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Digital Transformation in the Maritime Supply Chain: Systematic Literature Review

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ABSTRACT

The maritime sector plays a vital role in global trade and increasingly requires digital transformation to address operational complexity, logistics disruptions, and supply chain resilience challenges. This study aims to analyze digital transformation technologies in maritime supply chains through a Systematic Literature Review (SLR). The review followed the PRISMA protocol, including identification, screening, eligibility, and inclusion stages. Literature searches were conducted using Scopus, ScienceDirect, and Google Scholar with keywords related to digital transformation, maritime supply chains, smart ports, blockchain, and IoT. From 35 identified articles, 20 peer-reviewed studies published between 2020 and 2026 were selected after screening and full-text evaluation. The findings indicate that technologies such as IoT, AI, Blockchain, Big Data, ERP systems, and smart port technologies improve operational efficiency, transparency, real-time monitoring, and supply chain resilience. However, successful implementation depends on infrastructure readiness, cybersecurity, policy support, interoperability, and human resource capabilities.

1. Introduction

The maritime sector is the primary mode of international trade, transporting approximately 80% to 90% of global trade volume and connecting global supply chains across countries [1]. In Indonesia, the maritime sector contributes significantly to economic growth through fisheries, sea transportation, logistics efficiency, and marine tourism development [2], [3], [4]. Along with increasing global trade complexity and logistical disruptions, the maritime industry faces growing challenges related to operational efficiency, transparency, and supply chain resilience. Recent studies have highlighted the role of digital technologies such as IoT, Artificial Intelligence (AI), Blockchain, and Big Data in improving maritime supply chain performance. However, existing studies are still fragmented, focus on specific technologies or sub-sectors, and lack a comprehensive synthesis of digital transformation in maritime supply chains. Therefore, this study contributes by providing a systematic literature review (SLR) that identifies key digital technologies, analyzes their impacts on maritime supply chain performance and resilience, and highlights current challenges and future research directions in the maritime sector.

The tendency for conditions to constantly change and the inevitability of uncertainty require risk-based supply chain management for operational success and increase companies' desire to build organizational capabilities in relation to Supply Chain Orientation [5]. The maritime supply chain is a system that involves various stakeholders, spans regions, and is dynamic, resulting in high complexity due to various aspects, including the involvement of parties with different interests, which can increase the risk of information and decision inconsistency, and the uncertain nature of operations, which causes high variability in time and logistics costs, as well as global reach and diverse regulations. This

complexity cannot be optimally managed with conventional systems that have many limitations, such as fragmented information, lack of system integration, manual and document-based processes, and limitations in analytics and decision-making. The maritime sector in Indonesia faces significant challenges from various aspects, including a lack of qualified human resources and technological investment, which can hamper the effectiveness of Maritime Industry and Services Development policies [6], [7].

The Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, and Digital Twin open up new opportunities to build a more transparent, efficient, and adaptive supply chain to address the challenges of material flow transparency, operational efficiency, and waste minimization. In this regard, the urgency of digital transformation in the maritime sector is similar, namely the need for tools such as IoT, Blockchain, Big Data, and Real-Time Tracking Systems, increased global competitiveness, shipping safety and security, and environmental sustainability to improve operational efficiency through process automation and shipping route optimization, transparency, and supply chain visibility [8]. The implementation of Blockchain for maritime security in Indonesia can increase transparency and data traceability in the logistics and port sectors, reduce ship waiting times, and accelerate logistics clearance, which can prevent fraud and speed up verification. The reduction in logistics and operational costs strengthens trust between institutions, which needs to be supported by stable internet connectivity and adequate digital devices in Indonesia's coastal areas [9], [10].

The maritime sector covers Sea Transportation and Logistics, Maritime Industry and Shipbuilding, Marine Tourism, Fisheries and Marine Affairs, Marine Energy and Resources, and Maritime Defense and Security. This requires the implementation of maritime supply chain digitalization to minimize delays in decision-making, data and information inconsistencies, human error, and knowledge gaps among stakeholders, including coastal communities. On the other hand, the need for digital transformation is inversely proportional to the location and conditions of coastal communities, which have limited access to capital, socio-economic institutional infrastructure, and minimal knowledge in using technology. In fact, a survey of coastal locations in Indonesia shows that the Digital Literacy Index of Coastal Communities has good capabilities in digital culture and ethics with an index of 3. 9 but still requires more attention in improving digital security, which has the smallest index of 2.55, indicating the need for community education to increase awareness and practices to protect themselves from digital threats [11].

Based on the increasing attention to digital supply chain digitalization, numerous studies have been conducted using diverse approaches and perspectives. However, the existing literature remains fragmented and dispersed across various sources, making it difficult to obtain a comprehensive understanding of digital transformation in maritime supply chains. Therefore, this study aims to conduct a Systematic Literature Review (SLR) to identify, classify, and analyze previous studies related to digital transformation, supply chains, and the maritime sector. The review focuses on peer-reviewed research articles published between 2020 and 2026, selected based on relevant indexed keywords.

To achieve this objective, the study addresses the following research questions:

i. What digital technologies are most frequently applied in maritime supply chains?
ii. How does digital transformation influence the performance and resilience of maritime supply chains?
iii. What challenges and barriers are faced in implementing digital transformation in the maritime sector?
iv. What future research directions and strategic recommendations are proposed in the literature?

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2. Methods

This study uses a Systematic Literature Review (SLR) with the PRISMA framework to analyze digital transformation in the maritime supply chain. PRISMA was selected because it provides a systematic and transparent method for identifying, screening, and evaluating scientific literature. The study refers to [12], [13] regarding the importance of systematic literature reviews in identifying research trends and reducing bias. Literature searches were conducted using Scopus, ScienceDirect, and Google Scholar with keywords related to digital transformation and maritime supply chains. Reference management used Zotero, while VOSviewer was utilized for bibliometric and keyword analysis. The PRISMA stages included identification, screening, eligibility, and inclusion. From 35 initial articles, 25 articles passed screening, and 20 articles were finally selected after full-text evaluation. The selected studies discussed technologies such as IoT, AI, Blockchain, Big Data, ERP, and smart port systems in maritime logistics. The review results indicate that digital transformation improves transparency, operational efficiency, resilience, and decision-making in maritime supply chains. Technologies such as IoT, AI, Blockchain, and Big Data support automation, real-time monitoring, predictive analysis, and secure documentation. However, successful implementation also requires infrastructure readiness, cybersecurity, policy support, and human resource development. The Research Flowchart is shown in Figure 1.

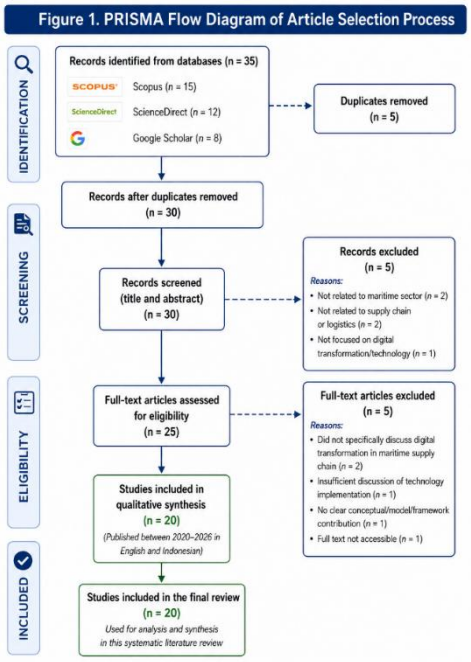

Figure 1. Research Flow Diagram *PRISMA* (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses)*

3. Results and Discussions

This chapter presents the results of a literature review analysis obtained through a Systematic Literature Review (SLR) approach. Articles that passed the selection stage were analyzed systematically to identify research patterns, development trends, methodological approaches, and research gaps that remain open. The research results are presented in a structured manner based on the main aspects, namely the year of publication, the research approach and methods used, the focus of the study and the technology implemented, as well as the main findings and contributions of each study to the development of theory and practice.

3.1 Search Results for Articles That Meet the Criteria

The article selection process was conducted systematically using the Systematic Literature Review (SLR) approach to ensure transparency, consistency, and relevance in identifying studies related to digital transformation in maritime supply chains. Before presenting the selected articles, inclusion and exclusion criteria were established to ensure that only relevant studies were analyzed. The criteria used in this review are presented in Table 1.

Table 1. Search Results for Articles That Meet the Criteria

No	Authors	Year	Title	Journal
1.	Su, Z [14]	2026	Digital Transformation in Port Logistics	Encyclopedia
2.	Piyd, OTL [1]	2025	Membangun Ketahanan Rantai Pasokan Maritim: Peran Strategis Manajemen Pelabuhan Dalam Menghadapi Gangguan Logistik Dan Disrupsi Perdagangan Internasional	Jurnal Ilmiah Wahana Pendidikan
3.	Liu, et al. [15]	2023	Maritime Supply Chain Resilience: From Concept to Practice	Elsevier: Computers & Industrial Engineering
4.	Handayani, et al [16]	2025	Evaluasi Manajemen Rantai Pasok Usaha Pembuatan Kapal Pinisi: Sebuah Penerapan Konsep Ekonomi Biru	Jurnal Ilmiah Pariwisata
5.	Nawir, et al [17]	2024	Industri Perdagangan dan Globalisasi Maritim di Indonesia.	Jurnal Ilmu Teknik dan Teknologi Mairitim
6.	Zhang, et al [18]	2024	Resilience Analysis of Maritime Transportation Networks: A Systematic Review.	Transportation Safety and Environment
7.	Alshareef, MH. [19]	2025	Supply Chain Resilience in Maritime Logistics Networks Integrating Blockchain Technology and Machine Learning Disruption Prediction	Journal Of Information Systems Engineering and Management
8.	Deanto & Marzaman [20]	2024	Transformasi Kebijakan Maritim Dalam Era Digital: Peran Teknologi Dalam Meningkatkan Efektivitas Dan Keamanan Lautan Di Indonesia	Journal Of International and Local Studies
9.	Osobajo, et al [21]	2021	Making Sense of Maritim Supply Chain: A Relationship Marketing Approach	Journal Of Shipping and Trade
10.	Tijan, et al [22]	2021	Digital Transformation in The Maritime Transport Sector	Technological Forecasting & Social Change
11.	Zeng, et al [23]	2025	Digitalization In The Maritime Logistics Industry: A Systematic Literature Review Of Enablers and Barriers	Journal Of Marine Science And Engineering
12.	Azisah, et al [24]	2025	Transformation Model And Systematic Approach For Smart Maritime Logistics: A Literature Review Analysis	Maritime Technology And Society
13.	Khazzar. et al [25]	2025	Artificial Intelligence In Port Logistics: A Bibliometric Analysis, Technological Integration And Research Dynamics	IJAFAME : International Journal Of Accounting, Finance, Auditing, Management and Economics
14.	Redekar, et al [26]	2025	Maritime Port Supply Chain Resilience: A Systematic Review	ARXIV
15.	Hussien, et al [27]	2025	Unlocking The Future: How Blockchain Influences Sustainable Supply Chain Performance: An Empirical Study On The Maritime Industry	The International Maritime Transport and Logistics (MARLOG)
16.	Dwiyani [28]	2026	Digital Transformation in Maritime Logistics: Integrating IoT and Blockchain for Supply Chain Transparency in Indonesian Shipping Networks	Marine Transport Management and Logistics Journal

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17.	Rahmasari, et al [29]	2025	The Role Of E-Logistics And Blockchain-Based Logistics Networks In Improving Maritime Industry Logistics Performance	Jurnal Ilmiah Manajemen Kesatuan
18.	Khasem, et al [30]	2024	Digital-Era Resilience: Navigating Logistics And Supply Chain Operations After COVID-19	MDPI
19.	Almeida, et al [31]	2023	Challenges in the Digital Transformation of Ports	MDPI
20.	Raza, et al [32]	2023	Digital transformation of maritime logistics: Exploring trends in the liner shipping segment	Elseiver : Computers In Industry

3.2 Basic Concepts of Maritime Supply Chain and Digital Transformation

The reviewed studies show that the maritime supply chain is a highly interconnected system involving shipping companies, port operators, logistics providers, customs authorities, and regulators across international trade networks. Several studies emphasized that increasing operational complexity, global disruptions, and coordination challenges have accelerated the need for digital transformation in maritime logistics. [15], [18] highlighted that supply chain resilience in the maritime sector depends on greater visibility, integration, and collaboration among stakeholders. Meanwhile, [22], [32] found that technologies such as IoT, Artificial Intelligence (AI), Blockchain, and Big Data improve real-time monitoring, operational efficiency, transparency, and decision-making in maritime operations. In addition, studies by [19] & [27] demonstrated that blockchain integration and intelligent digital systems support disruption prediction, secure documentation, and supply chain resilience. However, the reviewed literature also identified challenges related to infrastructure readiness, cybersecurity, regulatory coordination, and human resource capabilities. Overall, the reviewed studies indicate that digital transformation in maritime supply chains extends beyond technology adoption and requires integrated governance, interoperable systems, and stronger collaboration among maritime stakeholders.

The reviewed studies demonstrate that the maritime supply chain is a highly interconnected and multi-stakeholder system involving shipping companies, port operators, logistics providers, customs authorities, and regulators across international trade networks. Several studies emphasize that the increasing complexity of global maritime operations, combined with disruptions caused by the COVID-19 pandemic, has accelerated the need for digital transformation in maritime logistics. [15], [30] highlighted that maritime supply chain resilience depends on stronger collaboration, flexibility, visibility, and integration among stakeholders, particularly during periods of global uncertainty and disruption. Similarly, [21], [18] found that digital transformation in the maritime transport sector improves operational efficiency through real-time information exchange, automation, and data transparency, while also supporting regulatory compliance and reducing lead times.

Across the reviewed literature, technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, Big Data, and digital platforms are consistently identified as key enablers of maritime supply chain transformation. Recent studies by [25] also emphasized that AI integration within smart port ecosystems supports predictive analytics, anomaly detection, berth optimization, digital twins, and operational sustainability through real-time data infrastructures and intelligent decision-support systems. In addition, [19], [27] demonstrated that integrating blockchain and machine learning technologies into maritime logistics networks can improve transparency, disruption prediction, and supply chain resilience. Studies [20], [28] noted that blockchain implementation enhances maritime security, operational transparency, and coordination among stakeholders, although its adoption still faces challenges related to infrastructure readiness, cybersecurity, and human resource capabilities.

The maritime supply chain during the pandemic has led to increased container transport costs and congestion at several major ports around the world, demonstrating the unpreparedness of stakeholders to anticipate supply chain disruptions and the need for government assistance and support. The changing times demand that supply chains adapt to faster ways of serving customers, suppliers, colleagues, and even ship crews, requiring face-to-face or remote communication anytime and anywhere, which drives

the direction of digitalization in all aspects. However, this poses the threat of job losses due to technology taking over, so it needs to be accompanied by improvements in the quality of human resources in using, processing, and analyzing data into information in the logistics industry environment. The digitalization reform of the maritime supply chain also accelerates the supply and demand cycle, such as speeding up delivery times, increasing economic growth, and facilitating communication between vendors or suppliers in the context of relationship management.

3.3 Characteristics of The Maritime Supply Chain

In the maritime sector, the concept of supply chain is adapted to manage activities related to the movement of goods and resources by sea, involving various stakeholders, ports, shipping companies, terminal operators, freight forwarders, and relevant authorities. Maritime supply chain activities include sea transportation, loading and unloading at ports, storage, and integration with land and air transportation modes. The complexity of multi-stakeholders, dependence on port infrastructure, lack of visibility and transparency, complex regulations and administration, and limited adoption of digital technology are challenges faced by the maritime supply chain, which, according to many previous studies, can be minimized by implementing technology in the form of fragmented systems, visibility and real-time data, measurable data quality and standardization, and supporting human resource quality.

3.4 Digital Transformation in Maritime Supply and Maritime Logistics

Weather conditions, natural disasters, geopolitical instability, terrorist threats, and human resource limitations are the primary causes of disruption in maritime transportation networks [26]. These disruptions highlight the need for integrated digital systems and stronger resilience strategies within global maritime supply chains. Reference [32] also highlighted that data-driven systems, AI, and IoT technologies improve customer visibility, operational efficiency, and decision-making within maritime logistics networks. [23] found that digital transformation in maritime transportation contributes to cost reduction, improved resource planning, shorter lead times, enhanced stakeholder collaboration, and greater data transparency. Their study also highlighted the importance of real-time information regarding ship arrivals, berthing availability, navigation optimization, and emission reduction to improve operational performance and regulatory compliance. The literature further suggests that successful digital transformation requires more than simply digitizing existing processes. [15], [30] argued that digital platforms, automated systems, and early warning mechanisms can strengthen maritime supply chain resilience by improving visibility, flexibility, and responsiveness to disruptions. However, the reviewed studies also identified challenges related to infrastructure readiness, cybersecurity, investment costs, and workforce capability. Therefore, sustainable digital transformation in maritime logistics requires coordinated support from governments, industry stakeholders, and academic institutions to develop digital infrastructure, strengthen policies, and improve human resource competencies.

3.5 Digital Transformation in The Maritime Supply Chain and Shipyards

The era of globalization in the maritime sector has become a strategic pillar of economic development, requiring infrastructure strengthening, security improvements, and the development of the maritime industry through cross-institutional collaboration that requires connectivity, improved human resource quality, and improved development policies. This involves overcoming limitations in human resources, infrastructure, and regulations or licensing to improve efficiency, competitiveness, and economic growth [17]. Supporting factors for the implementation of Digital Transformation in Port Logistics require coherent policies to promote interoperability, data sharing, and standardization across ports and logistics operators. Public policy needs to recognize the socio-technical nature of digital transformation by combining investment in digital infrastructure with capacity building in human resources, digital skills, and organizational change, clarity of regulations on electronic trade

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documentation, data governance, cybersecurity, and enhanced international cooperation to reduce the digital divide. This aims to manage risks and contribute to global trade rather than simply introducing new technologies to improve operational performance through predictive optimization, increase resilience with anticipation and adaptive responses to disruptions, promote sustainability by facilitating environmental impact monitoring so that competitiveness and global supply chain integration are maintained, and there is a need for a conceptual framework that connects the construction of trust relationships, satisfaction, and commitment with maritime supply chain performance, which is an important point because it influences transparent interactions, analyzes competitive barriers among partners, and then commits to achieving partners' goals and objectives to build long-term relationships [14] [21].

The reviewed studies indicate that digital transformation in maritime supply chains and shipyards is essential for improving operational efficiency, competitiveness, and resilience. [1], [17] emphasized that strengthening maritime infrastructure, improving human resource capabilities, and simplifying regulatory frameworks are necessary to support sustainable maritime development. However, limitations in infrastructure, workforce readiness, and licensing systems remain major barriers to digital transformation in the maritime sector. Several studies also highlighted the importance of policy integration and stakeholder collaboration in maritime logistics. [14] argued that interoperable systems, standardized data sharing, cybersecurity, and digital governance are critical to improving transparency and global supply chain integration. In addition, [29] found that trust, collaboration, and long-term partnerships among maritime stakeholders significantly improve supply chain performance and resilience. The literature further suggests that post-pandemic maritime supply chain recovery requires stronger cooperation between shipping companies, port authorities, and governments. [31], [32] emphasized that collaboration between domestic shipping operators and international container leasing companies can reduce operational costs and increase supply chain flexibility during uncertain market conditions.

Similarly, [16], [24] highlighted the importance of coordination and resource integration in supporting sustainable maritime business operations. [15], [30] explained that maritime supply chain resilience can be enhanced through digital platforms, automation systems, shipping alliances, long-term cooperation agreements, and early warning systems. The revitalization of Indonesia's maritime supply chain in the post-pandemic era requires stronger collaboration between container ports and shipping companies. Cooperation between Indonesian port authorities and foreign shipping companies through equity joint ventures at designated terminals is essential to support national logistics needs. In addition, domestic shipping operators should collaborate with international container leasing companies to address uncertain market demand, reduce operational costs, and optimize short-term leasing strategies. These efforts also require political commitment and active government support to strengthen the maritime logistics ecosystem [16].

3.6 Digital Transformation in The Marine Tourism Supply Chain

Implementation of modern logistics management, supported by digital technologies, inventory control systems, and internal collaboration, can improve operational performance in maritime distribution processes. The study reported reductions in travel time, prevention of inventory stagnation, and increased customer satisfaction. Within the maritime supply chain context, advanced navigation software enables shipping companies to optimize routes and avoid congestion or adverse weather conditions, thereby improving delivery efficiency. Digital transformation in maritime-related tourism and service activities is closely connected to broader maritime logistics and supply chain digitalization. Although most selected studies focus on port logistics, maritime transportation, and supply chain resilience, several findings are also applicable to marine tourism operations, particularly regarding logistics efficiency, real-time visibility, and stakeholder coordination. The findings from [22] on digital transformation in the maritime transport sector support the importance of real-time information systems,

operational simplification, and improved coordination among maritime stakeholders. Similarly, [14] emphasized that digital integration and interoperable logistics systems are essential for improving efficiency and transparency across maritime operations. These concepts are relevant to marine tourism supply chains, where transportation reliability, scheduling accuracy, and service responsiveness directly influence customer satisfaction and operational performance.

The use of GPS tracking, digital warehouse management, and integrated communication systems in tourism-related maritime logistics reflects these broader resilience and visibility strategies identified in the reviewed literature. Furthermore, studies by [18], [26], [27]emphasized the importance of real-time monitoring and disruption management in maritime networks, which are also relevant for marine tourism activities that are highly affected by weather conditions, transportation delays, and service coordination challenges. Therefore, although the marine tourism discussion is supported by a more specific operational case, it remains aligned with the studies included in Table 1 because it demonstrates how digital technologies contribute to efficiency, transparency, coordination, and resilience within the broader maritime supply chain framework.

3.7 Digital Transformation in The Fisheries and Marine Supply Chain

The selected studies indicate that digital transformation in fisheries and marine supply chains is closely related to the implementation of Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems, which support operational integration, coordination, and decision-making processes. ERP and SCM technologies enable stakeholders in fisheries supply chains to manage inventory, logistics, procurement, and distribution more efficiently, thereby improving business continuity and competitiveness. Within the fisheries and marine supply chain context, digital integration is particularly important because the sector depends heavily on coordination among farmers, collectors, distributors, and transportation providers. The study emphasized the importance of digital communication, delivery scheduling, and weather information sharing to maintain product quality and supply chain continuity. The reviewed studies indicate that digital transformation in fisheries and marine supply chains focuses on improving operational coordination, information visibility, and supply chain resilience through integrated digital systems. Although ERP and Supply Chain Management (SCM) systems are commonly discussed in manufacturing and logistics contexts, their relevance to fisheries and marine supply chains lies in their ability to support real-time information sharing, inventory management, production planning, and coordination among multiple stakeholders, including fishermen, collectors, distributors, and logistics operators. The findings are consistent with the studies presented in Table 1, particularly [15], [18], [22], which emphasized the importance of visibility, integration, and real-time communication in strengthening maritime supply chain resilience and operational efficiency. In fisheries supply chains, these digital capabilities are essential because product quality, delivery timing, and operational continuity are highly influenced by environmental conditions and coordination among stakeholders.

In addition, studies related to maritime logistics digitalization, such as [14], [19] highlighted that integrated digital platforms, predictive systems, and information transparency improve responsiveness to disruptions and support more adaptive supply chain operations. These findings are relevant to fisheries and marine activities, where weather monitoring systems, digital scheduling, and communication technologies help fishermen and distributors anticipate sea conditions, reduce distribution uncertainty, and maintain product quality and delivery performance. Therefore, the implementation of ERP, SCM systems, weather monitoring applications, and digital communication technologies in fisheries supply chains reflects the broader digital transformation trends identified in Table 1. These technologies contribute to improving coordination, operational efficiency, transparency, and resilience across maritime-based supply chain activities. [30] also highlighted that digital forecasting systems, inventory optimization technologies, and integrated supply chain communication platforms improve responsiveness and operational continuity in highly uncertain logistics environments.

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3.8 Digital Transformation in The Maritime Defense and Security Supply Chain

The reviewed studies indicate that digital transformation in the maritime sector can be categorized into four interconnected aspects: maritime defense, cybersecurity, port logistics, and supply chain resilience. In the context of maritime defense and security, information technology supports real-time monitoring, maritime surveillance, and cybersecurity systems to improve the safety of maritime operations and protect strategic maritime data [20]. However, several challenges remain, including limited digital infrastructure in remote maritime areas, insufficient human resource capabilities, and concerns related to cybersecurity and data privacy. In terms of port logistics, blockchain technology has been identified as an important tool for improving efficiency, transparency, and coordination among stakeholders in maritime supply chains [19]. Blockchain integration enables real-time tracking of goods movement, reduces documentation errors and delays, accelerates port operations, and improves transparency in logistics processes. These technologies also support better coordination between shipping companies, port authorities, customs, and logistics operators.

The reviewed literature shows that digital transformation in the maritime sector supports several interconnected areas, including maritime defense, cybersecurity, port logistics, and supply chain resilience. Although these areas are closely related, the selected studies in Table 1 address them from different perspectives and objectives. From a maritime defense and security perspective, [20] emphasized the role of digital technologies and adaptive maritime policies in strengthening real-time monitoring, cybersecurity, and maritime governance. Their study highlighted challenges such as limited infrastructure in remote maritime regions, insufficient digital competencies among human resources, and increasing concerns regarding cybersecurity and data privacy. These findings indicate that digital transformation in maritime defense focuses primarily on security monitoring, information protection, and regulatory adaptation. In contrast, studies related to port logistics and maritime supply chain operations focus more on operational efficiency, transparency, and coordination among stakeholders. Alshareef, MH. [19] demonstrated that integrating blockchain technology and machine learning into maritime logistics networks improves transparency, traceability, and disruption prediction. Their studies suggest that digital technologies support resilience by enabling faster information exchange, predictive analysis, and coordinated responses across maritime networks.

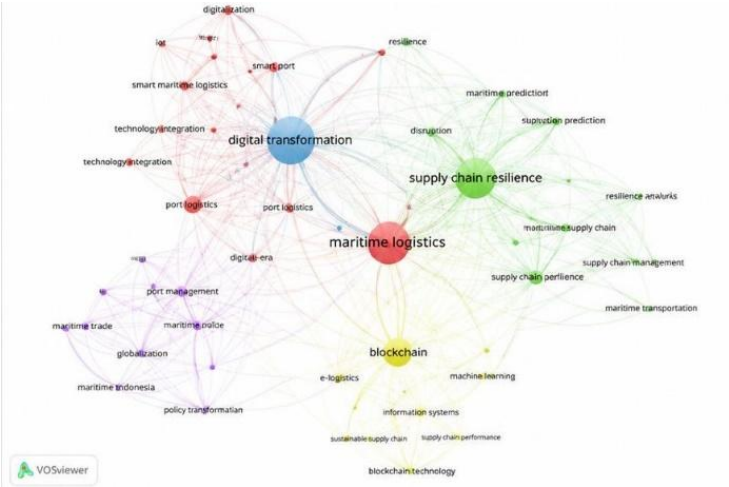

Figure 2. Visualization of the Systematic Literature Review (SLR)

Figure 2 presents a VOSviewer Systematic Literature Review (SLR) on Digital Transformation in Maritime Supply Chains. The visualization shows several main research clusters, including *digital transformation*, *maritime logistics*, *supply chain resilience*, and *blockchain*. The largest nodes indicate the most frequently discussed topics, while the connecting lines represent relationships between

keywords. The map demonstrates that recent studies mainly focus on technology integration, smart ports, logistics efficiency, blockchain implementation, and supply chain resilience in the maritime sector.

4. Conclusion

This study confirms that digital transformation plays a critical role in improving the efficiency, transparency, resilience, and sustainability of maritime supply chains. The implementation of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, Big Data, ERP systems, and smart port technologies supports real-time monitoring, predictive analysis, automation, and better coordination among maritime stakeholders. The reviewed literature also demonstrates that digital transformation is not limited to technological adoption but involves broader organizational changes, including governance adaptation, policy integration, infrastructure development, and human resource readiness. Furthermore, digitalization contributes to reducing logistics costs, improving operational responsiveness, strengthening supply chain resilience, and supporting sustainable maritime development.

Theoretically, this study contributes to the development of maritime supply chain literature by integrating findings related to digital transformation, supply chain resilience, smart maritime logistics, and maritime governance into a comprehensive conceptual understanding. The review also highlights the interrelationship between digital technologies, operational performance, and stakeholder collaboration within maritime ecosystems. Practically, the findings provide insights for governments, port authorities, logistics providers, shipping companies, and policymakers regarding the importance of investing in digital infrastructure, cybersecurity, workforce development, and interoperable information systems to support resilient and sustainable maritime operations.

Future research is recommended to focus on empirical investigations and comparative studies across different countries, ports, and maritime industries to evaluate the effectiveness of specific digital technologies in improving maritime supply chain performance. Further studies should also explore the integration of emerging technologies such as digital twins, autonomous shipping systems, green maritime technologies, and advanced cybersecurity frameworks. In addition, future research may examine policy implementation challenges, stakeholder readiness, and socio-economic impacts of digital transformation, particularly in developing maritime countries such as Indonesia.

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