

Enabling Digital Logistics: A Literature Review on Digitalization and Systems Integration

Andrei TIME*

National University of Science and Technology Politehnica Bucharest, Bucharest, Romania

ORCID ID: <https://orcid.org/0009-0005-6787-1681>

* Corresponding author, e-mail address andreitime85@yahoo.com

Torben TAMBO¹

Aarhus University, Herning, Denmark

ORCID ID: <https://orcid.org/0000-0001-8491-7286>

e-mail address torbento@btech.au.dk

Abstract. *Enhancing supply chain effectiveness through improved collaboration among partners is a central theme in logistics digitalization research. Objectives: In response to this trend, this study investigates the integration of Transport Management Systems (TMS) with third-party Software as a Service(SaaS), platforms, focusing on how such integrations can enhance logistics brokerage capabilities via system interoperability and digital transformation principles. A systematic literature review, guided by the PRISMA protocol, was conducted to examine peer-reviewed studies from the past five years addressing digitalization in logistics, particularly from the perspective of TMS integration and the evolving function of logistics brokers. The analysis employs a four-dimensional model based on Layered Systems and Modular Architecture Theory to synthesize current findings. Results indicate a fragmented understanding of the strategic potential of SaaS integration in logistics brokerage.*

The study underscores the critical role of platform interoperability and seamless system integration in optimizing logistics operations and enhancing service delivery across the supply chain. Implications: The findings offer practical implications for logistics brokers and supply chain managers, advocating for a holistic, system-level approach to digital integration. This research contributes to bridging existing knowledge gaps and contributes to a conceptual foundation for developing strategic frameworks that support effective TMS integration with partner SaaS platforms to generate synergies.

Keywords: Digital logistics, SaaS integration, Transport Management Systems, logistics brokerage, platform interoperability.

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Introduction

Effective supply chain management (SCM) ensures the seamless flow of goods from producers to consumers. SCM oversees the procurement of raw materials, transformation into finished products, and their distribution through logistics channels. The supply chain involves suppliers, manufacturers, distributors, retailers, and customers, with performance evaluated through operational costs, lead time, and product quality. Although core logistics functions remain stable, technology has transformed the sector by replacing manual processes with digital systems that increase transparency and efficiency. As competition intensifies, logistics providers must rapidly embrace innovation to stay competitive. At the heart of this transformation is the Transport Management System (TMS), evolving into a digital hub connecting diverse logistics functions. The rise of 'asset-light' service providers underscores the need for robust digital infrastructures linking multiple supply chain stakeholders.

Literature review

Logistics is fraught with challenges ranging from various national regulations across countries as well as the physical and informational burden of transporting and tracking vast amounts of freight [1][2]. To address these challenges, freight forwarders are focusing on digitalization—leveraging data-driven planning with predictive analytics and machine learning; adopting SaaS models that enable rapid deployment and reduced IT overhead; utilizing cloud-based TMS platforms to enhance real-time control and minimize in-house software costs; and integrating SaaS, SCM, and e-commerce systems to support seamless, automated logistics networks [2][3]. At the same time, logistics—and especially customs—brokers are assuming a pivotal role in overseeing documentation, regulatory compliance, and cross-border logistics efficiency—all underpinned by digital workflows [4].

Theoretically, our review is situated within the framework of Layered Systems and Modular Architecture Theory, which conceives of these logistics ecosystems as composed of discrete, loosely coupled modules—presentation, application, integration, and data layers [5]—offering scalability, maintainability, adaptability, and security. This layered perspective allows us to analyze SaaS integration strategies in terms of data reusability, performance scalability, plug-and-play connectivity, and security hierarchies—factors critical in dynamic, cloud-native logistics environments. By grounding our review in this modular architecture lens, we integrate technological design with organizational and strategic dimensions of digital transformation in transportation logistics.

Methodology

We conducted a comprehensive literature review using the PRISMA framework to identify key trends in digital transformation within logistics. The central question focused on which themes are shaping current research. We targeted English-language, peer-reviewed articles, reviews, and conference papers from 2020 onward, with emphasis on SaaS systems in logistics. Using Scopus for its breadth and advanced search capabilities, we applied the following keyword string: TITLE-ABS-KEY (software as a service) AND TITLE-ABS-KEY (principles) AND TITLE-ABS-KEY (digitalization) AND TITLE-ABS-KEY (transportation) with filters: PUBYEAR = 2024, subject areas COMP and ENGI, document type ar, and language English.

Our inclusion criteria prioritized empirical studies addressing real-world logistics software challenges in business, management, and engineering, while excluding purely theoretical, vague, or duplicate works. From 28 initial articles, title and abstract screening reduced the set to 16; one was added via backward referencing, totaling 17. Each was reviewed in full, focusing on original models or frameworks with practical relevance. Redundant approaches were excluded through critical team evaluation.

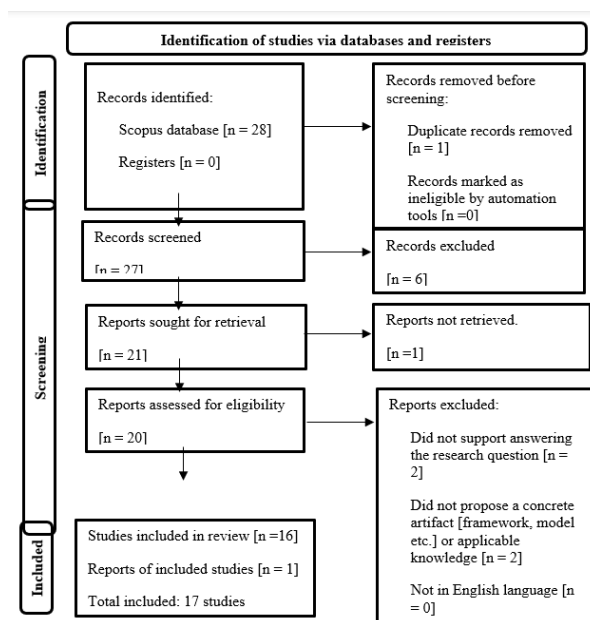


Figure 1: PRISMA diagram of literature review process

Source: Author's own contribution

To organize our findings, we compiled a detailed spreadsheet capturing each article’s objectives, methods, context, contributions, limitations, and future research suggestions. This structured approach enabled pattern recognition and deeper insight into digital logistics transformation. The review followed the PRISMA checklist and flow diagram, ensuring transparency and reproducibility. The result is a rigorous and well-documented synthesis of current literature in a fast-evolving domain..

Results and further discussions

Distribution of published studies per journal

The analysis revealed that The Institute of Electrical and Electronics Engineers (IEEE) led with 3 studies (18%), followed by the European Journal of Operational Re-search with 2 articles (12%). Other journals contributed single studies amounting to 6% each.

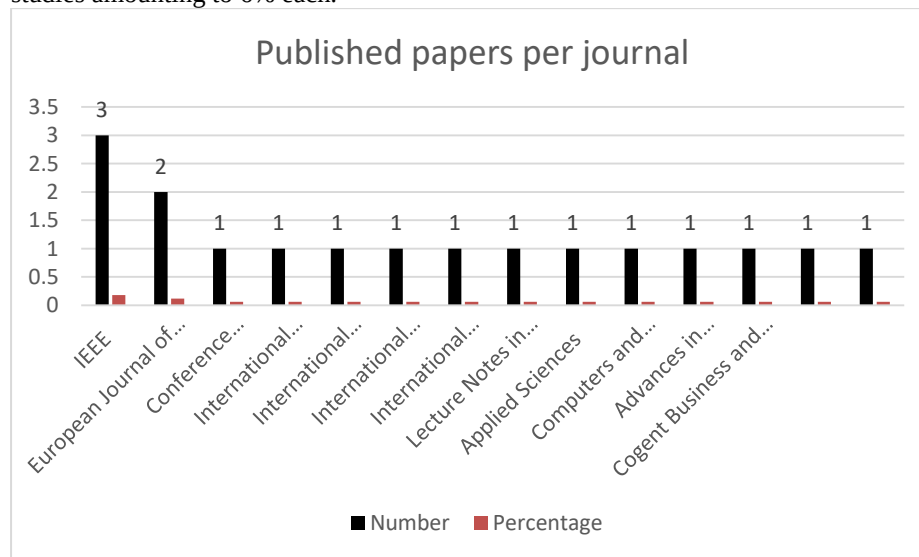


Figure 2: Published papers per journal

Source: Author’s own contribution

Distribution of published studies per country of origin

For the purpose of this analysis, the country of origin of the analyzed articles was assigned as the country of affiliation of the first author. As observed in the figure above, India accounted for 11% of the selected studies, followed by Russia (7%), and the U.S., Italy, Thailand, China, Greece, Saudi Arabia, Singapore, Germany and Ukraine 7% each with only one article.

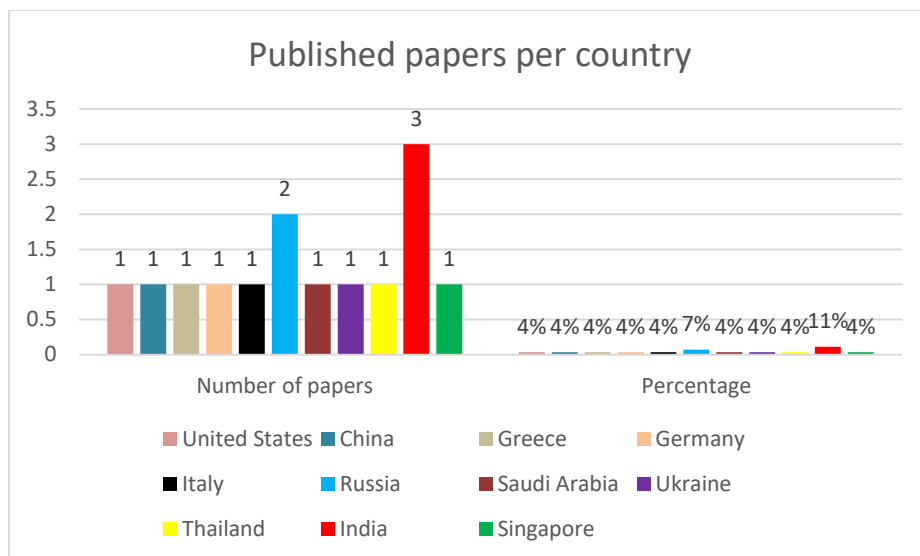


Figure 3: Published papers per country of origin
Source: Author's own contribution

The distribution of the articles per country of origin with India and Russia leading in this area. This could be interpreted as an effort on the part of the logistics industries of those respective countries to catch up with the newest trends in the West.

Chronological distribution of published studies

The study found that the number of publications peaked in 2020 (30%), declined in 2021 (0%), and gradually increased again in 2023 (25%) and 2024 (35%).

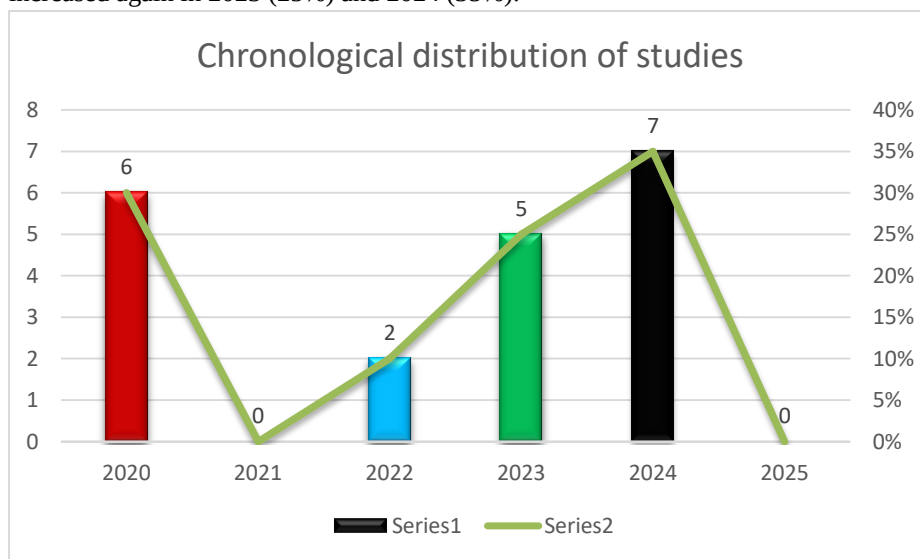


Figure 4: Chronological distribution of studies
Source: Author's own contribution

The chronological distribution of the articles shows a dramatic decrease in articles approaching digitalization in logistics in 2021 followed by a gradual rise to 2024. As this timeframe is consistent with the peak of the COVID-19 pandemic, some correlations could be drawn here.

Chronological distribution of published studies

As far as generic trends go, this study identifies two main areas of progress in the field: improving resource efficiency and enhancing customer-focused services. Resource optimization is addressed through technological support for traditional logistics [2; 3; 6; 7], new uses of data [8; 9], and collaboration with external actors like brokers [4; 5].

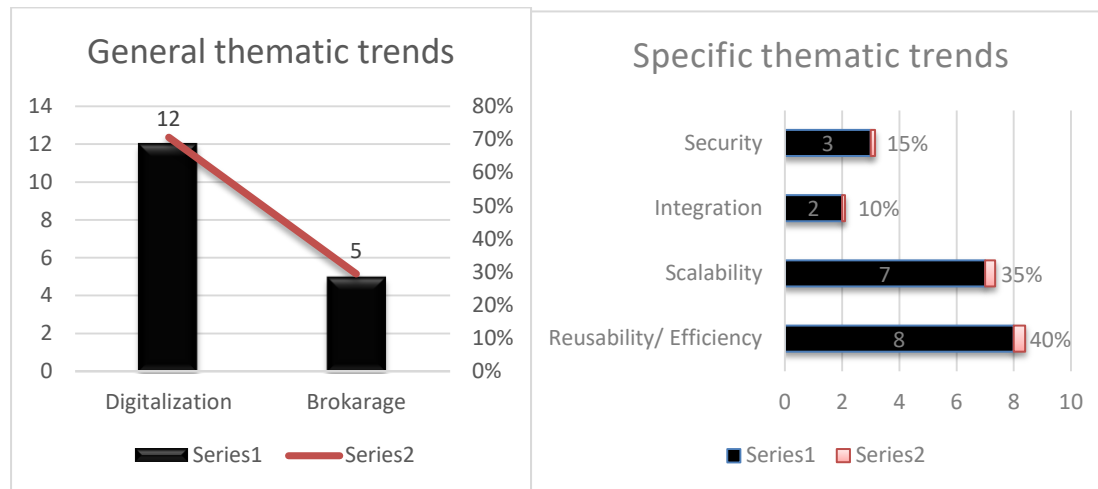


Figure 5: Distribution of published studies according to general and specific thematic trends
Source: Author's own contribution

The study found that 70% of articles focused on logistics digitalization, 25% on brokers as digital enablers. Beyond general themes, specific trends emerged: digital tools enhance transaction ease and security [3; 4; 9; 11–14], with blockchain [9; 13; 14], simulations, and predictive tools [2; 15] frequently cited. Efficiency via data reuse appeared in 40% of articles, cost reduction in 35%, security in 15%, and process optimization in 10%. Despite these insights, a practical framework is lacking, limiting industry application. Research gaps include a bias toward theory over practice [9; 11; 14; 16], weak links to customer satisfaction [3; 10; 17], and fragmented supply chain focus. Few studies adopt a system-wide view [6; 9; 19], and only two explore fully virtual platforms [9; 19]. To support granular analysis, a standardized framework is proposed—mapping thematic trends to a model inspired by Layered Systems and Modular Architecture Theory, segmented across two time periods (Table 1).

Table 1: Overview of logistics digitalization literature across research dimensions

Dimension	Research focus on digitalization in logistics literature [2020–2022]	Research focus on digitalization in logistics literature [2023–present]
Data Reusability	This theme is absent from the analyzed sample of literature pertaining to the period 2020-2022	Data is reused to enhance the role of logistics brokers by leveraging a software platform based on Structural Equation Modeling (SEM) integrated with multiple data sources (e.g. suppliers, authorities etc.) aiming at automating customs procedures [4] and to optimize logistics operations related to navigation by harnessing and enriching meta-data via a big-data analytics framework built on open-source technologies [2]
Scalability/Performance	Increased performance is achieved	[3] suggests concepts for the

	through the improvement of the management of operations of logistics providers the employment of industrial engineering tools [9]; [15] proposes the enhancement of logistics brokers by decreasing carrier costs using a mathematical model for scientifically pricing carrier routes.	optimization of performance of SaaS-based TMS (Transport Management System) applications in tracking shipments in logistics
Plug-and-play integration	[8] proposes a framework for the improving organizational planning by applying a framework for customizing SaaS-based optimization models. [11] Increases the profitability of e-grocers and e-tailers by managing the demand of home deliveries through a route-based approximate dynamic programming method combining dynamic pricing and dynamic route-planning. [19] increases the efficiency of last-mile logistics providers by vehicle sharing and optimizing route-planning through a shared information technology platform.	[7] proposes a method for distributed traffic flow management based on proactive management and a vehicle movement model to increase traffic management efficiency.
Security layering	Increases the efficiency and security of monetary transactions throughout the supply chain through a blockchain-based smart contract for supply chain transactions [9]. [14] Increases revenues of farmers by providing a direct link to end customers via a farm robot and blockchain- based e-commerce application.	[12] suggests a secure vehicular network employing access technologies based on SDN (Software Defined Network) to improve logistics providers efficiency. [13] identifies blockchain innovation in managing supply chain issues in the manufacturing and logistics sectors by offering a transparent, secure and decentralized link between supply chain actors.

Source: Author's own contribution

This section addresses the main trends shaping research on digital transformation in logistics, with a particular focus on the knowledge gaps revealed through our re-view. The analysis was guided by the research question: What are the main trends affecting research related to the process of digital transformation in logistics?

The findings indicate that while digital transformation is a growing focus in logistics research, several critical gaps persist. First, there is a notable lack of emphasis on strategic alignment and organizational fit. Many studies assess digital tools in isolation from the broader strategic and operational context of the firms implementing them. As a result, important aspects such as compatibility with existing business models, scalability, and long-term organizational needs are often underexplored. This limits the applicability of findings to real-world implementation scenarios.

Second, the literature reveals a limited use of conceptual frameworks to guide and structure research. Most studies adopt case-specific or technology-focused approaches without leveraging integrative models that can compare findings across contexts. To address this, our study introduces a conceptual model that systematically maps logistics

software solutions to general performance factors (see Table 1), offering a structured basis for thematic analysis and enabling better comparisons across studies.

Third, there is insufficient focus on integration and interoperability—especially in terms of how digital logistics systems interface with third-party platforms, external partners, or broader supply chain networks. Much of the literature examines digitalization within siloed logistics operations, overlooking the increasingly inter-connected nature of modern supply chains. This gap is particularly pressing as companies move toward more collaborative, data-driven, and platform-based ecosystems.

Despite these limitations, the review identifies several emerging trends in the re-search landscape: a shift toward performance-based evaluation of logistics digitalization; a growing awareness of the need for context-specific digital strategies; early efforts to structure fragmented research through conceptual models.

These trends reflect a transition from narrowly focused studies to more strategic and comparative perspectives. However, the full potential of digital transformation research in logistics remains constrained by the lack of strategic framing, limited methodological consistency, and underdeveloped discussion of interoperability.

Future research should build on these insights by applying structured frameworks to assess performance outcomes in different operational contexts, and by prioritizing the strategic alignment of digital solutions. In particular, more attention should be paid to system integration, data exchange, and collaborative digital ecosystems across the supply chain.

Conclusion

This study critically examines digital transformation in logistics, highlighting structural gaps that hinder both academic progress and real-world applicability. Key challenges—such as misalignment between digital tools and organizational strategy, fragmented conceptual foundations, and insufficient emphasis on interoperability—undermine the effectiveness of digital initiatives across logistics networks.

To address these issues, the paper introduces a conceptual model that connects logistics software performance with strategic and operational dimensions. Through the use of concepts from Layered Systems and Modular Architecture Theories, this model offers practitioners and academics a structured view of the body of knowledge, thereby facilitating the selection and evaluation of digital solutions that align with broader business objectives of companies. This is done by organizing the knowledge into distinct, manageable categories to support more informed decision-making and insight.

The practical implications are significant: readers can use this model to assess current digital solutions not only on technical merit but also on strategic fit and integration potential with a potential subject company.

It is important to note that this study was limited by exclusive reliance on the Scopus database, potentially overlooking impactful articles from other sources. The scope was further limited to peer-reviewed publications in English. Additional research dimensions—such as alternative literature classifications—could reveal patterns not evident in the current approach. Despite efforts to ensure comprehensive coverage, some relevant studies may have been missed due to varied terminology and the general nature of selected keywords.

Future research should build on this foundation by empirically validating the model across diverse logistics contexts and exploring its adaptability within broader supply chain ecosystems. Such efforts will advance both theoretical understanding and practical guidance for digital transformation in logistics.

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