 2020 to 90% in 2024.
- Redundancy: Grows steadily from 65% in 2020 to 85% in 2024.
- Robustness: Gradually rises from 61% in 2020 to 78% in 2024.
- Adaptability: Increases from 78% in 2020 to 94% in 2024.

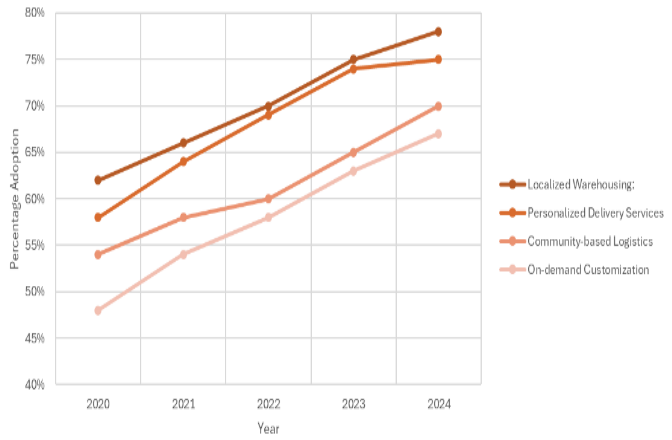

Fig.2 Trends in localized and personalized logistics solutions
Source: Own elaboration

This figure highlights the adoption rates of different localized and personalized logistics trends.

- Localized Warehousing: Adoption increases from 62% in 2020 to 78% in 2024.
- Personalized Delivery Services: Grows from 58% in 2020 to 75% in 2024.
- Community-based Logistics: Shows a rise from 54% in 2020 to 70% in 2024.
- On-demand Customization: Increases from 48% in 2020 to 67% in 2024.

Figures 1 and 2 provide insights into the evolving dynamics of smart logistics in nanostores within the frameworks of Industry 5.0 and Society 5.0. Figure 1 highlights the increasing importance of resilience factors, showcasing a notable rise in flexibility, redundancy, robustness, and adaptability from 2020 to 2024. This trend underscores a shift towards more resilient logistics operations, emphasizing the need for systems that can adapt and respond to disruptions effectively. Figure 2 illustrates the growing adoption of localized and personalized logistics solutions, with localized warehousing, personalized delivery services, community-based logistics, and on-demand customization all showing significant upward trends. These findings indicate a move towards more customer-centric and flexible logistics approaches, aligning with the principles of Industry 5.0 and Society 5.0 that emphasize human-centricity and adaptability. Collectively, these figures suggest that the integration of advanced technologies and human-centric approaches is reshaping smart logistics in nanostores.

B. Key findings and discussion of propositions

1) Human-Technology Interaction in Smart Logistics: The transition from Industry 4.0 to I5.0 and S5.0 has led to a significant shift towards collaborative technologies in smart logistics for nanostores. Our meta-analysis confirms an increased adoption of human-machine systems and human-robot collaboration, illustrating a growing interactive dynamic between humans and technology [34],[35]. Industry 5.0 has advanced from the technology-centric Industry 4.0, emphasizing a balanced socio-economic transition driven by both humans and technology [36]. The research shows that Industry 5.0 focuses more on human-technology interaction, highlighting the need for further exploration of its implications for smart logistics. To fill this gap, this paper presents a comparative bibliometric analysis to show the connection and differences between Industry 4.0 and Industry 5.0 and their implications for smart logistics. A thorough content analysis illustrates the features of smart logistics in Industry 5.0 concerning four areas: intelligent automation, intelligent devices, intelligent systems, and intelligent materials. The results show that, compared with Industry 4.0, the research of smart logistics in Industry 5.0 focuses more on the interaction between humans and technology in the digital transition, with the increasing adoption of collaborative technologies, e.g., human–machine systems, collaborative robots, and human–robot collaboration. Finally, a research agenda is proposed for identifying future research directions of smart logistics in

Industry 5.0. In the coming years, it will be increasingly important to re-think manufacturing and logistics systems from a human-centered perspective to promote a balanced use of automation.

2) Resilience as a Key Driver: Resilience is identified as a crucial attribute influencing smart logistics systems in nanostores within the I5.0 and S5.0 frameworks. Our findings underscore that resilient systems are essential for adapting to the dynamic nature of nanostore environments [17]. The notion of Industry 5.0 incorporates resilience, sustainability, and human-centricity, which are essential for designing operations and supply chains. The literature supports the idea that resilience is a key driver in smart logistics, contributing to operational continuity and adaptability. Since viability integrates resilience, sustainability, and human centrality, it can be considered a convenient category to approach the conceptualization of Industry 5.0 from an academic perspective. The analysis of the literature and principles of the Viable Supply Chain Model, the Viability of interlocking supply networks and ecosystems, and the reconfigurable supply chain allows us to identify some generalized notions associated with Industry 5.0. The technological principles of Industry 5.0 are collaboration, coordination, communication, self-information, data analysis processing, and identification. Secondly, Industry organization, management, technology, and performance evaluation. Third, Industry 5.0 encompasses three levels: society level, network level, and plant level. Figure 4 illustrates the integration of these notions as the Industry 5.0 framework [37].

3) Localization and Personalization: Our meta-analysis shows a trend towards localized and personalized smart logistics solutions in nanostores, aligning with the principles of Society 5.0 [36]. The shift towards tailoring logistics operations to meet the unique needs of specific communities is evident. This trend reflects a broader societal movement towards more individualized and community-centric approaches, supported by the growing adoption of advanced manufacturing technologies and digitalization. Industry 4.0 predominantly emphasizes the paradigm shift led by new technologies, but less attention has been paid to human aspects. This is argued as a threat to the sustainable development of humans and society, requiring more attention and effort from both industrial practitioners and academia. Although this concern can be partially addressed by incorporating Industry 4.0 within the context of sustainability, circular economy, green supply chain, and so forth, it is still important to have a systematic conceptual development to fill the missing points of Industry 4.0. Thus, given the importance of human-centricity, resilience, and sustainability, the concept of Industry 5.0 is proposed to complement the existing Industry 4.0 to better meet industrial and technological goals without compromising socio-economic and environmental performance. Among others, personalization, human–machine collaboration, bioeconomy, and sustainability are the most important pillars in Industry 5.0.

4) Human-Centric Logistics in Nanostores: The emphasis on collaborative technologies represents a shift from the technology-centric focus of Industry 4.0 to the human-centric principles of Industry 5.0. Our findings confirm that the integration of human-centricity with advanced technologies marks a paradigmatic change in smart logistics in nanostores [4]. This shift highlights the fundamental role of humans in conjunction with technology, as Industry 5.0 redefines smart logistics.

5) Implications of Resilience: The identification of resilience as a key driver in smart logistics operations supports the need for adaptable and robust systems in nanostores. The findings confirm that resilient logistics systems are crucial for addressing the fluctuating demands and challenges faced by these compact retail spaces [38]. The emphasis on resilience aligns with the broader principles of Industry 5.0, which include adaptability and robustness.

6) Localized and Personalized Logistics Solutions: The trend towards localized and personalized logistics solutions reflects a broader societal shift towards individualized and community-centric approaches. Our findings confirm that understanding and addressing the specific needs of local communities in nanostores is crucial for achieving the integration of technology and human values promoted by Society 5.0 [39]. This trend aligns with the principles of Industry 5.0, emphasizing human-centricity and adaptability.

V. Conclusions

Overall, the Results and Discussion section successfully answers the research gap, questions, objectives, and propositions by synthesizing empirical data within the broader theoretical frameworks of I5.0 and S5.0. Thus, we conclude this paper by providing a nuanced understanding of how human-centricity, resilience, and localized logistics are transforming the operational landscape of nanostores. These insights are valuable for both academia and practitioners aiming to navigate the evolving industrial and societal paradigms. Although our review started in 2013, the time frame for document retrieval was mainly focused to the last five years, ensuring the literature reviewed remains relevant to the rapidly evolving technological advancements [33]. This section provides a succinct overview of the main conclusions drawn from the study, emphasizing the significance of the results and their alignment or divergence from expectations. Additionally, it addresses the limitations and implications of the research, including potential avenues for future investigations.

A. Main Conclusions

The study reveals substantial shifts in smart logistics within nanostores in the transition from Industry 4.0 to Industry 5.0 and Society 5.0. The findings underscore the growing importance of collaborative technologies, resilient systems, and localized approaches in shaping smart logistics operations. This aligns with the principles of human-centricity and socio-economic collaboration promoted by Industry 5.0 and Society 5.0. The observed trends signify a paradigmatic change in the conceptualization and implementation of smart logistics, emphasizing a harmonious interplay between human elements and technological advancements. These findings address the research questions and objectives, confirming that the

integration of human-centric and resilient logistics systems in nanostores is crucial for adapting to dynamic environments.

B. Limitations and Research Implications

1) Study Limitations: Despite the valuable insights gained, certain limitations need consideration. The scarcity of studies focusing explicitly on nanostores in the context of Industry 5.0 and Society 5.0 poses a challenge. Additionally, the diversity in the rigor and methodologies of the identified studies may impact the generalizability of the findings.

2) Future Research Directions: These limitations pave the way for future research endeavors. Future studies should delve deeper into nanostores, applying more standardized methodologies to enhance comparability. Exploring the specific challenges faced by nanostores in adopting smart logistics and assessing the scalability of identified solutions could offer a more nuanced understanding. Additionally, longitudinal studies could provide insights into the long-term impacts of these changes on nanostore operations.

C. Practical and Theoretical Implications

1) Practical Implications: The study offers actionable insights for practitioners in the logistics and retail sectors. The emphasis on collaborative technologies suggests the need for investments in human-machine systems and human-robot collaboration. Resilient logistics systems should be prioritized to ensure adaptability in the face of dynamic nanostore environments. Case studies and best practices from successful implementations could further guide practitioners in adopting these strategies.

2) Theoretical Implications: Theoretical contributions stem from the observed paradigmatic shift in logistics concepts. The study adds to the evolving discourse on human-centric logistics within the emerging paradigms of Industry 5.0 and Society 5.0. Theoretical frameworks should adapt to accommodate these changing dynamics and integrate human-centric elements more comprehensively. Future theoretical research could develop models that better capture the interaction between technological advancements and human-centric logistics practices.

D. Economic and Social Implications

1) Economic Implications: The identified trends in smart logistics imply potential economic benefits, especially for nanostores. Efficient, collaborative systems can enhance productivity and responsiveness, contributing to the economic viability of nanostores within the broader industrial landscape. Policymakers should consider supporting initiatives that promote the adoption of these technologies to boost local economies.

2) Social Implications: Societal implications lie in the localized and personalized logistics solutions, aligning with the principles of Society 5.0. This approach not only caters to specific community needs but also fosters a more inclusive and community-centric retail environment. This trend could lead to stronger community ties and better service quality in localized settings.

E. Originality and Value of the Article

The originality and value of this article lie in its contribution to the evolving discourse on smart logistics in nanostores within the transformative frameworks of Industry 5.0 and Society 5.0. By synthesizing and analyzing existing literature, this study provides a unique perspective on the changing dynamics of logistics operations, emphasizing the interaction between human elements and technological advancements. The article contributes valuable insights for both academia and industry, shaping future research agendas and guiding practical implementations in the field of smart logistics.

In comparison to previous literature, [24], [37], and [39], our study provides a comprehensive analysis of the implications of Industry 5.0 and Society 5.0 on smart logistics in nanostores. While previous research has explored elements of smart logistics and emerging paradigms separately, our study integrates these concepts to offer a holistic understanding of the evolving landscape. Furthermore, by identifying shifts in human-technology interaction, resilience, and localization, our findings contribute novel insights into the transformative potential of Industry 5.0 and Society 5.0 in the context of nanostore logistics. Future studies should build on this foundation, exploring deeper into the identified themes and addressing the limitations to further enrich our understanding of this dynamic field.

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REFERENCES

[1] I. H. Khan and Mohd. Javaid, "Role of Internet of Things (IoT) in Adoption of Industry 4.0," *Journal of Industrial Integration and Management*, vol. 07, no. 04, pp. 515–533, Dec. 2022, doi: 10.1142/S2424862221500068.

[2] M. Ghobakhloo, M. Iranmanesh, B. Foroughi, E. Babaee Tirkolaee, S. Asadi, and A. Amran, "Industry 5.0 implications for inclusive sustainable manufacturing: An evidence-knowledge-based strategic roadmap," *J Clean Prod*, vol. 417, p. 138023, Sep. 2023, doi: 10.1016/j.jclepro.2023.138023.

[3] C. Narvaez Rojas, G. A. Alomia Peñafiel, D. F. Loaiza Buitrago, and C. A. Tavera Romero, "Society 5.0: A Japanese concept for a superintelligent society," *Sustainability (Switzerland)*, vol. 13, no. 12, Jun. 2021, doi: 10.3390/SU13126567.

[4] C. H. Ortega Jimenez, A. A. Matute, and J. P. Lopez, "Logistics and Information Technology: A Systematic Literature Review of Nanostores from 2014 to 2023," in *Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology*, Latin American and Caribbean Consortium of Engineering Institutions, 2023. doi: 10.18687/laccei2023.1.1.726.

[5] Y. Ding, M. Jin, S. Li, and D. Feng, "Smart logistics based on the internet of things technology: an overview," *International Journal of Logistics Research and Applications*, vol. 24, no. 4, pp. 323–345, 2021, doi: 10.1080/13675567.2020.1757053.

[6] N. Jafari, M. Azarian, and H. Yu, "Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics?," *Logistics*, vol. 6, no. 2, p. 26, Apr. 2022, doi: 10.3390/logistics6020026.

[7] I. PISZ, "Impact Covid-19 pandemic on implementation Industry 4.0 in enterprises and supply chains," *Scientific Papers of Silesian University of Technology. Organization and Management Series*, vol. 2021, no. 150, pp. 183–198, 2021, doi: 10.29119/1641-3466.2021.150.14.

[8] J. Müller, "Enabling Technologies for Industry 5.0 Results of a workshop with Europe's technology leaders," 2020, doi: 10.2777/082634.

[9] P. K. R. Maddikunta *et al.*, "Industry 5.0: A survey on enabling technologies and potential applications," *J Ind Inf Integr*, vol. 26, p. 100257, Mar. 2022, doi: 10.1016/J.JII.2021.100257.

[10] M. C. Tavares, G. Azevedo, and R. P. Marques, "The Challenges and Opportunities of Era 5.0 for a More Humanistic and Sustainable Society—A Literature Review," Dec. 01, 2022, *MDPI*. doi: 10.3390/soc12060149.

[11] L. Melnyk, O. Kubatko, I. Dehtyarova, O. Matsenko, and O. Rozhko, "The effect of industrial revolutions on the transformation of social and economic systems," *Problems and Perspectives in Management*, vol. 17, no. 4, pp. 381–391, 2019, doi: 10.21511/ppm.17(4).2019.31.

[12] D. Kolberg and D. Zühlke, "Lean Automation enabled by Industry 4.0 Technologies," in *IFAC-PapersOnLine*, May 2015, pp. 1870–1875. doi: 10.1016/j.ifacol.2015.06.359.

[13] A. Adel, "The Convergence of Intelligent Tutoring, Robotics, and IoT in Smart Education for the Transition from Industry 4.0 to 5.0," *Smart Cities 2024, Vol. 7, Pages 325-369*, vol. 7, no. 1, pp. 325–369, Jan. 2024, doi: 10.3390/SMARTCITIES7010014.

[14] C. Humberto, J. Rodolfo, C.-A. D. Jennifer, and M.-M. A. Narciso, "Technology: Sustainable Engineering for a Diverse, Equitable, and Inclusive Future at the Service of Education, Research, and Industry for a Society 5.0. Hybrid Event."

[15] N. Jafari, M. Azarian, and H. Yu, "Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics?," *Logistics*, vol. 6, no. 2, p. 26, Apr. 2022, doi: 10.3390/logistics6020026.

[16] A. O. Mohmmad Alhusban and C. H. Ortega-Jimenez, "Unveiling Dynamics in Nanostores: An Extensive Meta-Analysis of the Interplay of Supply Chain Integration and Operational Performance," in *Proceedings of the 3rd LACCEI International Multiconference on Entrepreneurship, Innovation and Regional Development (LEIRD 2023): "Igniting the Spark of Innovation: Emerging Trends, Disruptive Technologies, and Innovative Models for Business Success,"* Latin American and Caribbean Consortium of Engineering Institutions, 2023. doi: 10.18687/LEIRD2023.1.1.459.

[17] C. Cimini, A. Lagorio, S. Cavalieri, O. Riedel, C. E. Pereira, and J. Wang, "Human-technology integration in smart manufacturing and logistics: current trends and future research directions," *Comput Ind Eng*, vol. 169, p. 108261, Jul. 2022, doi: 10.1016/j.cie.2022.108261.

[18] D. Mourtzis, J. Angelopoulos, and N. Panopoulos, "A Literature Review of the Challenges and Opportunities of the Transition from Industry 4.0 to Society 5.0," *Energies (Basel)*, vol. 15, no. 17, p. 6276, Aug. 2022, doi: 10.3390/en15176276.

[19] C. H. Ortega-Jiménez, J. R. Sorto-Bueso, A. M. Amador-Matute, J. D. Cruz-Amaya, and N. A. Melgar-Martínez, "Unlocking Retail Success: A Comprehensive Exploration of Information and Communication Technology (Ict) Operations Practices in Nanostores," Aug. 11, 2023. doi: 10.18687/LACCEI2024.1.1.1282.

[20] A. Adel, "Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas," *Journal of Cloud Computing 2022 11:1*, vol. 11, no. 1, pp. 1–15, Sep. 2022, doi: 10.1186/S13677-022-00314-5.

[21] M. A. Al Doghan and V. P. K. Sundram, "Agility and Resilience in Logistics Management: Supply chain optimization," *International Journal of Construction Supply Chain Management*, vol. 13, no. 1, pp. 1–16, 2023, doi: 10.14424/IJCSCM2023130101.

[22] E. Marín-Garcia, J.-N. Torres-Marín, A. Chaverra-Lasso, E. Marín-Garcia, J.-N. Torres-Marín, and A. Chaverra-Lasso, "Smart Greenhouse and Agriculture 4.0," *Revista científica*, vol. 46, no. 46, pp. 37–50, Jan. 2023, doi: 10.14483/23448350.19816.

[23] J. Leng, W. Sha, Z. Lin, J. Jing, Q. Liu, and X. Chen, "Blockchained smart contract pyramid-driven multi-agent autonomous process control for resilient individualised manufacturing towards Industry 5.0," *Int J Prod Res*, vol. 61, no. 13, pp. 4302–4321, 2023, doi: 10.1080/00207543.2022.2089929.

[24] S. Saniuk, S. Grabowska, and M. Straka, "Identification of Social and Economic Expectations: Contextual Reasons for the Transformation Process of Industry 4.0 into the Industry 5.0 Concept," *Sustainability 2022, Vol. 14, Page 1391*, vol. 14, no. 3, p. 1391, Jan. 2022, doi: 10.3390/SU14031391.

[25] A. Saradha, "Industry 5.0 and Society 5.0," in *Industrial Revolution and Metaverse: Industry 5.0*, Quing Publications, 2023, pp. 1–7. doi: 10.54368/qpbc.2023.1.1.

[26] J. Chocholáč *et al.*, "SMART CITY AND URBAN LOGISTICS - RESEARCH TRENDS AND CHALLENGES: SYSTEMATIC LITERATURE REVIEW," *Communications - Scientific Letters of the University of Žilina*, vol. 25, no. 4, pp. A175–A192, 2023, doi: 10.26552/COM.C.2023.076.

[27] A. Liberati *et al.*, "The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration," *J Clin Epidemiol*, vol. 62, no. 10, pp. e1–e34, Oct. 2009, doi: 10.1016/J.JCLINEPI.2009.06.006.

[28] M. M. Roshid, A. Waaje, T. N. Meem, and A. Sarkar, "Logistics 4.0: A Comprehensive Literature Review of Technological Integration, Challenges, and Future Prospects of Implementation of Industry 4.0 Technologies," *Int J Technol Knowl Soc*, vol. 20, no. 1, pp. 65–85, 2024, doi: 10.18848/1832-3669/CGP/V20I01/65-85.

[29] C. H. ORTEGA-JIMENEZ and A. O. MOHMMAD ALHUSBAN, "Nanostores and Society 5.0: Paradigm Shifts in Supply Chains through Bibliometric Analysis," Aug. 11, 2023. doi: 10.18687/LACCEI2024.1.1.1616.

[30] S. N. Rodda, R. Bijker, S. S. Merkouris, J. Landon, C. O. Hawker, and N. A. Dowling, "How to Peer Review Quantitative Studies, Qualitative Studies, and Literature Reviews: Considerations from the 'Other' Side," *Curr Addict Rep*, vol. 11, no. 5, pp. 771–782, Oct. 2024, doi: 10.1007/S40429-024-00594-8/TABLES/3.

[31] M. R. ACEVEDO AMAYA and C. H. ORTEGA-JIMENEZ, "Revolutionizing Supply Chains: Unleashing Reconfigurability and Flexibility through Industry 4.0 Integration," Aug. 11, 2023. doi: 10.18687/LACCEI2024.1.1.1853.

[32] "(3) (PDF) Industria 5.0: Un futuro de colaboración hombre-máquina y sostenibilidad." Accessed: Oct. 01, 2024. [Online]. Available: https://www.researchgate.net/publication/379515319_Industry_50_A_Future_of_Human-Machine_Collaboration_and_Sustainability?channel=doi&linkId=660d50bf10ca86798737db11&showFulltext=true

[33] S. Kraus, P. Jones, N. Kailer, A. Weinmann, N. Chaparro-Banegas, and N. Roig-Tierno, "Digital Transformation: An Overview of the Current State of the Art of Research," *Sage Open*, vol. 11, no. 3, Sep. 2021, doi: 10.1177/21582440211047576/ASSET/IMAGES/LARGE/10.1177_21582440211047576-FIG5.JPEG.

[34] M. R. ACEVEDO AMAYA and C. H. ORTEGA-JIMENEZ, "Revolutionizing Supply Chains: Unleashing Reconfigurability and Flexibility through Industry 4.0 Integration," Aug. 11, 2023. doi: 10.18687/LACCEI2024.1.1.1853.

[35] N. Jefroy, M. Azarian, and H. Yu, "Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics?," *Logistics*, vol. 6, no. 2, Jun. 2022, doi: 10.3390/LOGISTICS6020026.

[36] A. Liberati *et al.*, "The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration," *J Clin Epidemiol*, vol. 62, no. 10, pp. e1–e34, Oct. 2009, doi: 10.1016/J.JCLINEPI.2009.06.006.

[37] D. Ivanov, "The Industry 5.0 framework: viability-based integration of the resilience, sustainability, and human-centricity perspectives," *Int J Prod Res*, vol. 61, no. 5, pp. 1683–1695, Mar. 2023, doi: 10.1080/00207543.2022.2118892.

[38] P. K. R. Maddikunta *et al.*, "Industry 5.0: A survey on enabling technologies and potential applications," *J Ind Inf Integr*, vol. 26, p. 100257, Mar. 2022, doi: 10.1016/J.JII.2021.100257.

[39] A. Villar, S. Paladini, and O. Buckley, "Towards Supply Chain 5.0: Redesigning Supply Chains as Resilient, Sustainable, and Human-Centric Systems in a Post-pandemic World," *Operations Research Forum*, vol. 4, no. 3, pp. 1–46, Sep. 2023, doi: 10.1007/S43069-023-00234-3/FIGURES/19.