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Smart & Resilient Logistics Corridors Future Gateway to the Green Trade

CHARTING THE RESEARCH LANDSCAPE OF SUSTAINABLE MARITIME LOGISTICS: A BIBLIOMETRIC REVIEW

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ABSTRACT

The current global context, defined by accelerated digitalisation, pressure for sustainability, and the need for resilience in supply chains, has fundamentally transformed the field of maritime transport. Consequently, this study aims to map the academic landscape of sustainable maritime transport through a bibliometric analysis and to compare these findings with a concurrent analysis of industry practices. We analyzed a sample of 763 documents and a set of recent industry and policy reports from major European ports and international bodies. A strategic fusion of disciplines was identified, with a dominant presence of categories focused on the environment and sustainability. This interdisciplinarity is fueled by an intensification of global collaboration, with the People's Republic of China consolidating its central position. The analysis also revealed a growing interest in cutting-edge topics like digitalisation, systemic resilience, and decarbonisation. By comparing research and practice, we found strong convergence on these themes, while also identifying gaps where academia is more advanced (e.g., AI/ML, blockchain) or where industry priorities remain underexplored. By mapping these trends and their alignment, the study provides a solid knowledge base for researchers and practitioners, helping to identify research gaps and to inform future directions of study.

1. INTRODUCTION

The maritime sector, vital for global trade, is adapting to market, economic, and environmental pressures (Laskar et al. 2025). In response to geopolitical and climate challenges, "smart" and "resilient" maritime transport have become increasingly significance (Tsoulfas 2025). These concepts reflect the industry's shift towards integrating advanced technologies to improve efficiency, safety, and recovery from disruptions (Liu et al. 2025).

A major challenge is decarbonisation, which requires fundamental changes like adopting alternative fuels and optimizing routes (Cunha et al. 2025). Concurrently, digitalisation is transforming supply chains with solutions like big data, machine learning, and the Internet of Things (IoT), enhancing resource management and operational visibility (Belabyad et al. 2025). This enables more efficient resource management and increased visibility into operations (Belabyad et al. 2025). Scientific research is exploring the intersection of these trends (Haddad and Nasib 2023). Studies show that digital technologies can improve traceability and reduce risks in supply chains (Cromwell et al. 2025). Machine learning enhances safety through predictive maintenance (Xue et al. 2025), while big data enables real-time route optimization to cut fuel consumption and emissions (Caprace et al. 2025). Resilience strategies, often based on AI models, help ports and ships withstand crises (Mohsendokht et al. 2025).

The push for decarbonisation is supported by investments in innovative fuels and technologies (Halpe et al. 2025). For example, machine learning allows for predictive analysis of weather-based routing (Latinopoulos et al. 2025), and big data tools optimize fleet management (Zampeta et al. 2025). Recent surveys confirm the industry's strong commitment to these technologies and decarbonisation goals (Laskar et al. 2025). This transformation underscores the need for interdisciplinary research to ensure the sector's long-term viability (Deselnicu et al. 2023).

2. METHODOLOGY

To map the scientific landscape of these developments, a rigorous search formula was devised, which allowed the extraction of a body of 763 documents from the Web of Science database, published during the 2020-2026 period, of either Article or Proceedings paper type.

The search formula was structured into two main components:

$$\begin{aligned} \boldsymbol{TS} = (&"maritime" \\ \boldsymbol{AND}\ &(\text{transport}\boldsymbol{OR}\text{logistic*}) \\ \boldsymbol{AND}\ &("smart" \\ \boldsymbol{OR}\ &\text{resilient} \\ \boldsymbol{OR}\ &\text{intelligent} \\ \boldsymbol{OR}\ &\text{digital} \\ \boldsymbol{OR}\ &\text{sustainability} \\ \boldsymbol{OR}\ &"resilience")) \end{aligned} \tag{1}$$

Every sequence of the formula has a specific role (Table 1) in defining the analysis corpus:

Sequence from the query formula	*Justification and context*
("maritime" AND ("transport" OR "logistic*"))	This sequence represents the operational core of the study. The term "maritime" defines the geographical scope, while "transport" and "logistics" (including variations such as "logistics") define the core activity. Together,

	these terms ensure that the selected documents focus on the movement of goods by sea and the management of associated supply chains.
("smart" OR resilient OR intelligent OR "digital")	This sequence of terms covers the technological and modernisation aspects. Terms such as "smart", "intelligent" and "digital" are often used to describe the digital transformation of ports, ships and operations. They indicate a research focus on advanced technology use.
("sustainability" OR "resilience")	This sequence represents sustainability and adaptability. "Sustainability" is a key concept associated with reducing emissions, safeguarding the marine environment, and developing eco-friendly solutions. "Resilience" reflects the sector's interest in its capacity to withstand global disruptions, ranging from economic crises and pandemics to geopolitical and environmental challenges.

Table 1. Justification of keywords in the query formula

This methodical approach enabled the creation of a representative sample through the query formula, providing a solid basis for analysing the evolution of collaborations and research topics in the field of maritime transport and logistics.

The search was conducted for documents published between 2020 and 2026. The final sample included 763 documents (Articles - 670 and Proceedings Papers - 95). All bibliometric analyses, including co-authorship and co-occurrence analyses, were performed using VOSviewer software to allow visualisation and interpretation of collaboration structures and the thematic landscape. Each analysis was designed to answer a specific research question (Table 2):

Research question	*Justification and context*	*Filters applied*	*Resulting sample*
Who are the key researchers and how do they collaborate?	Co-authorship of authors	min. 2 documents, min. 1 citation	268 authors out of 2644
What are the most prominent institutions and how is their collaboration structured?	Co-authorship of organisations	min. 5 documents, min. 5 citations	54 organisations out of 1110
What are the international collaboration networks and which countries hold a central position?	Co-authorship of countries	min. 5 documents, min. 5 citations	52 countries out of 91
What are the main thematic clusters and how have they evolved over time?	Co-occurrence of keywords	min. 5 occurrences	203 keywords out of 3652
Which are the most influential journals in the field?	Citation of sources	min. 5 documents, min. 5 citations	28 journals out of 341

Table 2. Research questions and associated bibliometric analyses

The research questions and the corresponding bibliometric analyses were designed to provide a comprehensive overview of the field. Analysing co-authorship at the level of authors, organisations and countries was essential for mapping the social structure of research and identifying the key actors and collaborative networks that define scientific productivity and influence. This approach enabled us to address key questions regarding the dynamics of international collaboration and the role of centres of excellence in disseminating knowledge.

To understand the intellectual structure and direction of research, a co-occurrence analysis of keywords was performed. This identified thematic clusters, providing valuable insight into emerging trends. Examining these keywords over time enabled us to observe the transition of research interest from traditional topics to new paradigms, such as digitisation and artificial intelligence - an essential aspect for understanding the field's evolution.

Finally, to evaluate the impact and prestige of channels for disseminating knowledge, we performed a citation analysis of sources. This method enabled us to identify the most influential journals, which serve as the primary platforms for publishing and validating scientific discoveries. Combining all these analyses provided a comprehensive understanding of the field, from collaboration dynamics to idea evolution and the impact of scientific publications.

Also, we performed an industry practice analysis, based on a set of recent industry and policy reports, including annual and sustainability publications from major European ports (Rotterdam, Antwerp-Bruges, HHLA), the ESPO Environmental Report 2024, the Port Environmental Review System (PERS) Application 2022, and UNCTAD's Review of Maritime Transport 2024. Together, these sources show both operational practices at port level, and broader global trends in maritime logistics. By comparing the emerging trends in both research and practice implementation, we can extract a correct image of the main themes that shape the maritime world today.

3. RESULTS AND DISCUSSIONS

The Clarivate Web of Science database was used to identify research categories addressing the topic of smart and resilient maritime transport and logistics. The distribution of documents across these categories clearly illustrates the interdisciplinary nature of the field (Figure 1):

Figure 1: Distribution of documents by Web of Science categories

The figures provided reflect the deeply interdisciplinary nature of the study of smart and resilient maritime transport and logistics. With over 15% of articles falling under the Transportation category, it is clear that the central theme remains firmly anchored in the core field of mobility and the movement of goods. However, this category is closely followed by a significant presence of environmental themes, with Environmental Sciences (15.465%) and Green and Sustainable Science and Technology (14.941%). This juxtaposition highlights a fundamental research trend: innovation in maritime transport is now inherently linked to its ecological impact and the imperative of sustainability, rather than being viewed in isolation.

Furthermore, the significant representation of categories such as Environmental Studies (13.237%) and Oceanography (9.961%) indicates that research is broadening its scope to include the global impact on marine environments and ecosystems, in addition to engineering and technical aspects. These fields contribute to a holistic understanding of the pressures exerted by maritime activities and to the development of integrated solutions. Meanwhile, the importance of technical approaches is highlighted by Engineering, Marine (12.058%) and Engineering, Ocean (8.519%), from ship and port system design to the optimisation of operations in specific environmental conditions.

Alongside the core pillars of transport and the environment, the analysis reveals a significant strategic and operational element. The Management category (8.912%) and, in particular, Operations Research and Management Science (8.126%) indicate that a significant proportion of research focuses on efficiency, optimisation and decision-making. Research in this field highlights the need for a strategic and operational approach to manage complex supply chains. This approach involves both efficiency and the integration of technological advancements, such as "smart" and "digital" solutions. In conclusion, the distribution of categories shows that studying modern maritime transport involves a strategic intersection of engineering, environmental sciences and management, with each component being important for building a truly resilient and sustainable system.

3.1. Analysis of co-authorship

The co-authorship analysis of authors targeted the collaboration structure among researchers, using specific selection criteria: a minimum of 2 documents and a minimum of 1 citation per author. Out of a total of 2644 authors, these eligibility conditions were met by 268. The main metric, total link strength, revealed the contribution of prominent authors (Table 3):

Author	Documents	Citations	Total link strength
Yang, Zaili	7	271	19
Yuen, Kum Fai	11	121	19
Li, Kevin X.	7	73	17
Mei, Qiang	5	6	17
Wang, Peng	4	3	15
Yang, Yang	5	12	15
Feng, Yinwei	3	55	14
Wang, Shuaian	7	85	14
Wang, Xinjian	3	55	14
Chen, Jihong	8	134	13
Liu, Xiaotong	3	3	13
Wang, Xueqin	7	92	13
Yan, Ran	6	78	13
Li, Huanhuan	3	126	12
Titjan, Edvard	6	172	11

Table 3. Top authors by total link strength (> 10)

The temporal analysis (Overlay Visualisation) highlighted intensified collaborations in recent years (Figure 2), with new nodes representing recent publications dispersed across multiple clusters:

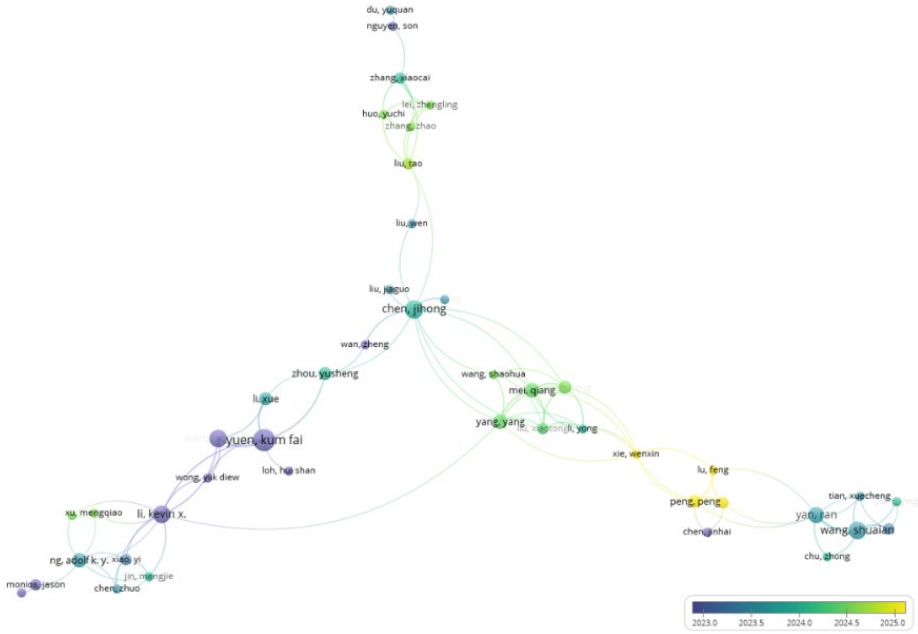

Figure 2: Overlay visualisation of co-authorship among authors

Although there are few nodes, the yellow and light green colours indicate recent research activity and the formation of new partnerships, particularly within groups focusing on emerging topics.

At the institutional level, the analysis included 54 organisations out of 1110. These were selected based on the criterion of having published at least five documents and received at least five citations. Examining the co-authorship network by organisation reveals a diverse collaborative structure (Figure 3), with several significant clusters, indicating distinct centres of excellence (Figure 4):

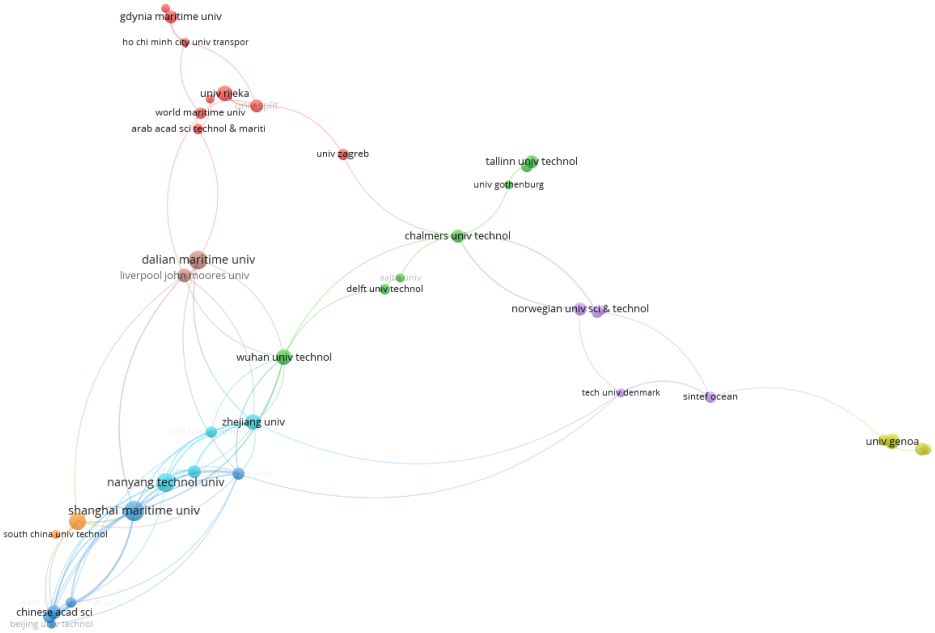

Figure 3: Overlay visualisation of co-authorship among institutions

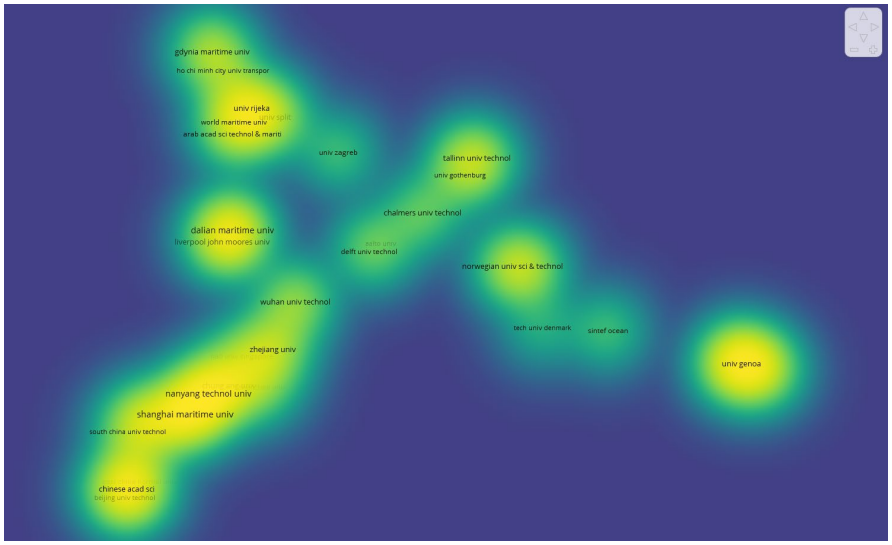

Figure 4: Density visualisation of co-authorship among institutions

For example, a central cluster formed by Chinese universities (Dalian Maritime University, Wuhan University of Technology, Zhejiang University and Shanghai Maritime University) highlights intense collaboration at the national level.

In terms of international collaboration, 52 countries out of a total of 91 were emphasized. The co-authorship network by country confirms an intensification of global collaboration, with the People's Republic of China occupying a central position, acting as a major hub connecting multiple research networks. Other European countries, such as Germany, Italy and the United Kingdom, form important clusters, but with fewer global links compared to China (Figure 5):

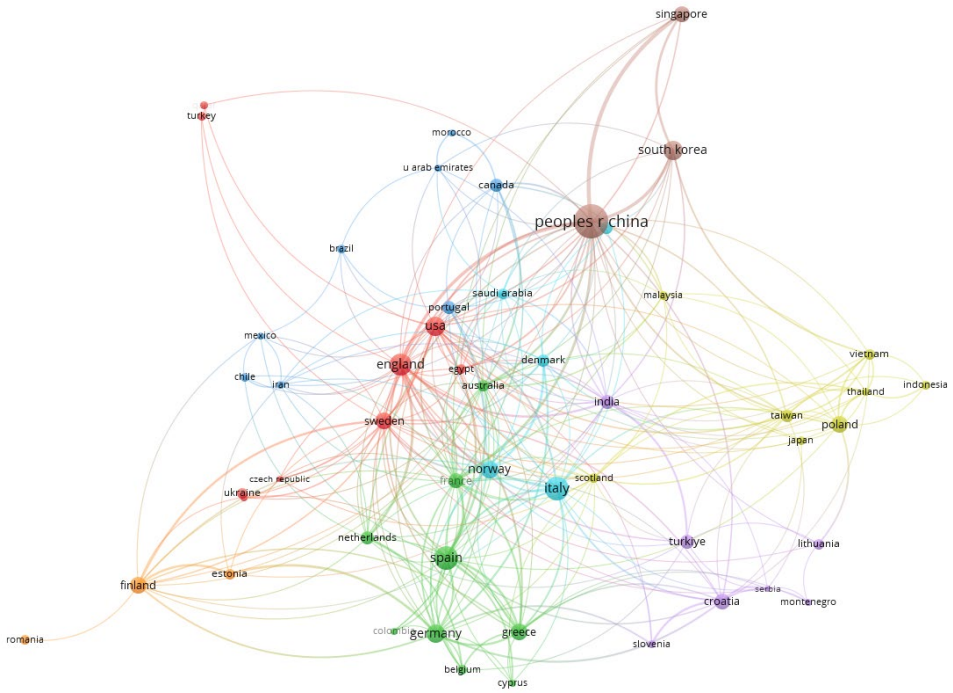

Figure 5: Network visualisation of co-authorship among countries

The countries that have conducted the most recent research, as indicated by the yellow and light green nodes in the temporal visualisation (Figure 6), are China, Egypt, Cyprus, Iran, Chile, Portugal, Saudi Arabia, Turkey, Taiwan, Thailand, Vietnam, Japan and Indonesia.

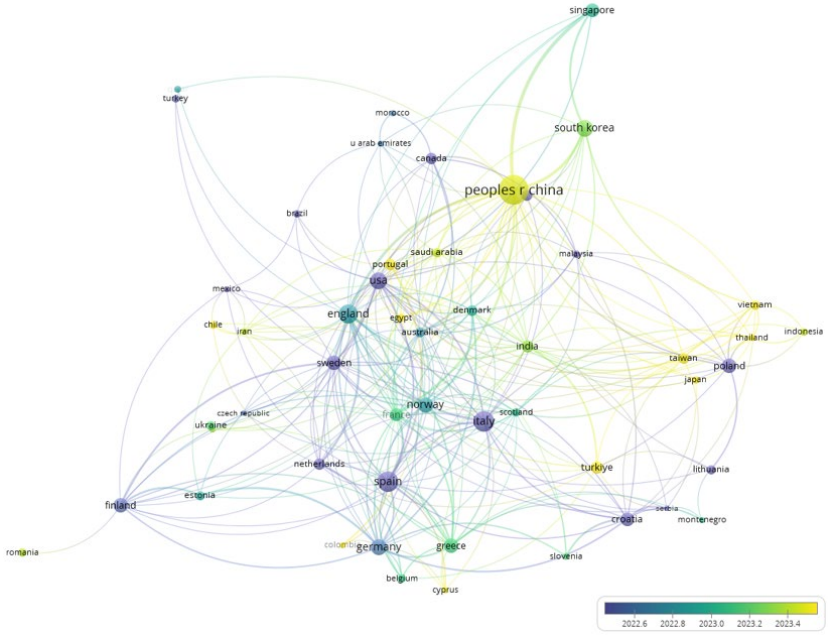

Figure 6: Overlay vizualization of co-authorship among countries

This distribution reveals an evolving global collaborative landscape, featuring a robust Asia-Pacific presence, alongside notable contributions from the Middle East, South America, and Europe.

3.2. Analysis of co-occurrence

The aim of the keyword co-occurrence analysis was to identify the main research topics and trends in the field. Of the 3,652 keywords analysed, 203 met the criterion of appearing at least five times. Network Visualisation (Figure 7) reveals a complex structure divided into several distinct clusters, each representing a specialised research topic. One of these clusters (the red one) focuses on sustainability issues in maritime transport, including concepts such as "decarbonisation" and "emissions". Another cluster, represented by the green colour, is characterised by cutting-edge and innovative themes, connecting terms such as "deep learning," "machine learning," "big data," and "cybersecurity".

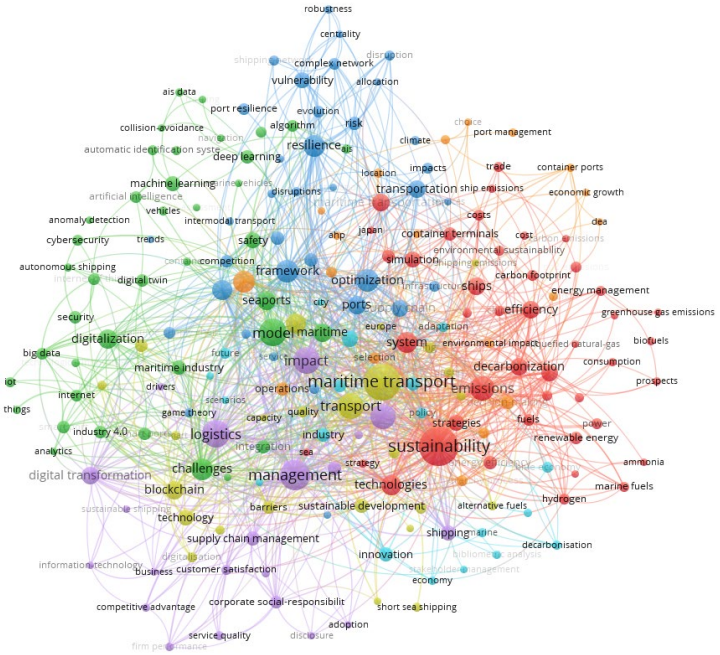

Figure 7: Network visualisation of keyword co-occurrence

A separate temporal visualisation analysis (Figure 8) confirms these trends, showing the field's rapid evolution. The yellow and light green colours in the visualisation indicate recent research activity, with most nodes concentrated around themes such as digitisation and green solutions, including "digital transformation", "blockchain", "decarbonisation" and "hydrogen".

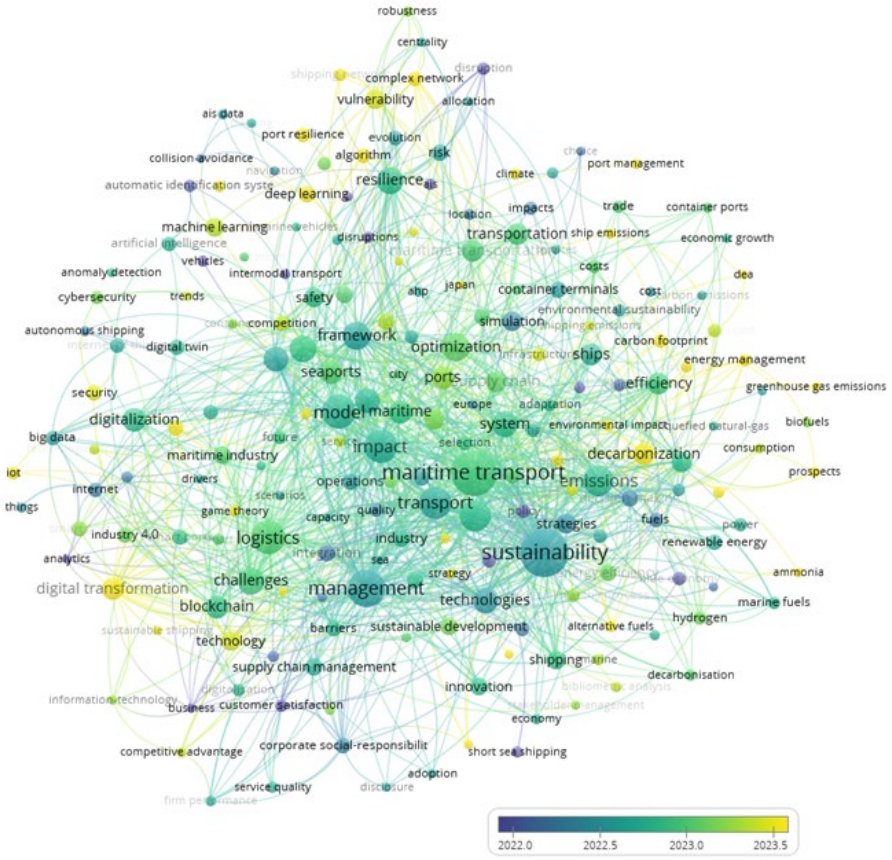

Figure 8: Overlay visualisation of keyword co-occurrence

This suggests a shift in focus from traditional themes to technological innovations and sustainable solutions, reflecting the current direction of research.

3.3. Analysis of citations

The citation analysis aimed to identify the scientific publications with the greatest impact in the field. This was based on a sample of 28 sources, which were selected from a total of 341. Sources were required to have a minimum of five documents and five citations to be eligible. Following the analysis, several top journals stood out. For instance, Sustainability stands out as a key source, boasting 63 documents and 528 citations, which demonstrate its significant influence in the field. Other notable publications include the Journal of Marine Science and Engineering (44 documents, 275 citations) and Ocean & Coastal Management (15 documents, 235 citations), both of which have a strong link strength.

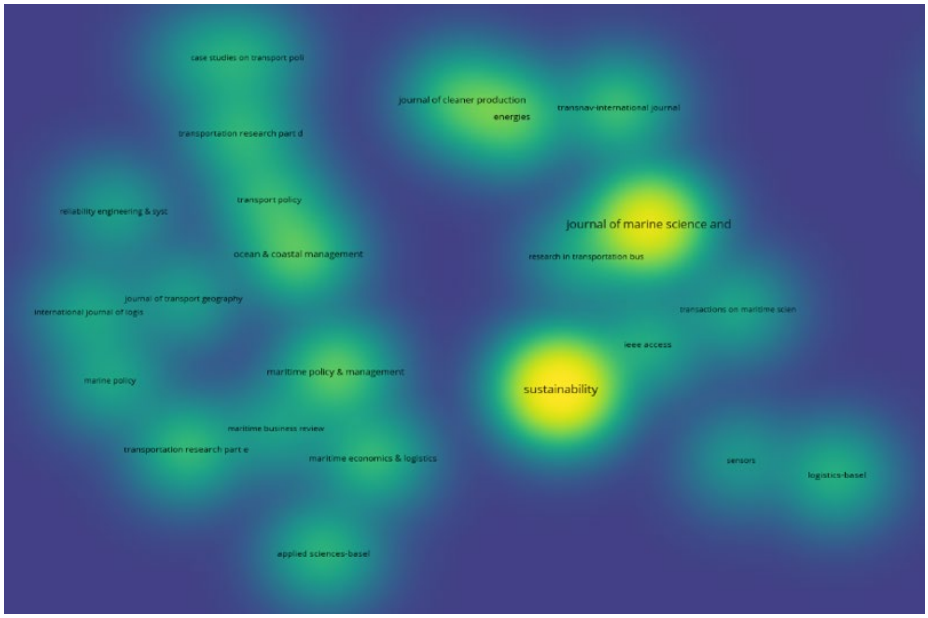

Figure 9: Density visualisation of citation analysis by source

The density visualisation (Figure 9) suggests that each journal contributes to the development of a specific subfield, from sustainability to maritime engineering and coastal management. The analyses show the deeply interdisciplinary nature of smart and resilient maritime transport and logistics. Collaboration is dynamic and fragmented, with key authors, institutions, and countries forming the core. Chinese universities and China globally are major collaboration hubs. A temporal analysis indicates a diversification of contributions from regions like the Asia-Pacific, the Middle East, and South America. A keyword analysis confirms a shift toward advanced topics such as deep learning and big data, along with a focus on decarbonization and hydrogen as green solutions. These themes highlight the field's rapid evolution. Finally, citation analysis identifies influential journals like Sustainability, the Journal of Marine Science and Engineering, and Ocean & Coastal Management as core research hubs.

3.4. Maritime logistic practice

Recent industry reports provide a comprehensive overview of global maritime logistics, emphasizing sustainability, digital transformation, infrastructure development, resilience, and security. European ports such as Hamburg (HHLA), Rotterdam, and Antwerp-Bruges outline strategies and investments in green energy, digital platforms, and intermodal connectivity, while also addressing broader challenges, including geopolitical disruptions, climate action, and workforce issues (Table 4).

Theme	*Key objectives and practices*
Sustainability and energy transition	Ports set ambitious decarbonization targets, invest in alternative fuels (LNG, hydrogen, ammonia), expand shore power facilities, and strengthen environmental monitoring (EcoPorts, PERS).
Digitalisation and innovation	Digital platforms optimize customs, scheduling, and traffic management. AI and smart technologies support predictive modeling, automation, and decarbonization.
Infrastructure and connectivity	Investments focus on modernizing terminals, expanding hinterland rail/barge links, and addressing congestion through intermodal solutions.

Resilience and security	Ports respond to disruptions by diversifying routes and enhancing cooperation. They also prioritize cybersecurity, fraud prevention, and crime reduction.
Performance and transparency	Benchmarking tools and data-driven platforms improve environmental reporting, operational efficiency, and supply chain integration.

Table 4. Justification of keywords in the query formula, based on key industry practices in sustainable maritime logistics

Together, these themes reflect a sector in transition: committed to climate neutrality and operational efficiency, driven by digital innovation, and challenged by geopolitical, social, and security risks. Figure 10 compares the main themes identified in the bibliometric analysis and industry practices.

The color scale ranges from dark red (low emphasis) to dark green (high emphasis). Green cells in both columns indicate strong alignment, while differences in color intensity highlight gaps where research is ahead of practice (red) or, conversely, where industry priorities remain underexplored in the academic literature (orange).

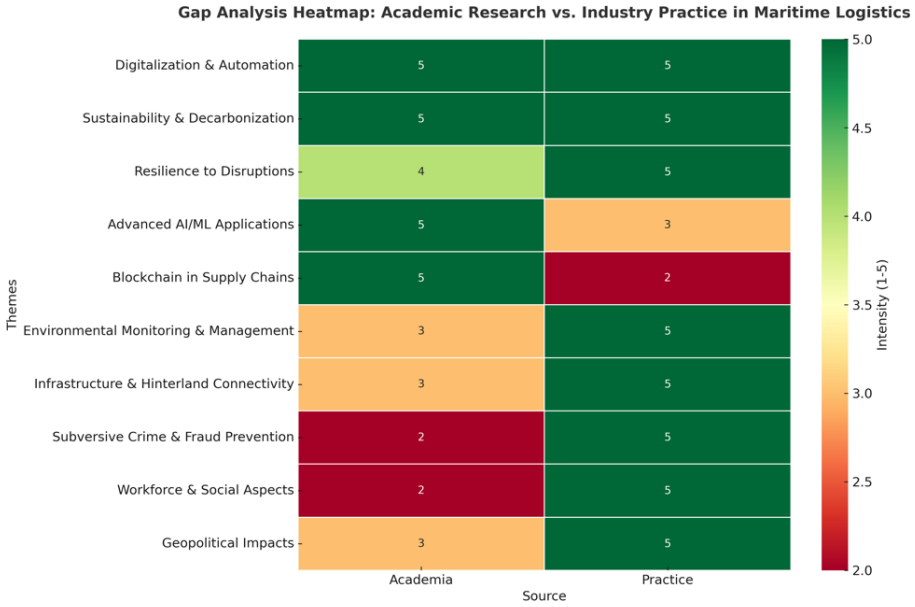

Figure 10. Heatmap comparing thematic intensities between academic research and industry practice

The heatmap shows strong convergence between academia and practice on digitalisation, sustainability, and resilience. Research is more advanced on AI/ML and blockchain, while industry reports highlight practical gaps in environmental management, infrastructure, security, workforce, and geopolitics. This contrast reveals complementary strengths and areas where academic and practical priorities could be better aligned.

4. CONCLUSIONS

The research landscape for smart and resilient maritime transport is rapidly evolving and deeply interdisciplinary. The analysis shows a shift in global dynamics, with the Asia-Pacific region, led by China. The most prominent trends focus on technological innovation and sustainability, with keywords like "digital transformation," "deep learning," and "decarbonisation" becoming central. This highlights a move from isolated topics to integrated solutions.

In conclusion, while there is a clear convergence in recognizing the importance of digitalisation, sustainability, and general resilience, academic research appears to be ahead in exploring advanced AI applications and blockchain technology. On the other hand, the industrial practice faces concrete challenges in areas such as detailed environmental management, physical infrastructure investments and hinterland connectivity, combating subversive crime and fraudulent ship registrations, workforce development and social aspects, and managing direct geopolitical impacts - areas that seem to be insufficiently explored or detailed in the analyzed bibliometric study.

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