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DIGITAL PLATFORMIZATION OF ENTERPRISE LOGISTICS ACTIVITIES: A BIBLIOMETRIC ANALYSIS OF THE STRUCTURING AND TRENDS OF GLOBAL RESEARCH ..... 75 –98

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Trushkina N.V. Ph.D. (in Economics), Senior Researcher Research Center for Industrial Problems of Development of the NAS of Ukraine (Ukraine)

ORCID – 0000-0002-6741-7738
Researcher ID C-1441-2018
Scopus author id: – 57210808778
E-Mail: nata_tru@ukr.net

Harmash O.M. PhD (in Economics), Associate Professor Department of International Business and Logistics, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine)

ORCID – 0000-0003-4324-4411
Researcher ID – I-4542-2018
Scopus author id: – 57218381499
E-Mail: kim_ol@ukr.net

Shkrygun Yu.O. Postgraduate Student, Institute of Industrial Economics of NAS of Ukraine (Ukraine)

ORCID –0000-0002-7623-8213
Researcher ID –
Scopus author id: –
E-Mail: shkrigun.y@gmail.com

DIGITAL PLATFORMIZATION OF ENTERPRISE LOGISTICS ACTIVITIES: A BIBLIOMETRIC ANALYSIS OF THE STRUCTURING AND TRENDS OF GLOBAL RESEARCH

Nataliia Trushkina, Oleh Harmash, Yuliya Shkrygun. «Digital platformization of enterprise logistics activities: a bibliometric analysis of the structuring and trends of global research». *This article presents a comprehensive bibliometric analysis of global research on the digital platformization of enterprise logistics activities based on metadata extracted from the international scientometric database Scopus for the period 2006–2026. The purpose of the study is to identify the structural parameters of the scientific field, its dynamic evolution, sectoral composition, concentration of intellectual influence, and thematic clustering. To ensure the reproducibility of the findings, a formalized search design was implemented with precise specification of the query parameters, coverage period, and data export date.*

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The study employs a two-block analytical approach. Block A (n=249) reflects the interdisciplinary structure of the research domain, whereas Block B (n=166) was constructed following thematic screening in order to ensure the subject validity of the logistics focus. The results demonstrate an exponential increase in the number of publications after 2019 and reveal a structural turning point in the development of the field associated with the diffusion of Industry 4.0 technologies, the scaling of platform architectures, and the growing attention to supply chain resilience.

The analysis identifies a core-periphery citation structure and a high concentration of intellectual influence within the field. Keyword cluster analysis using VOSviewer enabled the identification of five interrelated thematic domains: platform ecosystems in supply chain management; digital transformation and Industry 4.0; applications of artificial intelligence and machine learning in logistics; digital twins and cyber-physical systems; and blockchain as an infrastructure of trust and traceability. The findings are interpreted through the lens of platform economy theory and two-sided market theory, allowing digital platformization to be conceptualized as an institutional and technological mechanism for coordinating actors within logistics ecosystems.

The practical significance of the study lies in its potential application for designing strategies of digital transformation in enterprise logistics, developing models for integrating platform-based solutions into supply chains, and substantiating investment decisions in digital ecosystems. The generalized cluster structure facilitates the identification of key technological development trajectories and supports consideration of platform dependency risks, cybersecurity challenges, and data governance issues in the implementation of digital solutions.

***Keywords**:* enterprise economics, digital platform, logistics platformization, logistics activities, logistics management, supply chain management, logistics costs, global logistics flows, risk management, digital transformation, Industry 4.0, platform economy, two-sided markets, digital ecosystem, bibliometric analysis, cluster analysis, artificial intelligence in logistics, digital twin, blockchain in supply chain management, customer relationship management strategy, omnichannel interaction, big data, digital infrastructure, geopolitical shock, economic crises, threats; uncertainty, sustainable development, globalization

Наталія Трушкіна, Олег Гармаш, Юлія Шкригун. «Цифрова платформізація логістичної діяльності підприємств: бібліометричний аналіз структуризації та трендів глобальних досліджень». *У статті здійснено комплексний бібліометричний аналіз глобальних досліджень цифрової платформізації логістичної діяльності підприємств на основі метаданих міжнародної наукометричної бази Scopus за період 2006–2026 років. Метою дослідження є виявлення структурних параметрів наукового поля, його динаміки, галузевої композиції, концентрації інтелектуального впливу та тематичної кластеризації. Для забезпечення відтворюваності результатів застосовано формалізований дизайн пошуку з чіткою фіксацією параметрів запиту, періоду охоплення та дати експорту даних. У роботі використано двоблоковий підхід: блок А (n=249) відображає міждисциплінарну структуру тематики, тоді як блок В (n=166) сформовано після тематичного скринінгу для забезпечення предметної валідності логістичного фокусу.*

Результати засвідчили експоненційне зростання кількості публікацій після 2019 року та структурний перелом у розвитку досліджень, пов'язаний із поширенням Industry 4.0, масштабуванням платформних архітектур і підвищенням уваги до стійкості ланцюгів постачання. Виявлено ядерно-периферійну структуру цитованості та високу концентрацію інтелектуального впливу. Кластерний аналіз ключових слів із використанням VOSviewer дозволив виокремити п'ять взаємопов'язаних тематичних напрямів: платформні екосистеми SCM; цифрова трансформація та Industry 4.0; застосування AI/ML у логістиці; цифрові двійники та кіберфізичні системи; blockchain як

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інфраструктура довіри та трасованості. Отримані результати інтерпретовано через призму платформної економіки та теорії двосторонніх ринків, що дозволяє розглядати платформізацію як інституційно-технологічний механізм координації учасників логістичних екосистем.

Практична значущість дослідження полягає у можливості використання його результатів для формування стратегій цифрової трансформації логістичної діяльності підприємств, розроблення моделей інтеграції платформних рішень у ланцюги постачання та обґрунтування інвестицій у цифрові екосистеми. Узагальнена кластерна структура дає змогу ідентифікувати ключові технологічні напрями розвитку та враховувати ризики платформної залежності, кібербезпеки й управління даними під час впровадження цифрових рішень.

Ключові слова: економіка підприємства, цифрова платформа, платформізація логістики, логістична діяльність, логістичний менеджмент, управління ланцюгами постачання, витрати на логістику, глобальні логістичні потоки, ризик-менеджмент, цифрова трансформація, Industry 4.0, платформна економіка, двосторонні ринки, цифрова екосистема, бібліометричний аналіз, кластерний аналіз, штучний інтелект у логістиці, цифровий двійник, blockchain у SCM, CRM-стратегія, омніканальна взаємодія, Big Data, цифрова інфраструктура, геополітичний шок, економічні кризи, загрози, невизначеність, сталий розвиток, глобалізація

Introduction. The current stage of development of the global economy is characterized by the simultaneous intensification of globalization linkages and the reconfiguration of value chains under the influence of digital transformation, geopolitical shocks, and increasing logistical uncertainty. In this context, logistics can no longer be viewed as a purely operational function. It is evolving into a critical mechanism for ensuring enterprise competitiveness, facilitating access to international markets, and sustaining business process continuity. However, traditional models of organizing logistics activities are increasingly misaligned with the requirements of the global economy, where speed, data consistency, and decision-making flexibility have become decisive factors.

The rapid expansion of data volumes and digital interactions is reshaping the logic of coordination within supply chains. According to the United Nations Conference on Trade and Development [1], the digital economy accounts for more than fifteen percent of global gross domestic product, while digital platforms increasingly serve as infrastructures for value creation and redistribution in international markets. This indicates the systemic impact of digitalization on the structure of the global economy. Consequently, logistics, which integrates material and information flows, has become one of the central domains of platform-based transformation.

The transition from linear interaction schemes to platform-based coordination mechanisms, including digital matching, real-time dispatching, and integrated stakeholder interaction, necessitates a reconsideration of traditional management models. Expert assessments by McKinsey [2] confirm the scale of the potential benefits of digitalization: the implementation of the Supply Chain 4.0 concept may lead to up to a thirty percent reduction in operational costs through enhanced data transparency and process synchronization. Digital platforms therefore establish a qualitatively new level of manageability of logistics flows.

An additional argument arises from the transformation of global data flows. The McKinsey Global Institute [3] demonstrates that digital flows have become an independent driver of economic growth and international integration, with cross-border data transfers expanding multiple times over the past decade. This intensifies the demand for digital infrastructure solutions capable of

scaling coordination across international logistics networks.

The growing uncertainty within global supply chains further highlights the importance of resilience and risk management. According to the Digital Trends in Supply Chain Survey conducted by PwC in 2023 [4], eighty-six percent of operations executives emphasize the necessity of investing in digital technologies for risk monitoring. The PwC Digital Factory Transformation Survey of 2022 [5] reports a sixty-seven percent increase in the share of companies identifying flexibility and resilience as key drivers of digital investment. These findings indicate that platformization represents a strategic response of business to an increasingly risk-intensive environment.

The World Bank, in its report Connecting to Compete 2023 [6], underscores that disruptions in global value chains have reinforced the critical role of logistics systems, with supply security and predictability emerging as strategic priorities. Within this framework, digital platforms are viewed as instruments for integrating physical and information flows, thereby enhancing transparency and accelerating international trade.

The Organisation for Economic Co-operation and Development [7] notes that online platforms are characterized by network effects, scalability, and reduced transaction barriers, which reshape market structures and competitive dynamics. For logistics, this implies a transition from localized optimization toward ecosystem-based interaction. Similarly, the DHL Logistics Trend Radar [8] identifies artificial intelligence, data analytics, and digital infrastructure as key drivers of logistics transformation in the coming years.

Therefore, the digital platformization of enterprise logistics activities constitutes an objective response to the structural challenges of the global economy, including data fragmentation, rising transaction costs, heightened risks, and the need for flexible coordination of international flows. Its study is both scientifically and practically significant for the development of effective mechanisms for transforming logistics systems in the digital era.

Literature and researches review. Digital platformization of enterprise logistics activities is interpreted in contemporary scholarly discourse as a multidimensional transformation process encompassing changes in business models, the restructuring of value chain architectures, institutional shifts, and the implementation of algorithmic governance. An analysis of relevant publications indexed in the Scopus database makes it possible to distinguish several interrelated theoretical and methodological strands, each emphasizing different dimensions of platform-driven transformation in logistics.

The first strand conceptualizes the digital platform as a mechanism for transforming the enterprise business model. P. Bajec et al. [9] demonstrate that the implementation of a business-to-business multimodal platform alters the structure of the Business Model Canvas, generating a new configuration of resources, channels, and value creation flows. R. Agarwala et al. [10] further develop this perspective by showing that digital business-to-business platforms reshape the architecture of value creation and value capture through the integration of search, matching, and transaction functions within a unified digital environment. O. Purba et al. [11] provide empirical evidence on the effectiveness of a national digital logistics ecosystem, identifying a statistically significant relationship between system and information quality and user satisfaction. Collectively, these studies conceptualize platformization as an instrument of strategic modernization in logistics management.

The second strand focuses on the institutional and structural consequences of platformization. S. Hardaker [12] analyzes the role of digital platforms in the formation of Digital Free Trade Zones, interpreting them as instruments of infrastructural power. V. Helwing, P. Verfürth, and M. Franz [13], as well

as M. Franz, V. Helwing, and P. Verfürth [14], demonstrate that business-to-business platforms transform global production networks in logistics, influencing competitive structures and labor relations. In this context, the platform emerges not merely as a technological solution but as a mechanism for redistributing economic power within global value chains.

The third strand emphasizes algorithmic governance and socio-organizational aspects of platformization. F. De Stavola [15] introduces the concept of forced synchronization, illustrating how algorithms coordinate physical logistics processes. S. Haddad and N. Nasib [16] examine the impact of online platforms on the operational efficiency of logistics firms, while I. Ibrahim et al. [17] conceptualize digital logistics tools as elements of the communication infrastructure of public platforms.

The interdisciplinary nature of the phenomenon is confirmed by the work of K. Parker et al. [18], which demonstrates the universality of the platform-based coordination model across economic sectors. A macro-level theoretical generalization is proposed by O. Vyshnevskyi [19], who interprets digital platformization as an institutional mechanism for the strategic development of the national economy.

It should be noted that the authors' previous studies [20–23] concentrated on applied mechanisms of logistics digitalization, including smart contracts, digital customer relationship management solutions, and enterprise logistics management systems. The present research logically extends this body of work by moving from an instrumental perspective toward a systemic structuring of the global scientific field.

To synthesize the identified approaches, it is appropriate to compare them in terms of theoretical framework, level of analysis, and limitations (Table 1). The analysis demonstrates that the majority of studies exhibit a clearly delineated single-level orientation, focusing either on the micro level of business models, the meso level of production networks, or the macro level of institutional transformation. Cross-level integration remains limited.

Table 1. Comparison of Theoretical and Methodological Approaches

Representatives of Scholarly Schools	Theoretical Framework	Level of Analysis	Primary Focus	Limitations
P. Bajec et al.	Business Model Canvas	Micro	Business model transformation	Limited number of cases
R. Agarwala et al.	Value architecture	Micro	Value creation and capture	Single-case design
S. Hardaker	Infrastructural power	Macro	Geoeconomic influence of platforms	Regional specificity
V. Helwing et al.	Global Production Networks	Meso	Redistribution of value and labor	Qualitative design
F. De Stavola	Labour process theory	Micro	Algorithmic governance	Contextual localization

Source: compiled by the authors based on [9; 10; 12; 13; 15].

Further systematization makes it possible to structure scholarly approaches according to levels of transformation: technological, organizational, and institutional (Table 2). At the technological level, research predominantly concentrates on digital platform architectures and the algorithmization of processes [10; 11]. The organizational level encompasses the restructuring of business models and management mechanisms [9; 16]. The institutional level focuses on the

redistribution of power and the transformation of global production networks [12–14; 19].

Table 2. Classification of Scholarly Approaches to the Digital Platformization of Enterprise Logistics Activities by Levels of Transformation

Level of Transformation	Nature of Change	Main Research Emphases	Representatives
Technological	Integration of digital infrastructure, process algorithmization, automation of flows	Artificial intelligence, blockchain, data integration, platform architecture	R. Agarwala et al.; O. Purba et al.
Organizational	Business model restructuring, transformation of logistics processes and management mechanisms	Value creation, business-to-business ecosystems, operational efficiency	P. Bajec et al.; S. Haddad & N. Nasib
Institutional	Redistribution of power, formation of new interaction rules, transformation of global production networks	Infrastructural power, labor relations, strategic governance	S. Hardaker; V. Helwing et al.; M. Franz et al.; O. Vyshnevskyi

Source: compiled by the authors based on [9–14; 16; 19].

Thus, contemporary scholarly discourse on the digital platformization of enterprise logistics activities is characterized by thematic heterogeneity and methodological fragmentation. The absence of a comprehensive quantitative analysis that integrates technological, organizational, and institutional dimensions while simultaneously reflecting the dynamics, geographical distribution, and institutional concentration of research justifies the application of bibliometric methods. This determines the logic of the subsequent empirical analysis based on the Scopus publication dataset.

Aim and objectives. The thematic heterogeneity and methodological fragmentation identified in the preceding sections indicate the absence of a comprehensive systematization of the global scholarly discourse on the digital platformization of enterprise logistics activities. Existing studies predominantly concentrate on specific technological, organizational, or institutional aspects of transformation, while an integrated understanding of the structure, developmental dynamics, and institutional concentration of scientific research in this field remains insufficiently developed. This circumstance necessitates the application of quantitative analytical instruments for a comprehensive assessment of the evolution of the scientific domain.

The purpose of this study is to conduct a comprehensive bibliometric analysis of global research on the digital platformization of enterprise logistics activities in order to identify its structural characteristics, developmental dynamics, thematic clusters, and the geographical and institutional concentration of scholarly activity.

The achievement of this objective required the application of a set of interrelated *general scientific and specialized research methods*. At the theoretical level, methods of analysis and synthesis were employed to generalize existing approaches to the interpretation of digital platformization. In addition, the system approach was applied, enabling the phenomenon to be conceptualized as a multi-level process encompassing technological, organizational, and institutional dimensions of logistics system transformation.

The core empirical instrument of the study is the bibliometric method, which involves the quantitative processing and interpretation of a body of scientific

publications indexed in the international scientometric database Scopus. Within the bibliometric framework, statistical analysis was applied to assess publication dynamics, calculate absolute and relative growth rates, and determine the structural distribution of documents by type, subject area, country, organization, and funding sponsor. Classical formulas for relative increase and compound annual growth rate were used to ensure the methodological validity and temporal comparability of indicators.

Keyword content analysis was employed to determine the subject structure of the research field and to identify dominant thematic directions. Network analysis, including co-occurrence analysis, co-citation analysis, and citation analysis, enabled the identification of intellectual linkages among authors, countries, and thematic clusters. Elements of cluster analysis were applied to group related research streams and to reveal the internal configuration of the scientific domain. The visualization of network structures was performed using VOSviewer software, which made it possible to map the intellectual architecture of the research field, assess the density of relationships among key concepts, and trace the evolution of research trends over time.

The integrated combination of these methods ensures not only the quantitative measurement of publication activity but also a structural interpretation of the development of research on the digital platformization of enterprise logistics activities within the broader context of global economic transformation.

Results, analysis and discussion. In this study, the platformization of enterprise logistics activities is conceptualized as the transfer of coordination and transactional functions of logistics to digital platforms that: (a) connect at least two distinct groups of participants, such as shippers, carriers, and warehouse operators; (b) enable the matching of demand and supply for logistics capacities; (c) standardize access rules, data structures, and interaction protocols through interfaces and regulatory frameworks defined as platform governance; and (d) generate network effects while creating conditions for ecosystem integration of services, including artificial intelligence analytics, digital twin technologies, and blockchain-based traceability, among others [24–27]. Such a theoretical framework makes it possible to interpret bibliometric findings not as a fragmented collection of technologies in logistics, but as evidence of the development of a platform-based infrastructure of logistics activities.

The bibliometric analysis was conducted using metadata extracted from the Scopus database. The search was performed within the TITLE-ABS-KEY field using the following query logic: (digital platform OR electronic platform OR platformization) AND (logistics activity), with the application of filters PUBSTAGE = final and LANGUAGE = English, and the exclusion of affiliations from the Russian Federation. The explicit specification of search parameters and the date of data extraction is essential for ensuring the reproducibility of bibliometric procedures, as indexing and metadata in Scopus are subject to change over time. This approach is consistent with established recommendations for transparent reporting of bibliometric research [28–30]. As a result, the initial dataset comprised 249 documents published between 2006 and 2026 (Table 3).

During the initial relevance screening, a systematic homonymy effect was identified. A portion of the documents entered the dataset due to references to logistic regression in a statistical context and physical activity within a health-related discourse.

This methodological issue is significant for two reasons. First, it directly affects the validity of logistics-related conclusions due to domain mixing. Second, it reveals the cross-domain nature of the platform category, as digital platforms constitute an infrastructural phenomenon applied across multiple sectors. For this reason, a dual-corpus design was implemented.

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Table 3. Scopus Search Parameters and Dataset Formation (n = 249)

Parameter	Description
Database	Scopus (Elsevier)
Search field	TITLE-ABS-KEY
Query logic	(digital platform OR electronic platform OR platformization) AND (logistics activity)
Filters	PUBSTAGE = final; LANGUAGE = English; EXCLUDE (AFFILCOUNTRY = Russian Federation)
Coverage period	2006–2026
Total records	249 documents

Source: compiled by the authors based on processing of the Scopus database.

Block A (n=249) was used to describe the boundaries of the interdisciplinary field, whereas Block B (n=166) was constructed for subject-specific analysis of the platformization of enterprise logistics activities after excluding health-dominant records and records where logistic was used in a statistical sense (Table 4). The selection logic is presented in a PRISMA format as an instrument for transparent reporting of bibliometric dataset refinement [31].

Table 4. PRISMA Reporting of the Formation of Blocks A and B

Stage	Number of Records	Comment
Identification: Scopus records after filters	249	Initial dataset (final stage; English; excluding Russian Federation)
Deduplication	0	Single database; duplicates not expected
Baseline bibliometric analysis	249	Block A (general overview of the field)
Additional thematic screening: logistics focus	83 excluded	Records where logistic refers to a statistical term or where health context dominates
Final Corpus (Block) A	249	Full dataset retained for transparency
Final Corpus (Block) B	166	Focused analysis of logistics platformization

Source: compiled by the authors based on processing of the Scopus database.

Accordingly, structural bibliometric characteristics, including document types, sources, countries, and citation patterns, are reported for Corpus A with explicit caution regarding the presence of health-related content. Thematic conclusions regarding logistics platformization are derived through keyword normalization, application of a VOSviewer thesaurus, and cluster interpretation with emphasis on the logistics core.

The distribution of document types (Table 5) reflects both the institutionalization of the topic and its technological dynamism. Journal articles account for 46.6 percent of publications, indicating the gradual formation of a theoretical and methodological core. At the same time, the substantial share of conference papers (30.5 percent) and conference reviews (8.8 percent) corresponds to the technological nature of digital platforms in logistics, where integration architectures, optimization algorithms, and Industry 4.0 modules are actively tested within conference settings before transitioning into journal publications for conceptual consolidation [28; 30]. It is also significant that citations are predominantly concentrated in journal articles and reviews, while conference materials receive comparatively lower citation counts. This pattern is typical of interdisciplinary technological fields and aligns with recommendations to interpret bibliometric influence through distributional analysis rather than relying solely on mean values [28; 30].

Table 5. Distribution of Documents by Type

Document Type	Number	Share, percent
Article	116	46.6
Conference paper	76	30.5
Conference review	22	8.8
Book chapter	20	8.0
Review	6	2.4
Book	6	2.4

Source: compiled by the authors based on processing of the Scopus database.

The subject area distribution (Table 6) indicates that the technological core of the field is formed by Computer Science and Engineering. However, logistics platformization also demonstrates a pronounced organizational and economic dimension represented by Business, Decision Sciences, and Economics. This finding is consistent with platform theory, which conceptualizes platforms as institutional and technological environments. In logistics, a platform does not merely introduce information technologies; it establishes transaction rules, capacity access conditions, and data standards, thereby reshaping the coordination structure of supply chains through platform governance mechanisms [24–27]. The presence of Medicine (19.3 percent) in Corpus A empirically confirms the homonymy effect and justifies the use of Corpus B and keyword normalization for logistics-specific conclusions.

Table 6. Distribution by Scopus Subject Areas

Subject Area	Number of Documents	Share, percent
Computer Science	108	43.4
Engineering	87	34.9
Medicine	48	19.3
Social Sciences	48	19.3
Business, Management and Accounting	37	14.9
Mathematics	29	11.6
Decision Sciences	28	11.2
Economics, Econometrics and Finance	19	7.6
Environmental Science	17	6.8
Earth and Planetary Sciences	15	6.0
Energy	15	6.0

Note: The cumulative percentage may exceed one hundred because Scopus assigns a single document to multiple subject categories.

Source: compiled by the authors based on processing of the Scopus database

The temporal dynamics (Table 7) demonstrate a pronounced shift from sporadic publications to sustained growth after 2019. Importantly, 224 of 249 documents, approximately ninety percent, were published between 2019 and 2026, indicating the relative novelty of the domain in its contemporary configuration. The compound annual growth rate for the period 2006–2025 is approximately 23.8 percent, calculated by the authors based on Scopus data. The 2026 indicator does not reflect a genuine decline, as the dataset was extracted at the beginning of the year.

Table 7. Dynamics of the Number of Publications (2006–2026) and Annual Growth Rates

Year	Number of Publications	Absolute Increase	Growth Rate, percent	Increase Rate, percent
2006	1	not applicable	not applicable	not applicable
2007	1	0	100.0	0.0
2008	3	+2	300.0	200.0
2009	0	−3	0.0	−100.0
2010	2	+2	not applicable	not applicable
2011	0	−2	0.0	−100.0
2012	0	0	not applicable	not applicable
2013	4	+4	not applicable	not applicable
2014	5	+1	125.0	25.0
2015	0	−5	0.0	−100.0
2016	2	+2	not applicable	not applicable
2017	3	+1	150.0	50.0
2018	4	+1	133.3	33.3
2019	15	+11	375.0	275.0
2020	16	+1	106.7	6.7
2021	23	+7	143.8	43.8
2022	27	+4	117.4	17.4
2023	29	+2	107.4	7.4
2024	45	+16	155.2	55.2
2025	58	+13	128.9	28.9
2026*	11	−47	19.0	−81.0

Note: For years with a base value equal to zero, growth rates are not calculated. The 2026 data reflect an incomplete year, as the dataset was extracted in February 2026.

Source: compiled by the authors based on processing of the Scopus database.

From an interpretative perspective, the structural shift observed after 2019 can be explained by the convergence of three processes: first, the technological maturation of platform architectures and application programming interface integration; second, the scaling of Industry 4.0 in manufacturing and logistics; and third, the growing emphasis on supply chain resilience, within which platforms are conceptualized as infrastructures of transparency, rapid coordination, and capacity allocation. During this period, logistics increasingly began to be interpreted as an ecosystem-based platform environment rather than merely a set of operations supported by information technologies [24–27].

To assess intellectual influence, citation indicators were applied, including total citation counts, median citation value, and the h-index according to the methodology proposed by Hirsch [32]. Within Corpus A, the dataset accounts for 4,745 citations, a median citation value of 1, and an h-index of 22 [32]. The citation distribution is highly asymmetric: ten percent of documents, representing twenty-five publications, accumulate 85.7 percent of all citations, whereas the lower fifty percent of documents account for only 0.53 percent of citations. Approximately 39.8 percent of documents have received no citations. The Gini coefficient for citation inequality equals 0.908, indicating an extremely high concentration of intellectual influence (Figure 1).

This distribution reveals a pronounced core–periphery structure within the field. A relatively small group of foundational publications shapes the theoretical language and conceptual framework of the domain, while a substantial proportion of works represent applied extensions or sector-specific adaptations [28; 30].

For the specific topic of logistics platformization, this conclusion has an additional methodological implication. Within Corpus A, high citation counts are partially generated by publications from the health domain, which enter the dataset due to query homonymy. This underscores the necessity of distinguishing between impact and relevance. High citation performance does not automatically ensure substantive alignment with logistics. Therefore, key thematic conclusions are derived from Corpus B and from normalized keyword datasets to ensure domain-specific validity [28; 31].

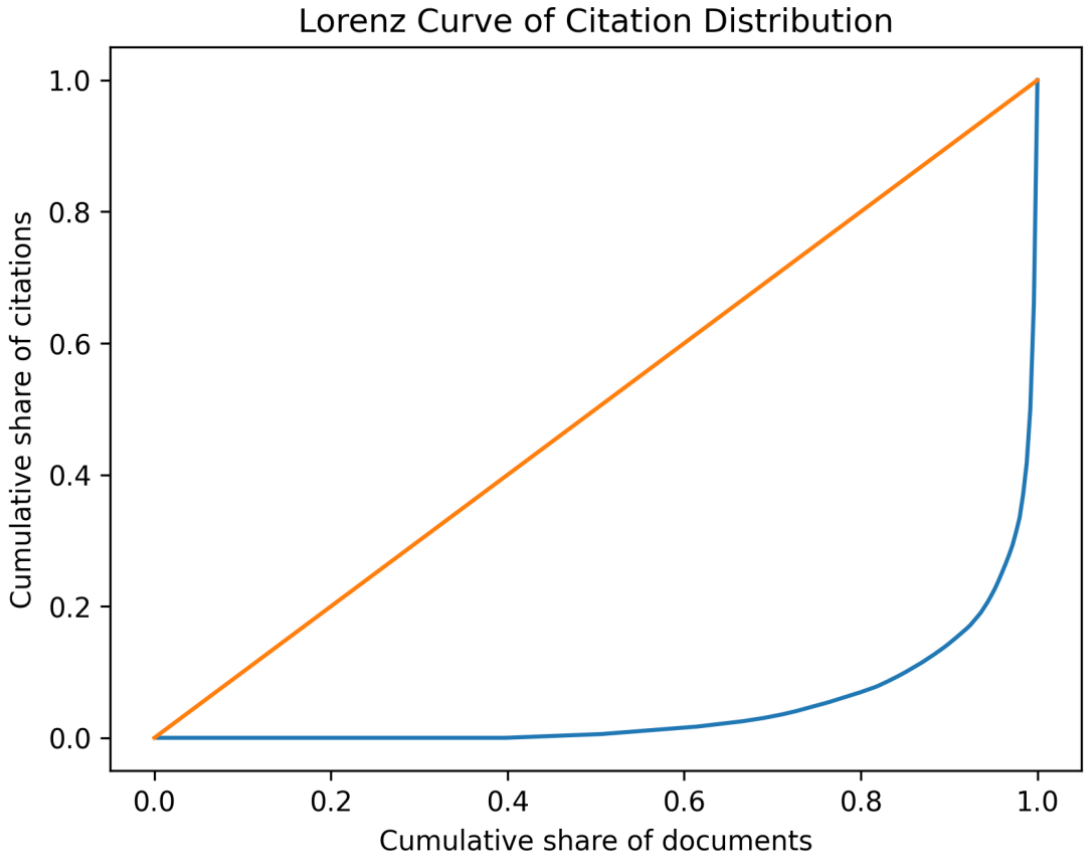

Figure 1. Lorenz Curve for the Distribution of Citations
Source: calculated and constructed by the authors based on processing of the Scopus database and with the use of artificial intelligence technologies.

The next analytical step involves the identification of knowledge centers through the analysis of source titles and the most highly cited publications. Table 8 demonstrates that, in terms of total citations, leading positions are occupied by journals that shape conceptual understandings of digital integration and platform-based coordination, such as MIS Quarterly. At the same time, highly cited health-oriented journals are also present, which confirms the homonymy effect within Corpus A (Table 8).

For logistics platformization, key foundational works within the dataset include studies on digitally enabled supply chain integration and reviews of blockchain applications in supply chain management. These publications conceptually explain how platforms create added value through data integration, enhanced transparency, and the reduction of coordination costs [33–35].

To avoid the methodological fallacy that equates high citation counts with logistics relevance, Table 9 presents the top ten most cited documents along with a concise interpretation of their thematic focus. This enables a clear distinction between foundational works directly relevant to supply

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chain management platformization [33–38] and publications that entered the dataset due to homonymy within the health-related cluster.

Table 8. Leading Sources by Total Citations in Corpus A (n=249)

Source Title	Number of Documents	Total Citations	Interpretative Relevance
MIS Quarterly: Management Information Systems	1	1614	Methodological core of digitally enabled supply chain integration
Journal of Medical Internet Research	5	1011	Health cluster (homonymy); indirect relevance
IEEE Access	2	406	Review of blockchain solutions in supply chain management
JAMA – Journal of the American Medical Association	1	225	Health domain
Sensors	2	109	Industry 4.0 and digital twin context
Journal of Cleaner Production	1	104	Production and logistics risk models
Frontiers in Psychiatry	2	75	Health domain
Computers & Industrial Engineering	1	66	Applied manufacturing-logistics platform research
Computers and Electrical Engineering	1	62	Adjacent algorithmic domain
Sustainability	2	60	Broad sustainability discourse

Source: compiled by the authors based on processing of the Scopus database.

Table 9. Top 10 Most Cited Documents in Corpus A

Authors	Shortened Title	Year	Journal	Citations	Key Focus
A. Rai, R. Patnayakuni, N. Seth	Firm performance impacts of digitally enabled supply chain integration capabilities	2006	MIS Quarterly	1614	Digitally enabled supply chain integration; capability approach; performance impact
E. Kontos et al.	Predictors of eHealth usage…	2014	JMIR	759	eHealth platforms; digital divide (not logistics)
S.E. Chang, Chen Y.	When blockchain meets supply chain…	2020	IEEE Access	386	Blockchain in supply chain management; trust; traceability; smart contracts
C.K. Ra et al.	Association of digital media use…	2018	JAMA	225	Digital media platforms in health research (not logistics)
K.Parker et al.	The use of digital platforms for physical activity…	2021	JMIR	171	Physical activity; digital platforms (not logistics)
C.Z. Li et al.	A model for simulating schedule risks…	2018	J Cleaner Production	104	Risk modeling in production-logistics cycles
A. Martínez-Gutiérrez et al.	Digital twin for automatic transportation in Industry 4.0	2021	Sensors	94	Digital twin; automated guided vehicles; cyber-physical logistics systems
L. Giusti et al.	Everything Will Be Fine… on a digital platform	2020	Frontiers in Psychiatry	73	Mental health on digital platforms (not logistics)

D. Battini et al.	WEM-Platform… manufacturing and logistics systems	2022	Computers & Industrial Engineering	66	Real-time platform in manufacturing-logistics integration
V. Chang et al.	Digital payment fraud detection methods…	2022	Computers and Electrical Engineering	62	Machine learning methods; adjacent analytical domain

Source: compiled by the authors based on [33–38].

The geographical structure of the field is particularly important for interpreting platformization, as digital platforms scale through network effects, integration standards, and transnational supply chains [24–27]. Table 10 indicates that the leading countries by publication volume are the United States, India, China, and Italy. In contrast, in terms of total citations, the leading positions are held by the United States, Taiwan, Australia, and Italy.

An important conclusion follows: productivity measured by publication count is not equivalent to intellectual influence. This discrepancy is partially explained by the extreme concentration of citation distribution and by time-lag effects, as older publications have had more time to accumulate citations [32].

Table 10. Top Countries by Publication Volume and Total Citations (n=249)

Countries by Publication Volume	Documents	Countries by Citation Count	Citations
United States	32	United States	2833
India	29	Taiwan	386
China	28	Australia	334
Italy	23	Italy	320
United Kingdom	12	China	275
Germany	9	United Kingdom	170
Malaysia	8	Hong Kong	166
Greece	6	Spain	107
Spain	6	Germany	97
Sweden	6	Malaysia	94

Source: compiled by the authors based on processing of the Scopus database.

The institutional funding context further confirms the dual structure of Corpus A. Among funding sponsors, both innovation-oriented European programs, such as the European Commission and Horizon 2020, and health-oriented institutions, including the National Institutes of Health and the National Health and Medical Research Council, are represented (Table 11). For substantive conclusions regarding logistics platformization, this reinforces the necessity of relying on Corpus B and on keyword normalization procedures.

Table 11. Top Funding Sponsors Supporting Research in the Selected Domain

Funding Sponsor	Documents	Share, percent
European Commission	6	2.41
National Institutes of Health	4	1.61
National Natural Science Foundation of China	4	1.61
CAPES	3	1.20
Horizon 2020	3	1.20
Horizon 2020 Framework Programme	3	1.20
National Health and Medical Research Council	3	1.20
VINNOVA	3	1.20

FCT (Portugal)	2	0.80
GACR (Czech Republic)	2	0.80

Source: compiled by the authors based on processing of the Scopus database.

Because bibliometric maps are sensitive to metadata quality, keyword cleaning and normalization constituted a crucial analytical stage. The original Index Keywords in Corpus A contained dominant medical and social descriptors, such as female, male, human, as well as methodological markers including logistic regression, which distort the thematic interpretation of logistics platformization (Table 12).

To mitigate this effect, established recommendations for co-word analysis and thesaurus-based normalization in VOSviewer were applied: first, merging synonyms and alternative spellings, for example block-chain into blockchain, machine-learning into machine learning, and electronic commerce into electronic commerce; second, removing non-informative index terms such as human, male, female, adult, as well as purely methodological expressions such as logistic regression; and third, focusing thematically on the logistics core through the use of Corpus B [29]. A minimum frequency threshold was applied to ensure network interpretability. In practical terms, this means that dominant visible terms typically exhibit frequencies of approximately five occurrences or higher (Table 12).

Table 12. Most Frequent Terms Before and After Keyword Cleaning

Index Keywords "Before Cleaning"	Frequency	Author Keywords "After Cleaning" (Logistics Focus)	Frequency
female	45	machine learning	25
male	41	logistics	19
human	36	digital transformation	11
adult	35	blockchain	9
article	29	digital platform	8
information management	24	electronic commerce	7
adolescent	22	random forest	7
humans	20	fraud detection	7
young adult	18	artificial intelligence	6
logistic regression	18	supply chain	5
social media	18	deep learning	5
cross-sectional study	17	supply chain management	5
physical activity	16	digitalization	5
machine-learning	16	Industry 4.0	5
middle aged	16	digital twin	5

Source: compiled by the authors based on Scopus data and keyword normalization using VOSviewer tools.

As a result of the conducted analysis, several types of visualizations were generated using VOSviewer: cluster visualization representing the thematic structure; overlay visualization by average publication year; overlay visualization by average citation impact; density visualization highlighting areas of conceptual concentration; and country-level maps displaying citation intensity and network linkages. These visualizations are not merely illustrative elements but empirical instruments demonstrating how technological and managerial narratives converge within the concept of logistics platformization.

The cluster map (Figure 2) reveals two principal regularities. First, a distinct health-related cluster, including terms such as humans, female, male, and cross-sectional study, clearly emerges. This cluster directly reflects the homonymy effect and supports the methodological decision to construct

Corpus B and normalize terminology. Second, within the logistics-digital segment, several interconnected contours become visible: an information and management contour, including information management, digital transformation, logistics, and electronic commerce; an algorithmic and analytical contour, comprising machine learning, learning systems, data mining, and predictive analytics; and an institutional and transactional contour centered around blockchain, trust, and traceability in supply chain management. This configuration corresponds to the theoretical logic of the platform ecosystem. A platform does not generate systemic effects without the integration of data and processes, decision-support analytics, and mechanisms of trust and compliance [24–27].

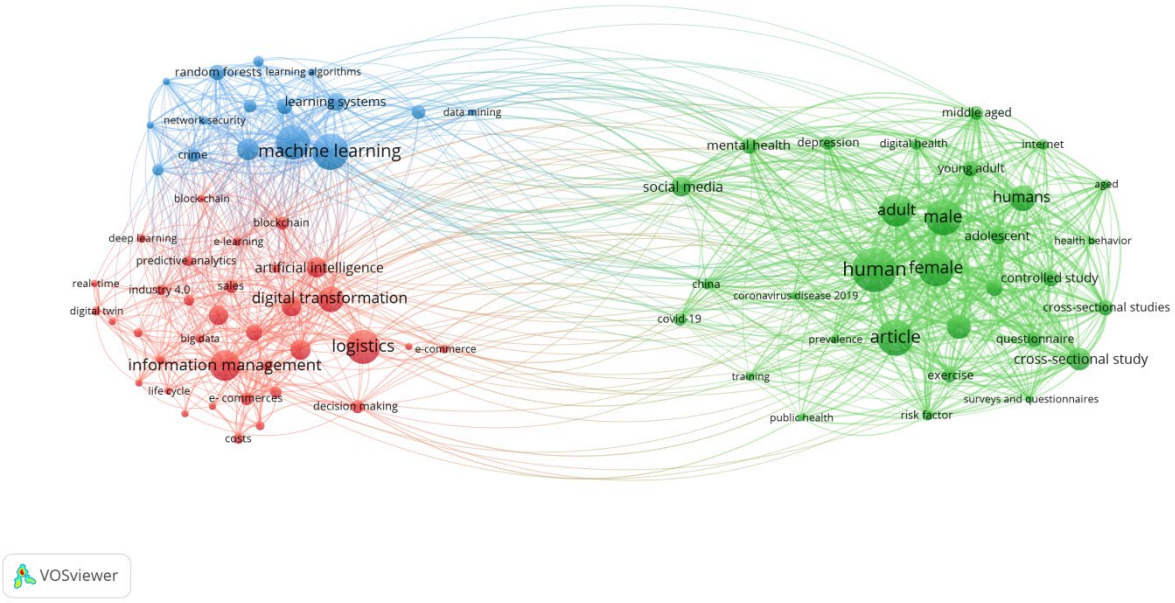

Figure 2. Keyword Co-occurrence Network

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

The overlay visualization by publication year (Figure 3) indicates that the most recent terms are concentrated around algorithmic and digital infrastructure solutions, including terminology related to artificial intelligence and machine learning, Industry 4.0, and digital twin technologies. In contrast, a portion of the managerial and process-oriented vocabulary, such as information management, demonstrates an earlier average temporal appearance within the dataset. This pattern corresponds to the phase-based logic of platformization. In the initial phase, emphasis is placed on digital integration, particularly the structuring and synchronization of data architectures and information flows. In the subsequent phase, analytical, predictive, and cyber-physical modules are layered onto the platform environment as an advanced functional superstructure. Thus, the evolution of the research field reflects a transition from connectivity and interoperability toward intelligent automation, real-time analytics, and digitally synchronized logistics ecosystems.

Such temporal differentiation of terms confirms that logistics platformization is not a

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single-stage technological adoption process but a cumulative transformation trajectory. The platform first establishes a standardized coordination infrastructure, and only thereafter enables the scalable deployment of artificial intelligence tools, digital twins, and advanced decision-support mechanisms within enterprise logistics systems.

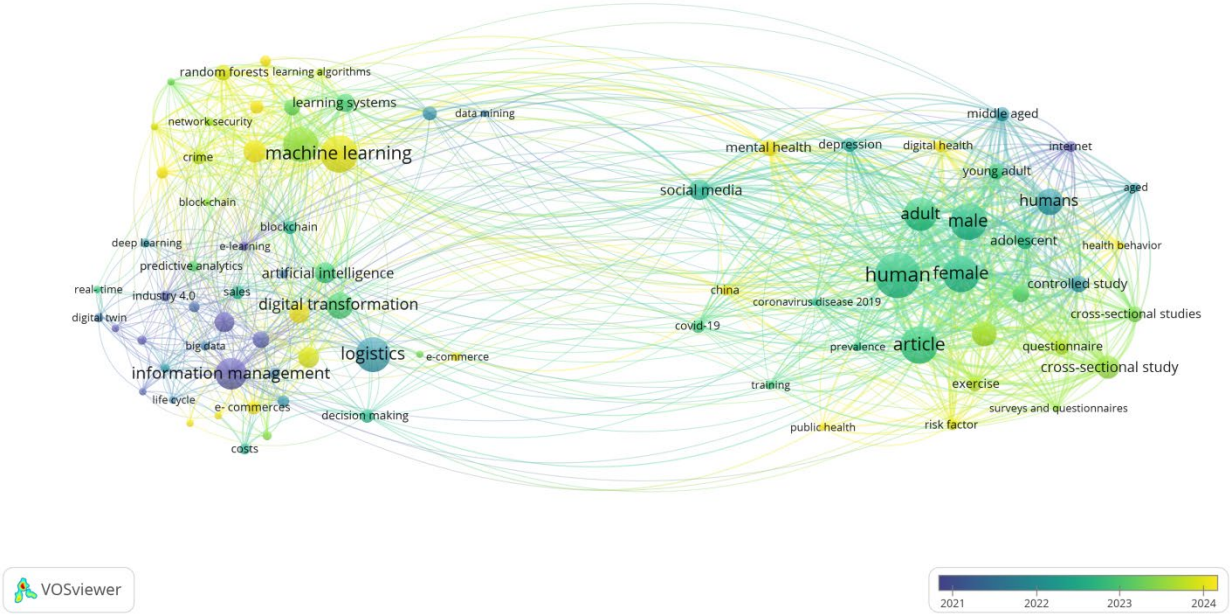

Figure 3. Overlay Visualization by Publication Year
Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

The overlay visualization by citation impact (Figure 4) makes it possible to identify which terms are associated with higher average scientific influence. In the context of logistics platformization, these typically include concepts related to supply chain integration and infrastructures of trust, such as blockchain in supply chain management [34], as well as digitally enabled integration capabilities and their effect on firm performance [33]. These terms form part of the conceptual core of the field, linking technological infrastructure with measurable organizational outcomes.

The density visualization (Figure 5) further confirms the dual structure of the dataset. Two distinct density centers can be observed: a logistics-digital core and a health-related core. This empirical configuration methodologically justifies the dual-corpus design, as it demonstrates that without thematic refinement the intellectual architecture of the field would be distorted by cross-domain contamination.

Geographical maps (Figure 6 and Figure 7) reveal the dominance of the United States as the principal citation hub, accompanied by secondary levels of activity in countries such as Italy, China, and India. The international collaboration network displays moderate connectivity: several relatively strong cross-national linkages are visible, yet the overall density of cooperation remains limited. This pattern is typical of emerging or technologically evolving domains, where a substantial proportion of research is grounded in local datasets, national digitalization programs, and the specific institutional characteristics of domestic logistics markets.

Taken together, these visualizations provide empirical evidence that logistics platformization is developing as a globally distributed yet structurally concentrated research field, characterized by a strong core of high-impact conceptual works, growing technological specialization, and still-maturing patterns of international scholarly collaboration.

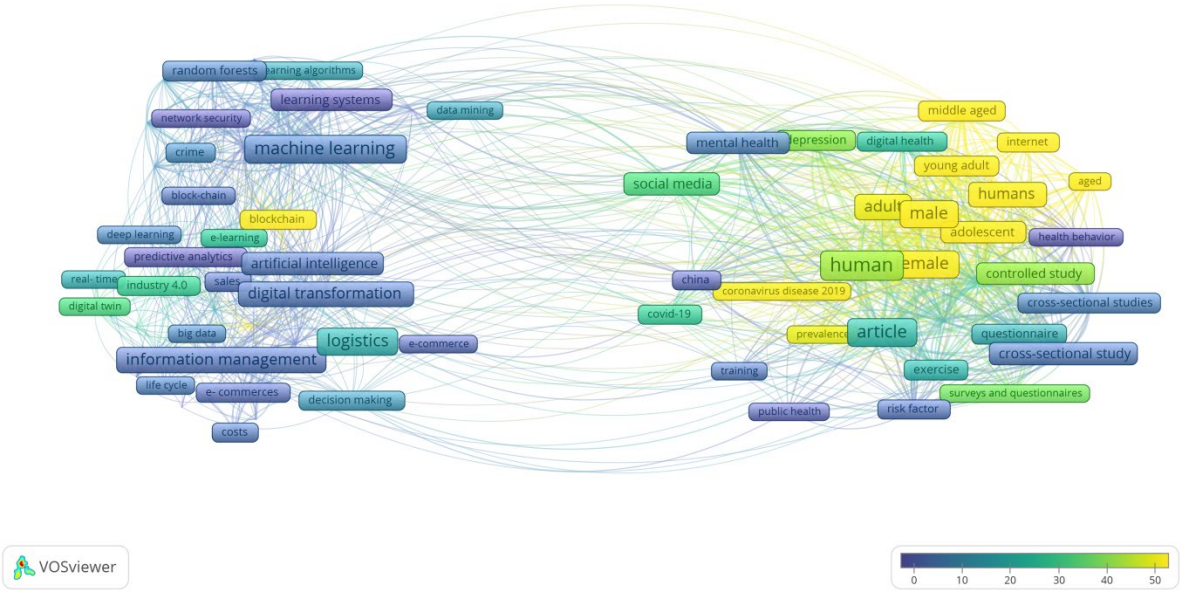

Figure 4. Overlay Visualization by Average Citation Impact of Terms

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

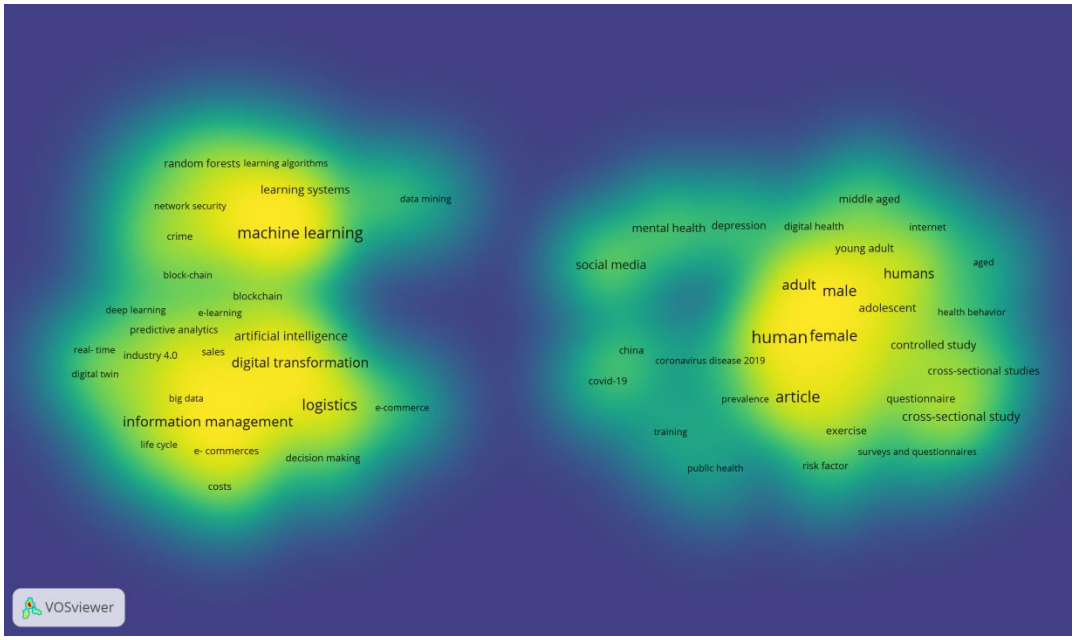

Figure 5. Density Visualization of Keywords

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

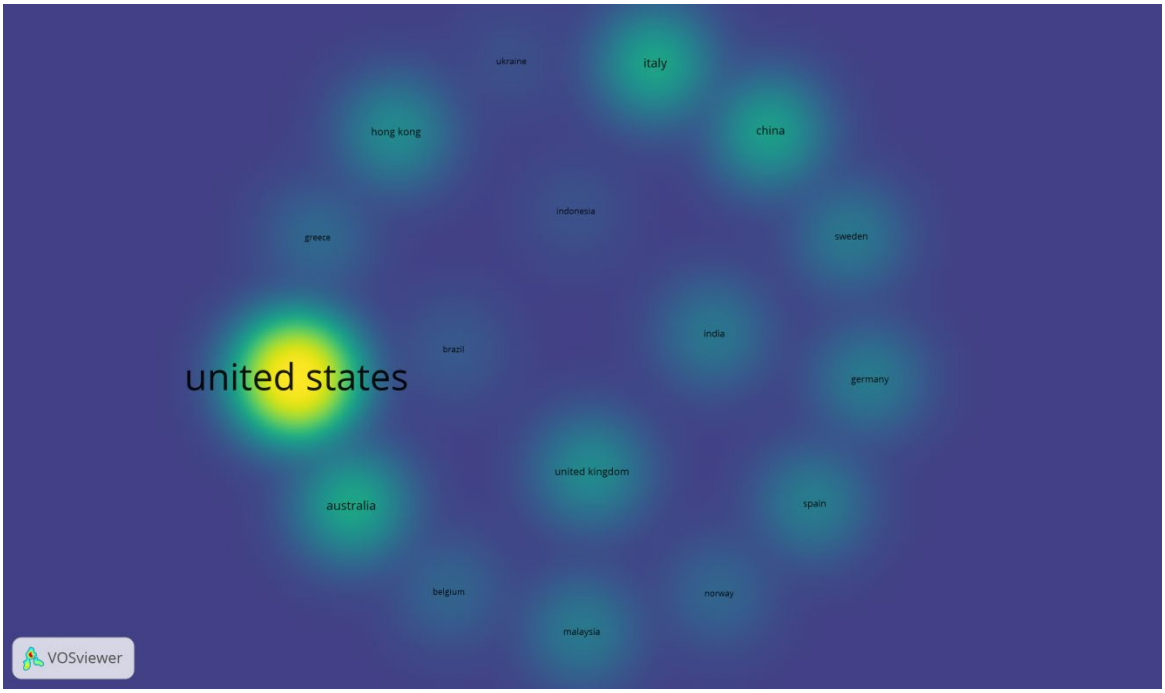

Figure 6. Country Map by Total Citation Count

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

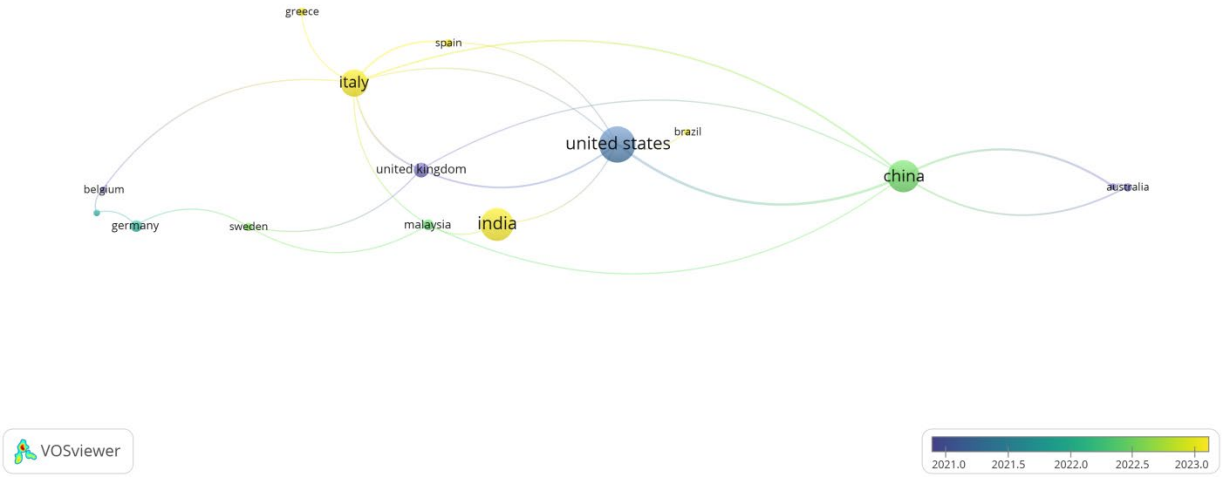

Figure 7. Network of International Collaboration Among Countries

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

The thematic generalization of clusters is presented in Table 13, which provides a synthesized structure, and in Table 14, which contains a detailed analytical matrix. In combination with Figures 2–7, these results allow the platformization of enterprise logistics activities to be interpreted as an integrated ecosystem in which the platform performs the role of a coordination core, while artificial intelligence and machine learning technologies, digital twin systems, and blockchain solutions function as

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complementary ecosystem modules that collectively generate value [24–27].

Accordingly, logistics platformization should not be reduced to a single technological instrument. Rather, it represents an architecture of data, rules, and services capable of scaling interaction among supply chain management participants.

Table 13. Thematic Clusters of Global Research on the Digital Platformization of Enterprise Logistics Activities (Co-word Analysis)

Cluster	Conceptual Core	Typical Keywords	Dominant Dimension	Central Research Questions
Platform logistics and supply chain management ecosystems	Platform as a mechanism of coordination, matching, and transactions in supply chains	digital platform; logistics; supply chain; marketplace; electronic commerce	Organizational and market	How do platform models transform coordination and access to logistics capacity?
Digital transformation and Industry 4.0	Process digitalization and system integration in supply chains	digital transformation; digitalization; Industry 4.0; data integration	Processual	Which data architectures generate measurable performance effects?
Artificial intelligence and machine learning in logistics	Forecasting and optimization based on platform data	machine learning; artificial intelligence; deep learning; predictive analytics	Analytical	How can forecast accuracy be improved and data quality managed?
Digital twin and cyber-physical systems	Simulation and management of physical flows	digital twin; simulation; automation; automated guided vehicles	Engineering	How can scenarios be tested and automation integrated?
Blockchain in supply chain management	Trust, traceability, and compliance	blockchain; smart contracts; traceability; trust	Institutional	How can data immutability and transparent accountability be ensured?

Note: Corpus A contains a health-related cluster as a consequence of query homonymy; logistics-specific conclusions are based on Corpus B and keyword normalization [31].

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

Table 14. Detailed Matrix of Thematic Clusters in Logistics Platformization

Cluster Name	Conceptual Core	Dominant Dimension	Typical Research Questions	Practical Implications for Enterprises
Logistics platforms and service marketplaces	Multisided markets; matching; network effects; service-level agreements and ratings	Market and organizational	How does the platform alter partner selection, pricing structures, negotiation speed, and access to capacity?	Faster carrier and warehouse search; risk of platform lock-in; data access asymmetry
Supply chain integration as	Application programming interface	Processual and infrastructural	How can data compatibility across	Increased transparency and

platform infrastructure	integration; interoperability; data standards; enterprise resource planning, warehouse management systems, transportation management systems, Internet of Things		supply chain actors be ensured? Which integration standards enable scalability?	controllability of flows; cybersecurity requirements; need for data governance
Artificial intelligence and machine learning enabled logistics	Demand and delay forecasting; route optimization; inventory management; machine learning operations	Analytical	How can model bias and drift be mitigated? How can platform data quality be secured?	Cost reduction and service improvement; risks of erroneous decisions and regulatory exposure
Digital twin and cyber-physical logistics	Digital twins; simulation; robotics; scenario management	Engineering	How can digital and physical systems be integrated? How can implementation scenarios be evaluated?	Reduced downtime and improved safety; high capital intensity and data requirements
Blockchain and trust in supply chains	Data immutability; traceability; smart contracts; compliance	Institutional and transactional	Which supply chain segments benefit from immutable records? How can solutions be scaled?	Reduced disputes and counterfeiting; integration and interoperability challenges
Platform risks and cybersecurity	Fraud detection; security by design; privacy; access management	Managerial	How can risks of platform dependency and data leakage be managed? How can secure platforms be designed?	Increased resilience; additional cybersecurity and compliance costs

Source: constructed by the authors based on processing of the Scopus database using VOSviewer software.

The obtained results allow logistics platformization to be conceptualized as a transition from localized digitalization initiatives to an ecosystem-based coordination infrastructure. The structural shift observed after 2019 indicates that the scholarly field increasingly conceptualizes platforms not as isolated online tools but as environments in which data, processes, and transactions in supply chain management are systematically coordinated.

Within the framework of platform economy theory, this corresponds to the expansion of multisided markets for logistics services and the strengthening of network effects [24–25]. From the perspective of ecosystem theory, it reflects the emergence of a network of complementary services, including analytics, automation, identification, and compliance, orchestrated around the platform as a central node [26–27]. From an institutional perspective, the platform functions as a governance mechanism: it establishes data standards, access rules, and trust infrastructures, thereby reshaping bargaining positions within the supply chain and potentially generating platform lock-in, data asymmetry, and new forms of risk.

The cluster results and VOSviewer maps demonstrate that technological directions such as artificial intelligence and machine learning, digital twins, and Industry 4.0 do not operate in isolation. Instead, they form an integrated package of platformization. In practical terms, the effectiveness of logistics

platformization emerges only when three components are simultaneously implemented: first, integration of data and processes across supply chain systems; second, analytical manageability based on platform data; and third, trust, traceability, and compliance in transactions, including blockchain-enabled mechanisms [33–36]. In this sense, the logistics platform constitutes not only a technological infrastructure but also an organizational one, transforming contracting practices, planning procedures, dispatching, service quality control, and data exchange.

At the same time, several limitations define the boundaries of generalization. First, the analysis is based exclusively on the Scopus database, and thus reflects the structure of the field within this indexing system; certain regional or specialized publications may remain unindexed. Second, the English language filter may lead to underrepresentation of research published in national languages. Third, the homonymy of the terms logistic, activity, and platform generates interdisciplinary noise; although a dual-corpus design was implemented, residual cross-domain contamination may persist. Fourth, citation indicators are subject to time lag effects: publications from 2024 to 2026 have not yet had sufficient time to accumulate citations, and comparisons between recent and older works require caution. Fifth, clustering results in VOSviewer depend on inclusion thresholds, normalization procedures, and parameter settings; alternative configurations could alter cluster boundaries, although the overall thematic architecture remains stable. Finally, bibliometric analysis describes the structure of scientific discourse but does not directly measure the economic effects of platformization, such as cost reduction, productivity gains, or supply chain resilience, and therefore requires further empirical validation.

Future research should integrate bibliometric mapping with empirical models assessing the performance effects of logistics platformization. Priority directions include evaluation of platform impact on key performance indicators, including cost efficiency, lead time, reliability, service level, and resilience; analysis of risks related to platform dependency and data asymmetry; modeling of governance mechanisms within supply chain platforms, including access rules and interoperability standards; investigation of the integration of artificial intelligence, machine learning, and digital twins as the operational intelligence layer of the platform; and assessment of the economic feasibility of blockchain-based trust infrastructures in specific supply chains. Such a transition from bibliometric description to empirical verification will enable not only the mapping of knowledge structures but also the identification of causal relationships between platformization and enterprise logistics performance.

Conclusions. In today's environment of digital transformation and sustainable development, marketing logistics is becoming a strategic tool for building customer loyalty, where the key determinants are speed and reliability of delivery, personalization, transparency, proactive communication, environmental responsibility and effective problem solving. Traditional approaches no longer meet customer expectations, which reduces retention, trust, and customer lifetime value. The proposed Sustainable AI-Driven Marketing Logistics Model provides a systematic increase in loyalty and enhances the competitiveness of enterprises in conditions of uncertainty. Its cyclical nature allows for continuous improvement of processes, adaptation to change, and accumulation of trust and brand reputation, making marketing logistics a powerful strategic asset of the digital age.

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